


The logo features a stylized graphic on the left, composed of concentric, overlapping shapes in white and light blue, resembling an eye or a stylized 'C'. To the right of this graphic, the text 'ICS 2019' is written in a bold, sans-serif font, with 'ICS' in white and '2019' in light blue. Below 'ICS 2019', the word 'STANDARDS' is written in a larger, white, sans-serif font.

# ICS 2019 STANDARDS



 Gothenburg, Sweden

**The 2019 compilation of the International Continence Society  
Standardisations, Consensus statements, Educational  
modules, Terminology and Fundamentals documents, with the  
International Consultation on Incontinence algorithms**

## ICS STANDARDS 2019

ICS Standards 2019 brings together many of the major initiatives of the International Continence Society in its role of supporting healthcare professionals to deliver care and develop knowledge.

Contained here are the current documents developed by the organisation. These include the ICS Consensus Statements, which reflect leading opinion in challenging areas of practice. The Fundamentals of Assessment section is a compilation of succinct reviews setting out the most important components for acquiring or consolidating clinical knowledge, with examples, in lower urinary tract symptoms, incontinence and prolapse. The Standardisations are the state-of-the-art reference sources for the specialist professional, developed by expert working groups overseen by the ICS Standardisation Steering Committee. The International Consultation on Incontinence algorithms are therapy pathways derived by expert committees responsible for detailed literature review and interpretation as part of the regular Consultations process- published most recently in 2017. These documents are a powerful resource intended to help all healthcare professionals dealing with the broad scope of this clinical area.



**Sherif Mourad**

ICS General Secretary

# CONTENTS

## 1. ICS Standardisations ..... 4

An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction .....	5
The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction .....	22
An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD) .....	67
International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function .....	77
A Standard for Terminology in Chronic Pelvic Pain Syndromes: A Report From the Chronic Pelvic Pain Working Group of the International Continence Society .....	87
An International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Organ Prolapse (POP) .....	112
An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Report on the Terminology for Female Anorectal Dysfunction .....	144
International Continence Society Good Urodynamic Practices and Terms 2016: Urodynamics, uroflowmetry, cystometry, and pressure-flow study .....	169
Good Urodynamic Practices: Uroflowmetry, Filling Cystometry, and Pressure-Flow Studies .....	187
International Continence Society Guidelines on Urodynamic Equipment Performance .....	200
International Continence Society Guidelines on Urodynamic Equipment Performance .....	201
An International Urogynecological Association (IUGA)/ International Continence Society (ICS) joint report on the terminology for the assessment of sexual health of women with pelvic floor dysfunction .....	211
An International Urogynecological Association (IUGA)/ International Continence Society (ICS) joint report on the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction .....	232

An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Report on the Terminology for Reporting Outcomes of Surgical Procedures for Pelvic Organ Prolapse .....	256
---	-----

An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Terminology and Classification of the Complications Related Directly to the Insertion of Prostheses (Meshes, Implants, Tapes) and Grafts in Female Pelvic Floor Surgery .....	263
--	-----

Developing Evidence-Based Standards for Diagnosis and Management of Lower Urinary Tract or Pelvic Floor Dysfunction .....	274
--	-----

## 2. Fundamentals ..... 278

Fundamental Assessment of Lower Urinary Tract Dysfunction .....	279
---	-----

A commentary on expectations of healthcare professionals when applying the international continence society standards to basic assessment of lower urinary tract function .....	283
--	-----

Fundamentals of terminology in lower urinary tract function .....	289
---	-----

Basic concepts in nocturia, based on international continence society standards in nocturnal lower urinary tract function .....	296
---	-----

Neurological lower urinary tract dysfunction essential terminology	301
--	-----

The fundamentals of chronic pelvic pain assessment, based on international continence society recommendations .....	308
--	-----

How to use the Pelvic Organ Prolapse Quantification (POP-Q) system? .....	315
--	-----

The fundamentals of uroflowmetry practice, based on International Continence Society good urodynamic practices recommendations .....	320
--	-----

Fundamentals of urodynamic practice, based on International Continence Society good urodynamic practices recommendations .....	326
--	-----

Basics of videourodynamics for adult patients with lower urinary tract dysfunction .....	337
---	-----

Why ICS standardization of lower urinary tract symptoms matters ..	343
--	-----

Critical steps in developing professional standards for the International Continence Society .....	345
---	-----

<b>3. The International Consultation on Incontinence Algorithms.....</b>	<b>351</b>		
Evaluation and treatment of urinary incontinence, pelvic organ prolapse and faecal incontinence .....	352	Detrusor Leak Point Pressures in Patients With Relevant Neurological Abnormalities.....	654
Evaluation.....	355	Electromyography in the assessment and therapy of lower urinary tract dysfunction in adults.....	672
Management Consensus Statements .....	360	Cystometry (basic module).....	688
Recommendations for Further Research in Epidemiology .....	409	Measurement of Post-Void Residual Urine.....	706
Recommendations for Primary Prevention, Continence Promotion, Models of Care and Education .....	411	Pad Weight Testing in the Evaluation of Urinary Incontinence .....	722
Recommendations for Translational and Clinical Research .....	413	Artefacts in Urodynamic Pressure Traces (Basic Module) .....	734
International Consultation on Incontinence Modular Questionnaire (ICIQ ):Questionnaires and Bladder Diary .....	416	Long-term Urinary Catheter Users Self-Care Practices and Problems.....	746
<b>4. ICS Consensus Documents .....</b>	<b>423</b>	A Web-Based Self-Management Intervention for Intermittent Catheter Users .....	816
Artificial Urinary Sphincter: Executive Summary of the 2015 Consensus Conference .....	424	Cystometry in children .....	833
International Continence Society consensus on the diagnosis and treatment of nocturia.....	427	Pressure flow study in children.....	849
International continence society white paper regarding female genital mutilation/cutting .....	448	<b>6. ICS Glossary .....</b>	<b>862</b>
International Continence Society Best Practice Statement for Use of Sacral Neuromodulation.....	459	A.....	862
The clinical role of LASER for vulvar and vaginal treatments in gynecology and female urology: An ICS/ISSVD best practice consensus document .....	504	M.....	892
Terminology report from the International Continence Society (ICS) Working Group on Underactive Bladder (UAB).....	519	B.....	867
<b>5. ICS Education Modules.....</b>	<b>523</b>	N.....	898
Ambulatory Urodynamic Monitoring .....	524	O.....	903
Analysis of Voiding, Pressure Flow Analysis (Basic Module).....	542	P.....	906
Guideline for Prevention of Catheter-associated Urinary Tract Infections 2009 .....	558	Q.....	920
Cough stress test in the evaluation of female urinary incontinence: Introducing the ICS-Uniform Cough Stress Test .....	639	R.....	920
		S.....	922
		T.....	925
		U.....	926
		V.....	932
		L.....	892



## 1. ICS STANDARDISATIONS

The Standardisations are flagship ICS documents that are the reference point for all terminology and practice in the relevant clinical areas, developed by the ICS, often in partnership with other professional bodies. They ensure that the term for a symptom, condition or disease has the same meaning for all healthcare professionals. They are a series of evidence-based pragmatic documents, developed by experts following a defined process (1), and covering the substantial majority of all relevant areas. Such terminology strength underpins the advancement of research and clinical practice. This compilation incorporates the current ICS Standardisations applicable in 2019. For a quick search on individual terms, the ICS also has a searchable glossary: [www.ics.org/glossary](http://www.ics.org/glossary)

The ICS also has a historical compilation of older Standardisations that have been superseded.



**Marcus Drake**  
ICS Trustee



## REVIEW ARTICLE

## An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction

Bernard T. Haylen,<sup>1\*,1,§</sup> Dirk de Ridder,<sup>2,§,§</sup> Robert M. Freeman,<sup>3,1,§,§</sup> Steven E. Swift,<sup>4,1,§</sup> Bary Berghmans,<sup>5,§,§</sup> Joseph Lee,<sup>6,1</sup> Ash Monga,<sup>7,§,§</sup> Eckhard Petri,<sup>8,1</sup> Diaa E. Rizk,<sup>9,1</sup> Peter K. Sand,<sup>10,1,§,§</sup> and Gabriel N. Schaer<sup>11,†</sup>

<sup>1</sup>University of New South Wales, Sydney, New South Wales, Australia

<sup>2</sup>University Hospital, UZ Leuven, Belgium

<sup>3</sup>Derriford Hospital, Plymouth, Devon, UK

<sup>4</sup>Medical University of South Carolina, Charleston, South Carolina

<sup>5</sup>Maastricht University Hospital, Maastricht, the Netherlands

<sup>6</sup>Mercy Hospital for Women, Melbourne, Victoria, Australia

<sup>7</sup>Princess Anne Hospital, Southampton, UK

<sup>8</sup>Klinikum Schwerin, Schwerin, Germany

<sup>9</sup>Ain Shams University, Cairo, Egypt

<sup>10</sup>Evanston Continence Centre, Evanston, Illinois

<sup>11</sup>Kantonsspital, Aarau, Switzerland

**Introduction:** Next to existing terminology of the lower urinary tract, due to its increasing complexity, the terminology for pelvic floor dysfunction in women may be better updated by a female-specific approach and clinically based consensus report. **Methods:** This report combines the input of members of the Standardization and Terminology Committees of two international organizations, the International Urogynecological Association (IUGA), and the International Continence Society (ICS), assisted at intervals by many external referees. Appropriate core clinical categories and a subclassification were developed to give an alphanumeric coding to each definition. An extensive process of 15 rounds of internal and external review was developed to exhaustively examine each definition, with decision-making by collective opinion (consensus). **Results:** A terminology report for female pelvic floor dysfunction, encompassing over 250 separate definitions, has been developed. It is clinically based with the six most common diagnoses defined. Clarity and user-friendliness have been key aims to make it interpretable by practitioners and trainees in all the different specialty groups involved in female pelvic floor dysfunction. Female-specific imaging (ultrasound, radiology, and MRI) has been a major addition while appropriate figures have been included to supplement and help clarify the text. Ongoing review is not only anticipated but will be required to keep the document updated and as widely acceptable as possible. **Conclusion:** A consensus-based terminology report for female pelvic floor dysfunction has been produced aimed at being a significant aid to clinical practice and a stimulus for research. *Neurourol. Urodynam.* 29:4–20, 2010. © 2009 Wiley-Liss, Inc.

**Key words:** consensus; diagnosis; female pelvic floor dysfunction; symptomatology; terminology; urodynamics

### INTRODUCTION

There is currently no single document addressing all elements required for diagnoses in the area of female pelvic

floor dysfunction in a comprehensive way. Indeed, the diagnoses themselves have not been all completely defined. The term “diagnosis” is defined as “the determination of the nature of a disease; *clinical*: made from a study of the

#### Conflicts of interest:

B.T. Haylen: Assistance from Boston Scientific to attend London Terminology Meeting. D. De Ridder: Advisor for Astellas, Allegan, Ipsen, Bard, American Medical Systems, Xention. Speaker for Astellas, Allegan, American Medical Systems, Bard, Pfizer. Investigator for Ipsen, American Medical Systems, Allegan, Astellas, Johnson & Johnson. R.M. Freeman: Past Advisory Boards: Lilly/Bi, Astellas, Pfizer. S.E. Swift, B. Berghmans, J. Lee, E. Petri, D.E. Rizk: No disclosures. A. Monga: Consultant for Gynecare. Advisor for Astellas and Pfizer. P.K. Sand: Advisor for: Allergan, Astellas, GSK, Coloplast, Ortho, Pfizer, Sanofi, Aventis, Watson. Speaker for: Allergan, Astellas, GSK, Ortho, Pfizer, Watson. Investigator for: Boston Scientific, Pfizer, Watson, Ortho, Bioform. G.N. Schaer: Advisor (in Switzerland) for Astellas, Novartis, Pfizer.

<sup>1</sup>Standardization and Terminology Committees IUGA.

<sup>2</sup>Standardization and Terminology Committees ICS.

<sup>3</sup>Joint IUGA/ICS Working Group on Female Terminology.

\*Correspondence to: Bernard T. Haylen, Associate Professor, St. Vincent's Clinic, Suite 904, 438 Victoria Street, Darlinghurst, 2010 NSW, Australia.

E-mail: haylen@optusnet.com.au

Received 16 July 2009; Accepted 16 July 2009

Published online 15 December 2009 in Wiley InterScience

(www.interscience.wiley.com)

DOI 10.1002/nau.20798

symptoms, signs of a disease; *laboratory*”: multiple options mentioned.<sup>1</sup> Such a specific report would require a full outline of the terminology for all symptoms, signs, urodynamic investigations for female pelvic floor dysfunction, the imaging associated with those investigations, and the most common diagnoses.

It may have been possible in the past to combine all the terminologies for lower urinary tract function in men, women, and children into one report. The International Continence Society (ICS) has provided leadership in terminology for lower urinary tract dysfunction over decades employing combined or generic reports. The 1988 report by the Committee on the Standardization of Terminology<sup>2</sup> is one such example. With the increasing specificity and complexity of female diagnoses, a combined report may now be an anachronism. The 2002 report<sup>3</sup> still provided the traditional core terminology and some useful modifications, many of which are repeated in this document. However, it also revealed evidence that (i) a coherent and user-friendly combined report may be starting to become too difficult and (ii) the terminology for women, due to the absence of specific diagnoses as well as other female-specific terminology, may not have been advantaged by this approach.<sup>4</sup> The need for standardized terminology in female pelvic floor dysfunction to enable accurate communication for clinical and research purposes has been highlighted for some time.<sup>5</sup> There is indeed the need for a general terminology, forming a “backbone” or “core” terminology to which more specific terminologies can be attached.

A female-specific terminology report should be

- (1) *As user-friendly as possible*: It should be able to be understood by all clinical and research users.
- (2) *Clinically based*: Symptoms, signs, and validated investigations should be presented for use in forming workable diagnoses. The second, third, and fourth sections will address symptoms, signs, and urodynamic investigations and current associated pelvic imaging modalities routinely used in the office or urodynamic laboratory to make those diagnoses, respectively. A number of related radiological investigations as well as magnetic resonance imaging (MRI) have also been included. The detailed description of electromyography and related nerve conduction, reflex latency, and other sensory studies contained in Ref.<sup>2</sup> will again<sup>3</sup> not be re-instantiated here. This report does not specifically address terminology for neurogenic pelvic floor dysfunction.

The fifth section will address the most common diagnoses of pelvic floor dysfunction. The terms<sup>3</sup> “urodynamic observation” and “condition” (non-medical) have not been used in this report. The scope of the report will exclude (i) more invasive investigations requiring an anesthetic and (ii) evidence-based treatments for each diagnosis.

- (3) *Able to indicate origin and to provide explanations*: Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition will be included and duly referenced. A large number of terms in female pelvic floor function and dysfunction, because of their long-term use, have now become generic, as apparent by their listing in medical dictionaries.

Where a specific explanation is deemed appropriate to explain a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (footnotes i, ii, iii, ...). Wherever possible, evidence-based medical principles will be followed.

Neurourology and Urodynamics DOI 10.1002/nau

## Terminology for Female Pelvic Floor Dysfunction 5

As in earlier ICS reports,<sup>2,3</sup> when a reference is made to the whole anatomical organ, the vesica urinaria, the correct term is the bladder. When the smooth muscle structure known as the m. detrusor urinae is being discussed, then the correct term is detrusor.

It is suggested that acknowledgement of these standards in written publications related to female pelvic floor dysfunction, being indicated by a footnote to the section “Methods and Materials” or its equivalent, to read as follows: “Methods, definitions and units conform to the standards jointly recommended by the International Incontinence Society (ICS) and the International Urogynecological Association, except where specifically noted.”

### SYMPTOMS

*Symptoms*: Any morbid phenomenon or departure from the normal in structure, function, or sensation, experienced by the woman and indicative of disease<sup>1</sup> or a health problem. Symptoms are either volunteered by, or elicited from the individual, or may be described by the individual's caregiver.<sup>2,3</sup>

#### Urinary Incontinence Symptoms

- (i) *Urinary incontinence (symptom)*: Complaint of involuntary loss of urine.<sup>i</sup>
- (ii) *Stress (urinary) incontinence*: Complaint of involuntary loss of urine on effort or physical exertion (e.g., sporting activities), or on sneezing or coughing. *N.B.*: “activity-related incontinence” might be preferred in some languages to avoid confusion with psychological stress.
- (iii) *Urgency (urinary) incontinence*: Complaint of involuntary loss of urine associated with urgency.<sup>ii</sup>
- (iv) *Postural (urinary) incontinence: (NEW)* Complaint of involuntary loss of urine associated with change of body position, for example, rising from a seated or lying position.<sup>iii</sup>
- (v) *Nocturnal enuresis*: Complaint of involuntary urinary loss of urine which occurs during sleep.<sup>3</sup>
- (vi) *Mixed (urinary) incontinence*: Complaint of involuntary loss of urine associated with urgency and also with effort or physical exertion or on sneezing or coughing.
- (vii) *Continuous (urinary) incontinence*: Complaint of continuous involuntary loss of urine.<sup>3,6</sup>
- (viii) *Insensible (urinary) incontinence: (NEW)* Complaint of urinary incontinence where the woman has been unaware of how it occurred.
- (ix) *Coital incontinence: (NEW)* Complaint of involuntary loss of urine with coitus. This symptom might be further divided into that occurring with penetration or intromission and that occurring at orgasm.

#### Bladder Storage Symptoms

- (i) *Increased daytime urinary frequency*: Complaint that micturition occurs more frequently during waking hours than previously deemed normal by the woman.<sup>iv</sup>

<sup>i</sup>“Continence” is defined as the voluntary control of bladder and bowel function.

<sup>ii</sup>“Urgency” replaces “urge” as the “accepted” terminology for the abnormal rather than the normal phenomenon.

<sup>iii</sup>This is a common symptom, the mechanism of which has not been adequately researched. It is uncertain whether it should be linked to Urinary Incontinence Symptoms Section (ii) or (iii).

<sup>iv</sup>Traditionally seven episodes of micturition during waking hours have been deemed as the upper limit of normal, though it may be higher in some populations.<sup>7</sup>

## 6 Haylen et al.

- (ii) *Nocturia*: Complaint of interruption of sleep one or more times because of the need to micturate.<sup>3 v</sup> Each void is preceded and followed by sleep.
- (iii) *Urgency*: Complaint of a sudden, compelling desire to pass urine which is difficult to defer.<sup>vi</sup>
- (iv) *Overactive bladder (OAB, Urgency) syndrome*: Urinary urgency, usually accompanied by frequency and nocturia, with or without urgency urinary incontinence, in the absence of urinary tract infection (UTI) or other obvious pathology.

**Sensory Symptoms**

*Sensory symptoms*: A departure from normal sensation or function, experienced by the woman during bladder filling.<sup>1</sup> Normally, the individual is aware of increasing sensation with bladder filling up to a strong desire to void.<sup>3</sup>

- (i) *Increased bladder sensation*: Complaint that the desire to void during bladder filling occurs earlier or is more persistent to that previous experienced. *N.B.*: This differs from urgency by the fact that micturition can be postponed despite the desire to void.
- (ii) *Reduced bladder sensation*: Complaint that the definite desire to void occurs later to that previously experienced despite an awareness that the bladder is filling.
- (iii) *Absent bladder sensation*: Complaint of both the absence of the sensation of bladder filling and a definite desire to void.<sup>3</sup>

**Voiding and Postmicturition Symptoms**

*Voiding symptoms*: A departure from normal sensation or function, experienced by the woman during or following the act of micturition.<sup>1</sup>

- (i) *Hesitancy*: Complaint of a delay in initiating micturition.
- (ii) *Slow stream*: Complaint of a urinary stream perceived as slower compared to previous performance or in comparison with others.
- (iii) *Intermittency*: Complaint of urine flow that stops and starts on one or more occasions during voiding.
- (iv) *Straining to void*: Complaint of the need to make an intensive effort (by abdominal straining, Valsalva or suprapubic pressure) to either initiate, maintain, or improve the urinary stream.
- (v) *Spraying (splitting) of urinary stream*: Complaint that the urine passage is a spray or split rather than a single discrete stream.
- (vi) *Feeling of incomplete (bladder) emptying*: Complaint that the bladder does not feel empty after micturition.
- (vii) *Need to immediately re-void*: Complaint that further micturition is necessary soon after passing urine.
- (viii) *Postmicturition leakage*: Complaint of a further involuntary passage of urine following the completion of micturition.
- (ix) *Position-dependent micturition: (NEW)* Complaint of having to take specific positions to be able to micturate spontaneously or to improve bladder emptying, for

example, leaning forwards or backwards on the toilet seat or voiding in the semi-standing position.

- (x) *Dysuria*: Complaint of burning or other discomfort during micturition. Discomfort may be intrinsic to the lower urinary tract or external (vulvar dysuria).
- (xi) *(Urinary) retention: (NEW)* Complaint of the inability to pass urine despite persistent effort.

**Pelvic Organ Prolapse (POP) Symptoms**

*Prolapse symptoms*: A departure from normal sensation, structure, or function, experienced by the woman in reference to the position of her pelvic organs. Symptoms are generally worse at the times when gravity might make the prolapse worse (e.g., after long periods of standing or exercise) and better when gravity is not a factor, for example, lying supine. Prolapse may be more prominent at times of abdominal straining, for example, defecation.

- (i) *Vaginal bulging*: Complaint of a “bulge” or “something coming down” towards or through the vaginal introitus. The woman may state she can either feel the bulge by direct palpation or see it aided with a mirror.
- (ii) *Pelvic pressure*: Complaint of increased heaviness or dragging in the suprapubic area and/or pelvis.
- (iii) *Bleeding, discharge, infection*: Complaint of vaginal bleeding, discharge, or infection related to dependent ulceration of the prolapse.
- (iv) *Splinting/digitation*: Complaint of the need to digitally replace the prolapse or to otherwise apply manual pressure, for example, to the vagina or perineum (splinting), or to the vagina or rectum (digitation) to assist voiding or defecation.
- (v) *Low backache*: Complaint of low, sacral (or “period-like”) backache associated temporally with POP.

**Symptoms of Sexual Dysfunction**

A departure from normal sensation and/or function experienced by a woman during sexual activity.

- (i) *Dyspareunia*: Complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration.<sup>vii</sup>
- (ii) *Superficial (introital) dyspareunia*: Complaint of pain or discomfort on vaginal entry or at the vaginal introitus.
- (iii) *Deep dyspareunia*: Complaint of pain or discomfort on deeper penetration (mid or upper vagina).
- (iv) *Obstructed intercourse*: Complaint that vaginal penetration is not possible due to obstruction.
- (v) *Vaginal laxity*: Complaint of excessive vaginal laxity.
- (vi) *Other symptoms*: Refs. 9,10.<sup>viii</sup>

**Symptoms of Anorectal Dysfunction**

- (i) *Anal incontinence (symptom)*: Complaint of involuntary loss of feces or flatus.<sup>ix</sup>

<sup>vii</sup>Dyspareunia, the symptom most applicable to female pelvic floor dysfunction, will depend on many factors including a woman's introital relaxation and/or pain tolerance and her partner's hesitancy or insistence.

<sup>viii</sup>Other symptoms of female sexual dysfunction including (i) decreased sexual desire, (ii) decreased sexual arousal, (iii) decreased orgasm, and (iv) abstinence are less specific for female pelvic floor dysfunction and will not be defined here. The Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (PISQ) is a measure of sexual function in women with urinary incontinence or pelvic organ prolapse.<sup>9</sup>

<sup>ix</sup>Symptoms of defecatory dysfunction are commonly associated with pelvic organ prolapse, particularly posterior vaginal prolapse.

<sup>v</sup>It is common to void during the night when sleep is disturbed for other reasons—for example, insomnia, lactation—this does not constitute nocturia.<sup>8</sup>

<sup>vi</sup>The use of the word “sudden,” defined as “without warning or abrupt,” used in earlier definitions<sup>2,8</sup> has been subject to much debate. Its inclusion has been continued. Grading of “urgency” is being developed.

- (ii) *Fecal incontinence*: Complaint of involuntary loss of feces.<sup>11</sup>
  - (a) Solid.
  - (b) Liquid.
  - (c) *Passive fecal incontinence*: such as soiling without sensation or warning or difficulty wiping clean.
  - (d) *Coital fecal incontinence*: occurring with vaginal intercourse.
- (iii) *Flatal incontinence*: Complaint of involuntary loss of flatus.<sup>11</sup>
- (iv) *Fecal (rectal) urgency*: Sudden, compelling desire to defecate that is difficult to defer.
- (v) *Fecal (flatal) urgency incontinence*: Involuntary loss of feces (flatus) associated with urgency.
- (vi) *Straining to defecate*: Complaint of the need to make an intensive effort (by abdominal straining or Valsalva) to either initiate, maintain, or improve defecation.
- (vii) *Feeling of incomplete (bowel) evacuation*: Complaint that the rectum does not feel empty after defecation.
- (viii) *Diminished rectal sensation*: Complaint of diminished or absent sensation in the rectum.<sup>11</sup>
- (ix) *Constipation*: Complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate (Rome II Criteria).<sup>4</sup>
- (x) *Rectal prolapse*: Complaint of external protrusion of the rectum.
- (xi) *Rectal bleeding/mucus*: Complaint of the loss of blood or mucus per rectum.

#### Lower Urinary Tract Pain and/or Other Pelvic Pain

- (i) *Bladder pain*: Complaint of suprapubic or retropubic pain, pressure, or discomfort, related to the bladder, and usually increasing with bladder filling. It may persist or be relieved after voiding.<sup>3, xi</sup>
- (ii) *Urethral pain*: Complaint of pain felt in the urethra and the woman indicates the urethra as the site.<sup>3</sup>
- (iii) *Vulval pain*: Complaint of pain felt in and around the vulva.<sup>3</sup>
- (iv) *Vaginal pain*: Complaint of pain felt internally within the vagina, above the introitus.<sup>3</sup>
- (v) *Perineal pain*: Complaint of pain felt between the posterior fourchette (posterior lip of the introitus) and the anus.<sup>3</sup>
- (vi) *Pelvic pain*: The complaint of pain perceived to arise in the pelvis, not associated with symptoms suggestive of lower urinary tract, sexual, bowel, or gynecological dysfunction. It is less well defined than the above types of localized pain.
- (vii) *Cyclical (menstrual) pelvic pain*: Cyclical pelvic pain related to menses that raises the possibility of a gynecological cause.
- (viii) *Pudendal neuralgia*: Burning vaginal or vulval (anywhere between anus and clitoris) pain associated with tenderness over the course of the pudendal nerves. Recently, five essential criteria (Nantes criteria) have been proposed for

<sup>11</sup>Rome II Criteria for Symptoms of Anorectal Dysfunction Section (ix): Complaint that bowel movements are infrequent (<3/week) and need to strain, lumpy or hard stool bloating, sensation of incomplete evacuation, sensation of anorectal obstruction, or blockage abdominal pain, need for manual assistance, in more than one-quarter of all defecations.<sup>12</sup>

<sup>x1</sup>The definitions of pelvic pain and especially chronic pelvic pain are being debated in several societies with a view to simplification and restructuring of the classification. The chronic (present for at least 3 months) pain syndromes have not been included till consensus is reached.

## Terminology for Female Pelvic Floor Dysfunction 7

the diagnosis of pudendal neuropathy<sup>13</sup>: (a) pain in the anatomical region of pudendal innervation; (b) pain that is worse with sitting; (c) no waking at night with pain; (d) no sensory deficit on examination; (e) relief of symptoms with a pudendal block.

- (ix) Chronic lower urinary tract and/or other pelvic pain syndromes.<sup>x1</sup>

#### Lower Urinary Tract Infection

- (i) *Urinary tract infection (UTI)*: Scientific diagnosis of a UTI is the finding of microbiological evidence of significant bacteriuria and pyuria<sup>xii</sup> usually accompanied by symptoms such as increased bladder sensation, urgency, frequency, dysuria, urgency urinary incontinence, and/or pain in the lower urinary tract.
- (ii) *Recurrent urinary tract infections (UTIs)*: At least three symptomatic and medically diagnosed UTI in the previous 12 months.<sup>xiii</sup> The previous UTI(s) should have resolved prior to a further UTI being diagnosed.
- (iii) *Other related history*: For example, hematuria, catheterization.

#### SIGNS

*Sign*: Any abnormality indicative of disease or a health problem, discoverable on examination of the patient; an objective indication of disease<sup>1</sup> or a health problem.

#### Urinary Incontinence Signs

All examinations for urinary incontinence are best performed with the woman's bladder comfortably full.

- (i) *Urinary incontinence*: Observation of involuntary loss of urine on examination: this may be urethral or extraurethral.<sup>3</sup>
- (ii) *Stress (urinary) incontinence (clinical stress leakage)*: Observation of involuntary leakage from the urethra synchronous with effort or physical exertion, or on sneezing or coughing.<sup>3</sup>
- (iii) *Urgency (urinary) incontinence*: Observation of involuntary leakage from the urethra synchronous with the sensation of a sudden, compelling desire to void that is difficult to defer.
- (iv) *Extraurethral incontinence*: Observation of urine leakage through channels other than the urethral meatus, for example, fistula.
- (v) *Stress incontinence on prolapse reduction (occult or latent stress incontinence)*: (*NEW*) Stress incontinence only observed after the reduction of co-existent prolapse.<sup>xiv</sup>

<sup>xii</sup>Commonly suggested criteria for: (i) bacteriuria are >100,000 CFU/ml on voided specimen or >1,000 CFU/ml on catheterized specimen; (ii) pyuria are >10 WBC/mm<sup>3</sup>.

<sup>xiii</sup>Recurrent urinary tract infections (UTIs) have not been consistently defined. There is the difficulty of balancing the practical clinical definition and the scientific one. Records of diagnostic tests are often inaccessible over the medium to longer term. With a bias toward the former category, a definition might be the presence of at least three medically diagnosed UTI over the previous 12 months. "Recur" strictly means to "occur again" or "be repeated." This would imply a minimum of (i) two or more or the more commonly accepted, (ii) three or more UTI in the previous 12 months.

<sup>xiv</sup>Stress incontinence on prolapse reduction is a sign frequently alluded to but not properly defined to date. The means of reducing the prolapse will vary. A pessary or ring might, at times, obstruct the urethra, giving a false negative for this sign.

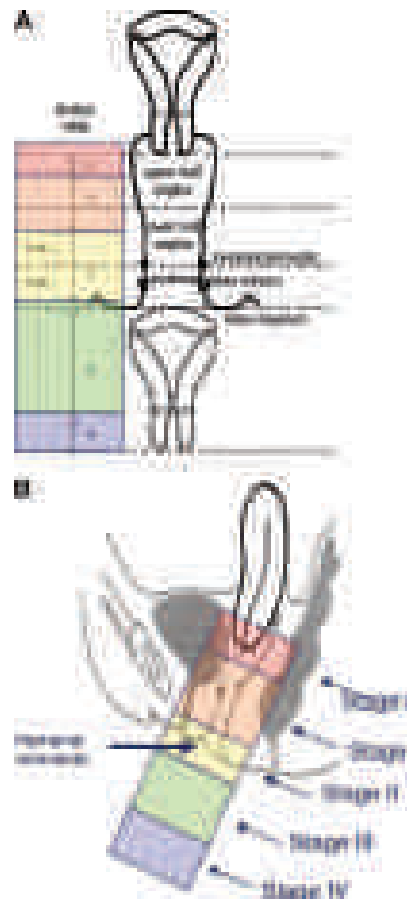
### Signs of Pelvic Organ Prolapse

All examinations for POP should be performed with the woman's bladder empty (and if possible an empty rectum). An increasing bladder volume has been shown to restrict the degree of descent of the prolapse.<sup>14</sup> The choice of the woman's position during examination, for example, left lateral (Sims), supine, standing, or lithotomy, is that which can best demonstrate POP in that patient and which the woman can confirm, for example, by use of a mirror or digital palpation. The degree of prolapse may be worse later in the day (after a lengthy time in the erect position) than it is earlier in the day. The hymen remains the fixed point of reference for prolapse description.<sup>15</sup>

- (i) *Pelvic organ prolapse (definition)*: The descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix), or the apex of the vagina (vaginal vault or cuff scar after hysterectomy). The presence of any such sign should be correlated with relevant POP symptoms. More commonly, this correlation would occur at the level of the hymen or beyond.
- (ii) *Pelvic organ prolapse (POPQ) (Staging 3, 15)*:  
*Stage 0*: No prolapse is demonstrated.  
*Stage I*: Most distal portion of the prolapse is more than 1 cm above the level of the hymen.  
*Stage II*: Most distal portion of the prolapse is 1 cm or less proximal to or distal to the plane of the hymen.  
*Stage III*: The most distal portion of the prolapse is more than 1 cm below the plane of the hymen.  
*Stage IV*: Complete eversion of the total length of the lower genital tract is demonstrated.<sup>xv</sup>
- (iii) *Uterine/cervical prolapse*: Observation of descent of the uterus or uterine cervix.
- (iv) *Vaginal vault (cuff scar) prolapse*: Observation of descent of the vaginal vault (cuff scar after hysterectomy).<sup>18 xvi</sup>
- (v) *Anterior vaginal wall prolapse*: Observation of descent of the anterior vaginal wall. Most commonly this would be due to bladder prolapse (cystocele, either central, paravaginal, or a combination). Higher stage anterior vaginal wall prolapse will generally involve uterine or vaginal vault (if uterus is absent) descent. Occasionally, there might be anterior enterocele (hernia of peritoneum and possibly abdominal contents) formation after prior reconstructive surgery.<sup>18 xvi</sup>
- (vi) *Posterior vaginal wall prolapse*: Observation of descent of the posterior vaginal wall. Most commonly, this would be due to rectal protrusion into the vagina (rectocele). Higher stage posterior vaginal wall prolapse after prior

<sup>xv</sup>The ICS POP quantification system which describes the topographic position of six vaginal sites is the subject of a review by the IUGA Standardization and Terminology Committee with a view to simplification. These sites and the methodology behind the measurement format<sup>15</sup> have therefore not been included here. Consensus was not reached on inserting a valuation of the different prolapse stages into the report, though it will be subject to ongoing discussion: for example, considering Stage 0 or 1 as different degrees of normal support. Considering Stage 2 or more, where the leading edge is at or beyond the hymen as definite prolapse.<sup>16,17</sup>

<sup>xvi</sup>Most gynecologists are generally comfortable with the terms cystocele, rectocele, vaginal vault prolapse, and enterocele. Coupled with the brevity of these terms and their clinical usage for up to 200 years,<sup>18</sup> the inclusion of these terms is appropriate. Some regard it as important to surgical strategy to differentiate between a *central cystocele* (central defect with loss of rugae due to stretching of the subvesical connective tissue and the vaginal wall) and a *paravaginal defect* (rugae preserved due to detachment from the arcus tendineus fascia pelvis).



**Fig. 1. A,B:** Prolapse staging—0, I, II, III, and IV (uterine—by the position of the leading edge of the cervix).

hysterectomy will generally involve some vaginal vault (cuff scar) descent and possible enterocele formation.<sup>18 xvi</sup> Enterocele formation can also occur in the presence of an intact uterus.

### Other Pelvic Examinations/Signs<sup>2,3,19</sup>

The internal examinations are generally best performed with the woman's bladder empty.

- (i) *Vulval examination*: Abnormalities include cysts, other tumors, atrophic changes, or lichen sclerosis.
- (ii) *Urethral inspection/palpation*:  
 (a) *Urethral mucosal prolapse*: Prolapse, generally circumferential and larger, of the distal urethral urothelium.



- (b) *Urethral caruncle*: Smaller eversion of the urethral urothelium, generally involving the posterior lip.
- (c) *Urethral diverticulum*: The presence of a sac opening from the urethra. It might be suspected by a lump or tenderness along the line of the urethra or external urethral discharge on urethral massage.
- (iii) *Vaginal examination*: Examination for vaginal length and mobility, presence of scarring and/or pain, and estrogenization. The location of any vaginal pain should be noted. Included here is any tenderness over the course of the pudendal nerve (see Lower Urinary Tract Pain and/or Other Pelvic Pain Section (viii)).
- (iv) *Bimanual pelvic examination*: Observations for any pelvic mass or unusual tenderness by vaginal examination together with suprapubic palpation.
- (v) *Pelvic floor muscle function*<sup>3,19</sup>: Can be qualitatively defined by the tone at rest and the strength of a voluntary or reflex contraction as strong, normal, weak or absent, or by a validated grading symptom. Voluntary pelvic floor muscle contraction and relaxation may be assessed by visual inspection, by digital palpation (circumferentially), electromyography, dynamometry, perineometry, or ultrasound. Factors to be assessed include muscle strength (static and dynamic), voluntary muscle relaxation (absent, partial, complete), muscular endurance (ability to sustain maximal or near maximal force), repeatability (the number of times a contraction to maximal or near maximal force can be performed), duration, coordination, and displacement. It is desirable to document findings for each side of the pelvic floor separately to allow for any unilateral defects and asymmetry. The ICS report into the standardization of terminology of pelvic floor muscle function and dysfunction<sup>19</sup> provides a fuller description of the assessment of pelvic floor muscle function including the following:
  - (a) *Normal pelvic floor muscles*: Pelvic floor muscles which can voluntarily and involuntarily contract and relax.
  - (b) *Overactive pelvic floor muscles*: Pelvic floor muscles which do not relax, or may even contract when relaxation is functionally needed, for example, during micturition or defecation.
  - (c) *Underactive pelvic floor muscles*: Pelvic floor muscles which cannot voluntarily contract when this is appropriate.
  - (d) *Non-functioning pelvic floor muscles*: Pelvic floor muscles where there is no action palpable.
- (vi) *Examination for levator (puborectalis) injury*: The puborectalis muscle may be assessed for the presence of major morphological abnormalities by palpating its insertion on the inferior aspect of the os pubis. If the muscle is absent 2–3 cm lateral to the urethra, that is, if the bony surface of the os pubis can be palpated as devoid of muscle, an “avulsion injury” of the puborectalis muscle is likely.<sup>20</sup>
- (vii) *Perineal examination*<sup>19</sup>: When the patient is asked to cough or Valsalva, the perineum should show no downward movement; ventral movement may occur because of the guarding actions of the pelvic floor muscles.
  - (a) *Perineal elevation*: This is the inward (cephalad) movement of the vulva, perineum, and anus.
  - (b) *Perineal descent*: This is the outward (caudal) movement of the vulva, perineum, and anus.
- (viii) *Rectal examination*: Observations can include:
  - (a) *Anal sphincter tone and strength*: Assessment on digital examination, as good or poor in the absence of any quantitative assessment.

Neurourology and Urodynamics DOI 10.1002/nau

## Terminology for Female Pelvic Floor Dysfunction 9

- (b) *Anal sphincter tear*: May be recognized as a clear “gap” in the anal sphincter on digital examination.
- (c) *Confirm presence or absence of rectocele* and if possible, differentiate from enterocele. Diagnose perineal body deficiency.
- (d) Confirm presence or absence of fecal impaction.
- (e) *Other rectal lesions*: Intussusception, rectovaginal fistula, or tumor.
- (f) *Anal lesions*: Hemorrhoids, fissure.
- (g) *Other perianal lesions*: Anocutaneous fistula.

### Other Relevant Examinations/Signs<sup>2</sup>

The following general examinations and signs may be relevant:

- (i) *Neurological signs*: For patients with possible neurogenic lower urinary tract or pelvic floor dysfunction, there should be particular note of those neurological signs related to S2–S4, but these should be complemented by a more general neurological examination as indicated.
- (ii) *Abdominal signs*: Among numerous possible abdominal signs are:
  - (a) *Bladder fullness/retention*: The bladder may be felt by abdominal palpation or suprapubic percussion.
  - (b) *Other abdominal masses* or distension (e.g., ascites).
  - (c) *Scars*: Indicating previous relevant surgery or traumas.
  - (d) *Renal area*: Examination for tenderness, masses.

### Frequency volume chart/Bladder diary

- (i) *Frequency-volume chart (FVC)*: The recording of the time of each micturition and the volume voided for at least 24 hr. Two or 3 days of recording (not necessarily consecutive) will generally provide more useful clinical data. Information obtained will confirm:
  - (a) *Daytime urinary frequency*: Number of voids by day (wakeful hours including last void before sleep and first void after waking and rising).
  - (b) *Nocturnal frequency/nocturia*: Number of times sleep is interrupted by the need to micturate. Each void is preceded and followed by sleep.
  - (c) *Twenty-four-hour frequency*: Total number of daytime voids and episodes of nocturia during a specified 24-hr period.
  - (d) *Twenty-four-hour urine production*: Summation of all urine volumes voided in 24 hr.
  - (e) *Maximum voided volume*: Highest voided volume recorded.
  - (f) *Average voided volume*: Summation of volumes voided divided by the number of voids.
  - (g) *Median functional bladder capacity*: Median maximum voided volume in everyday activities.
  - (h) *Polyuria*: Excessive excretion of urine resulting in profuse and frequent micturition.<sup>3</sup> It has been defined as over 40 ml/kg body weight during 24 hr or 2.8 L urine for a woman weighing 70 kg.<sup>21</sup>
  - (i) *Nocturnal urine volume*: Cumulative urine volume from voids after going to bed with the intention of sleeping to include the first void at the time of waking with the intention of rising (excludes last void before sleep).

The bladder diary is a record of the volume of urine voided over a 24-hr period. It is a useful tool for the assessment of the degree of urinary incontinence. It is a useful tool for the assessment of the degree of urinary incontinence. It is a useful tool for the assessment of the degree of urinary incontinence.

TIME	DATE	TIME	TIME	TIME
00:00		00:00		
01:00		01:00		
02:00		02:00		
03:00		03:00		
04:00		04:00		
05:00		05:00		
06:00		06:00		
07:00		07:00		
08:00		08:00		
09:00		09:00		
10:00		10:00		
11:00		11:00		
12:00		12:00		
13:00		13:00		
14:00		14:00		
15:00		15:00		
16:00		16:00		
17:00		17:00		
18:00		18:00		
19:00		19:00		
20:00		20:00		
21:00		21:00		
22:00		22:00		
23:00		23:00		
24:00		24:00		

Fig. 2. Example of a bladder diary.

- (j) *Nocturnal polyuria*: Excess (over 20–30% age dependent) proportion of urine excretion (nocturnal voided volume/total 24 hr voided volume  $\times$  100%) occurs at night (or when patient is sleeping).<sup>xvii</sup>
- (ii) *Bladder diary*: Adds to the FVC above, the fluid intake, pad usage, incontinence episodes, and the degree of incontinence. Episodes of urgency and sensation might also be recorded, as might be the activities performed during or immediately preceding the involuntary loss of urine. Additional information obtained from the bladder diary involves severity of incontinence in terms of leakage episodes and pad usage.

Pad Testing

Quantification of the amount of urine lost over the duration of testing, by measuring the increase in the weight of the perineal pads (weighed pre- and posttesting) used. This may give a guide to the severity of incontinence. Different durations from a short (1 hr) test to a 24- and 48-hr tests have been used with provocation varying from normal everyday activities to defined regimens.

URODYNAMIC INVESTIGATIONS AND ASSOCIATED PELVIC IMAGING

*Urodynamics*: Functional study of the lower urinary tract.  
*Clinical sequence of testing*: Urodynamic investigations generally involve a woman attending with a comfortably full bladder for free (no catheter) uroflowmetry and postvoid residual urine volume (PVR) measurement prior to filling and voiding (with catheter) cystometry.

<sup>xvii</sup>More than 20% (young adults) to 33% (over 65 years) have been suggested as excessive.<sup>3</sup>



### Uroflowmetry

- (i) *Ideal conditions for free (or spontaneous—no catheter) uroflowmetry*: Ideally, all free uroflowmetry studies should be performed in a completely private uroflowmetry room. Most modern uroflowmeters have a high degree of accuracy ( $\pm 5\%$ ) though regular calibration is important.<sup>22</sup>
- (ii) *Urine flow*: Voluntary urethral passage of urine which may be:
  - (a) *Continuous*: No interruption to flow.
  - (b) *Intermittent*: Flow is interrupted.
- (iii) *Flow rate*: Volume of urine expelled via the urethra per unit time. It is expressed in ml/sec.<sup>2,3</sup>
- (iv) *Voided volume (ml)*: Total volume of urine expelled via the urethra.<sup>2,3</sup>
- (v) *Maximum (urine) flow rate (MUFR, ml/sec)*— $Q_{max}$ : Maximum measured value of the flow rate<sup>2,3</sup> correcting for artifacts.<sup>3</sup>
- (vi) *Flow time (sec)*: The time over which measurable flow actually occurs.<sup>2,3</sup>
- (vii) *Average (urine) flow rate (AUFR, ml/sec)*— $Q_{ave}$ : Voided volume divided by the flow time (Fig. 3).<sup>2,3</sup>
- (viii) *Voiding time (sec)*: This is the total duration of micturition, that is, includes interruptions. When voiding is completed without interruption, voiding time is equal to flow time.<sup>2,3</sup>
- (ix) *Time to maximum flow (sec)*: This is the elapsed time from the onset of urine flow to maximum urine flow.<sup>2,3</sup>
- (x) *Interpretation of the normality of free uroflowmetry*: Because of the strong dependency of urine flow rates on voided volume,<sup>23</sup> they are best referenced to nomograms where the cutoff for abnormally slow (MUFR, AUFR) has been determined and validated,<sup>22,24,25</sup> as under the 10th centile of the respective Liverpool nomogram.<sup>25</sup> References to a specific urine flow rate as the lower limit of normal provided a specific volume has been voided require further validation studies (Fig. 4).<sup>26</sup>

### Postvoid Residual (Urine Volume)

- (i) *Postvoid residual*: Volume of urine left in the bladder at the completion of micturition.<sup>1,3</sup>
- (ii) *Conditions for PVR measurement*: PVR reading is erroneously elevated by delayed measurement due to additional renal input (1–14 ml/min) into bladder volume.<sup>27</sup>

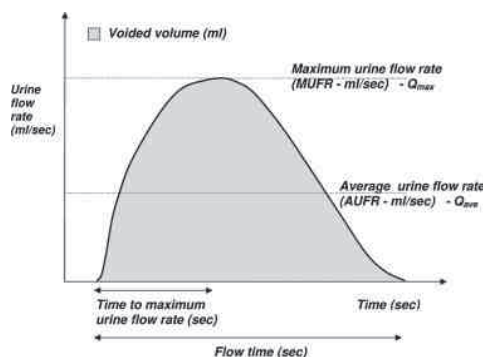


Fig. 3. A schematic representation of urine flow over time.

Neurourology and Urodynamics DOI 10.1002/nau

### Terminology for Female Pelvic Floor Dysfunction 11

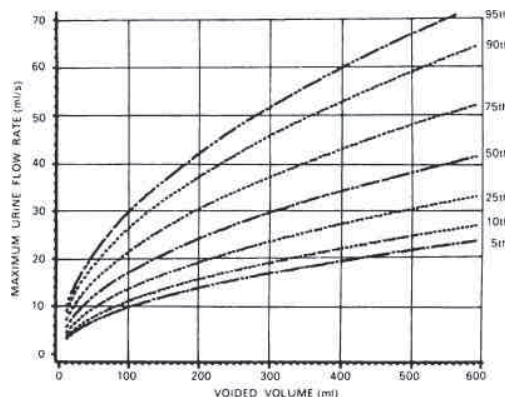


Fig. 4. Liverpool nomogram for maximum urine flow rate in women. Equation:  $\ln(\text{maximum urine flow rate}) = 0.511 + 0.505 \times \ln(\text{voided volume})$ ; root mean square error =  $0.340^{22,24}$  (reproduced with permission).

Ultrasonic techniques (transvaginal, abdominal, Doppler planimetry) allow immediate (within 60 sec of micturition) measurement.<sup>27</sup> A short plastic female catheter provides the most effective bladder drainage for PVR measurement.<sup>27</sup>

- (iii) *Assessment of normality of PVR*: Quoted upper limits of normal may reflect the accuracy of measurement. Studies using “immediate” PVR measurement (e.g., transvaginal ultrasound) suggest an upper limit of normal of 30 ml.<sup>28</sup> Studies using urethral catheterization (up to 10 min delay) quote higher upper limits of normal of 50<sup>26</sup> or 100 ml.<sup>28</sup> An isolated finding of a raised PVR requires confirmation before being considered significant.

### Cystometry—General<sup>2,3,29</sup>

- (i) *Cystometry*: Measurement of the pressure/volume relationship of the bladder during filling and/or pressure flow study during voiding.<sup>2,29</sup>
- (ii) *Cystometrogram (CMG)*: Graphical recording of the bladder pressure(s) and volume(s) over time.<sup>2,29</sup>
- (iii) *Urodynamic studies*: These usually take place in a special clinical room (urodynamic laboratory) and involve (artificial) bladder filling with a specified liquid at a specified rate.<sup>3,29</sup>
- (iv) *Conditions for cystometry*<sup>2,3,29</sup>:
  - (a) *Pressures*: All systems are zeroed at atmospheric pressure.
  - (b) *External pressure transducers*: Reference point is the superior edge of the pubic symphysis.
  - (c) *Catheter mounted transducers*: Reference point is the transducer itself.
  - (d) *Initial bladder volume*: Bladder should be empty.
  - (e) *Fluid medium*: Usually water or saline (or contrast if radiology involved).
  - (f) *Temperature of fluid*: Should ideally be warmed to body temperature.
  - (g) *Position of patient*: Sitting position is more provocative for abnormal detrusor activity than the supine position. At some point in the test, filling might desirably take place with the woman standing.

12 Haylen et al.

- (h) *Filling rate*: The filling rate, including any changes during testing, should be noted on the urodynamic report.
  - (v) *Intravesical pressure ( $p_{ves}$ )*: The pressure within the bladder.<sup>1–3</sup>
  - (vi) *Abdominal pressure ( $p_{abd}$ )*: The pressure surrounding the bladder. It is usually estimated from measuring the rectal pressure, though vaginal and infrequently the pressure through a bowel stoma can be measured as an alternative. The simultaneous measurement of abdominal pressure is essential for interpretation of the intravesical pressure trace<sup>2,3</sup>. Artifacts on the detrusor pressure trace may be produced by an intrinsic rectal contraction.
  - (vii) *Detrusor pressure ( $p_{det}$ )*: The component of intravesical pressure that is created by forces in the bladder wall (passive and active). It is estimated by subtracting abdominal pressure from intravesical pressure.<sup>3</sup>
  - (viii) *Ambulatory urodynamics*: These investigations are a functional test of the lower urinary tract, performed outside the clinical setting, involving natural filling and reproducing the woman's everyday activities.
- Filling Cystometry<sup>2,3,29</sup>**
- (i) *Filling cystometry*: This is the pressure/volume relationship of the bladder during bladder filling.<sup>1,2</sup> It begins with the commencement of filling and ends when a “permission to void” is given by the urodynamicist.<sup>3</sup>
  - (ii) *Aims of filling cystometry*: These are to assess bladder sensation, bladder capacity, detrusor activity, and bladder compliance.<sup>2,3</sup>
- (iii) *Bladder sensation during filling cystometry*: This is usually assessed by questioning the woman in relation to the fullness of the bladder during cystometry.<sup>2</sup>
    - (a) *First sensation of bladder filling*: The feeling when the woman first becomes aware of bladder filling.<sup>3</sup>
    - (b) *First desire to void<sup>2</sup>*: The first feeling that the woman may wish to pass urine.
    - (c) *Normal desire to void*: The feeling that leads the woman to pass urine at the next convenient moment, but voiding can be delayed if necessary.
    - (d) *Strong desire to void*: The persistent desire to pass urine without the fear of leakage.
    - (e) *Urgency*: Sudden, compelling desire to pass urine which is difficult to defer.<sup>3 f</sup>
    - (f) *Bladder oversensitivity—also referred to as either “increased bladder sensation”<sup>3</sup> or “sensory urgency” (2—now obsolete)*: Increased perceived bladder sensation during bladder filling with: an early first desire to void; an early strong desire to void, which occurs at low bladder volume; a low maximum cystometric bladder capacity (Filling Cystometry Section (iv-b)); no abnormal increases in detrusor pressure.
    - (g) *Reduced bladder sensation*: Bladder sensation is perceived to be diminished during filling cystometry.
    - (h) *Absent bladder sensation*: The woman reports no bladder sensation during filling cystometry.
    - (i) *Pain*: The complaint of pain during filling cystometry is abnormal. Its site, character, and duration should be noted.
  - (iv) *Bladder capacity during filling cystometry*:
    - (a) *Cystometric capacity*: Bladder volume at the end of filling cystometry, when “permission to void” is

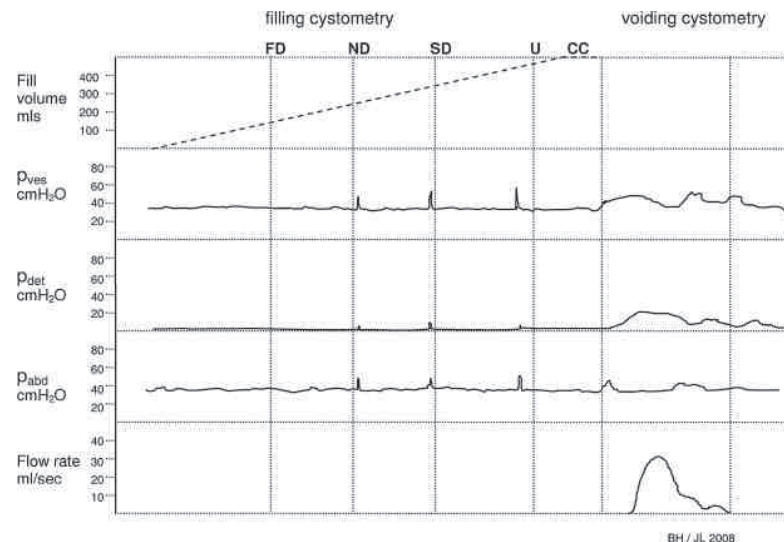


Fig. 5. Filling cystometry—normal detrusor function. Forty-eight-year-old female with urinary frequency. No phasic activity during filling. Voided with normal urine flow rate at normal detrusor voiding pressure. Normal study. FD, First desire to void; ND, Normal desire to void; SD, Strong desire to void; U, Urgency; CC, Cystometric capacity (permission to void given).

Neurourology and Urodynamics DOI 10.1002/nau

usually given by the urodynamicist. This endpoint and the level of the woman's bladder sensation at that time, for example, "normal desire to void", should be noted.

- (b) *Maximum cystometric capacity*: In patients with normal sensation, this is the bladder volume when she can no longer delay micturition.

(v) Detrusor function during filling cystometry:

- (a) *Normal (previously "stable") detrusor function*: There is little or no change in detrusor pressure with filling. There are no involuntary phasic contractions despite provocation with activities such as postural changes, coughing, hearing the sound of running water, hand-washing.
- (b) *Detrusor overactivity*: The occurrence of involuntary detrusor contractions during filling cystometry. These contractions, which may be spontaneous or provoked, produce a wave form on the cystometrogram, of variable duration and amplitude. The contractions may be phasic or terminal. Symptoms, for example, urgency and/or urgency incontinence may or may not occur. If a relevant neurological cause is present, then *neurogenic detrusor overactivity* is noted, otherwise

# Terminology for Female Pelvic Floor Dysfunction

13

*idiopathic detrusor overactivity* should be the term used (Fig. 6).

- (c) *Neurogenic detrusor overactivity*: This is where there is detrusor overactivity and there is evidence of a relevant neurological disorder.
- (vi) *Bladder compliance*<sup>2,3</sup>: This describes the relationship between a change in bladder volume and change in detrusor pressure<sup>3</sup>. Compliance is calculated by dividing the volume change ( $\Delta V$ ) by the change in detrusor pressure ( $\Delta P_{det}$ ) during that change in bladder volume ( $C = \Delta V / \Delta P_{det}$ ). Compliance is expressed as ml per cmH<sub>2</sub>O. Bladder compliance can be affected by:
- (a) *Bladder filling*: Faster filling is more provocative. An artifact may be produced which settles when filling is interrupted.
- (b) *Contractile/relaxant properties of the detrusor*: For example, postradiation changes of the detrusor wall.
- (c) *Starting point for compliance calculations*<sup>3</sup>: Usually the detrusor pressure at the start of bladder filling and the corresponding bladder volume (usually zero).
- (d) *End point for compliance calculations*<sup>3</sup>: The detrusor pressure (and corresponding bladder volume) at cystometric capacity or immediately before the start

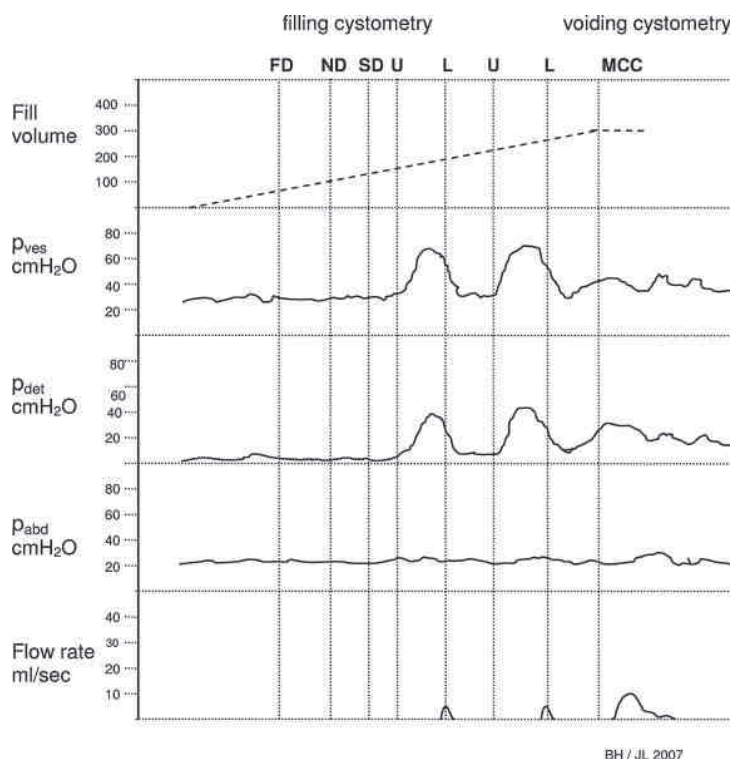


Fig. 6. Filling cystometry—detrusor overactivity. Fifty-two-year-old female with urgency and frequency. Phasic detrusor activity during filling. Leakage is associated with urgency and detrusor contractions. FD, First desire to void; ND, Normal desire to void; SD, Strong desire to void; U, Urgency; L, Leakage; MCC, Maximum cystometric capacity.

of any detrusor contraction that causes significant leakage (and therefore causes the bladder volume to decrease, affecting compliance calculations). Both points are measured excluding any detrusor contraction.

#### Urethral Function During Filling Cystometry (Filling Urethro-Cystometry)

- (i) *Urethral pressure measurement*<sup>2,3,29</sup>: Urethral pressure and urethral closure pressure are idealized concepts which represent the ability of the urethra to prevent leakage. Urethral pressure is currently measured by a number of different techniques which do not tend to have consistent results, either between methods or for a single method.<sup>30</sup> For example, the effect of catheter rotation will be relevant when urethral pressure is measured by a catheter-mounted transducer. Urethral pressure might, nonetheless, be measured:
  - At rest, with the bladder at a given volume.
  - During coughing or straining.
  - During the process of voiding.
- (a) *Urethral pressure (intraluminal)*: This is the fluid pressure needed to just open a closed urethra.
- (b) *Urethral pressure profile (UPP)*: This is a graph indicating the intraluminal pressure along the length of the urethra.
  - *Resting UPP*: The bladder and subject are at rest.
  - *Stress UPP*: Defined applied stress (e.g., cough, strain, Valsalva).

All systems are zeroed at atmospheric pressure. For external transducers, the reference point is the superior edge of the symphysis pubis. For catheter-mounted transducers, the reference point is the transducer itself. Intravesical pressure should be measured to exclude a simultaneous detrusor contraction. Methodology should be noted<sup>2</sup> including: patient position; catheter type; transducer orientation; fluid and rate of infusion (if fluid-filling system); bladder volume; rate of catheter withdrawal.

- (c) *Maximum urethral pressure (MUP)*: Maximum pressure in the UPP.
- (d) *Urethral closure pressure profile (UCPP)*: The relevant pressure is the urethral closure pressure (urethral pressure minus the intravesical pressure).
- (e) *Maximum urethral closure pressure (MUCP)*: Maximum pressure in the UCPP, that is, the maximum difference between the urethral pressure and the intravesical pressure.
- (f) *Functional profile length*: The length of the urethra along which the urethral pressure exceeds intravesical pressure in a woman.
- (g) *Functional profile length (on stress)*: The length over which the urethral pressure exceeds the intravesical pressure on stress.
- (h) *Pressure “transmission” ratio*: This is the increment in urethral pressure on stress as a percentage of the simultaneously recorded increment in intravesical pressure. For stress profiles obtained during coughing, pressure transmission ratios can be obtained at any point along the urethra. If single values are given, the position in the urethra should be stated. If several transmission ratios are defined at different points along the urethra, a pressure transmission “profile” is

obtained. During “cough profiles,” the amplitude of the cough should be stated if possible.

- (ii) *Urethral closure mechanism*<sup>3</sup>:
  - (a) *Normal urethral closure mechanism*: A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.
  - (b) *Incompetent urethral closure mechanism*: Leakage of urine occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.
  - (c) *Urethral relaxation incompetence (“urethral instability”)*: Leakage due to urethral relaxation in the absence of raised abdominal pressure or a detrusor contraction.
  - (d) *Urodynamic stress incontinence*: This is the involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.
- (iii) *Leak point pressures*<sup>2,31,32</sup>: There are two types of leak point pressure measurement. The pressure values at leakage should be measured at the moment of leakage.
  - (a) *Detrusor leak point pressure (detrusor LPP)*: This is a static test. The pressure is the lowest value of the detrusor pressure at which leakage is observed in the absence of increased abdominal pressure or a detrusor contraction. High detrusor LPP (e.g., over 40 cmH<sub>2</sub>O<sup>31</sup>) may put patients at risk for upper urinary tract deterioration, or secondary damage to the bladder in the cases of known underlying neurological disorders such as paraplegia or MS. There are no data on any correlation between detrusor LPP and upper tract damage in non-neurogenic patients.
  - (b) *Abdominal leak point pressure (abdominal LPP)*: This is a dynamic test. It is the lowest value of the intentionally increased intravesical pressure that provokes urinary leakage in the absence of a detrusor contraction.<sup>32</sup> The increase in pressure can be induced by a cough (cough LPP) or Valsalva (Valsalva LPP). Multiple estimates at a fixed bladder volume (200–300 ml) are desirable. Catheter size will influence LPP values and should be standardized. LPP values might also be affected by many other factors such as the technique to confirm urine loss, location of catheter, type of pressure sensor, bladder volume, rate of bladder filling, and patient position. A low abdominal LPP is suggestive of poor urethral function.<sup>xviii</sup>

#### Voiding Cystometry (Pressure Flow Studies)

- (i) *Voiding cystometry*: This is the pressure volume relationship of the bladder during micturition.<sup>1</sup> It begins when the “permission to void” is given by the urodynamicist and ends when the woman considers her voiding has finished.<sup>3</sup> Measurements to be recorded should be the intravesical, intra-abdominal, and detrusor pressures and the urine flow rate.
- (ii) *Measurements during voiding cystometry*<sup>2,3,29</sup>:
  - (a) *Premicturition pressure*: The pressure recorded immediately before the initial isovolumetric contraction.
  - (b) *Opening time*: The time elapsed from initial rise in pressure to the onset of flow. This is the initial isovolumetric contraction period of micturition. It re-

<sup>xviii</sup>The correlation between MUCP and abdominal LPP may depend on the catheter type used.

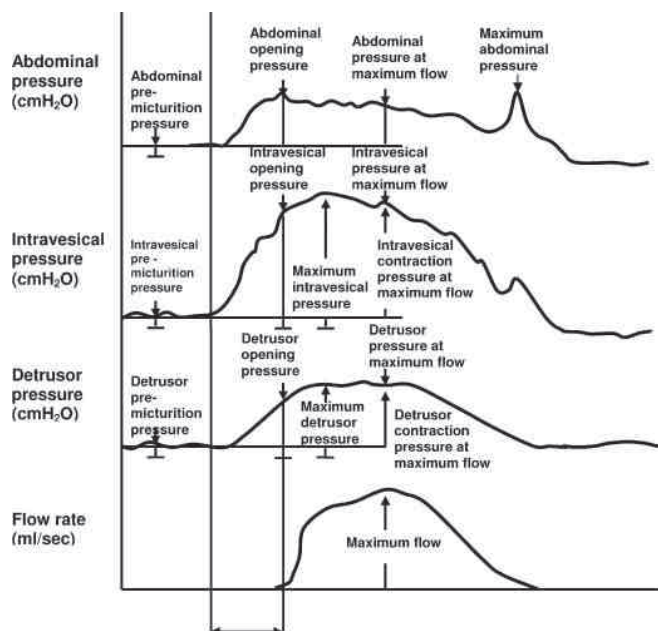


Fig. 7. A schematic diagram of voiding cystometry.

- flects the time taken for the fluid to pass from the point of pressure measurement to the uroflow transducer. Flow measurement delay should be taken into account when measuring the opening time.
- (c) *Opening pressure*: The pressure recorded at the onset of measured flow (consider time delay).
- (d) *Maximum pressure*: Maximum value of the measured pressure.
- (e) *Pressure at maximum flow*: Pressure recorded at maximum measured flow rate.
- (f) *Closing pressure*: Pressure recorded at the end of measured flow.
- (g) *Contraction pressure at maximum flow*: This is the difference between pressure at maximum flow and the premicturition pressure.
- (h) *Flow delay*: This is the delay in time between a change in pressure and the corresponding change in measured flow rate.

Figure 7 shows a schematic diagram of voiding cystometry.

(iii) Detrusor function during voiding<sup>2,3</sup>:

- (a) *Normal detrusor function*: Normal voiding in women is achieved by an initial (voluntary) reduction in intra-urethral pressure (urethral relaxation).<sup>33</sup> This is generally followed by a continuous detrusor contraction that leads to complete bladder emptying within a normal time span. Many women will void successfully (normal flow rate and no PVR) by urethral relaxation alone, without much of a rise in detrusor pressure.<sup>34</sup> The amplitude of the detrusor contraction will tend to increase to cope with any degree of bladder outflow obstruction.<sup>35</sup>

- (b) *Detrusor underactivity*: Detrusor contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.
- (c) *Acontractile detrusor*: The detrusor cannot be observed to contract during urodynamic studies resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. The term “areflexia” has been used where there is a neurological cause but should be replaced by *neurogenic acontractile detrusor*.

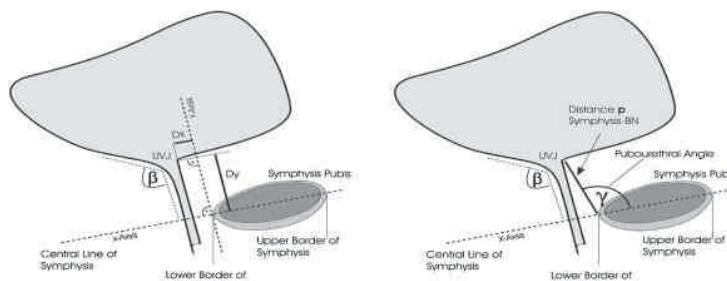
**Urethral Function During Voiding Cystometry  
(Voiding Urethro-Cystometry<sup>2,3,29</sup>)**

This technique may assist in determining the nature of urethral obstruction to voiding. Pressure is recorded in the urethra during voiding. This may be at one specific point, for example, high-pressure zone or it may be measured as a profile. A voiding urethral pressure profile (VUPP) uses a similar technique to that described above for the UPP measured during bladder filling. Simultaneous intravesical pressure measurement is required. Localization of the site of the intraurethral pressure measurement is desirable.

- (i) *Normal urethral function*: The urethra opens and is continuously relaxed to allow micturition at a normal pressure, urine flow, and PVR.<sup>xix</sup>

<sup>xix</sup>Symptomatic women with normal detrusor function do not have to rely as much on an increase in detrusor pressure to achieve successful voiding as men. With a shorter urethra (3–4 cm vs. 20 cm), urethral relaxation might suffice. The concept of urethral relaxation, prior to detrusor contraction, is a change from prior definitions.<sup>2,3</sup>





**Fig. 8.** Ultrasound parameters: according to the recommendations of the German-speaking countries.  $\gamma$  (gamma), angle between the inferior edge of the symphysis and the urethrovesical junction (UVJ); h, distance between the UVJ and the horizontal; p, distance between the inferior edge of the symphysis and the UVJ; x and y, distance between the UVJ and the x- and y-axis; X, axis of the symphysis, with 0 at its lower edge; Y, axis perpendicular to that of the symphysis.<sup>36</sup>

- (ii) **Bladder outflow obstruction:** This is the generic term for obstruction during voiding. It is a reduced urine flow rate and/or presence of a raised PVR and an increased detrusor pressure.<sup>xx</sup> It is usually diagnosed by studying the synchronous values of urine flow rate and detrusor pressure and any PVR measurements. A urethral stricture or obstruction due to higher degrees of uterovaginal prolapse or obstructed voiding after stress incontinence procedures are among possible causes.
- (iii) **Dysfunctional voiding:** This is characterized by an intermittent and/or fluctuating flow rate due to involuntary intermittent contractions of the peri-urethral striated or levator muscles during voiding in neurologically normal women. This type of voiding may also be the result of an acontractile detrusor (abdominal voiding) with electromyography (EMG) or video-urodynamics required to distinguish between the two entities.
- (iv) **Detrusor sphincter dyssynergia (DSD):** This is incoordination between detrusor and sphincter during voiding due to a neurological abnormality (i.e., detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscles). This is a feature of neurological voiding disorders. Neurological features should be sought. Videocystourethrography (VCU—Radiological Imaging Section (i:a)) is generally valuable to conclude this diagnosis.

#### Ultrasound Imaging<sup>36</sup>

- (i) **Ultrasound in urogynecology:** Ultrasound has become an increasingly frequent adjunct investigation in urogynecology and female urology both in the office and in the urodynamic laboratory.
- (ii) **Modalities in current routine clinical use:**
  - (a) **Perineal:** Curved array probe applied to the perineum. This term incorporates transperineal and translabial ultrasound.
  - (b) **Introital:** Sector probe applied to the vaginal introitus.
  - (c) **Transvaginal (T-V):** Intravaginal curvilinear, linear array, or sector scanning.
  - (d) **Transabdominal (T-A):** Curvilinear scanning applied to the abdomen.

<sup>xx</sup>In symptomatic women, detrusor voiding pressure, urine flow (rate), and PVR are important markers of bladder outflow obstruction. In the original definition, only detrusor pressure and urine flow rate were included.

- (iii) **Current routine possible uses of ultrasound in urogynecology and female urology:**

#### (a) Bladder neck descent/mobility/opening:

- Position of bladder neck at rest and on Valsalva.<sup>xxi</sup>

**N.B.:** Ideally the Valsalva should be standardized but it is appreciated that at present a reliable non-invasive method is lacking. Consensus has not been reached on criteria for excessive bladder neck mobility nor the relationship of this finding to a diagnosis of urodynamic stress incontinence.<sup>37</sup>

- Position of bladder neck during pelvic floor contraction.
- Retrovesical angle (RVA): That is, angle between proximal urethra and trigonal surface of the bladder.
- Urethral rotation: That is, rotation of the proximal urethra on Valsalva.<sup>xxii</sup>
- Angle gamma: That is, angle defined by lines from the infero-posterior symphyseal margin to the bladder neck at rest and on Valsalva.<sup>xxi</sup>
- Urethral funneling: That is, opening of the proximal third of the urethra during coughing or on Valsalva.<sup>v</sup>
- Urine loss: Full urethral opening during coughing, Valsalva,<sup>xxi</sup> bladder contraction, or micturition.

Figure 8 demonstrates schematically some of the ultrasound parameters.

- (b) **Postvoid residuals:** See the Postvoid Residual (Urine Volume) Section.
- (c) **Intercurrent pelvic pathology:** For example, uterine and adnexal pathology.
- (d) **Uterine version:** Anteverted or retroverted; flexion at level of isthmus.<sup>38 xxii</sup>
- (e) **Bladder abnormalities:** For example, tumor, foreign body.
- (f) **Urethral abnormality:** For example, diverticulum.

<sup>xxi</sup>In scientific studies, consideration should be given to standardization of the Valsalva strength, for example, by using an intrarectal pressure transducer.

<sup>xxii</sup>The use of transvaginal ultrasound with an empty bladder optimizes this assessment.<sup>39</sup>

- (g) *Postoperative findings*: For example, bladder neck position and mobility, position of meshes, tapes, or implants.
- (h) *Pelvic floor/levator defects*: Bladder neck elevation during pelvic floor contraction.
- (i) *Descent of pelvic organs*: Visualization of descent of the bladder, uterine cervix, and rectum during Valsalva and coughing.
- (iv) *3D and 4D ultrasound*: The potential of 3D ultrasound in urogynecology and female urology is currently being researched with validated applications likely to be included in future updates of this report and/or separate ultrasound reports. Applications with the most current research include: (i) major morphological abnormalities such as levator defects<sup>39</sup> and (ii) excessive distensibility of the puborectalis muscle and levator hiatus ("ballooning"<sup>40</sup>). The additional diagnostic potential of 4D (i.e., the addition of movement) ultrasound awaits clarification by further research.
- (v) *Other assessments*: Synchronous ultrasound screening of the bladder and/or urethra and measurement of the bladder and abdominal pressure during filling and voiding cystometry.
- (vi) *Anal ultrasound (endosonography)*<sup>41</sup>: This is the gold-standard investigation in the assessment of anal sphincter integrity. There is a high incidence of defecatory symptoms in women with anal sphincter defects.

### Radiological Imaging

- (i) Modalities in current routine clinical use:
  - (a) *Videocystourethrography (VCU)*<sup>42</sup>: Synchronous radiological screening of the bladder and measurement of the bladder and abdominal pressure during filling and voiding cystometry. When indicated for complex cases, VCU allows direct observation of the effects of bladder events, the position and conformation of the bladder neck in relation to the pubic symphysis, bladder neck closure during rest and stress, diverticula of the bladder and urethra, vesico-vaginal and urethro-vaginal fistulae, vesico-ureteric reflux and voiding events.
- (ii) *Other modalities*: None of these are office or urodynamic laboratory based.
  - (a) *Intravenous urography (IVU)*<sup>42</sup>: This provides an anatomical outline of the urinary tract including a nephrogram prior to passage of the contrast to the calyces, renal pelvis, ureter, and bladder.
  - (b) *Micturating cystogram (MCU)*<sup>43</sup>: The principal use is the detection of vesico-ureteric reflux, some fistulae and diverticula.
  - (c) *Defecography*<sup>41</sup>: This demonstrates normal anatomy of the anorectum as well as disorders of rectal evacuation. Barium paste is inserted rectally prior to defecation over a translucent commode. Measurement of the anorectal angle is allowed with evidence of the presence, size, or emptying of any rectocele. Enteroceles, rectal intussusception, and mucosal prolapse might be diagnosed as well as a spastic pelvic floor (anismus).
  - (d) *Colporecto-cystourethrography (Colpo-cystodefecography)*<sup>42</sup>: This involves the instillation of radio-opaque media into bladder, vagina, and rectum simultaneously for pelvic floor evaluation with images obtained during rest and straining.

Neurourology and Urodynamics DOI 10.1002/nau

## Terminology for Female Pelvic Floor Dysfunction 17

### Magnetic Resonance Imaging<sup>45,46</sup>

- (i) MRI in urogynecology and female urology:

MRI provides the opportunity to examine the soft tissue structures of the pelvic support apparatus in toto. It is non-invasive, has excellent soft tissue contrast resolution without exposure to ionizing radiation, and allows the study of function of pelvic floor structures under different dynamic conditions such as increased abdominal pressure during Valsalva.<sup>44,45</sup> Several anatomical landmarks used for pelvic measurements are also easily identified in MRI and most measurements are thus highly reproducible. Currently, the clinical value of these examinations is still under investigation with its impact on therapeutic decisions not yet fully evaluated.

- (ii) Current possible measurements using MRI in urogynecology and female urology<sup>44,45</sup>:
  - (a) Bladder neck and cervical descent/mobility:
    - Position of bladder neck and cervix at rest and on Valsalva.
    - *Pubo-coccygeal line*: A line extending from the inferior border of the pubic symphysis to the last joint of the coccyx. Bladder neck or cervical descent >2 cm below this line with straining indicates weakness of the pelvic floor. If alternative landmarks are used in scientific papers they should be clearly described.

Figure 9A shows a number of possible measurements using MRI imaging.

- (b) *Intercurrent pelvic pathology*: For example, fibroids, ovarian pathology.
- (c) *Uterine version*: Anteverted or retroverted; flexion at the isthmus.<sup>47</sup>
- (d) *Bladder abnormalities*: For example, tumor; foreign body.
- (e) *Urethral abnormality*: For example, diverticulum.
- (f) *Postoperative findings*: For example, bladder neck mobility.
- (g) *Pelvic floor measurements/levator defects*: Assessment of the configuration of pelvic floor muscles, in particular, the levator ani.
- (h) Descent of pelvic organs:

*N.B.*: Diagnostic ability may be enhanced by the use of 3D MRI. New techniques with high-speed sequence of pictures allow a functional MRI.

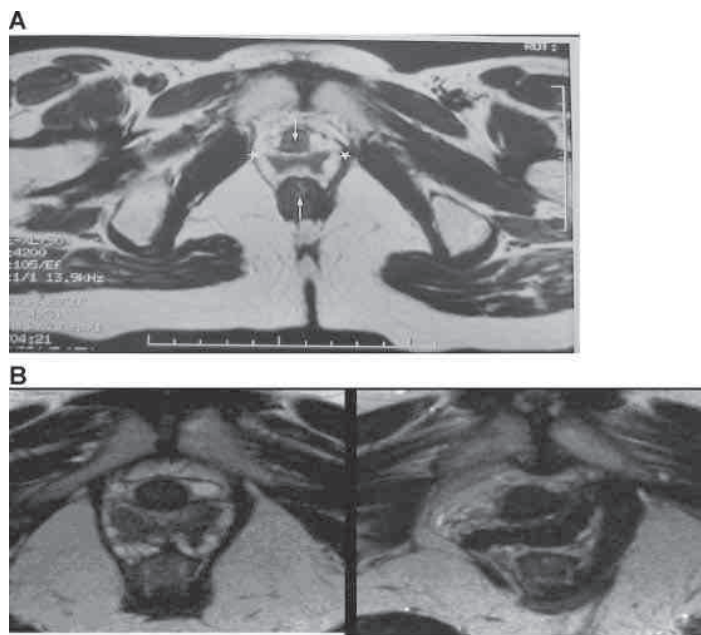
### DIAGNOSES (MOST COMMON)

This report<sup>xxiii</sup> again<sup>2,3</sup> highlights the need to base diagnoses for female pelvic floor dysfunction on the correlation between a woman's symptoms, signs, and any relevant diagnostic investigations.

### Urodynamic Stress Incontinence

*Definition*: As noted in the Urethral Function During Filling Cystometry Section (ii:d), this diagnosis is by *symptom*,

<sup>xxiii</sup>The most common diagnoses are those where there is evidence for a prevalence of 10% or more in women presenting with symptoms of pelvic floor dysfunction.



**Fig. 9. A:** Axial T2-weighted image of the pelvic floor of a healthy nulliparous Caucasian woman showing measurement of the antero-posterior diameter of the genital hiatus between the *arrows* from mid-urethra to mid-anus at the level of the lower border of the pubic symphysis. Transverse diameter (width) of the levator hiatus was measured between the *stars* at the point of maximum extension of the levator muscles at the level of the urinary bladder and proximal urethra. Reproduced from Am J Obstet Gynecol with the permission from the Publisher.<sup>46</sup>  
**B:** An example of a unilateral levator defect of the pubococcygeus muscle (right image) seen on MRI imaging (reproduced with kind permission from Mr. Olubenga Adekanmi; Image reviewed by Prof. John DeLancey).

*sign, and urodynamic investigations* involves the finding of involuntary leakage during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.<sup>xxiv</sup>

#### Detrusor Overactivity

**Definition:** As noted in the Filling Cystometry Section (v:b), this diagnosis by *symptoms and urodynamic investigations* is made in women with lower urinary tract symptoms (more commonly OAB-type symptoms—the Bladder Storage Symptoms Section (iv)) when involuntary detrusor muscle contractions occur during filling cystometry.<sup>xxv</sup>

#### Bladder Oversensitivity

**Definition:** Bladder oversensitivity, a diagnosis made by *symptoms and urodynamic investigations*, is more likely to occur in women with symptoms of frequency and nocturia, and a voiding diary showing a clearly reduced average voided

<sup>xxiv</sup>This is the most common urogynecological diagnosis, occurring in up to 72% patients presenting for the first time.<sup>49</sup> This diagnosis may be made in the absence of the symptom of stress (urinary) incontinence in women who have the sign of occult or latent stress incontinence.

<sup>xxv</sup>The prevalence of detrusor overactivity can vary widely between 13%<sup>48</sup> and 40%<sup>49</sup> of patients undergoing urodynamic studies at different centers.

volume. Also referred to as “increased bladder sensation,”<sup>3</sup> bladder oversensitivity replaces the now obsolete term of “sensory urgency.”<sup>50,51</sup> As noted in the Filling Cystometry Section (iii:f), it can be defined as an increased perceived bladder sensation during bladder filling (Sensory Symptoms Section (i)) with specific cystometric findings of: (i) an early first desire to void (Filling Cystometry (iii:b)); (ii) an early strong desire to void, which occurs at low bladder volume (Filling Cystometry (iii:d)); (iii) a low maximum cystometric bladder capacity (Filling Cystometry (iv:b)); no abnormal increases in detrusor pressure.<sup>51,52</sup> Specific bladder volumes at which these findings occur will vary in different populations. There should be no known or suspected UTI.<sup>xxvi</sup>

#### Voiding Dysfunction

- (i) **Definition:** Voiding dysfunction, a diagnosis by *symptoms and urodynamic investigations*, is defined as abnormally slow and/or incomplete micturition.<sup>53</sup> Abnormal slow urine flow rates and abnormally high postvoid residuals, the basis of this diagnosis, are outlined in the Uroflow-

<sup>xxvi</sup>The prevalence of the oversensitive bladder in urogynecology and female urology patients (from studies on the now obsolete term “sensory urgency”) is around 10–13%.<sup>51,52</sup>



metry Section (x) and Postvoid Residual Section (iii). This diagnosis should be based on a repeated measurement to confirm abnormality.<sup>xxvii</sup>

- (ii) *Further evaluation—pressure/flow studies (voiding cystometry).* Pressure: flow studies are indicated to evaluate the cause of any voiding dysfunction. Some possible causes have been already defined: Voiding Cystometry Section (iii.b) detrusor underactivity and (iii.c) acontractile detrusor; Urethral Function During Voiding Cystometry Section (ii) bladder outflow obstruction.
- (iii) Alternative presentations:
  - (a) *Acute retention of urine*<sup>3</sup>: This is defined as a generally (but not always) painful, palpable, or percussable bladder, when the patient is unable to pass any urine when the bladder is full.
  - (b) *Chronic retention of urine*: This is defined as a non-painful bladder, where there is a chronic high PVR.<sup>xxviii</sup>

### Pelvic Organ Prolapse

**Definition:** This diagnosis (Signs of pelvic organ prolapse (i)) by *symptoms and clinical examination, assisted by any relevant imaging*, involves the identification of descent of one or more of the anterior vaginal wall (central, paravaginal, or combination cystocele), posterior vaginal wall (rectocele), the uterus (cervix), or the apex of the vagina (vaginal vault or cuff scar) after hysterectomy.<sup>xxix</sup> The presence of any such sign should correlate with relevant POP symptoms.

Figure 10 demonstrates different types and stages of clinical presentations of prolapse. Figure 10A does not distinguish cystocele type.

### Recurrent Urinary Tract Infections

**Definition:** This diagnosis by *clinical history* assisted by the *results of diagnostic tests* involves the determination of the occurrence of at least three symptomatic and medically diagnosed UTIs over the previous 12 months.<sup>xxx</sup>

### ACKNOWLEDGMENTS/ADDENDUM

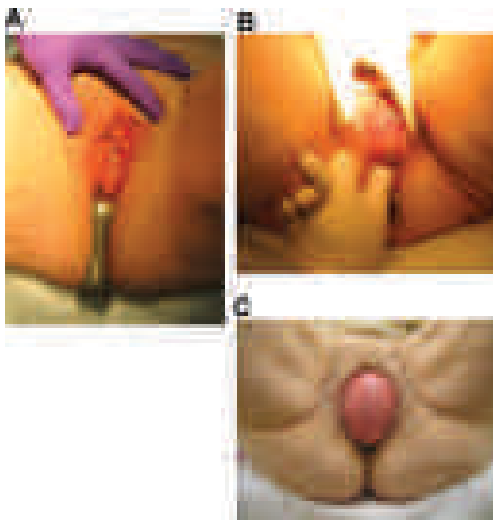
No discussion on terminology should fail to acknowledge the fine leadership shown by the ICS over many years. The legacy of that work by many dedicated clinicians and scientists is present in all the reports by the different Standardization Committees. It is pleasing that the ICS leadership has accepted this joint IUGA/ICS initiative as a means of progress in this important and most basic area.



This document has involved 12 rounds of full review, by co-authors, of an initial draft, with the collation of comments

<sup>xxvii</sup> Depending on definition, voiding dysfunction has a prevalence of 14%<sup>54</sup> to 39%,<sup>48</sup> the latter figure making it either the third or fourth most common urodynamic diagnosis (after urodynamic stress incontinence, pelvic organ prolapse, and possibly detrusor overactivity).

<sup>xxviii</sup> Approximately 2% of postvoid residual measurements are over 200 ml.<sup>28</sup> This is a suggested cut off.



**Fig. 10.** Different types and stages of pelvic organ prolapse. **A:** Stage II anterior vaginal wall prolapse; **(B)** stage III uterine prolapse; and **(C)** stage IV vaginal vault prolapse.

(and figures—Version 14). Following web site publication, there have been a further two rounds to review the comments made. Versions 7, 9, 11, and 17 were subject to live Meetings in London (June 2008), Taipei (September 2008), Cairo (October 2008), Lake Como, Italy (June 2009) and San Francisco (September 2009). The co-authors acknowledge the input to an early version of the document by Professor Don Wilson and Dr. Jenny King. Versions 9, 10, and 12 were subject to external review. The extensive comments by those reviewers, Professor Gunnar Lose (Version 9), Dr. Søren Broström (Version 10), Mr. Philip Toozs-Hobson (Version 10), Mr. Ralph Webb, Dr. Kristene Whitmore, and Professor Cor Baeten (Version 12) are also gratefully acknowledged. The comments by the following reviewers in response to web site publication (December 2008 to January 2009) are also much appreciated: Dr. Kiran Ashok, Dr. Rufus Cartwright, Dr. Johannes Coetzee, Professor Peter Dietz, Dr. Howard Goldman, Mr. Sharif Ismail, Mrs. Jane Meijlink, Professor. Don Ostergard. Version 16 was subject to a further invited external review by Professor Ted Arnold, Professor Jacques Corcos, Dr. Harry Vervest, and Professor Jean-Jacques Wyndaele, and the consideration of comments by Professor Paul Abrams and Professor Werner Schaefer. Version 17 will be for web site and dual journal publication.

<sup>xxix</sup> Around 61%<sup>48</sup> of women presenting for initial urogynecological assessment will have some degree of prolapse, not always symptomatic. Objective findings of prolapse in the absence of relevant prolapse symptoms may be termed “anatomic prolapse.” Approximately half of all women over the age of 50 years have been reported to complain of symptomatic prolapse.<sup>55</sup> There is a 10% lifetime incidence for women of undergoing surgery to correct pelvic organ prolapse.<sup>56</sup>

<sup>xxx</sup> Using this definition, two or more and three or more UTIs can occur with a prevalence of 19% and 11%, respectively, in women presenting with symptoms of pelvic floor dysfunction.<sup>57</sup> This then becomes a significant, generally intercurrent, diagnosis likely to require treatment additional to that planned for the other diagnoses found.

## REFERENCES

1. Stedman's Medical Dictionary. Baltimore, USA: Lippincott, Williams and Wilkins; 2006.
2. Abrams P, Blaivas JG, Stanton SL, et al. The standardisation of terminology of lower urinary tract function. *Scand J Urol Nephrol Suppl* 1988;114:5–19.
3. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function. Report from the standardisation subcommittee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
4. Haylen BT, Chetty N. International Continence Society 2002 Terminology Report. Have urogynecological diagnoses been overlooked? *Int Urogynecol J* 2007;18:373–7.
5. Weber AM, Abrams P, Brubaker L, et al. The standardization of terminology for researchers in female pelvic floor disorders. *Int Urogynecol J* 2001;12:178–86.
6. Blaivas JG, Appell RA, Fantl JA, et al. Definition and classification of urinary incontinence: Recommendations of the Urodynamic Society. *Neurourol Urodyn* 1997;16:149–51.
7. Fitzgerald MP. Variability of 24-hour voiding diary variables amongst asymptomatic women. *J Urol* 2003;169:207–9.
8. Cardozo LD. Urinary frequency and urgency. In: Stanton SL, Monga AK, editors. *Clinical urogynaecology*. London: Churchill Livingstone; 2000. pp 309–19.
9. Basson R, Berman J, Burnett A, et al. Report of the international consensus development conference on female sexual dysfunction: Definitions and classifications. *J Urol* 2000;163:888–93.
10. Rogers GR, Villarreal A, Kammerer-Doak D, et al. Sexual function in women with/without urinary incontinence and or pelvic organ prolapse. *Int Urogynecol J* 2001;12:361–5.
11. Norton C, Christiansen J, Butler U, et al. Anal incontinence. In: Abrams P, Khoury CL, Wein A, editors. *Incontinence*, 2nd ed. Plymouth: Health Publications Ltd; 2002. p 985–1044.
12. Drossman DA. The functional gastrointestinal disorders and the Roma II process. *Gut* 1999;45:1–6.
13. Labat JJ, Riant T, Robert R, et al. Diagnostic criteria for pudendal neuralgia by pudendal nerve entrapment (Nantes criteria). *Neurourol Urodyn* 2008;27:306–10.
14. Yang A, Mostwin J, Genadry R, et al. Patterns of prolapse demonstrated with dynamic fastscan MRI: reassessment of conventional concepts of pelvic floor weaknesses. *Neurourol Urodyn* 1993;12:310–1.
15. Bump RC, Mattiasson A, Bo K, et al. The standardization of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol* 1996;175:10–11.
16. Swift SE, Woodman P, O'Boyle A, et al. Pelvic Organ Support Study (POSS): The distribution, clinical definition and epidemiology of pelvic organ support defects. *Am J Obstet Gynecol* 2005;192:795–806.
17. Swift SE, Tate SB, Nichols J. Correlation of symptomatology with degree of pelvic organ support in a general population of women: What is pelvic organ prolapse? *Am J Obstet Gynecol* 2003;189:372–9.
18. Ricci JV. One hundred years of gynaecology. Chapter 15. Philadelphia: The Blakiston Company; 1945. p 308–25.
19. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: Report from the Pelvic Floor Clinical Assessment Group of the International Continence Society. *Neurourol Urodyn* 2005;24:374–80.
20. Dietz HP, Shek KL. Validity and reproducibility of the digital detection of levator trauma. *Int Urogynecol J* 2008;19:1097–101.
21. Van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology of nocturia: Report from the Standardization Subcommittee of the International Continence Society. *Neurourol Urodyn* 2002;21:179–83.
22. Haylen BT, Yang V, Logan V. Uroflowmetry: Its current clinical utility in women. *Int Urogynecol J* 2008;19:899–903.
23. Fantl JA, Smith PJ, Schneider V, et al. Fluid weight uroflowmetry in women. *Am J Obstet Gynecol* 1982;145:1017–24.
24. Haylen BT, Ashby D, Sutherst JR, et al. Maximum and average urine flow rates in normal male and female populations—The Liverpool Nomograms. *Br J Urol* 1989;64:30–8.
25. Haylen BT, Parys BT, Ashby D, et al. Urine flow rates in male and female urodynamic patients compared with the Liverpool nomograms. *Br J Urol* 1990;65:483–8.
26. Costantini E, Mearini E, Pajoncin C, et al. Uroflowmetry in female voiding disturbances. *Neurourol Urodyn* 2003;22:569–73.
27. Haylen BT, Lee J. The accuracy of measurement of the post-void residual in women (Editorial). *Int Urogynecol J* 2008;19:603–6.
28. Haylen BT, Lee J, Logan V, et al. Immediate postvoid residuals in women with symptoms of pelvic floor dysfunction: Prevalences and associations. *Obstet Gynecol* 2008;111:1305–12.
29. Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
30. Lose G, Griffith D, Hosker D, et al. Standardization of urethral pressure measurement: Report from the Standardization Sub-Committee of the International Continence Society. *Neurourol Urodyn* 2002;21:258–60.
31. McGuire EJ, Cespedes RD, O'Connell HE. Leak-point pressures. *Urol Clin North Am* 1996;23:253–62.
32. Stöhrer M, Goepel M, Kondo A, et al. The standardization of terminology in neurogenic lower urinary tract dysfunction. *Neurourol Urodyn* 1999;18:139–58.
33. Morrison JFB, Torrens MJ. Neurophysiology. In: Stanton SL, Monga AK, editors. *Clinical urogynaecology*. London: Churchill Livingstone; 2000. p 20.
34. Tanagho EA, Miller ER. The initiation of voiding. *Br J Urol* 1970;42:175–83.
35. Groutz A, Blaivas JG, Chaikin DC. Bladder outflow obstruction in women: Definition and characteristics. *Neurourol Urodyn* 2000;19:213–20.
36. Tunn R, Schaer G, Peschers U, et al. Updated recommendations on ultrasonography in urogynecology. *Int Urogynecol J* 2005;16:236–41.
37. Lewicky-Gaupp C, Blaivas J, Clark A, et al. "The cough game": Are there characteristic urethrovaginal movement patterns associated with stress incontinence. *Int Urogynecol J* 2009;20:171–5.
38. Haylen BT, McNally G, Ramsay P, et al. A standardised ultrasonic diagnosis and an accurate prevalence for the retroverted uterus in general gynaecology patients. *Aust J Obstet Gynaecol* 2007;47:326–8.
39. Dietz HP. Quantification of major morphological abnormalities of the levator ani. *Ultrasound Obstet Gynecol* 2007;29:329–34.
40. Dietz HP, De Leon J, Shek K. Ballooning of the levator hiatus. *Ultrasound Obstet Gynecol* 2008;31:676–80.
41. Henry MM, Sultan AH. Lower intestinal tract disease. In: Stanton SL, Monga AK, editors. *Clinical urogynaecology*, Chapter 38. London: Churchill Livingstone; 2000. p 444–5.
42. Monga AK, Stanton SL. Radiology and MRI. In: Stanton SL, Monga AK, editors. *Clinical urogynaecology*, Chapter 10. London: Churchill Livingstone; 2000. p 103–16.
43. Woodhouse CRJ. General urological investigations. In: Stanton SL, Monga AK, editors. *Clinical urogynaecology*, Chapter 8. London: Churchill Livingstone; 2000. p 88–90.
44. Fielding JR. Practical MRI imaging of female pelvic floor weakness. *Radiographics* 2002;22:295–304.
45. Torricelli P, Pecchi A, Caruso-Lombardi A, et al. Magnetic resonance imaging in evaluating functional disorders of female pelvic floor. *Radiol Med* 2002;103:488–500.
46. Rizk DE, Czechowski J, Ekelund L. Dynamic assessment of pelvic floor and bony pelvis morphologic condition with the use of magnetic resonance imaging in a multi-ethnic, nulliparous, and healthy female population. *Am J Obstet Gynecol* 2004;191:83–9.
47. Rizk DE, Czechowski J, Ekelund L. Magnetic resonance imaging of uterine version in a multi-ethnic, nulliparous, healthy female population. *J Reprod Med* 2005;50:81–3.
48. Haylen BT, Verity L, Schulz S, et al. Has the true incidence of voiding difficulty in urogynecology patients been underestimated? *Int Urogynecol J* 2007;18:53–6.
49. Wise B. Frequency/urgency syndromes. In: Cardozo LD, Staskin D, editors. *Textbook of female urology and urogynaecology*. London: Isis Medical Media; 2001. p 903.
50. Creighton SM, Dixon J. Bladder hypersensitivity. In: Stanton SL, Monga AK, editors. *Clinical Urogynaecology*. London: Churchill Livingstone; 2000. p 321–7.
51. Haylen BT, Chetty N, Logan V, et al. Is sensory urgency part of the same spectrum of bladder dysfunction as detrusor overactivity? *Int Urogynecol J* 2007;18:123–8.
52. Wise B. Frequency/urgency syndromes (sensory urgency section). In: Cardozo LD, Staskin D, editors. *Textbook of female urology and urogynaecology*. London: Isis Medical Media; 2001. p 912.
53. Sutherst JR, Frazer MI, Richmond DH, et al. Introduction to clinical gynaecological urology. London: Butterworths; 1990. p 121.
54. Massey JA, Abrams PH. Obstructed voiding in the female. *Br J Urol* 1988;61:36–9.
55. Swift SE. The distribution of pelvic organ support in a population of female subjects seen for routine gynaecologic health care. *Am J Obstet Gynecol* 2000;183:277–85.
56. Brown JS, Waetjen LE, Subak LL, et al. Pelvic organ prolapse surgery in United States. *Am J Obstet Gynecol* 1997;186:712–6.
57. Haylen BT, Lee J, Husselbee S, et al. Recurrent urinary tract infections in women with symptoms of pelvic floor dysfunction. *Int Urogynecol J* 2009;20:837–42.

# The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction

Carlos D'Ancona<sup>1</sup> | Bernard Haylen<sup>2</sup> | Matthias Oelke<sup>3</sup> |  
 Luis Abranches-Monteiro<sup>4</sup> | Edwin Arnold<sup>5</sup> | Howard Goldman<sup>6</sup> |  
 Rizwan Hamid<sup>7</sup> | Yukio Homma<sup>8</sup> | Tom Marcelissen<sup>9</sup> | Kevin Rademakers<sup>9</sup> |  
 Alexis Schizas<sup>10</sup> | Ajay Singla<sup>11</sup> | Irela Soto<sup>12</sup> | Vincent Tse<sup>13</sup> |  
 Stefan de Wachter<sup>14</sup> | Sender Herschorn<sup>15</sup> |

On behalf of the Standardisation Steering Committee ICS and the ICS Working Group on Terminology for Male Lower Urinary Tract & Pelvic Floor Symptoms and Dysfunction

<sup>1</sup> Universidade Estadual de Campinas, São Paulo, Brazil

<sup>2</sup> University of New South Wales, Sydney, Australia

<sup>3</sup> St. Antonius Hospital, Gronau, Germany

<sup>4</sup> Hospital Beatriz Ângelo Loures, Lisbon, Portugal

<sup>5</sup> University of Otago, Christchurch, New Zealand

<sup>6</sup> Cleveland Clinic, Cleveland, Ohio

<sup>7</sup> University College Hospitals, London, United Kingdom

<sup>8</sup> Japanese Red Cross Medical Centre, Tokyo, Japan

<sup>9</sup> Maastricht University, Maastricht, The Netherlands

<sup>10</sup> Guy's & St Thomas's Hospitals, London, United Kingdom

<sup>11</sup> Massachusetts General Hospital, Harvard, Boston

<sup>12</sup> Complejo Hospitalario, Panama City, Panama

<sup>13</sup> University of Sydney, Sydney, Australia

<sup>14</sup> University of Antwerp, Antwerp, Belgium

<sup>15</sup> University of Toronto, Ontario, Canada

**Introduction:** In the development of terminology of the lower urinary tract, due to its increasing complexity, the terminology for male lower urinary tract and pelvic floor symptoms and dysfunction needs to be updated using a male-specific approach and via a clinically-based consensus report.

**Methods:** This report combines the input of members of the Standardisation Committee of the International Continence Society (ICS) in a Working Group with recognized experts in the field, assisted by many external referees. Appropriate core clinical categories and a subclassification were developed to give a numeric coding to each definition. An extensive process of 22 rounds of internal and external review was developed to exhaustively examine each definition, with decision-making by collective opinion (consensus).

**Results:** A Terminology Report for male lower urinary tract and pelvic floor symptoms and dysfunction, encompassing around 390 separate definitions/descriptors, has been developed. It is clinically-based with the most common diagnoses defined. Clarity and user-friendliness have been key aims to make it interpretable by practitioners and trainees in all the different specialty groups involved in male lower urinary tract and pelvic floor dysfunction. Male-specific imaging (ultrasound, radiology, CT, and MRI) has been a major addition whilst appropriate figures have been included to supplement and help clarify the text.

**Conclusions:** A consensus-based Terminology Report for male lower urinary tract and pelvic floor symptoms and dysfunction has been produced aimed at being a significant aid to clinical practice and a stimulus for research.

Carlos D'Ancona (Content) and Bernard Haylen (Production) are equal first authors.

*Neurourology and Urodynamics*. 2019;1–45.

wileyonlinelibrary.com/journal/nau

© 2019 Wiley Periodicals, Inc. | 1

### Correspondence

Carlos D'Ancona, MD, PhD, Universidade Estadual de Campinas, Rua Dr Miguel Penteado 1073, Campinas – SP. CED 13020-118, Brazil.  
Email: cdancona@uol.com.br

### KEYWORDS

lower urinary tract dysfunction, lower urinary tract symptoms, male, male urinary tract imaging, male urodynamics, terminology

## INTRODUCTION

There is currently no single document addressing all elements required for diagnoses applicable to adult (fully grown and physically mature<sup>1</sup> – *new*) male lower urinary tract and pelvic floor dysfunction. Indeed, the diagnostic entities themselves may have not been all completely defined. The term “diagnosis” is defined as “the determination of the nature of a disease; **clinical**: made from a study of the symptoms and signs of a disease<sup>1</sup>; **laboratory**:” investigative options to be mentioned. Such a specific report would require a full outline of the terminology for all symptoms, signs, urodynamic investigations for male lower urinary tract (LUT) and pelvic floor (PF) dysfunction, the imaging associated with those investigations and the most common diagnoses.

It may have been possible in the past to combine all terminology for lower urinary tract function for men, women and children into one Report. The International Continence Society (ICS) has provided leadership in terminology for lower urinary tract dysfunction over decades employing combined or generic reports. The 1988<sup>2</sup> and 2002<sup>3</sup> Reports by the Committee on Standardization of Terminology are such examples. With the increasing specificity and complexity of the diagnoses in both sexes, combined reports, let alone attempting to cover “all patient groups from children to the elderly,”<sup>3</sup> may now be an anachronism. With evidence that the absence of specific female diagnoses as well as other female specific terminology, may not have been advantaged by a combined approach,<sup>4</sup> there occurred the development and 2010 publication of an International Urogynecological Association (IUGA)/ICS Joint Report on the Terminology for Female Pelvic Floor Dysfunction.<sup>5</sup> The 2002 Report<sup>3</sup> still provides the traditional core male terminology and some useful modifications, many of which are repeated in this document. The current report, with the large number of *new* and *changed* definitions, acknowledges that a male-specific update of terminology for LUT and PF symptoms and dysfunction is now timely.

It is hoped that some of the advantages noted in the female-specific document<sup>5</sup> might be seen here in this male document: (i) more comprehensive coverage of male-specific terminology; (ii) greater coherency and user-friendliness; (iii) greater specificity of male diagnoses; and (iv) more accurate communication for clinical and research purposes. It is also an aim in this document, to develop a general male terminology,

forming a “backbone” or “core” terminology, to facilitate an update of the other subcategories of male-specific terminologies. There have been seven other (IUGA-ICS) female PF-related terminology documents,<sup>6–12</sup> all published, following the production of the initial joint IUGA/ICS document on female pelvic floor dysfunction.<sup>5</sup> The authors of that document<sup>5</sup> have kindly permitted the template of that Report to be used as the basis for the current Report. Four other male terminology reports have been initiated: (i) male anorectal dysfunction; (ii) surgical management of male LUT dysfunction; (iii) sexual health in men with LUT/PF dysfunction and (iv) conservative management of male LUT/PF dysfunction, to follow the publication of this “core” report.

This Terminology Report is inherently and appropriately a definitional document, collating the definitions of those terms, that is, words used to express a defined concept in a particular branch of study,<sup>1</sup> here core male terminology. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. The aim is to assist clinical practice and research. Explanatory notes on definitions have been referred, where possible, to the “Footnotes section.” Table 1 lists the number of definitions: (i) new; (ii) changed; (iii) total by section, compared with the previous male-inclusive Reports.<sup>2,3</sup>

As with its female terminology equivalent, qualities for a male-specific terminology report should be:

- (1) User-friendly: It should be able to be understood by all clinical and research users.
- (2) Clinically-based: Symptoms, signs, validated investigations and imaging should be presented for use in forming diagnoses. Sections 1-4 will address symptoms, signs, urodynamic investigations and current associated imaging modalities routinely used in the office, urodynamic laboratory, or imaging department to make those diagnoses. Readership is not assumed to be limited to medical specialists, accounting for a more extended “basic” physical examination (Section 2). Related radiological investigations, computerized tomography (CT) and magnetic resonance imaging (MRI) as well as a description of electromyography (EMG) has been included. This report limits terminology for neurogenic lower urinary tract dysfunction (LUTD) as this is covered by a separate ICS Report.<sup>13</sup>

**TABLE 1** Total, new and changed definitions (compared with previous male-inclusive Reports<sup>2,3</sup>)

Section	New definitions/descriptors	Changed definitions/descriptors	Total
Introduction & Symptoms	60	23	118
Signs	73	14	98
Investigations	23	25	106
Imaging	42	n/a	42
Diagnoses	14	9	26
Total	211 (54%)	71 (18%)	390

- (3) Section 5 will address the most common diagnoses of male lower urinary tract and pelvic floor dysfunction. The terms<sup>3</sup> “urodynamic observation” and “condition” (non-medical) have not been used in this report. The scope of the report will exclude (i) diagnostic pathology (blood, urine, histology); (ii) more invasive investigations requiring an anesthetic; (ii) evidence-based treatments for each diagnosis.
- (4) Origin: Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition will be included and duly referenced. Many terms in male lower urinary tract and pelvic floor function, because of their long-term use, have now become generic, as apparent by their listing in medical dictionaries.
- (5) Able to provide explanations: Where a specific explanation is deemed appropriate to explain a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (*Footnote [FN] 1,2,3 ...*). Wherever possible, evidence-based medical principles will be followed.

As in earlier ICS Reports,<sup>2,3,5</sup> when a reference is made to the whole anatomical organ, the *vesica urinaria*, the correct term is the bladder. When the smooth muscle structure known as the *m. detrusor vesicae* is being discussed, then the correct term is detrusor.

It is suggested that acknowledgement of these standards in written publications related to male lower urinary tract and pelvic floor symptoms and dysfunction, be indicated by a footnote to the section “Methods and Materials” or its equivalent, to read as follows: “Methods, definitions and units conform to the standards recommended by the International Continence Society, except where specifically noted.”

SECTION 1: SYMPTOMS

**Symptom:** Any morbid phenomenon or departure from the normal in structure, function, or sensation, possibly indicative of a disease or health problem. Symptoms are either

volunteered by, or elicited from the individual, or may be described by the individual's partner or caregiver.<sup>2,3,5</sup>

**Complaint:** The description of the symptom.<sup>1</sup> (*NEW*)

**Main (Chief) Complaint:** The symptom that a patient states as the main reason for seeking medical advice.<sup>1</sup> (*NEW*) The degree of “bother (worry, concern)” for other symptoms can be variable.<sup>14</sup> (*NEW*)

**Lower urinary tract symptom (LUTS):** A symptom related to the lower urinary tract; it may originate from the bladder, prostate, urethra, and/or adjacent pelvic floor or pelvic organs, or at times be referred from similarly innervated anatomy, for example, lower ureter. (*NEW*)

STORAGE SYMPTOMS

**1.1 Storage Symptoms:** Lower urinary tract symptoms occurring during the bladder storage phase. (*NEW*)

*General Storage symptoms*

**1.1.1 Increased urinary frequency:** Complaint that voiding occurs more frequently than deemed normal by the individual (or caregivers).<sup>3,5</sup> Time of day and number of voids are not specified. (*NEW*)

**1.1.2 Increased daytime urinary frequency:** Complaint that voiding occurs more frequently during waking hours than previously deemed normal by the individual (or caregivers).<sup>3,5</sup> FN1.1 NB pollakiuria FN1.2 (*CHANGED*)

**1.1.3 Nocturia:** The number of times urine is passed during the main sleep period. Having woken to pass urine for the first time, each urination must be followed by sleep or the intention to sleep. This should be quantified using a bladder diary.<sup>18</sup>

**1.1.4 Polyuria (global symptom):** Complaint that the urine excretion volume over 24 h is noticeably larger than the previous experience.FN1.4 (*NEW*)

**1.1.4.1 Diurnal polyuria:** Complaint that daytime urine excretion volume is noticeably larger than the previous experience. (*NEW*)

**1.1.4.1 Nocturnal polyuria (symptom)<sup>18</sup>:** Complaint of passing large volumes of urine at night-time. (*NEW*)

### *Sensory symptoms*

**1.1.5 Bladder filling (sensory) symptoms:** Abnormal sensations experienced during bladder filling.<sup>1</sup> *(NEW)*

**1.1.5.1 Increased bladder filling sensation:** Complaint that the sensation of bladder filling occurs earlier or is more intense or persistent to that previously experienced.<sup>3,5</sup> *(CHANGED)* N.B. This differs from urgency by the fact that micturition can be postponed despite the desire to void.

**1.1.5.2 Urgency:** Complaint of a sudden, compelling desire to pass urine which is difficult to defer.<sup>3,5</sup> FN1.5, FN1.6

**1.1.5.3 Reduced bladder filling sensation:** Complaint that the sensation of bladder filling is less intense or occurs later in filling than previously experienced. *(CHANGED)*

**1.1.5.4 Absent bladder filling sensation:** Complaint of both the absence of the sensation of bladder fullness and a definite desire to void<sup>3</sup>

**1.1.5.5 Non-specific (atypical) bladder filling sensation (bladder dysesthesia):** Complaint of abnormal bladder filling sensation such as the perception of vague abdominal bloating, vegetative symptoms (nausea, vomiting, faintness), or spasticity. *(CHANGED)* F1.7 It differs from normal bladder filling sensation or pain, pressure or discomfort of the bladder.

### *Incontinence symptoms*

**1.1.6 Urinary incontinence symptoms<sup>16</sup>:** Involuntary loss of urine experienced during the bladder storage phase FN1.8, FN1.9 *(NEW)*

**1.1.6.1 Urinary incontinence (symptom):** Complaint of involuntary loss of urine.<sup>3,5</sup> FN 1.9

**1.1.6.2 Urgency urinary incontinence (UII)<sup>3,5</sup>:** Complaint of involuntary loss of urine associated with urgency.

**1.1.6.3 Stress urinary incontinence (SUI):** Complaint of involuntary loss of urine on effort or physical exertion including sporting activities, or on sneezing or coughing.<sup>3,5</sup> N.B. “*activity (effort)-related incontinence*” might be preferred in some languages to avoid confusion with psychological stress. FN1.10

**1.1.6.4 Mixed urinary incontinence (MUI):** Complaints of both stress and urgency urinary incontinence, that is, involuntary

loss of urine associated with urgency as well as with effort or physical exertion including sporting activities or on sneezing or coughing (stress).<sup>3,5</sup>

**1.1.6.5 Enuresis:** Complaint of intermittent (non-continuous) incontinence that occurs during periods of sleep.<sup>18</sup> *(CHANGED)*

**1.1.6.6 Continuous urinary incontinence:** Complaint of continuous involuntary loss of urine.<sup>3,5</sup> *(CHANGED)*

**1.1.6.7 Insensible urinary incontinence:** Complaint of urinary incontinence where the individual is aware of urine leakage but unaware of how or when it occurred.<sup>5</sup> *(CHANGED)*

**1.1.6.8 Postural urinary incontinence:** Complaint of urinary incontinence during change of posture or position, for example, from supine or seated to standing-FN1.12 *(NEW)*

**1.1.6.9 Disability associated incontinence:** Complaint of urinary incontinence in the presence of a functional inability to reach a toilet/urinal in time because of a physical (eg, orthopedic, neurological) and/or mental impairment. *(NEW)*

**1.1.6.10 Overflow incontinence:** Complaint of urinary incontinence in the symptomatic presence of an excessively (over-) full bladder (no cause identified). *(NEW)*

**1.1.6.11 Sexual arousal incontinence<sup>19</sup>:** Complaint of involuntary loss of urine during sexual arousal, foreplay and/or masturbation. *(NEW)*

**1.1.6.12 Climacturia<sup>19</sup>:** Complaint of involuntary loss of urine at the time of orgasm. *(NEW)*

### *Storage symptom syndrome*

**1.1.7 Overactive bladder (OAB, urgency) syndrome:** Urinary urgency, usually accompanied by increased daytime frequency and/or nocturia, with urinary incontinence (OAB-wet) or without (OAB-dry), in the absence of urinary tract infection or other detectable disease.<sup>3,5</sup> *(CHANGED)*

## **VOIDING SYMPTOMS**

**1.2 Voiding symptoms:** Lower urinary tract symptoms during the voiding phase (experienced during micturition). *(NEW)*

**1.2.1 Hesitancy:** Complaint of a delay in initiating voiding (when the individual is ready to pass urine). *(CHANGED)*



- 1.2.2. Paruresis (“bashful” or “shy bladder”):** Complaint of the inability to initiate voiding in public (i.e. voiding in the presence of other persons) despite there being no difficulty in private.<sup>20</sup>  
FN1.13 (NEW)
- 1.2.3 Episodic inability to void:** Complaint of occasional inability to initiate voiding despite relaxation and/or an intensive effort (by abdominal straining, Valsalva maneuver or suprapubic pressure). (NEW)
- 1.2.4 Straining to void:** Complaint of the need to make an intensive effort to either initiate, maintain or improve voiding or the urinary stream.<sup>3,5</sup> (CHANGED)
- 1.2.5 Slow (urinary) stream:** Complaint of a urinary stream perceived as overall slower than previous performance or in comparison with others.<sup>3,5</sup>
- 1.2.6 Intermittency:** Complaint of urine flow that stops and starts on one or more occasions during one voiding episode.<sup>3,5</sup>
- 1.2.7 Terminal dribbling:** Complaint that during the final part of voiding there is noticeable slowing of the flow to drops or a trickling stream. (CHANGED)
- 1.2.8 Spraying (splitting) of urinary stream:** Complaint that the urine passage is a spray or split rather than a single directional stream.<sup>3,5</sup> (CHANGED)
- 1.2.9 Position-dependent voiding:** Complaint of having to adopt specific positions to be able to void spontaneously or to improve bladder emptying, for example, needing to void in a seated position. (NEW)
- 1.2.10 Dysuria:** Complaint of pain, burning, other discomfort, or difficulty during voiding. Discomfort may be intrinsic to the lower urinary tract (eg, bladder or urethra), external, or referred from other adjacent similarly innervated structures, for example, lower ureter. FN1.14 (CHANGED)
- 1.2.11 Stranguria:** Complaint of voiding which is slow, difficult and spasmodic (at times “drop by drop”), usually associated with pain. (NEW)<sup>FN1.15</sup>
- 1.2.12 Hematuria:** Complaint of passage of visible blood mixed with urine. This may be initial (at the beginning), terminal (at the end) or total (throughout bladder emptying). (NEW)
- 1.2.13 Pneumaturia<sup>1</sup>:** Complaint of the passage of gas (or air) from the urethra during or after voiding. (NEW)
- 1.2.14 Fecaluria<sup>1</sup>:** Complaint of passage of feces (per urethram) in the urine. (NEW)
- 1.2.15 Chyluria (albiduria)<sup>1</sup>:** Complaint of passage of chyle (pale or white, milky cloudy) in the urine.<sup>1</sup> (NEW)

**1.2.16 Urinary retention:** Complaint of the inability to empty the bladder completely.<sup>1</sup> (NEW)

**1.2.16.1 Acute urinary retention (AUR):** Complaint of a rapid onset, usually painful suprapubic sensation (from a full bladder) due to inability to void (non-episodic), despite persistent intensive effort.<sup>FN1.16</sup> (NEW)

**1.2.16.2 Chronic urinary retention (CUR):** Complaint of chronic or repeated inability to empty the bladder, despite the ability to pass some urine. This may result in the frequent passage of small amounts of urine or urinary incontinence and a distended bladder FN1.17 (NEW)

## POST-VOIDING SYMPTOMS

**1.3 Postvoiding Symptom:** Lower urinary tract symptom experienced after voiding has ceased. (NEW)

**1.3.1 Feeling of incomplete (bladder) emptying:** Complaint that the bladder does not feel empty after voiding has ceased.<sup>3,5</sup> (CHANGED)

**1.3.2 Need to immediately re-void (“Encore” or “Double” voiding):** Complaint that further voiding is necessary soon after passing urine (cessation of flow).<sup>3,5</sup> (CHANGED)

**1.3.3 Post-voiding incontinence:** Complaint of a further involuntary passage (incontinence) of urine or dribbling following the completion of voiding.<sup>3,5</sup> FN1.18- (NEW)

**1.3.4 Post-micturition urgency:** Complaint of persistent urgency post-voiding. (NEW)

*Voiding symptom syndrome (proposal for further research)*  
– *Underactive bladder syndrome:* FN1.19

## 1.4 Lower Urinary Tract Pain and/or Other Pelvic Pain

**1.4.1 Pain:** A variably unpleasant sensation.<sup>1</sup> It may be described as pressure or discomfort by the patient. Pain should be characterized by site, type, frequency, duration, precipitating, and relieving factors.<sup>FN1.20; FN 1.21</sup> (CHANGED)

**1.4.2 Bladder pain:** Complaint of suprapubic or retropubic pain, pressure or discomfort related to the bladder, and usually associated with bladder filling. It may persist or be relieved after voiding.<sup>3,5</sup> (CHANGED)

**1.4.3 Urethral pain:** Complaint of pain, pressure or discomfort felt in the urethra<sup>3,5</sup> before, during and/or after voiding and the man indicates the urethra as the site. (CHANGED)

**1.4.4 Scrotal pain:** Complaint of pain, pressure or discomfort felt in and around the scrotum.<sup>3</sup> It may be localized to the testis, epididymis, cord structures, or scrotal skin.

**1.4.5 Perineal pain:** Complaint of pain, pressure, or discomfort felt on the surface or in the depth of the tissue between the scrotum and the anus.<sup>3</sup>

**1.4.6 Pelvic pain:** Complaint of pain, pressure, or discomfort related to the pelvis but not clearly related to the bladder, urethra, scrotum, or perineum.<sup>3</sup>

**1.4.7 Ejaculatory pain:** Complaint of pain, pressure, or discomfort felt in the perineum, suprapubic region and/or penis during ejaculation, but may continue for a time afterwards. *(NEW)*<sub>FN 1.22</sub>

**1.4.8 Anorectal pain symptoms:** Complaint of pain, pressure or discomfort particularly during defecation or straining to defecate but can occur at any time. *(NEW)*

**1.4.8.1 Pain during straining /defecation:** Pain during defecation or straining to defecate.

**1.4.8.2 Inflammatory anorectal pain:** Pain characterized by burning or stinging (inflammation, radiation, sepsis). *(NEW)*

**1.4.8.3 Non-inflammatory anorectal pain:** Blunted anorectal pain (proctalgia fugax, Levator ani syndrome, pudendal neuralgia). *(NEW)*

**1.4.9 Coccygeal pain (coccydynia):** Complaint of pain, pressure, or discomfort in the coccygeal region. *(NEW)*

**1.4.10 Pudendal pain (neuralgia):** Complaint of pain, pressure, or discomfort in one or more of the areas innervated by the pudendal nerve (may be caused by inflammation or entrapment of the pudendal nerve and involving its dermatome). *(CHANGED)*

**1.4.11 Chronic pelvic pain syndromes:** See ICS standard for terminology in chronic pelvic pain syndromes.<sup>23</sup> <sub>FN1.21</sub>

## 1.5 Urinary tract infection (UTI)

### 1.5.1 Symptoms of acute urinary tract infection:

Symptoms such as increased bladder sensation, urgency, frequency, dysuria/stranguria, pain in the lower urinary tract with or without urgency urinary incontinence might suggest lower urinary tract infection. Confirmation of a UTI requires evidence of significant microorganisms and pyuria. <sub>(FN1.23, FN 1.24)</sub> *(CHANGED)*

**1.5.2 Recurrent urinary tract infections (UTIs):** A history of at least two symptomatic and medically

diagnosed UTI in the previous 12 months.<sub>FN1.25</sub> The previous UTI(s) should have resolved prior to a further UTI being diagnosed. *(CHANGED)*.

**1.5.3 Urethral discharge:** Of mucus, pus, or blood, from the urethral meatus. *(NEW)*

**1.6 Symptoms of sexual dysfunction:** Abnormal sensation and/or function experienced by a man during sexual activity. *(NEW)*

**1.6.1 Altered Libido:** Change in interest in sexual activity. *(NEW)*

**1.6.1.1 Decreased libido:** Complaint of decreased interest in sexual activity in comparison to previous experience. *(NEW)*

**1.6.1.2 Increased libido:** Complaint of increased interest in sexual activity in comparison to previous experience. *(NEW)*

**1.6.2 Erectile dysfunction<sup>25</sup>:** Complaint of inability to achieve and sustain an erection firm enough for satisfactory sexual performance. *(NEW)*

**1.6.3 Ejaculatory dysfunction:** Complaint of alteration of the emission of seminal fluids during ejaculation. *(NEW)*

**1.6.3.1 Anejaculation:** Complaint of absence of seminal fluid emission. May be associated with the absence of the sensation of orgasm or anorgasmia. *(NEW)*

**1.6.3.2 Delayed ejaculation:** Complaint of an increase in the time taken for ejaculation to occur. *(NEW)*

**1.6.3.3 Premature ejaculation:** Complaint of a persistent or recurrent pattern of too rapid achievement of ejaculation during partnered sexual activity,<sup>1</sup> that is, before the individual wishes it. <sub>FN 1.26</sub> *(NEW)*

**1.6.3.4 Decreased (low) semen volume<sup>\*\*</sup>:** Complaint of smaller amount of seminal fluid than normal or previously experienced <sub>FN1.27</sub>. *(NEW)*

**1.6.3.5 Increased (high) semen volume:** Complaint of higher amount of seminal fluid than normal or previously experienced. *(NEW)*<sub>FN1.27</sub>

**1.6.4 Hematospermia:** Complaint of the appearance of visible blood in the seminal fluid. Color of the seminal fluid may be red or brown. *(NEW)*

**1.6.5 Penile pain with intercourse (male dyspareunia):** Complaint of any penile discomfort occurring during intercourse. May be caused by penile disease, vaginal anatomy (eg, vaginal tightening, scarring, or exposed mesh) and/or may relate to various positions with intercourse. <sub>FN1.28</sub> *(NEW)*



**1.6.6 Obstructed intercourse:** Complaint that vaginal intercourse is not possible due to perceived obstruction. Whilst this may be a partner issue, it can occur in cases of penile curvature (Peyronie's disease) or penile carcinoma. *(NEW)*

## **1.7 Symptoms of anorectal dysfunction<sup>5,10,27</sup>; FN1.29**

**1.7.1 Anorectal incontinence (symptoms):** Complaint of involuntary loss of flatus or feces.<sup>5,10</sup> Can be further subdivided into:

**1.7.1.1 Flatal incontinence:** Complaint of involuntary loss of flatus (gas).<sup>5,10</sup>

**1.7.1.2 Fecal incontinence:** Complaint of involuntary loss of feces.<sup>5,10</sup>

- when feces is solid and/or
- when feces is liquid

**1.7.1.3 Fecal (rectal) urgency:** Complaint of a sudden, compelling desire to defecate that is difficult to defer.<sup>5,10</sup>

**1.7.1.4 Fecal (flatal) urgency incontinence:** Complaint of involuntary loss of feces (flatus) associated with fecal urgency.<sup>5,10,27</sup>

**1.7.1.5 Passive (insensible) fecal incontinence:** Complaint of involuntary soiling of liquid or solid stool without sensation or warning. *(NEW)*

**1.7.1.6 Overflow fecal incontinence:** Complaint of involuntary loss of stool due to an overfull rectum or fecal impaction. *(NEW)*

**1.7.1.7 Coital fecal incontinence:** Complaint of involuntary loss of stool occurring with intercourse.<sup>5,10</sup>

**1.7.1.8 Stress fecal incontinence (SUI):** Complaint of involuntary loss of feces on effort or physical exertion including sporting activities, or on sneezing or coughing. *(NEW)*

## **1.7.2 Anorectal sensory symptoms**

**1.7.2.1 Diminished rectal sensation (rectal hyposensitivity):** Complaint of diminished or absent sensation of filling in the rectum. *(CHANGED)*

**1.7.2.2 Increased rectal sensation (rectal hypersensitivity):** Complaint of a desire to defecate (during rectal filling) that occurs earlier or more persistent to that previously experienced. *(NEW)*

**NB:** for 1.7.2.1 and 1.7.2.2, can be to (i) first sensation; (ii) urge sensation; (iii) maximum tolerated volume.

**1.7.2.3 Tenesmus:** Complaint of an urgent desire to evacuate the bowel, accompanied by

involuntary straining and the passage of little fecal matter.<sup>1</sup>

**1.7.3 Defecatory or post-defecatory symptoms:** Symptoms experienced during or following the act of defecation. *(NEW)*

**1.7.3.1 Constipation:** Complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate. (Rome IV criteria<sup>28</sup>) FN1.30.

**1.7.3.1.1 Slow transit:** infrequent bowel motions due to delay in transit of bowel contents to reach rectum.

**1.7.3.1.2 Obstructed defecation:** Complaint of difficulty in evacuation due to a mechanical obstruction.

**1.7.3.2 Feeling of incomplete bowel evacuation:** Complaint that the rectum does not feel empty after defecation. May be accompanied by a desire to defecate again.<sup>5,10</sup>

**1.7.3.3 Straining to defecate:** Complaint of the need to make an intensive effort (by abdominal straining or Valsalva) or to use abdominal massage to either initiate, maintain, or improve defecation.<sup>5,10</sup>

## **1.7.3.4. Manual defecatory assistance**

**1.7.3.4.1 Internal: Anorectal Digitation:** Complaint of the need to use of fingers in the rectum to manually assist in evacuation of stool contents by scooping, stretching and/or stimulation.<sup>5</sup> *(NEW)*

**1.7.3.4.2 External: Perineal pressure or buttock separation:** Complaint of the need to press on the perineum or separate the buttocks to assist defecation. *(NEW)*

**1.7.3.5 Post defecatory soiling:** Complaint of soiling occurring after defecation. *(NEW)*

**1.7.3.6 Rectal bleeding/mucus:** Complaint of the loss of blood or mucus per rectum.

**1.7.4 Anorectal prolapse:** Complaint of external protrusion (bulge) of the anus or rectum (differentiation on subsequent examination between rectal mucosal prolapse and full thickness rectal wall prolapse which includes muscle and serosal layers). *(CHANGED)*

## **1.8 Other Relevant History**

Current medications, previous urological operations, radiotherapy, and catheterization should be noted.

### Footnotes for Section 1

1.1: Milsom et al.<sup>15</sup> first reported that frequency caused by an overactive bladder was arbitrarily defined as more than eight micturitions per 24 h, given that the normal voiding frequency in healthy individuals is typically under six micturitions per 24 h. It was higher than previously reported for healthy women using a frequency/volume chart (median 5.5 micturitions per 24 h).<sup>15–17</sup>

1.2: Pollakiuria: Complaint of abnormally (extraordinary<sup>1</sup>) frequent micturition (rarely used definition).

1.3: It is common to void during the night when sleep is disturbed for other reasons—eg, insomnia—this does not constitute nocturia.

1.4: Polyuria is more fully defined in the “Signs” section.

1.5: “Urgency” replaces “urge” as the “accepted” terminology for the abnormal rather than the normal phenomenon.

1.6: The use of the word “sudden,” defined as “without warning or abrupt,” used in earlier definitions<sup>2,3,5</sup> has been subject to much debate. Its inclusion has been continued.

1.7: This symptom generally occurs where there is some form of neurological disease.

1.8: “Continence” is defined as absence of involuntary leakage of bowel and bladder contents (i.e. normal voluntary control of bowel and bladder function).

1.9: In each specific circumstance, urinary incontinence should be further described by specifying relevant factors such as type, severity, precipitating factors, social impact, effect on hygiene, and quality of life, the measures used to contain the leakage, and whether or not the individual seeks or desires help because of urinary incontinence.

1.10: This change is to accommodate for ambiguity in some languages between stress and anxiety. This symptom would most commonly occur in men who have undergone (radical) prostatectomy. Men who had radical prostatectomy may experience activity-related incontinence and/or during sex.<sup>19</sup>

1.11: Small amounts of urine may be leaked without warning.

1.12: Men with post-prostatectomy incontinence do report this. It also happens in men after artificial sphincter placement. When they get up, they leak. Can be due to stress and without urge or other associated symptoms in the standing or upright position.

1.13: The term “pareuresis” is not in common usage, although the symptom is well-recognised.<sup>20</sup> Pareuresis is defined as the fear of being able to urinate in situations where other persons are present. Diagnostic and statistical manual of mental disorders. Arlington, VA: American Psychiatric Association; 2013.

1.14: Dysuria is a type of urethral pain but could be urethral in origin or referred there from a pathological process in bladder, lower ureter or prostate.

1.15: The symptom of “stranguria” is poorly understood, overlapping at times with urethral pain, dysuria, and pelvic pain.

1.16: The bladder is distended, palpable, and possibly tender. A significantly increased residual is present.

1.17: Non-neurogenic chronic urinary retention (CUR) in men (AUA consensus<sup>21</sup> supported by the current authors) can be defined as an elevated post-void residual of greater than 300 mL that has persisted for at least 6 months and is documented on two or more separate occasions. Evidence is not strong. CUR can be caused by different pathologies that create detrusor underactivity and/or result in chronic bladder outlet obstruction.<sup>21</sup>

1.18: May occur after clothing has been adjusted, due to some “pooling” of urine in the urethra if underwear, or clothing has caused some restriction during voiding or a urethral stricture or diverticulum.

1.19: Complaints of a slow urinary stream, hesitancy and straining to void, with or without sense of incomplete bladder emptying and dribbling, sometimes with storage symptoms: symptom grouping proposed to be suggestive of detrusor underactivity<sup>22</sup> (DU). Diagnosis of actual detrusor underactivity depends on urodynamic findings as discussed in Section 5 on Diagnoses.

1.20: It is often difficult to localize pain precisely, so descriptions as to location of the pain may be imprecise. For example, the term “bladder pain” does not necessarily indicate that the bladder is the cause. Pain thought to be arising from the bladder, or felt in the urethra, scrotum or perineum might be referred from the lower ureter, or bladder base or other pelvic organs.

1.21: The definitions of pelvic pain and especially chronic pelvic pain had been debated in several societies with a view to simplification and restructuring of the classification. The ICS has now published a report from chronic pelvic pain syndromes.<sup>23</sup>

1.22: Painful ejaculation (previously termed “odynorgasmia”), is a poorly characterized syndrome. It may be associated with urethritis, BPH, acute or chronic prostatitis, CPPS, seminal vesiculitis, seminal vesicular calculi or ejaculatory duct obstruction. Often, no obvious etiologic factor can be found.

1.23: Commonly suggested criteria for: (i) Bacteriuria are >100 000 CFU/mL on voided specimen or >1000 CFU/mL on catheterized specimen; (ii) Pyuria are >10 WBC/mm<sup>3</sup> in uncentrifuged urine. The presence of nitrites in the urine is supportive of a UTI involving a common organism (*E. Coli*, *Klebsiella*).

1.24: Those symptomatic patients with fewer colony counts may still harbor organisms detectable by mRNA analyses not widely available at present.<sup>24</sup> Testing for urinary microbiome is being explored but it is not widely available.

1.25: Recurrent urinary tract infections (UTIs) has not been consistently defined. They are far less common in men

than women but perhaps more significant. There is the difficulty of balancing the practical clinical definition and the scientific one. Records of diagnostic tests are often inaccessible over the medium to longer term. With a bias towards the former category, a definition might be the presence at least two symptomatic and medically diagnosed UTIs in 12 months. “Recur” strictly means to “occur again” or “be repeated.”

1.26: This symptom must have been present for at least 6 months and must be experienced on almost all or all (approximately 75-100%) occasions of sexual activity. It causes clinically significant distress in the individual. It has been called early ejaculation, rapid ejaculation, rapid climax or premature climax. There is no uniform cut-off defining “premature,” but a consensus of experts at the International Society for Sexual Medicine endorsed a definition of around 1 min after penetration. The International Classification of Diseases (ICD-10) applies a cut-off of 15 s from the beginning of sexual intercourse.

1.27: Mean semen volume is 3.9 mL (5<sup>th</sup> centile 1.5 mL; 95<sup>th</sup> centile 6.8 mL). Low semen volume is under 1.5 mL; high semen volume is over 6.8 mL.<sup>25,26</sup>

1.28: Dyspareunia (“hispareunia”), the symptom most applicable to male discomfort on sexual intercourse, will depend on many factors including a woman's introital relaxation and/or anatomical factors.

1.29. Symptoms of defecatory dysfunction are not uncommon in men, particularly those who have undergone anal sphincterotonies for fissure-in-ano.

1.30. Rome IV Criteria for 1.8.3.1 *Constipation*<sup>28</sup>: Complaint that bowel movements are (i) infrequent (<3/wk); (ii) need to strain; (iii) lumpy or hard stool bloating; (iv) sensation of incomplete evacuation; (v) sensation of anorectal obstruction or blockage abdominal pain, (vi) need for manual assistance, in more than one quarter of all defecation.

## SECTION 2: SIGNS

**Sign:** Any abnormality indicative of disease or a health problem, discoverable on examination of the patient; an objective indication of disease or a health problem.<sup>1</sup> (**CHANGED**)

**General principles of examination for male with symptoms of LUT/PF dysfunction**<sup>29</sup>: A comprehensive physical examination is done to seek potential influences on symptoms.<sup>FN2.1</sup> It should include abdominal examination, focussing on the suprapubic area to detect an enlarged bladder, or other abdominal mass, and digital examination of the rectum (prostate) as well as examination of the external genitalia, the perineum and lower limbs. The hernia orifices should also be evaluated. Penile lesions including meatal stenosis, phimosis, and penile cancer must be excluded.<sup>29–31</sup>

If a neurological diagnosis is suspected, then a focused neurological examination with evaluation of perianal crude and pinprick sensations need to be tested. Also, the anal muscle tone can be assessed with finger in the rectum and asking the patient to squeeze. (**NEW**)

### 2.1 General (visual) observations

**2.1.1 Mobility:** generalized muscle strength and ability to ambulate independently or with assistance. (**NEW**)

**2.1.2 Skin:** jaundice or pallor or skin irritation due to urinary loss. (**NEW**)

**2.1.3 Nutritional Status:** cachexia (possible underlying malignancy); obesity (possible endocrine abnormality<sup>29</sup> including metabolic syndrome). (**NEW**)

**2.1.4 Edema of genitalia and lower extremities:** Possible cardiac decompensation, renal failure, nephrotic syndrome, or pelvic and/or retroperitoneal lymphatic obstruction.<sup>29–31</sup> (**NEW**)

### 2.2 Abdominal examination<sup>3,5</sup>: Among numerous possible abdominal signs are:

**2.2.1 Bladder fullness/retention:** The bladder may be felt by abdominal palpation or detected by supra-pubic percussion. <sup>FN2.2</sup> (**CHANGED**)

**2.2.2 Other abdominal masses:** or distension (eg, ascites). (**NEW**)

**2.2.3 Scars:** Indicating previous relevant surgery, traumas, or evidence of previous radiotherapy. (**NEW**)

**2.2.4 Renal Area:** Examination for tenderness, masses. (**NEW**)

### 2.3 Lower Urinary Tract/Genital Examinations/Signs

#### 2.3.1 Genital skin:

**2.3.1.1** Excoriation, redness, irritation secondary to urinary incontinence and the effect of pads or diapers. (**NEW**)

**2.3.1.2** Mycotic infections (balanoposthitis, intertrigo, or scrotal): Moist, red pruritic skin usually in men with urinary or fecal incontinence, immune suppression or poorly controlled diabetes mellitus.<sup>32</sup> (**NEW**)

**2.3.1.3** Skin pigmentation: balanitis xerotica obliterans (BXO – syn. *lichen sclerosus*) and vitiligo may cause depigmentation (penile skin, scrotum, glans). (**NEW**)

**2.3.1.4** Cutaneous manifestations of sexually transmitted diseases: vesicles, ulcers. (**NEW**)

#### 2.3.2 Penile examination:

### 2.3.2.1 Foreskin abnormalities:

**2.3.2.1.1 Tumor or infection** (balanoposthitis, ie, inflammation of the glans penis and overlying foreskin<sup>1</sup>). (NEW)

**2.3.2.1.2 Phimosis**<sup>33</sup>: Partial or complete inability to retract the prepuce due to adhesion between the glans and the prepuce or a preputial ring. FN2.3 (NEW)

**2.3.2.1.3 Paraphimosis**<sup>33</sup>: Entrapment of the prepuce behind the glans. FN2.3 (NEW)

### 2.3.2.2 Position of the urethral meatus<sup>31</sup>:

**2.3.2.2.1 Hypospadias**: Refers to the urethral meatus sited on *ventral surface* of the penis, either congenital or acquired, proximal to its normal position on the tip of the glans. External urethral meatus may be on the glans penis (*glandular hypospadias*), sulcus (*coronal hypospadias*), shaft (*penile hypospadias*), scrotum (*scrotal hypospadias*), or perineum (*perineal hypospadias*). (NEW)

**2.3.2.2.2 Epispadias**: Refers to the urethral meatus sited on *dorsal surface* of the penis, either congenital or acquired, proximal to its normal position on the tip of the glans. (NEW)

**2.3.2.2.3 Neoplastic or inflammatory lesions** within the fossa navicularis.<sup>34</sup> (NEW)

**2.3.2.2.4 Post-hypospadias/epispadias repair**: including post-urethroplasty urethral fibrosis; palpated near the meatus or in the penile shaft. (NEW)

**2.3.2.2.5 Postoperative fistula**: Urine is visible at or near the incision lines. (NEW)

### 2.3.2.3 Urethral examination:

**2.3.2.3.1 Palpation**: along the ventral aspect of the penis and inferiorly into the perineum to detect fibrosis, lumps or tenderness along the shaft. (NEW)

**2.3.2.3.2 Tenderness**: suggestive of urethral or periurethral inflammation, often secondary to a urethral

stricture<sup>34</sup> or sexually transmitted disease. (NEW)

**2.3.2.3.3 Meatal stenosis**: narrowing changes of the distal urethra; post-infection, post-surgery. (NEW)

### 2.3.2.4 Examination of the glans and shaft

**2.3.2.4.1 Penile plaque**: palpation of node or plaque in the tunica usually on the dorsal aspect (perhaps related to Peyronie's disease). (NEW)

**2.3.2.4.2 Lichen sclerosus**: tight foreskin, cracking, and bleeding.

**2.3.2.5 General examination**: redness, ulcers, warts, (NEW)

### 2.3.3 Scrotal examination: (NEW)

**2.3.3.1 Normal**: The scrotum is a loose sac containing the testes and spermatic cord structures. The epididymis is palpable applied to the posterior surface of the testis as a ridge although occasionally it is sited on the anterior surface. FN 2.4 (NEW)

**2.3.3.2 Inflammation**: The epididymis may be swollen and tender, and if severe, the inflammatory process may involve the whole scrotal content (i.e. testis and epididymis [epididymo-orchitis]) and the scrotal skin as well. FN2.5 (NEW)

**2.3.3.3 Cystic dilatations of the epididymis**: (epididymal cysts or spermatocele) and hydroceles (fluid collections between the visceral tunica albuginea and parietal layer of the testicular peritoneum)—usually benign. The examination of these structures would be generally non-tender and without pain (as opposed to 2.3.3.2). FN2.6 (NEW)

**2.3.3.4 Inguinal bulge**: Examination and differentiation of hernia from hydrocele or cyst of spermatic cord or groin lymph nodes. (NEW) (use of transillumination may assist though ultrasound is generally diagnostic)

FN2.7

**2.3.4 Perineal examination**: this is generally performed with the patient in the lateral supine or in the lithotomy position. (NEW)

**2.3.4.1 Perianal dermatitis**: Skin infection at the perineum around the anus, usually associated with fecal incontinence or diarrhoea. (NEW)

**2.3.4.2 Fissures**: A break or tear in the skin of the perineum, anal sphincter or distal rectum usually associated with anal pain. (NEW)

**2.3.5 Rectal and prostate examination:** Digital rectal examination (DRE) is recommended<sup>35–37</sup> as part of the physical examination. Generally done with the patient standing and bent over the examining table, or with the patient in the left lateral knees bent position, or in the lithotomy position. DRE is usually pain-free. (NEW)

**2.3.5.1 Anal examination:** This can detect the following findings in the anal sphincter or distal rectum: (NEW)

**2.3.5.1.1 Benign diseases:** hemorrhoids, fissure, anal sphincter injury, levator discomfort, or pain. (NEW)

**2.3.5.1.2 Possible malignant diseases:** anal, distal rectal, and prostate carcinoma. (NEW)

**2.3.5.1.3 Anal tone:** increased or decreased anal sphincter tone might suggest similar changes in the urinary sphincter and may indicate neurologic disease. (NEW)

**2.3.5.1.4 Anal stricture:** a circumscribed narrowing or stenosis of the anal canal. (NEW)

**2.3.5.2 Prostate gland characteristics:** size, symmetry, firmness, nodules, and its relation to the pelvic sidewall and rectum can be assessed.<sup>35–37</sup> The gland is about the size of a walnut and has a consistency similar to that of the contracted thenar eminence of the thumb <sup>FN2.8.</sup> (NEW)

**2.3.5.3 Nodularity and/or firmness** – May indicate possible abnormality requiring further investigation.<sup>37</sup> (NEW)

**2.3.5.4 Prostate tenderness:** prostate palpation, as part of a DRE, is usually pain-free. Pain with prostatic palpation is variable though if present, it may be helpful in differentiating prostate/pelvic pain syndromes.<sup>34</sup> (NEW)

**2.3.5.5 Rectal examination (circumferential):** this might lead to the detection of non-urolological diseases such as rectal carcinoma, fistula and fecal impaction.<sup>FN2.9</sup> (NEW)

## 2.4 Focused neurological exam<sup>3,5</sup>

**2.4.1 Overall neurological status:** abnormalities of speech, gait as well as upper and lower extremity dexterity should be noted as they may indicate a neurological cause for the urological symptoms.

Neuropathy may impact also on management options.<sup>38</sup> <sup>FN2.10</sup> (CHANGED)

**2.4.2 Level of neurologic abnormality:** can occasionally be localized by the pattern of sensory or motor deficit noted during physical examination using a dermatome map.<sup>30</sup> (NEW)

**2.4.3 Penile, scrotal, or perianal sensory deficits:** may indicate damage or injury to sacral roots or nerves. Reflex testing in the genital area may also be performed. The most important of these is the BSR.<sup>39</sup> (NEW)

**2.4.4 Bulbospongiosus reflex (BSR)<sup>39</sup>** a reflex contraction of the striated muscle of the pelvic floor (anal sphincter) and the bulbo-spongiosus muscle that occurs in response to various stimuli in the perineum or genitalia. <sup>FN2.11</sup> (NEW)

**2.4.5. Cremasteric reflex:** contraction of the ipsilateral cremaster muscle, drawing the testis upwards, when the upper inner aspect of the thigh is stroked longitudinally. (NEW)

**2.5 Urinary Incontinence Signs<sup>3,5,40,41</sup>:** All examinations for the evaluation of urinary incontinence are best performed with the individual's bladder comfortably full.

**2.5.1 Urinary incontinence<sup>3,5</sup>:** observation of involuntary loss of urine on examination.

**2.5.2 Stress urinary incontinence (clinical stress leakage)<sup>3,5</sup>:** observation of involuntary leakage from the urethral orifice synchronous with effort or physical exertion, or on sneezing or coughing.

**2.5.3 Urgency urinary incontinence<sup>3,5</sup>:** observation of involuntary leakage from the urethral orifice associated with the individual reporting a sudden, compelling desire to void. (CHANGED)

**2.5.4 Extra-urethral incontinence<sup>3,5</sup>:** observation of urine leakage through channels other than the urethral meatus, for example, fistula. <sup>FN2.12</sup>

**2.6 Pelvic floor muscle (PFM) function.<sup>3,5,42,43</sup>** The following signs of PFM function may be assessed via the perineum (visual or tactile examination) or per rectum (digital palpation) examination. Digital rectal examination (DRE) may be less useful in male urinary dysfunctions where the urethral sphincter, inaccessible to DRE, has a more important role.<sup>44</sup> (NEW)

**2.6.1 Perineal examination<sup>3,5,42,43</sup>**—when the patient is asked to cough or bear down, the perineum should only show limited downward movement; ventral movement may occur because of the guarding actions of the pelvic floor muscles. (CHANGED)

**2.6.1.1 Perineal elevation<sup>43,44</sup>:** This is the inward (ventro-cephalad) movement of the perineum and anus. <sup>FN2.13</sup> Look for testicular lift and penile retraction. These need to be checked against movement of the scrotum and the whole penis. Correct movement occurs with the PFM only: the shaft of the penis draws in and the testes lift in a cephalad direction. These movements may be better visualized in standing than supine position. <sup>45–47</sup> (NEW)

**2.6.1.2 Perineal descent<sup>43</sup>:** This is the outward (dorso-caudal) movement of the perineum and anus.

## 2.6.2 Examinations<sup>43</sup>

**2.6.2.1 PFM state at rest;** aspects to assess.

<sup>FN2.13</sup>

**2.6.2.1.1 Myalgia:** provoked by palpation. Levator muscle pain/tenderness may be elicited by palpation of these muscles via rectal examination. <sup>43</sup> <sup>FN 2.14</sup> (NEW)

- **Tender point:** Tenderness to palpation at a specific soft tissue body site. (NEW)

**2.6.2.1.2 Tone:** state of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement. Muscle tone has two components, the contractile component and the viscoelastic component. Muscle tone may be altered in the presence or absence of pain. (CHANGED)

**2.6.2.1.3 Increased PFM tone (non-neurogenic hypertonicity):** increased tone in a patient without an intercurrent neurological diagnosis. (CHANGED)

**2.6.2.1.4 Decreased PFM tone (non-neurogenic hypotonicity):** decreased tone in a patient without an intercurrent neurological diagnosis. (CHANGED)

**2.6.2.1.5 Symmetry:** if examining in the left lateral, there will be a gravity effect and the dependent side will have a different feel to

the upper side and appear as asymmetrical. This may affect PFM tone. Not so common in men. (NEW)

**2.6.2.1.6 PFM injury:** for example, palpable anal sphincter gap though overall not common unlike women. (NEW)

**2.6.2.2 PFM contractile function:** Aspects to assess

**2.6.2.2.1 Voluntary contractility<sup>43</sup>:** the individual is able to contract the PFM on demand. A contraction is felt as a tightening, lifting, and squeezing action under/around the finger. (NEW)

**2.6.2.2.2 Strength<sup>43</sup>:** Force-generating capacity of a muscle. It is generally expressed as maximum voluntary contraction. (NEW)

**2.6.2.2.3 Endurance<sup>43</sup>:** the ability to sustain near maximal or maximal force, assessed by the time a patient is able to sustain a maximal static or isometric contraction. (NEW)

**2.6.2.2.4 Repeatability<sup>43</sup>:** the ability to repeatedly develop near maximal or maximal force, determined by assessing the maximum number of repetitions the patient can perform before detectable decline in force. Record number of contractions in a row. (NEW)

**2.6.2.2.5 Co-contraction:** contraction or activation of two or more muscles at the same time. Identify which muscles are co-contracting and whether the co-contraction is synergistic. (NEW)

**2.6.2.2.6 Relaxation ability:** return of the PFM to its original resting tone following the voluntary contraction. Also includes the ability to maintain PFM relaxation in anticipation of or during any type of touch. (NEW)

**2.6.2.3 PFM response to increased intra-abdominal pressure:** for example, strain/Valsalva/cough aspects to assess



### 2.6.2.3.1 Direction of contraction (elevation, descent)

## 2.6.3 Diagnoses related to PFM examinations

**2.6.3.1 Overactive pelvic floor muscles:** Pelvic floor muscles which do not relax, or may even contract when relaxation is functionally needed, for example, during voiding or defecation. (**CHANGED**)

**2.6.3.2 Underactive pelvic floor muscles:** Pelvic floor muscles which cannot voluntarily contract when instructed to do so or when required. (**CHANGED**)

## 2.7 Frequency-Volume Chart/Bladder Diary

### 2.7.1 Frequency-volume chart (FVC).<sup>3,5,18,48</sup>

The recording of the time of each micturition together with the volume voided for at least 24 h. Ideally a minimum of three days of recording (not necessarily consecutive) will generally provide more useful clinical data. It is relevant to discriminate daytime and nighttime micturition.

**2.7.2 Bladder diary:** Adds to the FVC above, the fluid intake, pad usage, incontinence episodes, the degree of incontinence and the circumstances at the time of the leakage. \*\* Signs where FVC or Bladder diary are important. Episodes of urgency and sensation might also be recorded, as might be the activities performed during or immediately preceding the involuntary loss of urine. Additional information obtained from the bladder diary involves: Severity of incontinence in terms of leakage episodes and pad usage.

**2.7.2.1 Daytime:**<sup>18</sup> the period between waking up with the intention of arising until going to bed with the intention of sleeping (awake hours). (**NEW**)

**2.7.2.2 Night-time:**<sup>18</sup> The individual's main daily period of sleep. It commences at the time of going to bed with the intention of sleeping and concludes when the individual decides to no longer attempt to sleep and rise for the next day. (**CHANGED**) <sup>FN2.15, FN2.16</sup>

**2.7.2.3 Main sleep period:**<sup>18</sup> The period from the time of falling asleep to the time of rising for the next day.

**2.7.2.4 Nocturnal:** Occurring or active at night.<sup>1</sup> For example, symptoms

and signs that occur at night.<sup>18</sup> (**CHANGED**)

### 2.7.2.5 Daytime (urinary) frequency.<sup>3,5</sup>

Number of voids during daytime (awake hours including first void after waking up from sleep and last void before sleep)\*\*.

**2.7.2.6 Night-time (urinary) frequency:**<sup>18</sup> Total number of night-time voids irrespective of sleep.\*\*

**2.7.2.7 Nocturia:** The number of times an individual passes urine during their main sleep period, from the time they have fallen asleep up to the intention to rise from that period. This is derived from the bladder diary.<sup>18</sup>

**2.7.2.8 24-hour (urinary) frequency:**<sup>3,5,18,48</sup> Total number of daytime and night-time voids during a specified 24-hour period.\*\* (**CHANGED**)

**2.7.2.9 24-hour urine volume:**<sup>18</sup> Summation of all urine volumes during a specified 24 h period. The first void after rising is discarded and the 24-hour period begins at the time of the next void and is completed by including the first void, after rising, the following day.\*\* (**CHANGED**)

**2.7.2.10 Maximum voided volume:** Highest voided volume recorded during the assessment period. (**CHANGED**) This usually equals bladder capacity.\*\*

**2.7.2.11 Average voided volume:** Summation of volumes voided divided by the number of voids during the assessment period.\*\* (**CHANGED**)

**2.7.2.12 Mean maximum voided volume (functional capacity):** Mean maximum voided volume in everyday activities.\*\*

**2.7.2.13 Polyuria:** Excessive production of urine.<sup>1,3,5</sup> It has been defined as more than 40 mL urine/kg body weight during 24 h or 2.8 L urine for a man weighing 70 kg.<sup>48</sup>

**2.7.2.14 Nocturnal urine volume:**<sup>18</sup> Total volume of urine produced during the night. Volume measurement

begins after last void preceding sleep and concludes after the first day-time void (when the individual decides to no longer attempt to sleep).-FN2.16 \*\*

**2.7.2.15 Nocturnal (night-time) polyuria:**<sup>18,48</sup> \*\* Increased proportional production of urine during the night-time compared with the 24 h urine volume. FN2.17 (**CHANGED**). Nocturnal polyuria index (NPI) is most commonly used definition (Night-time urine volume/24 h urine volume) × 100%.  
- 33% in elderly, eg, >65 years;

- >20% in younger individuals
- 20-33% in “middle age”

Figure 1 (below): provides an example of a bladder diary.

**2.7.2.16 Pad Testing:** For individuals with urinary (fecal) incontinence symptoms, the quantification of the amount of urine (feces) lost over the duration of testing, by measuring the increase in the weight of the pads (weighed pre- and post-testing) used. This may give a guide to the severity of incontinence. Different durations from a short (1 h) test to a 24 and 48-hour tests have been used with provocation varying from normal everyday activities to defined regimens. FN2.18

DATE/TIME OCCURRENCE	LIQUID INTAKE (mL)	VOLUME OF URINE (mL)	LEAKS	PAD CHANGE
01.02.18			☆	
02.15		150		
07.15		200		
08.00	Mug 200 mL			
08.30		80	☆	PC
09.00	Cup 200mL		☆	
10.00		100		
12.00	2 cups 300mL			
14.00		100		
16.00		80		
17.00	Cup 200 mL		☆	PC
18.00		100	☆	
19.00	Cup 200 mL			
19.30		100		
20.00	Glass 100 mL	80		
20.30	Water (over 100mL)		☆	
22.00				PC
23.00		100		

**FIGURE 1** Bladder diary: This simple chart allows you to record the fluid you drink and the urine you pass over 3 days (not necessarily consecutive) in the week prior to your clinic appointment. This can provide valuable information. (i) Please fill in approximately when and how much fluid you drink, and the type of liquid. (ii) Please fill in the time and the amount (in mLs) of urine passed, and mark with a star if you have leaked or mark with a “PC” if you have needed to change your pad (Please find below an example of how to complete this form).  
Frequency = 9; Nocturia = 1; Urine production/24hr = 1250 mL; maximum voided volume = 300 mL; average voided volume = 125 mL



## Footnotes for Section 2

2.1: There is little evidence from clinical trials that carrying out a clinical examination improves care, but general consensus suggests that it remains an essential part of assessment of men with urinary incontinence<sup>2</sup> or other LUTS.

2.2: A normal bladder in the adult cannot be palpated or percussed until there is at least a volume of 150 mL of urine. At larger volumes of about  $\geq 500$  mL, a distended bladder may be visible in thin patients as a lower midline abdominal mass. Percussion is better than palpation for diagnosing a distended bladder. The examiner begins by percussing just above the symphysis pubis and continues cephalad until there is a change in tone from dull to resonant.<sup>30</sup>

2.3: If phimosis is severe, this can cause voiding symptoms. Most penile cancers occur in uncircumcised men and arise on the prepuce or glans and may be associated with voiding symptoms.<sup>33</sup>

2.4: Scrotal abnormalities can help in elucidating lower urinary tract symptoms in men. For example, men with epididymitis may have associated urinary infection symptoms secondary to coliform bacteriuria.<sup>34</sup>

2.5: Isolated orchitis secondary to UTI is rare, however, mycobacterial infection, mumps, and BCG treatment may cause orchitis.<sup>34</sup>

2.6: If very large they may distort the scrotum and urethra and interfere with normal voiding. A hydrocele is sometimes secondary to testis tumor or inflammatory processes in the epididymis or orchitis.

2.7: The presence of hernias, cystic swellings in the scrotum, and testicular tumors should be excluded by careful clinical examination.

2.8: During the DRE, prostate size and consistency can be estimated, although DRE tends to underestimate true prostate size.<sup>35,36</sup>

2.9: In patients with recto-urethral fistulas, the fistula can occasionally be palpated in the anterior rectal wall. The site of the fistula at or above the anal sphincter can occasionally be noted along with the degree of induration of the anterior rectal wall. With large fistulas the urethra can be palpated, especially if there is a Foley catheter in place.

2.10: For example, a person with Parkinson's may be unable to perform intermittent catheterization because of tremor. A focused neurological exam is also recommended, especially in patients suspected of having neurogenic bladder dysfunction.<sup>38</sup> Decreased perineal sensation and anal sphincter tone may be signs of neuropathy.<sup>41</sup>

2.11: This reflex is most commonly tested by placing a finger in the rectum and then squeezing the glans penis. If a Foley catheter is in place, the BSR can also be elicited by gently pulling on the catheter. If the BSR is intact, tightening

of the anal sphincter should be felt and/or observed.<sup>39</sup> The BSR tests the integrity of the spinal cord-mediated reflex arc involving S2-S4 and may be absent in the presence of sacral cord or peripheral nerve abnormalities.<sup>39</sup>

2.12: If the patient has had previous urethral or bladder surgery or trauma, the examiner should ascertain whether urinary leakage occurs through a fistula in a scar, or at any other site in the penis, perineum, groins, or lower abdomen.

2.13: Normally there is inward (cephalad) movement of the perineum and anus.

2.14: This is all part of doing a DRE, assessing anal sphincters and puborectalis.

2.15: For the purposes of the nocturia terminology, night-time is therefore defined by the individual's sleep cycle, rather than the solar cycle (from sunset to sunrise). Thus, some shift workers may have their "night" period during the daylight hours, as it is the time of their main sleep period.<sup>18</sup>

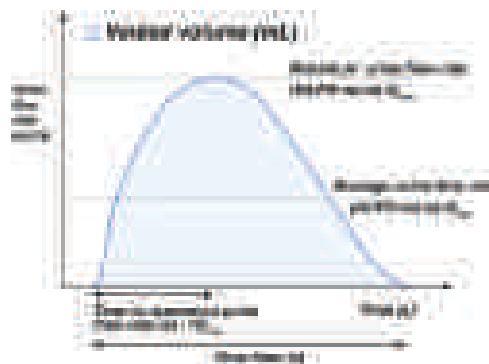
2.16: Volume measurement begins after the last void preceding sleep and concludes after the first daytime void. The first daytime void follows the individual's decision they will no longer attempt to sleep.<sup>18</sup>

2.17: There are several definitions in the literature that could be used to indicate nocturnal polyuria including:<sup>18</sup>

Nocturnal urine production based on body weight of greater than 10 mL/kg.<sup>49</sup>

1. Rate of nocturnal urine production  $>90$  mL/hr.<sup>50</sup> This is suggestive of nocturnal polyuria in men (about 450 mL per 8 h' sleep).<sup>51</sup> There are no studies looking at the rate of nocturnal urine production in women and this may well be different from that in men.
2. Nocturnal polyuria index is the most commonly used definition for nocturnal polyuria<sup>52</sup> (nocturnal urine volume/24-hour voided volume) based on nocturnal urine volume as part of total 24-hour urine volume (age dependent).
3. Nocturia index (nocturnal urine volume/maximum voided volume)<sup>53</sup>  $>1$ : nocturia occurs because maximum voided volume is smaller than nocturnal urine volume.  $>1.5$ : nocturia secondary to nocturnal urine over-production in excess of maximum bladder capacity, that is, nocturnal polyuria.

2.18: A pad test quantifies the severity of incontinence and may be the most objective measure of the incontinence. Severity of incontinence (quantified by pad weight) affects surgery outcomes. The 24-hour pad test and micturition diary are reliable instruments for assessing the degree of urinary loss and number of incontinent episodes, respectively. Increasing test duration to 48 and 72 h



**FIGURE 2** A schematic representation of urine flow over time and parameters of uroflowmetry

increases reliability but is associated with decreased patient compliance.<sup>54</sup> Overall, the 24-hour home test is the most accurate pad test for quantification and diagnosis of urinary incontinence because it is the most reproducible.<sup>55</sup> The 1-hour pad test may be used because it is easily done and standardized, however, there is no strict parallel with the 24-hour pad test and it may underestimate the weakness of the sphincter in the later part of the day.

### SECTION 3: URODYNAMIC INVESTIGATIONS

**Urodynamics:** Measurement of all the physiological parameters relevant to the function and any dysfunction of the lower urinary tract.<sup>56,57</sup> FN3.1, FN3.2. (NEW)

**Clinical sequence of testing:**<sup>3,5</sup> Urodynamic investigations generally involve an individual attending with a comfortably full bladder for free (no catheter) uroflowmetry and post-void residual (PVR) measurement prior to filling cystometry and pressure-flow study. (NEW)

#### 3.1 Uroflowmetry

**3.1.1 Ideal conditions for free (no catheter) uroflowmetry:** All free uroflowmetry studies should be performed in a completely private uroflowmetry room. Most modern uroflowmeters have a high degree of accuracy ( $\pm 5\%$ ) though regular calibration is important (Figure 2).<sup>58</sup>

**3.1.2 Urine flow:** Urethral passage of urine where the pattern of urine flow may be:<sup>2,3,5</sup>

**3.1.2.1 Continuous:** no interruption to urine flow.

**3.1.2.2 Intermittent:** urine flow is interrupted.

**3.1.3 Urine flow rate (UFR – unit: mL/s):** Volume of urine expelled via the urethra per unit time.<sup>2,3,5</sup>

**3.1.4 Voided volume (VV – unit: mL):** Total volume of urine expelled via the urethra during a single void.<sup>2,3,5</sup> (CHANGED)

**3.1.5 Maximum (urine) flow rate (MUFR – unit: mL/s) –  $Q_{\max}$ :** Maximum measured value of the urine flow rate<sup>2,3,5</sup> corrected for artefacts.<sup>3,5</sup>

**3.1.6 Flow time (FT – unit: s):** Time over which measurable flow actually occurs.<sup>2,3,5</sup>

**3.1.7 Average (urine) flow rate (AUFR – unit: mL/s) –  $Q_{\text{ave}}$ :** Voided volume divided by the flow time.<sup>2,3,5</sup>

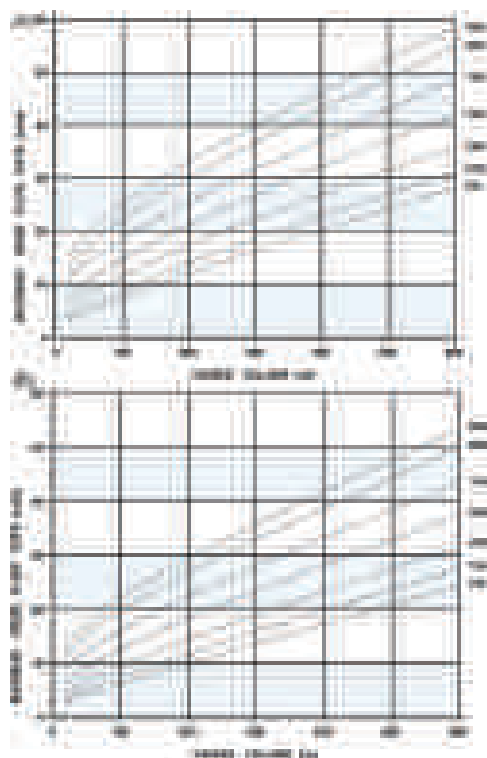
**3.1.8 Voiding time (VT – unit: s):** Total duration of micturition, including interruptions. When voiding is completed without interruption, voiding time is equal to flow time.<sup>2,3,5</sup>

**3.1.9 Time to maximum urine flow rate (tQmax – unit: s):** Elapsed time from the onset of urine flow to maximum urine flow.<sup>2,3,5</sup>

**3.1.10 Interpretation of the normality of free uroflowmetry:** Because of the strong dependency of urine flow rates in men on voided volume<sup>59,60</sup> and age,<sup>60</sup> they are best referenced to nomograms<sup>60–63</sup> where the cutoff for normality has been determined and validated. The individual should comment whether voiding was representative of his usual urine flow and whether he has diurnal variation in urine flow (Figure 3A, B). (NEW)

Figure 3A: the Liverpool nomograms<sup>60</sup> for the maximum urine flow ( $Q_{\max}$ ) in men aged up to 50 years (mean 35 years). (NEW)

Figure 3B: the Liverpool nomograms<sup>60</sup> for the maximum urine flow rate ( $Q_{\max}$ ) in men aged over 50 years (mean 60 years). (NEW)



**FIGURE 3** A and B, show the Liverpool nomograms<sup>60</sup> for the maximum urine flow rate in men (i) up to 50 years (mean 35 years) and (ii) over 50 years (mean 60 years). Equation for the maximum urine flow rate nomogram (divided by age as above) is:  
 $\text{Sq Root (MUFR)} = 2.37 + 0.18 \times \text{Sq Root (Void volume)} - 0.014 \times \text{age}$ . (Root mean square error: 0.727) (*NEW*). References to a specific urine flow rate as the lower limit of normal provided a specific volume has been voided require validation studies

The 25<sup>th</sup> percentile appeared to be most appropriate lower limits of normality for both urine flow rates to identify those men more likely to have voiding dysfunction (more commonly bladder outlet obstruction [BOO]).<sup>64</sup> Higher urine flow rate percentiles occurred in men with detrusor overactivity.<sup>64</sup> <sup>FN3.3</sup> Some racial differences in urine flow rates have been reported. <sup>FN3.4</sup> Ideally, abnormal uroflowmetry studies should be repeated. (*NEW*)

**3.2 Post-void residual (urine volume, PVR – unit: mL):** Volume of urine left in the bladder at the completion of voiding<sup>2,3,5</sup>

**3.2.1 Conditions for PVR measurement:** PVR reading is erroneously elevated by delayed measurement due to additional renal input (1–14 mL/min) into the bladder. <sup>FN3.5</sup> Ultrasonic techniques allow immediate (within 60 s of micturition) measurement to minimize the error. Immediate insertion of a transurethral

catheter for bladder drainage can still provide an effective and accurate PVR measurement. All urethral catheters, however, may not be of equal drainage efficacy <sup>FN3.6</sup>. Ultrasound PVR measurement should ideally be repeated at least once if PVR is present. (*NEW*) An overdistended rather than “comfortably full” bladder might lead to a falsely elevated initial PVR, assessed further by repeat voiding/repeat PVR.

**3.2.2 Assessment of normality of PVR:** Upper limits in normal community dwelling men without LUTS are age dependent with studies reporting a cut-off value of 10–30 mL<sup>67–70</sup>. *There are no adequate currently available data from which to quote expected/typical ranges of PVR in men with symptoms of lower urinary tract dysfunction.* Such studies would need to reflect the accuracy of measurement, including whether the PVR measurement is “immediate”

(eg, by ultrasound) or by urethral catheterization (unless also “immediate”). In the absence of such studies, our consensus view is that a PVR (ultrasound) over 50 mL, following double voiding, might prompt the suspicion of voiding dysfunction. (*NEW*)

### 3.3 Cystometry – General<sup>2,3,5,56,57</sup>

**3.3.1 Urodynamic studies:** These usually take place in a special clinical room (urodynamic laboratory) and involve (artificial) bladder filling with a specified liquid (ICS recommends physiological saline solution or X-ray contrast if video studies) at a specified rate.<sup>2,3,56,57</sup> FN3.7

**3.3.2 Cystometry:** Measurement of the pressure-volume relationship of the bladder during filling.<sup>2,3,56,57</sup> FN3.7

**3.3.3 Cystometrogram (CMG):** Graphical recording of the bladder pressure(s) and volume(s) over time.<sup>2,3,56,57</sup>

#### 3.3.4 Conditions for cystometry including

**3.3.4.1 Pressures (zeroing);\***

**3.3.4.2 Pressure transducers;\***

**3.3.4.3 Catheter mounted transducers; \***

**3.3.4.4 Initial bladder volume;\***

**3.3.4.5 Fluid medium\*** FN3.7 \* Covered in references<sup>56,57</sup>

**3.3.4.6 Temperature of fluid:** Fluid at room temperature is mostly used. It can be warmed to body temperature but without evidence that this influences results.<sup>71,72</sup> FN3.8 (*CHANGED*)

**3.3.4.7 Position of patient:** Sitting (standing) position is more provocative for abnormal detrusor activity (ie, overactivity) than the supine position. At some point in the test, filling might desirably take place with the patient standing (in those patients able to do so).<sup>71,73</sup> FN3.9 (*CHANGED*) Many men will void standing.

**3.3.4.8 Filling rate:** The filling rate, including any changes during testing, should be noted on the urodynamic report.<sup>3,56,57,71,73–76</sup> FN3.10. A medium fill rate (25–50 mL/min) should be applicable in most routine studies. Much slower filling rates (under 25 mL/min) are appropriate in men where there are concerns for poor compliance or with a bladder diary showing low bladder capacity or those

with neuropathic bladder. A higher filling rate is greater than 50 mL/min.

(*CHANGED*)

#### 3.3.5 Intravesical pressure ( $P_{\text{ves}}$ - unit: cm H<sub>2</sub>O):

The pressure within the bladder (as directly measured by the intravesical catheter).<sup>2,3,56,57</sup>

#### 3.3.6 Abdominal pressure ( $P_{\text{abd}}$ - unit: cm H<sub>2</sub>O):

The pressure in the abdominal cavity surrounding the bladder. It is usually estimated from measuring the rectal pressure, though the pressure through a bowel stoma can be measured as an alternative. FN3.11 The simultaneous measurement of abdominal pressure is essential for interpretation of the intravesical pressure trace.<sup>2,3,5</sup> Artifacts on the detrusor pressure trace may be produced by a rectal contraction.<sup>2,3,56,57</sup> (*CHANGED*)

#### 3.3.7 Detrusor pressure ( $P_{\text{det}}$ - unit: cm H<sub>2</sub>O):

The component of intravesical pressure that is created by forces in the bladder wall (passive and active). It is calculated by subtracting abdominal pressure from intravesical pressure ( $P_{\text{det}} = P_{\text{ves}} - P_{\text{abd}}$ ).<sup>2,3,56,57</sup> FN3.12

### 3.4 Filling Cystometry<sup>2,3,56,57</sup>

**3.4.1 Filling cystometry:** Pressure-volume relationship of the bladder during bladder filling. It begins with the commencement of filling and ends when a “permission to void” is given by the urodynamicist<sup>2,3,5,56,57</sup> or with incontinence (involuntary loss) of the bladder content (Figure 4).<sup>71</sup> (*CHANGED*)

**3.4.2 Aims of filling cystometry:** To assess bladder sensation, bladder capacity, detrusor activity and compliance as well as to document (the situation of and detrusor pressures during) urine leakage. (*CHANGED*)

**3.4.3 Bladder sensation during filling cystometry:** Usually assessed by questioning the individual in relation to the fullness of the bladder during cystometry.

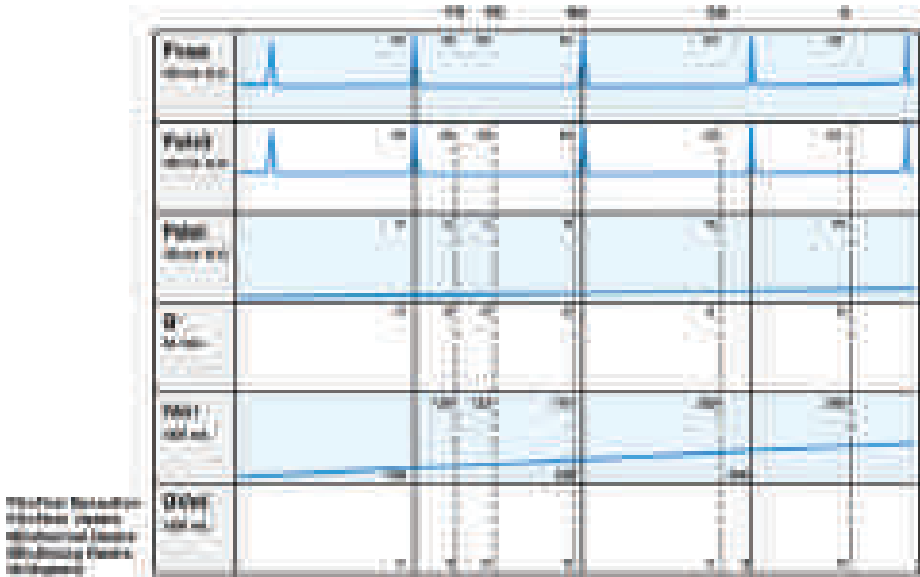
**3.4.3.1 First sensation of bladder filling:** The feeling when the individual first feels bladder filling.<sup>3,5,71,75</sup> FN3.13

**3.4.3.2 First desire to void:** The first feeling that the individual may wish to pass urine.<sup>3,5</sup> FN3.13

**3.4.3.3 Normal desire to void:** The feeling that leads the individual to pass urine at the next convenient moment, but voiding can be delayed if necessary.<sup>3,5</sup>

- 3.4.3.4 **Strong desire to void:** The persistent desire to pass urine without the fear of leakage.<sup>3,5,71</sup> FN 3.13
- 3.4.3.5 **Urgency:** Sudden, compelling desire to void which is difficult to defer.<sup>3,5</sup> FN1.4, FN1.5
- 3.4.3.6 **Bladder oversensitivity**<sup>5</sup>—Increased bladder sensation during bladder filling with: (*NEW – male*)
  - earlier first desire to void;
  - earlier strong desire to void, which occurs at low bladder volume;
  - lower maximum cystometric bladder capacity (**3.4.4.2**);
  - no abnormal increases in detrusor pressure.
- 3.4.3.7 **Reduced bladder sensation:** Bladder sensation perceived to be diminished during filling cystometry.
- 3.4.3.8 **Absent bladder sensation:** No bladder sensation during filling cystometry, at least to expected capacity of 500 mL.
- 3.4.3.9 **Pain:** the complaint of pain during filling cystometry is abnormal. Its site, character and duration should be noted.

- 3.4.4 **Bladder capacity during filling cystometry**<sup>3,5,56,57</sup>
- 3.4.4.1 **Cystometric capacity (units: mL):** Bladder volume at the end of filling cystometry, when a “permission to void” is usually given by the urodynamicist. This endpoint and the level of the individual's bladder sensation at that time, for example, “normal desire to void,” should be noted. This endpoint might be higher than normal in men with reduced bladder sensation.
- 3.4.4.2 **Maximum cystometric capacity (units: mL):** In individuals with normal sensation, this is the volume when one can no longer delay micturition during filling cystometry. FN3.14, FN3.15, FN3.16
- 3.4.5 **Detrusor function during filling cystometry**
- 3.4.5.1 **Normal detrusor activity/function:**<sup>3,5</sup> There is little or no change in pressure with filling. There are no detrusor contractions, spontaneous or provoked with activities such as postural changes, coughing or hearing the sound of running water. FN3.17 (**CHANGED**)



**FIGURE 4** Normal filling cystometry on multichannel urodynamics. (first desire 132 mL, normal desire to void 175 mL, strong desire to void 280 mL, urgency 340 mL. Detrusor contraction is absent during filling cystometry). Cough artefacts and good subtraction of  $P_{abd}$  from  $P_{ves}$  to get  $P_{det}$  are demonstrated

**3.4.5.2 Detrusor overactivity (DO):**<sup>3,5</sup> The occurrence of detrusor contraction(s) during filling cystometry. These contractions, which may be spontaneous or provoked, produce a wave form on the cystometrogram, of variable duration and amplitude. The contractions may be phasic or terminal. They may be suppressed by the patient or uncontrollable (**CHANGED**). Symptoms, for example, urgency and/or urgency incontinence or perception of the contraction may (note if present) or may not occur.

**3.4.5.2.1 Idiopathic (primary) detrusor overactivity:** No identifiable cause for involuntary detrusor contraction (s). (**CHANGED**) (Figure 5)

**3.4.5.2.2 Neurogenic (secondary) detrusor overactivity:**<sup>3,5,13</sup> Detrusor overactivity and evidence (history; visible or measurable deficit) of a relevant neurological disorder. (**CHANGED**)

**3.4.5.2.3 Non-neurogenic (secondary) detrusor overactivity:**

An identifiable possible non-neurological cause exists for involuntary detrusor contraction(s) during bladder filling. For example, functional (obstruction); stone, tumor (eg, carcinoma in situ), UTI.

FN3.18 (**CHANGED**)

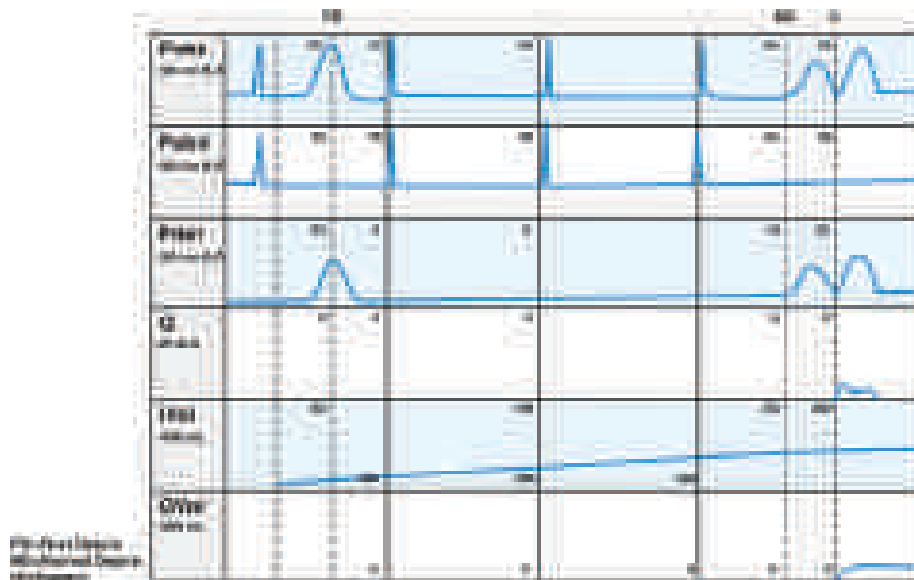
**3.4.6 Bladder (detrusor) compliance (unit: mL/cm H<sub>2</sub>O)**<sup>3,5,56,57,77–79</sup>

**3.4.6.1 Description:** Relationship between the change in bladder volume and simultaneous change in detrusor pressure as a measure for the distensibility of the bladder.<sup>3,5</sup>

**3.4.6.2 Calculation:** Divide the change of volume ( $\Delta V$ ) by the simultaneous change in detrusor pressure ( $\Delta P_{det}$ ) during filling cystometry – ( $C = \Delta V / \Delta P_{det}$ ). The compliance reflects the amount of fluid in the bladder to increase bladder pressure by 1 cm H<sub>2</sub>O and is expressed as mL per cm H<sub>2</sub>O.

**3.4.6.3.** Factors affecting the measurement of bladder compliance:

**3.4.6.3.1 Bladder filling speed:** The bladder should be filled at up to 50 mL/min if there is no



**FIGURE 5** Filling cystometry demonstrating detrusor overactivity: First desire to void occurred at 62 mL together a contraction; normal desire to void at 357 mL; urgency at 380 mL followed by a detrusor contraction There is also high pressure – slow flow during voiding



reason to suspect poor bladder compliance. Faster filling is more provocative and may artificially reduce bladder compliance. This artifact may settle when filling is interrupted or repeated with slower speed. *(CHANGED)*

#### 3.4.6.3.2 Contractile/relaxant properties of the detrusor (decreased compliance):

Properties of the bladder wall may reduce compliance, for example, pelvic radiation or chemotherapy or bladder overstretch. *(CHANGED)* Bladder outlet obstruction can result in detrusor muscle hypertrophy, intramural collagen and elastin deposition and contribute to reduced compliance. *(NEW)*

#### 3.4.6.3.3 Other factors affecting bladder compliance<sup>78</sup> (increased compliance):

Bladder diverticula (also pseudodiverticula) and vesico-ureteric reflux (high grade). *(NEW)*

#### 3.4.6.4 Starting point for compliance calculations:

Usually the detrusor pressure at the start of bladder filling and the corresponding bladder volume (usually zero).<sup>3</sup> Special attention should be made to ensure bladder is emptied at the commencement of measurement; incomplete emptying may artificially decrease bladder compliance. *(CHANGED)*

#### 3.4.6.5 End point for compliance calculations:

Detrusor pressure (and corresponding bladder volume) at cystometric capacity (allow time for pressure to settle after cessation of filling). Both points are measured excluding detrusor contraction. In the case of detrusor overactivity with leakage, both points should be measured or immediately before the start of any detrusor contraction (and therefore causes the bladder volume to decrease, affecting compliance calculations). Low compliance has been defined (in

women) as bladder compliance <10 mL/cm H<sub>2</sub>O (neurogenic) or <30 mL/cm H<sub>2</sub>O (non-neurogenic). Normal compliance is >30 mL/cm H<sub>2</sub>O (neurogenic) and 40 mL/cm H<sub>2</sub>O (non-neurogenic).<sup>79</sup> Recommended values in men have not been well-defined. <sup>FN3,19</sup> *(CHANGED)*

#### 3.4.7 Repeat Cystometry:

<sup>FN3,20</sup> The repetition of the urodynamic testing when abnormal bladder function, discrepancies between history and suspected urodynamic findings, technical errors and/or artifacts have been observed at immediate post-test analysis. *(CHANGED)*

#### 3.4.8 ICS Standard Urodynamic Test:

<sup>57</sup> Free uroflowmetry, postvoid residual, cystometry, and pressure-flow study are termed ICS standard urodynamic test (ICS-SUT).<sup>FN3,21</sup> *(CHANGED)*

### 3.5 Urethral function during filling cystometry (filling urethro-cystometry):

As filling urethro-cystometry is less well-explored in men than women, readers are referred to other reports for methodology.<sup>56,57,80</sup>

### 3.6 Urethral closure mechanism

#### 3.6.1 Normal urethral closure mechanism:

A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.

#### 3.6.2 Incompetent urethral closure mechanism:

Leakage of urine occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.

##### 3.6.2.1 Urodynamic stress incontinence (USI):

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

##### 3.6.2.2 Subtype: Intrinsic sphincter deficiency (ISD):

Very weakened urethral closure mechanism.

#### 3.6.3 Leak point pressures:

<sup>2,3,5,80,81,82</sup> There are two types of leak point pressure measurement. The pressure values at leakage should be measured at the moment of leakage.

##### 3.6.3.1 Detrusor leak point pressure (DLPP – unit: cm H<sub>2</sub>O):

This is a static test. The pressure is the lowest value of the detrusor pressure at which leakage is

observed during cystometry in the absence of increased abdominal pressure. DLPP is a reflection of the resistance of the bladder outlet or urethral sphincter. High DLPP (eg, over 40 cm H<sub>2</sub>O<sup>80</sup>) may put patients at risk for upper urinary tract deterioration, or secondary damage to the bladder in the cases of known underlying neurological disorders such as spinal cord injury or MS.<sup>81</sup> There are no data on any correlation between DLPP and upper tract damage in non-neurogenic patients. (*CHANGED*)

**3.6.3.2 Abdominal leak point pressure (ALPP – unit: cm H<sub>2</sub>O):** This is a dynamic test. It is the intentionally increased abdominal pressure that provokes urinary leakage in the absence of a detrusor contraction.<sup>82</sup> The patient can achieve this by coughing (CLPP) or straining (Valsalva Leak Point Pressure – VLPP). The VLPP allows measuring the lowest pressure (measured by the bladder or abdominal pressure) that causes urine leakage.

### 3.7 Pressure-Flow Studies<sup>2,3,5,56,57</sup> FN3.24

**3.7.1 Pressure-flow studies:** Pressure-volume (urinary flow) relationship of the bladder during voiding.<sup>1–3,5,56,57</sup> It begins when the “permission to void” is given by the urodynamicist and ends when the man considers his voiding has finished. Measurements to be recorded should be the intravesical ( $P_{ves}$ ) and abdominal ( $P_{abd}$ ) pressures and calculate the detrusor pressure ( $P_{det}$ ) as well as the urine flow rate. FN3.22 (*CHANGED*)

**3.7.2 Detrusor pressure and other measurements during pressure-flow studies** (Figure 6)<sup>2,3,5,56,57</sup>

**3.7.2.1 Detrusor opening pressure (unit: cm H<sub>2</sub>O):** Detrusor pressure recorded immediately before the commencement of urine flow. (*CHANGED*)

**3.7.2.2 Flow delay (unit: s):** The time elapsed from initial rise in pressure to the onset of flow. This is the initial isovolumetric contraction period of micturition. It reflects the time necessary for the fluid to pass from the point of pressure

measurement to the uroflow transducer. FN3.23 (*CHANGED*)

**3.7.2.3 Urethral opening pressure ( $P_{det,uo}$  – unit: cm H<sub>2</sub>O):** Detrusor pressure recorded at the onset of measured flow (consider time delay – usually under 1 s).

**3.7.2.4 Maximum detrusor pressure ( $P_{det,max}$  – unit: cm H<sub>2</sub>O):** Maximum registered detrusor pressure during voiding.

**3.7.2.5 Detrusor pressure at maximum flow ( $P_{det,Qmax}$  – unit: cm H<sub>2</sub>O):** Detrusor pressure recorded at maximum urine flow rate.

**3.7.2.6 Detrusor pressure at end of flow ( $P_{det,ef}$  – unit: cm H<sub>2</sub>O):** Detrusor pressure recorded at the end of urine flow.

**3.7.2.8 Postvoiding detrusor contraction:** An increase in detrusor pressure ( $P_{det}$ ) following the cessation of urinary flow (*NEW*)

### 3.7.3 Detrusor function during voiding<sup>2,3,5,56,57</sup>

**3.7.3.1 Normal detrusor contractile function:** Normal voiding in men is achieved by an adequate continuous detrusor contraction that leads to complete bladder emptying within a normal time span. It depends on central initiation and stimulation of the reflexes involved. The amplitude of the detrusor contraction (detrusor contraction strength/power) tends to increase in response to any increased urethral resistance until the bladder is empty.<sup>83</sup> (*CHANGED*)

**3.7.3.2 Detrusor underactivity (DU):** Low detrusor pressure or short detrusor contraction time, usually in combination with a low urine flow rate resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. (c.f. the term “hypocontractile detrusor” or detrusor hypocontractility describes a detrusor contraction of reduced strength). Detrusor underactivity can be of neurogenic<sup>13,84</sup> or non-neurogenic origin. (*CHANGED*)

**3.7.3.3 Acontractile detrusor:** The detrusor cannot be observed to contract (ie, no increase in  $P_{det}$ ) during urodynamic studies resulting in failure to void

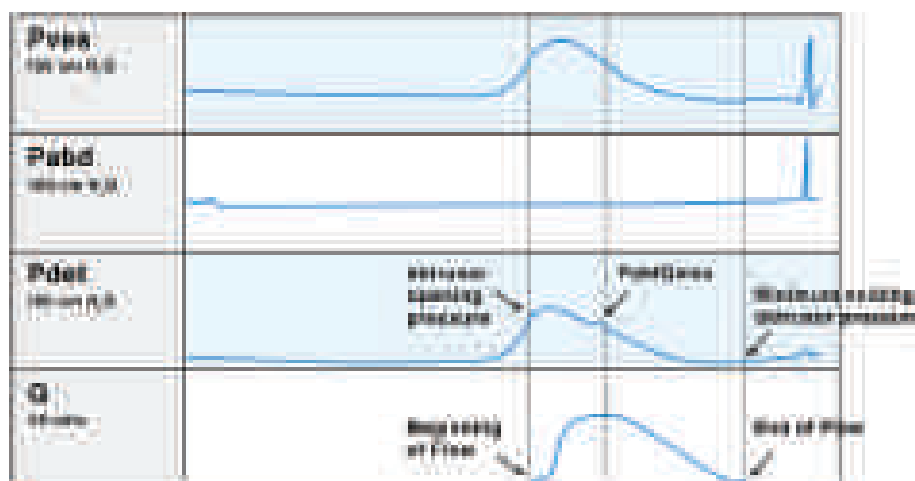


FIGURE 6 A schematic diagram of a pressure-flow study

(**CHANGED**). Limited voiding may occur by straining. The possibility of “inhibition” of a detrusor voiding contraction must be considered if the man subsequently voids normally post-cystometry. An acontractile detrusor can be of neurogenic or non-neurogenic origin. Neurogenic acontractile detrusor should replace the term “detrusor areflexia.”

**3.8 Urethral function during voiding:** This can be interpreted by the pressure-flow trace assisted at times by video cysto-urethrography (video-urodynamics – 4.3.4) and electromyography (EMG – 3.9) as available.

**3.8.1 Normal urethral function during voiding:**

Initiation of voiding begins with voluntary relaxation of the pelvic floor and striated sphincters (rhabdosphincter). The bladder then contracts with the bladder neck, the latter then opening due to its spiral arrangement of fibres. Voiding is prompted with the urethra being continuously relaxed to allow micturition at a normal detrusor pressure and urine flow, resulting in complete bladder emptying.<sup>85,86</sup>

FN3.24, FN3.25, FN3.26

**3.8.2 Abnormal urethral function during voiding:**

The urethral sphincter(s) do not relax completely or they are (temporarily) contracted during voiding, resulting in increased detrusor

pressure. Bladder emptying may be complete or incomplete (PVR present).

**3.8.2.1 Bladder outlet obstruction (BOO):**<sup>87,88</sup>

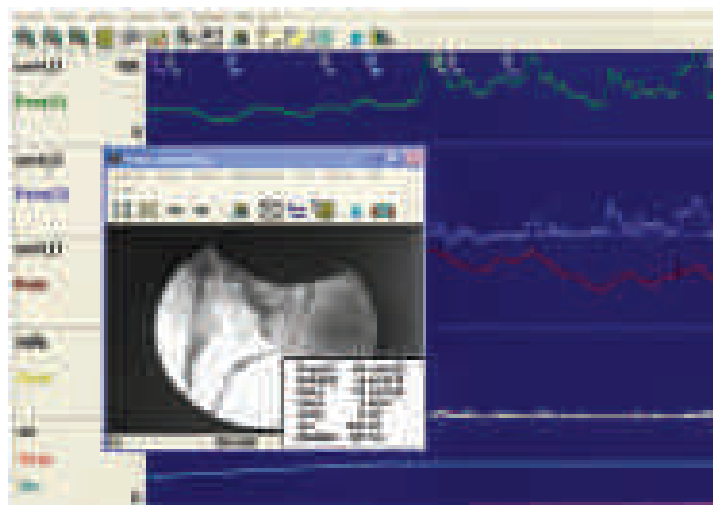
This is the generic term for obstruction during voiding. It is a reduced urine flow rate with a simultaneously increased detrusor pressure<sup>FN3.27</sup>. The Bladder Outlet Obstruction Index ( $BOOI = P_{det, Q_{max}} - 2Q_{max}$ ) will give a guide to the likelihood of obstruction being present.<sup>87</sup>

BOOI <20 cm H<sub>2</sub>O = non-obstruction;  
BOOI 20-40 cm H<sub>2</sub>O = equivocal;  
BOOI >40 cm H<sub>2</sub>O = obstruction)

(**CHANGED**)

**3.8.2.2 Dysfunctional voiding:** is characterized by an intermittent and/or fluctuating flow due to inadequate or variable relaxation generally of the sphincters during voiding in neurologically normal men (i.e. no historical, visible or measurable evidence of neurological disease). (**CHANGED**) Dysfunctional voiding may cause functional bladder outlet obstruction. This type of voiding may also be the result of an acontractile or underactive detrusor (voiding with abdominal straining). Video-urodynamics is required to diagnose primary bladder neck obstruction and/or rhabdosphincter discoordination.<sup>87</sup>

**3.8.2.3 Detrusor sphincter dyssynergia (DSD):**<sup>88</sup> Dyscoordination between



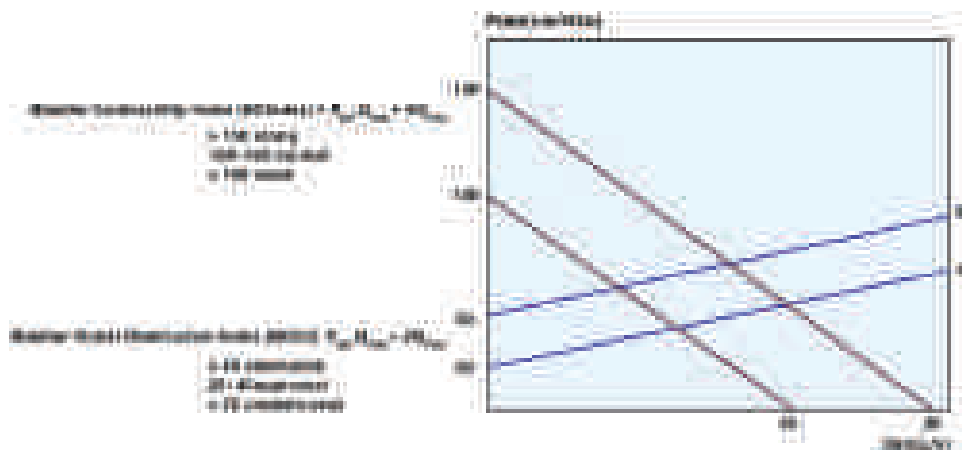
**FIGURE 7** Primary bladder neck obstruction in non-neurogenic patient: Urodynamic trace plus imaging

detrusor and rhabdosphincter function during voiding due to a neurological abnormality (ie, detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscle). This is a feature of neurological voiding disorders. Neurological features should be sought.<sup>88</sup> Video-urodynamics (4.3.4) is generally valuable to conclude this diagnosis. DSD generally occurs due to a lesion above the sacral level 3 but below pons. Sphincter EMG might be

helpful where facilities for video-urodynamics are unavailable.

**3.8.2.4 Primary Bladder Neck Obstruction (non-neurogenic):** During voiding, the bladder neck smooth muscle fails to adequately open. The detrusor pressure increases to try to overcome the resistance of the bladder neck and allow urine to flow (Figure 7).

**3.8.3 Pressure-Flow Analysis** Graphical presentation of the results or calculations based on the pressure-flow measurement (passive urethral

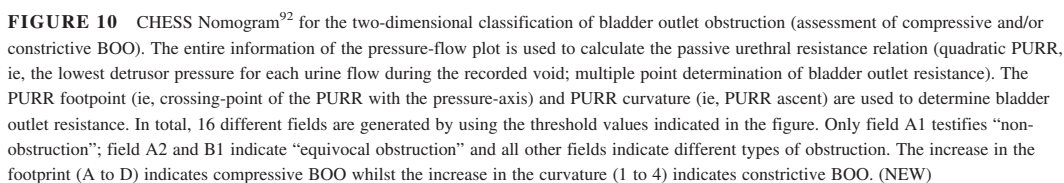


**FIGURE 8** ICS Nomogram<sup>89</sup>



### 3.8.3.1 ICS Nomogram<sup>89</sup>: Only $P_{\text{det}}$ at $Q_{\text{max}}$ is plotted into the nomogram (one point

determination of bladder outlet resistance). Depending on the position of this point on the nomogram, the patient can be categorised as “unobstructed,” “equivocal,” or “obstructed.” The calculation of BOOI is used to express bladder outlet resistance as a continuous variable. BOOI can be extracted from



the nomogram by drawing a line between  $P_{\text{det},Q_{\text{max}}}$  and the cutting point of the Y-axis (n.b. the line must be parallel to the lines drawn into the nomogram (ie, those for “unobstructed,” “equivocal,” or “obstructed”)).<sup>-FN3,28,FN3,29,FN3,30</sup> (NEW)

**3.8.3.2 Schäfer Nomogram**<sup>90,91</sup>:  $P_{\text{det},\text{muo}}$  (minimal urethral opening detrusor pressure) and  $P_{\text{det},Q_{\text{max}}}$  (detrusor pressure at maximum urine flow) together with corresponding urine flow rates are plotted into the nomogram (2-point determination of the bladder outlet resistance). The line between the two points represents the linearized passive urethral resistance relationship (linPURR) and the location of the linPURR in the nomogram indicates the amount of bladder outlet resistance of the patient. The nomogram differentiates 7 grades of bladder outlet resistance (grades 0 and I = no bladder outlet resistance); grades II to VI indicate increasing grades of BOO. The length (endpoint) of linPURR indicates detrusor contraction strength that can be very weak (VW), weak (W), normal (N), or strong (ST). (NEW)

### 3.9 Electromyography (EMG)

**3.9.1 Purpose:** Reflects the activity of the striated musculature (peri-urethral, rhabdosphincter and pelvic floor). EMG is poorly standardized with variance in the type of needle, needle versus patch electrode, and electrode placement.<sup>93</sup> Perineal patch electrodes are often preferred for easier placement, patient tolerance and allow greater mobility. However, they measure all the above striated musculature. In contrast, needle electrodes can be placed in the area of interest and measure activity of defined muscles or muscle groups for example, rhabdosphincter. (NEW)

**3.9.2 Interpretation:** May be difficult due to artifacts introduced by other equipment. In the urodynamic setting, an EMG is useful as a gross indication of the patient's ability to control the pelvic floor. (NEW)

**3.9.3 Detrusor-sphincter dyssynergia (DSD):** Simultaneous contraction of the detrusor and (rhabdosphincter) urethral sphincters with the

evidence of a neurological disorder (either visible or measurable neurological deficit or a history of neurological disease). The classification of DSD can be divided into two groups continuous versus intermittent. DSD type and degree of SCI lesions seem to correlate.<sup>93,94</sup>

(NEW)

**3.9.3.1 Type 1 DSD** occurs in patients with incomplete neurological lesions. Type 1 – there is a progressive increase in external urinary sphincter (EUS) contraction activity that peaks at maximal detrusor contraction followed by sudden relaxation of the EUS as the detrusor pressure declines allowing urination (Figure 12). (NEW)

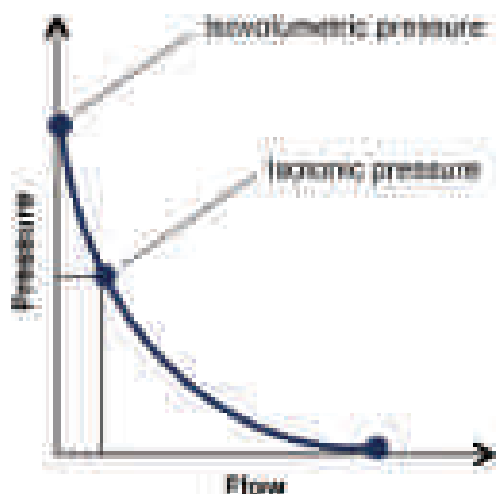
**3.9.3.2 Type 2 DSD** occurs more often in patients with complete lesions. Type 2 – occurs with continuous EUS contraction throughout the entire detrusor contraction resulting in urinary obstruction or inability to urinate.<sup>93,94</sup> (NEW)

**3.10 Ambulatory urodynamics:** A functional test of the lower urinary tract for which a transurethral catheter is placed in the bladder (and, in some protocols, another one in the rectum as is typical for a urodynamic study) performed outside the clinical setting, involving natural bladder filling by drinking and continuous recording of the bladder pressure ( $P_{\text{ves}}$ ) for a longer period of time (eg, 12 h). Ambulatory urodynamics can reproduce bladder function and urine loss during the individual's normal everyday activities. (CHANGED)

**3.11 Non-invasive urodynamics:** The penile cuff<sup>95</sup> and condom catheter<sup>96</sup> and urethral device<sup>97</sup> have been developed as non-invasive alternatives to pressure-flow studies. The principle of these tests is to interrupt the flow and measure the bladder pressure. The detrusor contraction is maintained and the urethral sphincter remains open; the column of fluid from the urethra to the bladder is sufficient to measure the bladder pressure (isovolumetric pressure). The external pressure on the urethra, which is needed to interrupt the flow, should be identical to the pressure in the bladder (ie, isovolumetric bladder pressure –  $P_{\text{ves, iso}}$ ). Therefore,  $P_{\text{ves, iso}}$  provides information on bladder pressure during voiding and, when urinary flow is also measured, it is able to distinguish between obstruction and non-obstruction (Figure 11). (NEW)

**3.12 Videourodynamics (Fluorourodynamics):** Functional test of the lower urinary tract in which filling





**FIGURE 11** Isometric and isotonic pressure are indirectly related to the condition of the muscles fibers (detrusor). The isometric contraction of the detrusor, that is contraction without length modification or without shortening of the muscle fibers. Isovolumetric pressure is established by the isometric contraction of the detrusor (no flow). Isotonic contraction is developing force with length modification and therefore, shortening the muscle fibers. In this case, the isotonic pressure is referring to the fact that it is being developed in the voiding phase

cystometry and pressure-flow studies (and possibly EMG) are combined with real-time imaging of the lower urinary tract (Figure 12). (see 4.3.3). (CHANGED)

**3.12.1 Bladder neck at rest:** Shut and competent on coughing and straining, possible exception post-prostatectomy.

**3.12.2 Bladder neck during voiding:** Bladder neck opens like a funnel.

**3.12.3 Bladder neck obstruction during voiding:** Bladder neck remains closed.

#### Footnotes for Section 3

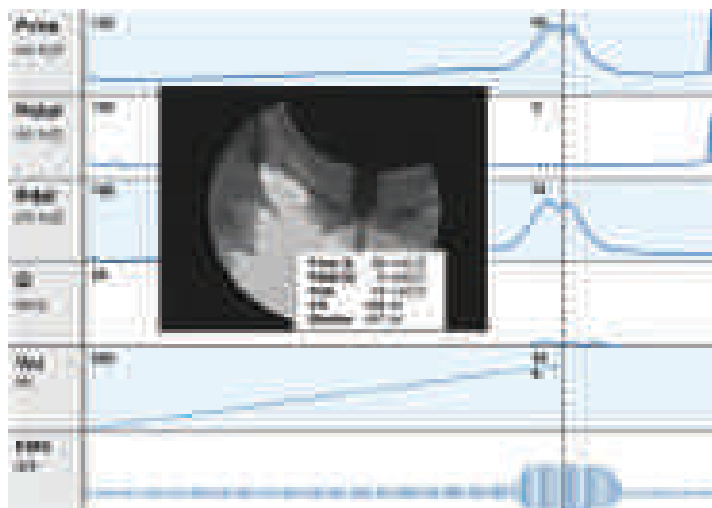
3.1: Urodynamics is the general term to describe all the measurements that assess the function or dysfunction of the LUT by the measurement of relevant physiological parameters.<sup>56,57</sup>

3.2: Urodynamic tests: Over the years, a variety of terms have been developed for the group of diagnostic tests that evaluate LUT function: uroflowmetry, post void residual (PVR), cystometry, pressure-flow studies, electromyography (EMG), urethral pressure profile (UPP), and videourodynamics (videocystourethrography – VCU) are the terms most frequently used in the scientific literature.<sup>56,57</sup>

3.3: Men with detrusor overactivity had the highest urine flow rates. Detrusor overactivity (previously “instability”) was present in 71% of men with centile rankings for the maximum urine flow rate over 50 mL/s.<sup>64</sup>

3.4: There is a notable difference between the available nomograms (Liverpool, Siroky, and Bristol), particularly between race and in older patients.<sup>60–63</sup>

3.5: These are figures for maximal diuresis in women in response to fluid loads of 500 mL and 1000 mL.



**FIGURE 12** Videourodynamics with EMG: During the voiding phase, high detrusor pressure, slow urine flow, increased electrical muscle activity and the image shows dilatation of the proximal urethra and narrowing of the membranous urethra (rhabdosphincter)

Equivalent male diuresis data is unavailable.<sup>65</sup> However, maximum diluting capacity of urine is generally regarded as 20 L/day which converts to 13.9 mL/min (exactly the same as female data<sup>65</sup>).

3.6: Not all catheters empty with similar efficacy. There is evidence in women that a less-compressible (silicone or plastic) catheter is much more effective than a more compressible (latex) catheter in draining the bladder.<sup>66</sup> Such evidence in men is unavailable.

3.7 Continuous fluid filling of the bladder via a transurethral (or other route, eg, cystostomy or Mitrofanoff) catheter, at least with intravesical and abdominal pressure measurement and display of detrusor pressure, including cough (stress) testing. Cystometry ends with "permission to void" or with incontinence of the total bladder content. The fluid type and temperature, filling method and rate, catheter sizes, pressure recording technique, and patient position should all be specified in the urodynamic protocol.

3.8: Body temperature fluid and room temperature fluid do not differently affect bladder sensory thresholds and do not unequally provoke detrusor overactivity or lower urinary tract irritation.<sup>71,72</sup>

3.9: Detrusor overactivity would have been missed in 76% of cases of cystometry was done in the supine position and 60% would have been missed if the study was done supine compared to seated<sup>71,73</sup>. The sitting or standing position is the most representative for daily life situations and is probably the least uncomfortable and/or embarrassing for the patient.<sup>73</sup>

3.10: Filling rate, especially when very fast and the volume infused is much larger than the functional bladder capacity, may influence the results or the representativeness of the cystometry. Evidence that filling rate should be changed during the cystometry is lacking. Diuresis, during cystometry, adds volume that is not recorded by the urodynamic system with automated filling volume recording, but that is relevant for interpretation of the results.

3.11: There is no specific evidence, but the position of the catheter-tip is usually above the bladder in a stoma, and bowel activity may much more likely cause artifacts in those cases, hampering measurement of absolute abdominal pressures, detrusor subtraction pressure, and therefore, the interpretation.

3.12: The urodynamic pressure is the excess pressure above atmosphere at the hydrostatic level of the upper edge of the symphysis pubis. This is valid for all pressures recorded with fluid-filled lines.

3.13: Values evaluated in healthy men<sup>75,76</sup> (mean  $\pm$  SD) are (i) First sensation of bladder filling: 222 mL  $\pm$  150 mL; (ii) First desire to void: 325  $\pm$  140 mL; (iii) Strong desire to void: 453  $\pm$  94 mL.

3.14: Maximum cystometric capacity that should be in healthy adult men, mean 552 mL (range 317-927 mL).<sup>76</sup>

3.15: Filling of more than 800 mL is seldom useful<sup>71</sup>.

3.16: Maximum bladder capacity under anaesthetic ("anatomical bladder capacity") – the volume to which the bladder can be filled under deep general or spinal anaesthetic, without urinary leakage, is rarely reported in scientific literature but may be of relevance in interstitial cystitis.<sup>71</sup>

3.17: "Normo-active detrusor" as several studies have demonstrated detrusor overactivity during filling in healthy individuals.

3.18: UTI is a very uncommon cause of DO. Most centres do not do urodynamic studies in the presence of an active infection because of the risk of septicæmia.

3.19: Normal values of bladder compliance in men have not been well-defined. Bladder compliance in the volunteers was higher than usually considered normal in adults during cystometric bladder filling.<sup>76</sup> In 28 healthy volunteers, men with mean age of 24 years (range 19-28), the mean compliance was 56.1 mL/cm H<sub>2</sub>O (SD 37.3). Since no precise figures exist for normal compliance in men, a prospective study of a large normal population is needed.

3.20: There is no convincing evidence that the clinical diagnosis on the basis of the first cystometry is often changed on repetition of the test. There is no definite evidence that immediate repetition of an adequately performed urodynamic test "for confirmation" is required. The recommendation of immediate repetition of the test: (i) when doubt exists as to whether the test has answered the clinical question; (ii) when technical errors and artifacts have been observed at immediate post-test analysis.

3.21: Cystometry and pressure-flow study, free uroflowmetry and PVR are termed ICS standard urodynamic test (ICS-SUT). This may be supplemented with other tests such as EMG, imaging, continuous urethral pressure(s), and/or urethral pressure profile measurements. All tests are performed in the patient's preferred or most usual position: comfortably seated and/or standing if possible.<sup>56,57</sup>

3.22: Voiding physiology depends on central neural activation, bladder contractility and coordinated urethral relaxation throughout the process. There remains much to learn about these components including central activation and its potential grading, and its role and interactions in detrusor underactivity and dysfunctional voiding.

3.23: It is usually between 0.5 to 0.8 s depending on the individual's position and the distance to the uroflowmeter.

3.24: The first "event" in voiding is relaxation of the pelvic floor. This may mean a drop in intra-abdominal

pressure in the rectal line, and an associated increase in the detrusor pressure which does not imply a detrusor contraction.

3.25: As any other muscular contraction, detrusor contraction has an isometric and an isotonic component. The isometric component means that detrusor fibers do not shorten and intravesical pressure rises. The isotonic component produces changes in fiber length; there is shortening and a flow ensues. The first is represented externally as  $P_{ves}$  or  $P_{det}$  and the second by flow. In voiding cystometry, in the presence of flow, detrusor pressure is a function of these two variables, governed by urethral resistance to flow.

3.26: Voluntary interruption of voiding: If the need to interrupt the flow were to arise, contraction of the pelvic floor and urethral sphincters can do this, resulting in an isometric detrusor pressure rise. Urine in the proximal urethra is milked back into the bladder.

3.27: In men with symptoms of lower urinary tract dysfunction, urine flow (rate) and PVR are important markers of bladder outlet obstruction, but are also dependent on the central initiation and continuation of the detrusor contraction and pressure. In the original definition, only pressure and urine flow were included.

3.28: Voiding cystometry graphic presentation: It has been recommended to present pressure-flow studies with a plot of the flow rate (mL/s) on the X-axis and the synchronous detrusor pressure (cm H<sub>2</sub>O) on the Y-axis in addition to the time-based graphs but the axis can be reversed. These plots can be added a cut-off value or a range of normality and equivocal zones. These cut-off values are population specific, varying widely among male patients.

The relation between detrusor pressure and generated synchronous flow indicate “*urethral resistance*.” With computing, these plots can be drawn since the beginning to the end of flow. *Urethral resistance* is then appreciated graphically throughout the whole emptying phase. Most of these resistance points are considered to be driven by urethral muscular activity. The point of less calculated resistance should be taken as an approximation to the urethral resistance free of active muscular urethral and peri-urethral contractions. This concept of “*passive urethral resistance relation*” is then taken as an “anatomical obstruction” caused by fixed structures as the prostate or strictures.

*Pressure-flow plots as a measure of detrusor voiding contraction.* “*Detrusor contractility*” can be used for any method that diagnoses or aims to diagnose “intrinsic” detrusor muscle properties (eg, potential [maximum] force or velocity), by any method.

In a given group of patients the *detrusor contractility* can be calculated upon series of stop-flow or interrupted-

voiding tests and mathematical or graphical analysis methods of pressure, flow and or other parameters. Cut-off values or a continuous scale of contractility can then be drawn. Independently of the magnitude of the detrusor contraction, it can be fading before the total emptying leading to incomplete voiding; “unsustained contraction” or “fading contraction” may then be used.

3.29: “ICS Nomogram”<sup>®</sup> formerly known as Abrams-Griffiths Nomogram and “Abrams-Griffiths number” (now BOOI) is more commonly used.

3.30: Catheter flow should be compared with free flow to ascertain whether dysfunctional voiding might only occur during urodynamics due to catheter placement.

## SECTION 4: IMAGING

**4.1 Overview:** Imaging has become increasingly important in the assessment of male lower urinary tract and pelvic floor dysfunction. Table 2 indicates possible imaging modalities by site and the main goals from kidney to pelvic floor. (NEW)

Application of the individual imaging technique is dependent on the suspected abnormality, ability of the imaging technique to visualize this abnormality and image resolution. In case of competing imaging techniques, non-radiological techniques should be preferred to avoid radiation exposure. (NEW)

### 4.2 Ultrasound Imaging

**4.2.1 Ultrasound in the assessment of the lower urinary tract:** As noted in Table 2, ultrasound imaging has become a relevant imaging modality in all sites that might be subject to investigation of male lower urinary tract and pelvic floor dysfunction both in the office and in the urodynamic suite. (NEW)

#### 4.2.2 Modalities in current routine clinical use:

**4.2.2.1 Transrectal:** Linear array or sector scanning per rectum. (NEW)

**4.2.2.2 Transabdominal:** Curved or linear arrays applied to the abdomen. (NEW)

**4.2.2.3 Perineal:** Curved or linear array probe applied to the perineum (transperineal). (NEW)

**4.2.2.4 Scrotal:** Linear array probe applied to scrotum looking at testes, epididymes and intrascrotal abnormalities. (NEW)

#### 4.2.3 Current routine uses of ultrasound in male LUT/PF dysfunction

**4.2.3.1 Post-void residual (PVR):** Transabdominal<sup>98,99</sup> or transrectal<sup>100</sup> (see section

**TABLE 2** Imaging modalities by site and goal

Location	Imaging technique	Purpose
Upper Urinary Tract	<ul style="list-style-type: none"> <li>Renal ultrasound</li> <li>IVU with X-ray or CT</li> <li>IVU with MRI</li> </ul>	detects the presence and degree of hydronephrosis, urothelial carcinoma/tumors, stones, other renal or ureteric abnormalities/ diseases.
Bladder	<ul style="list-style-type: none"> <li>Ultrasound bladder scanner</li> <li>Transabdominal ultrasound</li> <li>Transrectal ultrasound</li> <li>CT</li> <li>MRI</li> </ul>	measurement of post-void residual (PVR), detrusor or bladder wall thickness, intravesical prostatic protrusion (IPP) or bladder weight (to help judge BOO) or calcification. Evaluate the presence of other diagnoses such as neoplasm, stones or foreign bodies.
Prostate	<ul style="list-style-type: none"> <li>Transrectal ultrasound (3D, contrast-enhanced, Doppler)</li> <li>Transabdominal ultrasound</li> <li>MRI (T2-weighted, multiparametric, prostate segmentation, functional MRI).</li> </ul>	evaluate prostate volume, prostate anatomy, BOO. MRI: Evaluation for prostate cancer
Scrotum	<ul style="list-style-type: none"> <li>Scrotal ultrasound</li> </ul>	Testis, epididymis, tunica vaginalis
Urethra	<ul style="list-style-type: none"> <li>X-Ray (retrograde or antegrade urethrography)</li> <li>MRI</li> <li>Ultrasound</li> </ul>	evaluate congenital abnormalities, fistula, diverticula, (post-surgical) stricture, neoplasm
Ano-rectum	<ul style="list-style-type: none"> <li>Endoanal ultrasound (10-13-16 Hz axial and sagittal array)</li> <li>Defecography</li> <li>MRI</li> </ul>	Anal sphincter integrity; peri-anal sepsis, pelvic floor coordination during defecation
Penis	<ul style="list-style-type: none"> <li>Ultrasound</li> <li>CT</li> <li>MRI</li> </ul>	Peyronie's disease, corpora cavernosa rupture.
Lower urinary tract	<ul style="list-style-type: none"> <li>Video-cystourethrography</li> <li>Video-urodynamic</li> </ul>	Evaluate of the bladder during filling and/or voiding, vesico-ureteric reflux; bladder morphology – trabeculation, diverticulum; anatomical site; BOO; type of stress incontinence; urethral diverticulum; strictures, fistulae

**3.2.2)** ultrasound measurement of the bladder volume. The following formula shows the lowest transabdominal measurement error when compared with catheterization.<sup>99</sup> PVR calculation (by abdominal ultrasound) is done by multiplying the width (left to right borders), depth (anterior to posterior borders) and length (cranial to caudal borders) and multiplying this result with 0.52 (there are different multiplication factors available but 0.52 is the most common one) (Figure 13). *(NEW)*

$$\text{Volume} = (\text{width} \times \text{depth} \times \text{length}[\text{cm}]) \times 0.52[\text{mL}]$$

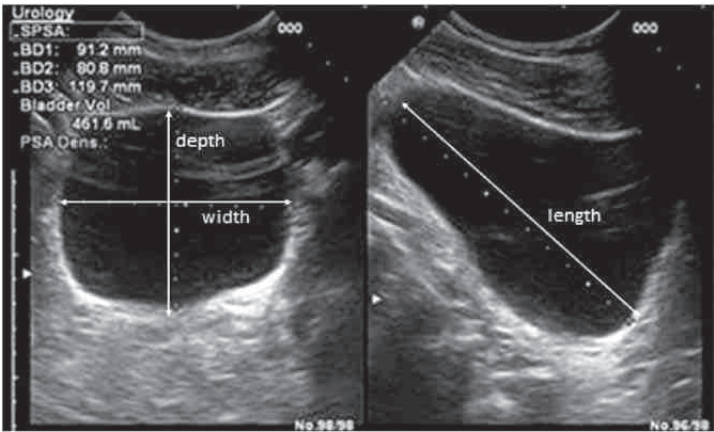
**4.2.3.2 Intercurrent abnormalities:** For example, prostate volume (transabdomi-

nal, intraabdominal, retroperitoneal, or intrapelvic tumor, hydronephrosis). *(NEW)*

**4.2.3.3 Bladder abnormalities:** For example, tumor, foreign body, overdistension, stones. *(NEW)*

**4.2.3.4 Detrusor wall thickness (DWT) or bladder wall thickness (BWT):** Transabdominal visualization of the anterior bladder wall with a (linear) high frequency ultrasound scanner for the detection of BOO if DWT is  $\geq 2$  mm in bladders filled with  $\geq 250$  mL (Figure 14) or BWT is  $\geq 5$  mm in bladders filled with 150 mL (Figure 14).<sup>101–105</sup> *(NEW)*

**4.2.3.5 Ultrasound-estimated bladder weight (UEBW):** can be calculated



**FIGURE 13** Determination of bladder (post-void residual) volume by transabdominal ultrasound imaging

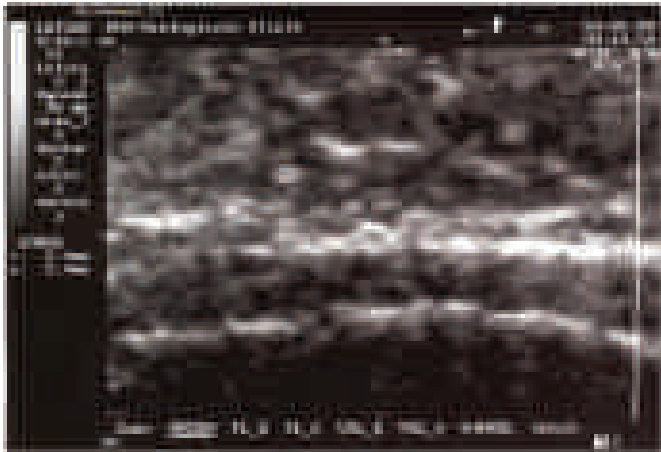
by measuring the urine volume in the bladder and BWT and applying the following formula (Figure 15).<sup>106,107</sup> (NEW)

**4.2.3.6 Intravesical Prostatic Protrusion (IPP):** Transabdominal measurement of the distance of the bladder base until the tip of the prostate in the bladder lumen<sup>108</sup> (Figure 16A and B). It is recommended to fill the bladder with 100-200 mL of fluid in order to receive representative measurements; bladder

filling over 400 mL will lower IPP values.<sup>108</sup> The IPP measurement can be divided into three grades: grade I = 0-4.9 mm; grade II = 5-10 mm; grade III = >10 mm.<sup>109</sup> IPP grade III is associated with prostate-related BOO.

**4.2.3.7 Urethral abnormality:** For example, diverticulum, urethral stenosis, degree, and depth of spongiofibrosis. (NEW)

**4.2.3.8 Postoperative findings:** For example, post-prostatectomy (urethral shape), male sling position, artificial urinary



**FIGURE 14** Ultrasound measurement of detrusor wall thickness (DWT) at the anterior bladder wall with a linear 7.5 MHz ultrasound array in a bladder filled >250 mL; the hypoechogenic detrusor (black bar) is sandwiched between the hyperechogenic (white) mucosa (bottom) and adventitia (top).<sup>101,102</sup> DWT is measured from the inner border of the mucosa to the inner border of the adventitia as demonstrated in the figure, whereas BWT is measured from the outer border of the mucosa to the outer border of the adventitia



**FIGURE 15** UEBW<sup>106,107</sup> FN 4.1. IV = inner volume; ID = inner radius; OD = outer radius; T = (bladder wall) thickness; TV = total volume. Note again, "D" refers to "radius" not "diameter". Volume of bladder wall itself should be 4/3pi times (Rt3-Rid3)

sphincter –placement of cuff and reservoir, bulking agents. (NEW)

**4.2.3.9 Prostate ultrasound:** determination of prostate and transition zone volume, prostate shape and visualization of the prostate parenchyma for calcifications, cysts, abscesses, or enlargement (Figure 17). (NEW)

**4.2.4 Pelvic floor:** For example, anal sphincter defects (see below)

**4.2.5 3D and 4D Ultrasound:** research modalities at present FN 4.2

**4.2.6 Other assessments:** Synchronous ultrasound screening of the bladder and/or urethra and measurement of the bladder and abdominal pressure during filling cystometry and pressure flow study (Video-ultrasound-urodynamics). (NEW)

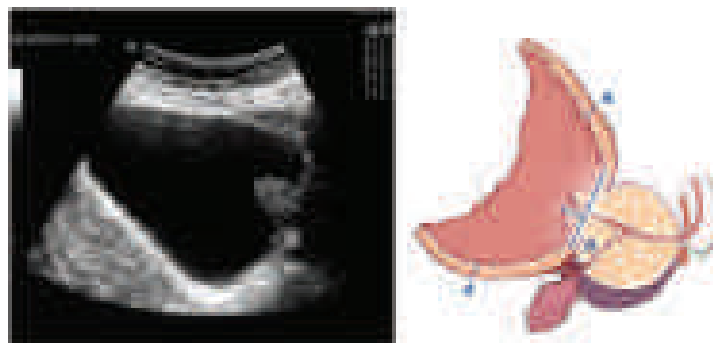
#### 4.2.7 Anal ultrasound (Endosonography<sup>110,111</sup>):

This is the gold standard investigation in the assessment of anal sphincter integrity. There is a high incidence of defecatory symptoms in men with anal sphincter defects (Figure 18). (NEW)

##### 4.2.7.1 Endoanal ultrasonography (EAUS)

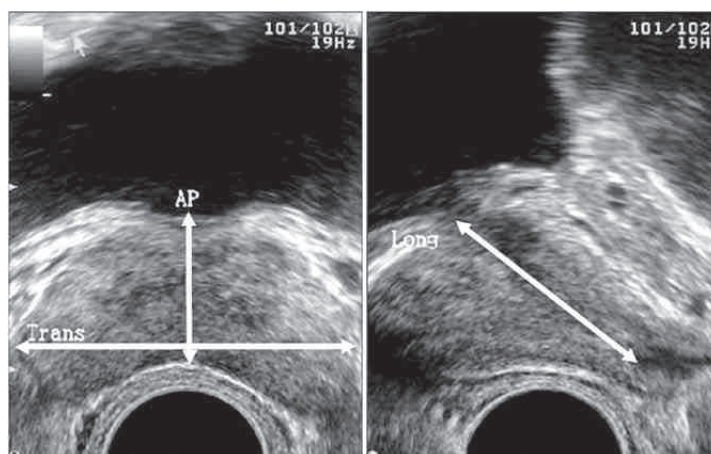
##### or Anal Endosonography (AES):

Ultrasound of the anal canal performed with a pole-like ultrasound probe placed in the anal canal giving a 360 degree image of the anal canal. It is usually performed with the patient placed in the lithotomy, prone position or sometime left lateral. Two dimensional AES; three dimensional AES – three-dimensional reconstruction of the anal canal is performed using either axial or sagittal images. (NEW)



**FIGURE 16** A: Transabdominal ultrasound measurement of intravesical prostatic protrusion (IPP). B: How to measure IPP – base of bladder (line A) to the most cranial part of the prostate (line B)





**FIGURE 17** Prostatic volume by transrectal ultrasound

**4.2.7.2 Anal Canal** – The anal canal in adults is between 2.5 and 5 cm in length and begins as the rectum narrows, passing posteriorly between the levator ani. Three levels of assessment in the axial plane.<sup>111</sup> (NEW)

**4.2.7.2.1 Upper level:** the hyper-echoic sling of the puborectalis muscle (PR) and the complete ring of the internal anal sphincter (IAS). (NEW)

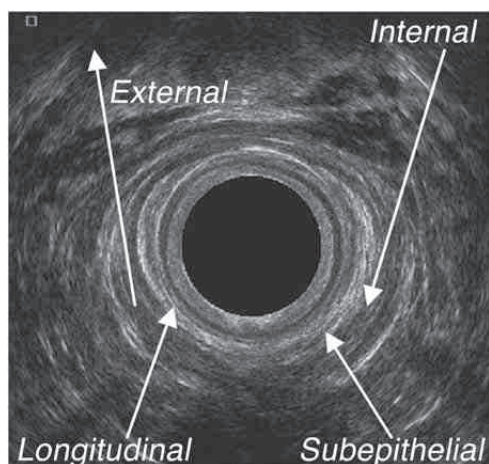
**4.2.7.2.2 Middle level:** corresponds to the superficial part of the EAS (concentric band of mixed echogenicity), the conjoined longitudinal layer, the IAS (concentric hypo-echoic ring), and the transverse superficial perineal muscles. (NEW)

**4.2.7.2.3 Lower level:** corresponds to the subcutaneous part of the EAS where the IAS is absent. (NEW)

**4.2.7.3 Internal anal sphincter** – The caudal continuation of the circular smooth muscle of the rectum forms the internal anal sphincter, which terminates caudally in a clearly defined edge, at a variable distance from the anal verge. (NEW)

**4.2.7.4 Longitudinal muscle** – Comprises smooth muscle cells continuous with the outer layer of the rectal wall, and striated muscle from various pelvic floor muscles. The longitudinal muscle lies between the internal and external anal sphincters in the inter-sphincteric space. (NEW)

**4.2.7.5 External anal Sphincter** – It is made up of striated muscle and surrounds the longitudinal muscle forming the outer border of the inter-sphincteric space. The external sphincter is divided into



**FIGURE 18** Normal anal canal anatomy as seen on anal endosonography (AES)

deep, superficial and subcutaneous parts, with the deep and subcutaneous parts of the sphincter forming rings of muscle, between them elliptical fibres from the superficial part of the external anal sphincter run anteriorly from the perineal body to the coccyx posteriorly. (NEW)

- 4.2.7.6 Puborectalis** – is formed from the most anterior fibres of the pubococcygeus muscle, this forms a sling pulling the rectum forward. (NEW)

### 4.3 Radiography

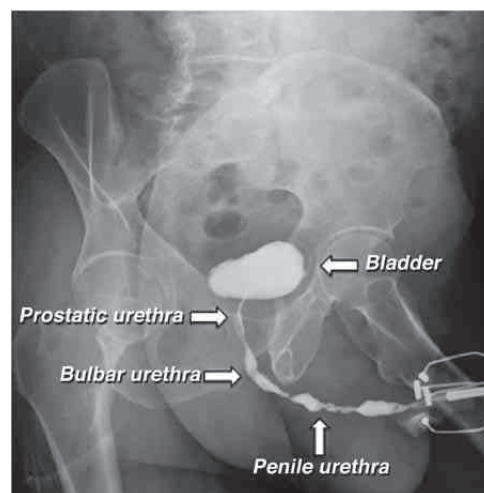
#### 4.3.1 Modalities in current routine clinical use

- 4.3.1.1 Intravenous urography (IVU):** This provides an anatomical outline of the upper urinary tract, ureters and bladder as well as the evaluation of the kidney function and excretion of contrast media. IVU consists of at least 3–4 abdominal images: one plain x-ray, one almost immediately after injection to evaluate for renal vascular uptake, one image 7 min and one image 15 min after infusion of contrast media (and bladder emptying). The preliminary plain x-ray may show calcification in kidney, ureter, bladder, seminal vesicles or vasa. (NEW)

- 4.3.1.2 Retrograde urethrocytography and voiding cystourethrography:** Unidirectional or combined contrast imaging of the urethra in a patient in the 30 degree oblique position to visualize the lumen, mainly to diagnose urethral strictures or diverticula (Figure 19). It is also of use to diagnose and stage urethral trauma. (NEW)

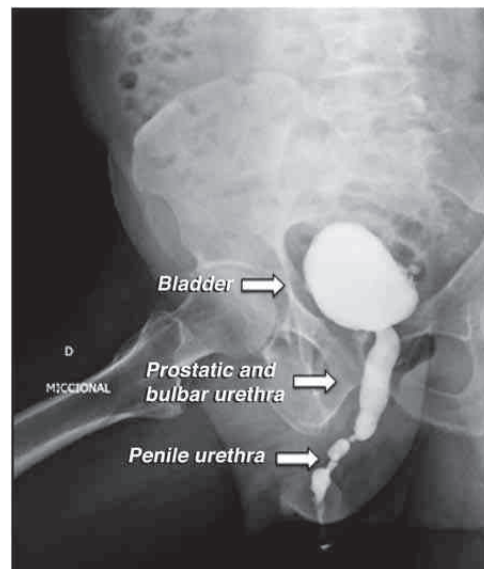
- 4.3.1.3 Voiding cystourethrography:** imaging of the bladder neck, urethra and prostate during voiding (Figure 20). The principal use is determining the site of any obstruction, for example, bladder neck or prostate. It can detect vesico-ureteric reflux, vesical or urethral fistulae, vesical or urethral diverticula and strictures. (NEW)

- 4.3.1.3.1 Videocystourethrography (VCU):** Synchronous radio-



**FIGURE 19** Retrograde urethrocytography of a patient with a penile urethral stricture

logical screening of the bladder and urethra during filling and voiding (Figure 21). The only difference between



**FIGURE 20** Voiding cystourethrography: Shows bladder diverticula, open bladder neck and prostatic urethra till stricture of penile urethra

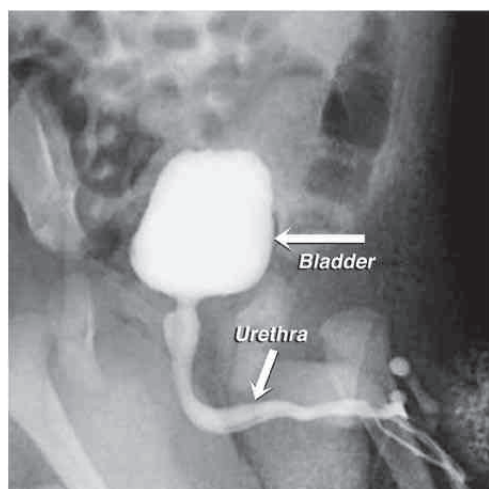


FIGURE 21 Example of Videocystourethrography

VCU and 4.3.1.3. is continuous image capture. (NEW)

**4.3.4 Videourodynamics<sup>112</sup>:** Videourodynamics refers to videocystourethrography with synchronous pressure and flow rate recordings. It is a dynamic study with function, during bladder filling and emptying. (NEW) See also Figure 12.

Video-urodynamics has two defining characteristics:

- It is a kinetic technique that records morphological and functional changes of the lower urinary tract as a function of time. This feature distinguishes this technique from the static images obtained by cystography.
- It is a technique that is applied simultaneously with conventional urodynamic studies.

Image acquisition for the urinary tract can be performed with X-rays (fluoroscopy) or by ultrasound. Although in a strict sense, the “video” prefix refers to the recording of the images and not to their acquisition.

**4.3.5 Defecography (Evacuation proctography):** This demonstrates the anatomy of the anorectum as well as disorders of rectal evacuation. Barium

paste is inserted rectally prior to defecation over a translucent commode. (NEW)

#### 4.4 Computerized Tomography (CT)

**4.4.1 CT Urogram (CT-U):** CT study of the urinary tract system using injected contrast, used to clarify diagnoses such as (i) tumors; (ii) renal disease; (iii) abnormal fluid collections/abscesses (iv) bladder diseases. (NEW)

**4.4.2 CT Kidneys, ureter, bladder (CT-KUB):** Non-contrast study aimed primarily at identifying stones but may identify other diseases. Aka “stone protocol.” (NEW)

#### 4.5 Magnetic Resonance Imaging<sup>113</sup>

**4.5.1 Magnetic resonance imaging (MRI) in male lower urinary tract and pelvic floor dysfunction:** MRI provides the opportunity to examine the soft tissue structures of the pelvic support apparatus. It is non-invasive, has excellent soft tissue contrast resolution without exposure to ionizing radiation and allows the study of function of pelvic floor structures under different dynamic conditions. Several anatomical landmarks used for pelvic measurements are also easily identified in MRI and most measurements are thus highly reproducible. T-weighting assists enhancement of fluid-filled structures. (NEW)

**4.5.2 Current possible measurements using MRI in male lower urinary tract and pelvic floor dysfunction.** FN4.2

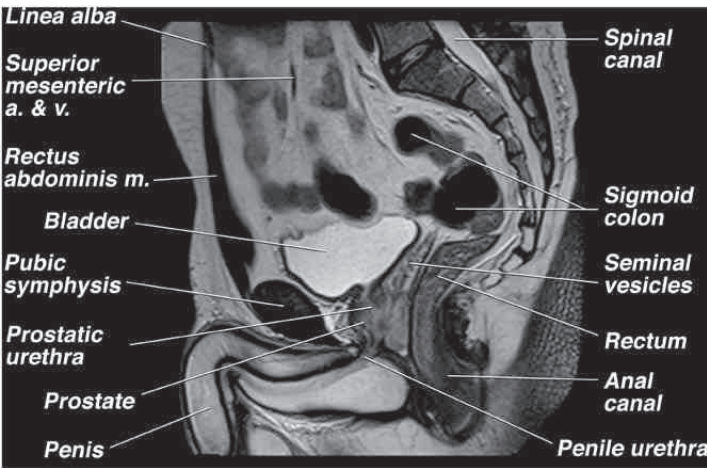
**4.5.2.1 Bladder abnormalities:** For example, tumor, foreign body, bladder wall abnormalities, intestine-vesical fistulae. (NEW)

**4.5.2.2 Urethral abnormality:** For example, diverticulum, recto-urethral fistulae. (NEW)

**4.5.2.3 Urethral sphincter length:**<sup>114</sup> prediction of post-prostatectomy incontinence. (NEW)

**4.5.2.4 Prostate abnormalities:** For example, benign enlargement, cancer, cysts, prostatorectal fistulae. (NEW)

**4.5.2.5 Intercurrent abnormalities:** For example, rectum – rectal dynamics are assessed during evacuation after adding ultrasound gel to the rectum. Anorectal and pelvic floor motion can be imaged



**FIGURE 22** MRI (sagittal) of male lower abdomen and pelvis

providing pelvic images at rest and when the subject strains. (NEW)

**4.5.2.6 Congenital abnormalities:** Detection of Mullerian duct remnants, aberrantly inserted ureters and duplicated pelvic structures. (NEW)

**4.5.2.7 Standardised MRI prostate imaging:** PI-RADS – prostate imaging reporting and data system (Figures 22–24).FN4,4, FN4,5 (NEW)

**Footnotes for Section 4**

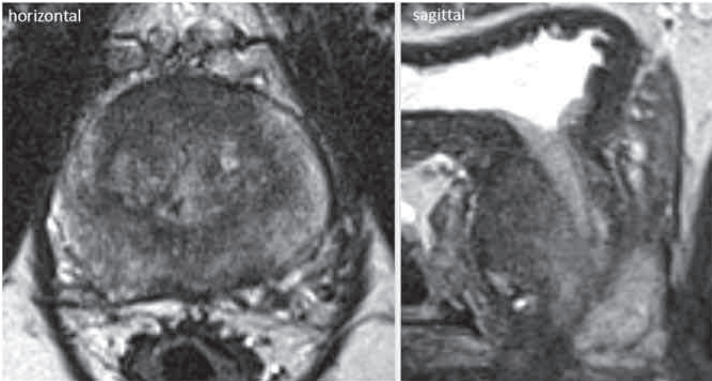
4.1: The “cut-off” value for obstruction has been suggested as 35 g (adult Asian men).<sup>106</sup>

4.2: The potential of 3D and 4D ultrasound in male lower urinary tract and pelvic floor dysfunction is

currently being researched with validated applications likely to be included in future updates of this Report and/or separate ultrasound reports.

4.3: Diagnostic ability may be enhanced by the use of 3D MRI. New techniques with high speed sequence of pictures allows for a functional MRI.

4.4: Prostate imaging has over the last 5 years become more standardised with the introduction of PI-RADS (Prostate Imaging Reporting and Data System), currently version 2. The recommended MRI prostate protocol consists of multiparametric study which consists at least of a diffusion sequence (DWI), high resolution anatomical sequences (T2 weighted) and dynamic contrast enhanced sequences (perfusion imaging). A score is given according to each sequence finding and an overall PI-RADS score is finally given based on a structured



**FIGURE 23** MRI of prostate showing low grade inflammatory changes in the peripheral zone



**FIGURE 24** MRI of prostate showing prostate cancer in the right posterolateral peripheral zone

reporting scheme. A score of 1–5 is given with one being benign and five being highly suspicious of malignancy. Ideally the MR studies are performed on a three Tesla strength MR scanner negating the need for an endorectal coil to achieve adequate resolution. MR spectroscopy imaging on the prostate is now rarely performed as it rarely adds value to the above multiparametric study.

## SECTION 5: DIAGNOSES (MOST COMMON)

This report, like previous ones,<sup>2,3,5</sup> highlights the need to base diagnoses for male lower urinary tract and pelvic floor dysfunction on the correlation between a man's symptoms, signs and any relevant diagnostic investigations. We include EMG and imaging as possible diagnostic investigations. The diagnoses are categorized according to three subgroups that reflect the function of the lower urinary tract, namely storage, voiding dysfunction and mixed storage and voiding dysfunction. *It should be noted that prevalence data for the relative frequency of the different male diagnoses are scarce.* <sup>FNS.1</sup> *More studies are required.* (NEW)

**STORAGE DYSFUNCTION (SD)** <sup>FNS.1</sup> Those diagnoses related to abnormal changes in bladder sensation, detrusor pressure or bladder capacity during filling cystometry. (NEW)

### 5.1 Bladder Factor

#### 5.1.1 Bladder Oversensitivity (BO)<sup>5</sup> <sup>FN5.2 FN 5.3</sup> (NEW – Male)

**5.1.1.1 Definition:** Bladder oversensitivity, a clinical diagnosis made by *symptoms and urodynamic investigations*, most likely to occur in individuals with symptoms of increased daytime frequency and nocturia. A frequency-volume chart shows a clearly reduced average voided volume (by day and night). As noted in section (3.4.3.6), it can be defined as: increased perceived bladder sensation during bladder filling with specific cystometric findings of: (i) early first desire to void (3.4.3.2); (ii) early strong desire to void, which occurs at low bladder volume (3.4.3.4); (iii) low maximum cystometric bladder capacity (3.4.4.2); and (iv) no abnormal increases in detrusor pressure. Specific bladder volumes at which these findings occur vary in different populations. <sup>FNS.3</sup>

#### 5.1.2 Detrusor Overactivity (DO) <sup>FN 5.1 FN5.4 FN5.5</sup>

<sup>FNS.6</sup>

**5.1.2.1 Definition:** As noted in section 3.4.5.2, this diagnosis by *symptoms and urodynamic investigations* is made in individuals with lower urinary tract symptoms (more commonly OAB symptoms – section 1.1.7) when detrusor muscle contractions occur during filling cystometry. (CHANGED)

#### 5.1.2.2 Subtypes

- (i) **Idiopathic (primary) detrusor overactivity:** As noted in 3.4.5.2.1, no identifiable cause for the involuntary detrusor contraction(s). (CHANGED)
- (ii) **Neurogenic (secondary) detrusor overactivity:**<sup>3,5,13</sup> As noted in 3.4.5.2.2, there is detrusor overactivity and evidence (history; visible or measurable deficit) of a relevant neurological disorder. (CHANGED)
- (iii) **Non-neurogenic (secondary) detrusor overactivity:** As noted in 3.4.5.2.3, an identifiable possible non-neurological cause exists for involuntary detrusor contraction (s) during bladder filling. For example, functional (obstruction); stone, tumor (eg, carcinoma in situ), UTI. (CHANGED)



**5.1.3 Reduced compliance storage dysfunction (RCSD):** this diagnosis by *symptoms and urodynamic investigations* is made in individuals with lower urinary tract symptoms, more commonly storage symptoms, when there is a non-phasic (at times linear or exponential) rise in detrusor pressure during filling cystometry with generally reduced capacity indicating reduced compliance (section 3.4.6). (NEW)

**5.1.3.1 Reduced compliance (RCSD) incontinence:** urinary incontinence directly related to the RCSD. (NEW)

**5.2 Outlet Factor** (Urethra/Sphincter Dysfunction – decreased urethral resistance – incompetence /insufficiency)

**5.2.1 Urodynamic Stress Incontinence (USI)** FN5.7

**5.2.1.1 Definition:** As noted in section (3.6.2.1), this clinical diagnosis by *symptom, sign and urodynamic investigations* involves the finding of involuntary leakage during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor muscle contraction.

FN5.7–FN5.10

**5.2.1.2 Subtype: Intrinsic sphincter deficiency (ISD** (See 3.6.2.1.1): Very weakened urethral closure mechanism. (CHANGED)

**VOIDING DYSFUNCTION (VD)** Those diagnoses related to abnormally slow and/or incomplete bladder emptying manifest as an abnormally slow urine flow rate (3.1.10) and/or an abnormally high post-void residual (3.2.2), with confirmation by pressure-flow studies (including any related imaging). (NEW – Male)

**5.3 Bladder factor – (poor or absent detrusor activity)**

**5.3.1 Detrusor Underactivity (DUA)** FN5.11

**5.3.1.1 Definition of DU:** As per 3.7.3.2 A diagnosis based on *urodynamic investigations* generally (but not always) with relevant *symptoms, signs* manifest by low detrusor pressure or short detrusor contraction in combination with a low urine flow rate (3.1.10) resulting in prolonged blad-

der emptying and/or a failure to achieve complete bladder emptying within a normal time span, with or without a high postvoid residual (3.2.2) (c.f. “hypocontractile detrusor” – detrusor contraction of reduced strength) (CHANGED)

**5.3.2 Detrusor Acontractility (DAC)** FN5.11

**5.3.2.1 Definition of DAC:** As per 3.7.3.3. a diagnosis by *urodynamic investigation*, generally (but not always) with relevant *symptoms, signs* manifest by the absence of an observed detrusor contraction during voiding studies resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. Voiding in men with DAC is usually achieved by straining or manual pressure on the bladder resulting generally in an abnormally slow urine flow rate (3.1.10) and/or an abnormally high postvoid residual (3.2.2) (CHANGED)

**5.3.2.2 Subtypes:**

- Neurogenic detrusor acontractility (See 3.7.3.3.1)
- Non-neurogenic detrusor acontractility (See 3.7.3.3.2)

**5.4 Outlet Factor (Urethral/Sphincter dysfunction)**

**5.4.1 Bladder Outlet Obstruction (BOO)** FN 5.1 FN5.12

**5.4.1.1 Definition of BOO:** A diagnosis based on *urodynamic investigations (pressure-flow studies ± imaging)*, generally (but not always) with relevant *symptoms* and/or *signs*, manifest by an abnormally slow urine flow rate (3.1.10) FN5.12 with evidence of abnormally high detrusor voiding pressures and abnormally slow urine flow (3.8.2.1) during voiding cystometry with or without an abnormally high PVR. (3.2.2). FN5.13 (CHANGED)

**5.4.1.2 Possible sites/causes of BOO:** Can be:

**5.4.1.2.1 Functional**

bladder neck obstruction, detrusor sphincter dysfunctions, pelvic floor overactivity. (NEW)

**5.4.1.2.2 Mechanical:** benign prostatic enlargement, urethral stricture, meatal stenosis). FN5.14–FN5.19



Imaging of the lower urinary tract especially video-urodynamics and EMG can be required to evaluate location/cause. *(NEW)*

#### 5.4.2 Alternate presentations of Voiding Dysfunction

**5.4.2.1 Acute retention of urine:** An individual is unable pass any urine despite having a full bladder, which on examination is painfully distended, and readily palpable and/or percussible. *(CHANGED)*

**5.4.2.2 Chronic retention of urine:** Generally (but not always) painless and palpable or percussible bladder, where there is a chronic high PVR. The patient experiences slow flow and chronic incomplete bladder emptying but can be asymptomatic. Overflow incontinence can occur. Some men with retention present with impaired renal function and/or hydronephrosis. *(CHANGED)*

**5.4.2.3 Acute on chronic retention:** An individual with chronic retention goes into acute retention and is unable to void. *(NEW)*

**5.4.2.4 Retention with overflow:** Involuntary loss of urine directly related to an excessively full bladder in retention. *(NEW)*

### 5.5 MIXED STORAGE AND VOIDING DYSFUNCTION

#### 5.5.1 Bladder Outlet Obstruction and Detrusor Underactivity (BOO-DU)

**5.5.1.1 Definition:** Urodynamic BOO (3.8.2.1) occurring synchronous with urodynamic DU (3.7.3.2) in pressure-flow analyses. FN5.20 *(NEW)*

#### 5.5.2 Detrusor Overactivity and Bladder Outlet Obstruction (DO-BOO)<sub>FN5.1</sub>

**5.5.2.1 Definition:** Urodynamic DO (3.4.5.2) on filling cystometry in the presence of BOO (3.8.2.1) on pressure-flow studies. FN5.21 *(NEW)*

#### 5.5.3 Detrusor Overactivity with Detrusor Underactivity (DO-DU)

**5.5.3.1 Definition:** Urodynamic DO (3.4.5.2) on filling cystometry) in combination with urodynamic DU (3.7.3.2) on pressure-flow studies. This diagnosis is intended to supersede the old expression “detrusor hyperactivity with impaired contractility” (DHIC) and detrusor overactivity with impaired contractility (DOIC). It is most common in the elderly group. *(NEW)*

### Footnotes for Section 5

5.1: Large series data on the relative frequency of diagnoses in men presenting with symptoms of LUT/PF dysfunction are scarce. The relative prevalence of six main diagnoses is known in women.<sup>4,5</sup> In a series of 504 consecutive men<sup>64</sup> aged 49-94 years, referred for urodynamic studies including videocystourethrography (VCU) and department review of results because of urological symptoms. The following diagnoses were made:

Detrusor overactivity (DO) 149 (29.6%)

DO plus obstruction (BOO) 124 (24.6%)

**i.e. Total DO (54.2%)**

Obstruction (BOO) alone 161 (31.9%)

**i.e. Total Obstruction (56.5%)**

Normal/ No Specific Dx 70 (13.9%) Some more recent diagnoses may not have been present in 1990.

5.2: Prevalence of Bladder Oversensitivity (BOS): In the EPIC study,<sup>115</sup> the prevalence rate for men who void with frequencies of greater than eight times per day is approximately 12%. The presence of bladder oversensitivity in urogynaecology patients is 10-13%.<sup>5</sup>

5.3: There should be no known or suspected urinary tract infection. Bladder oversensitivity is often a diagnosis after other more serious conditions such as lower urinary tract malignancy, including carcinoma-in-situ of the bladder, are excluded.

5.4: Prevalence of overall urinary incontinence in men by age:<sup>116</sup> 19-44 (4.8%); 45-64 (11.2%); 65-79 (21.1%); >80 (32.2%)

5.5: Prevalence of urgency (urinary) incontinence in men by age<sup>117</sup>: 19-44 (3.1%); 45-64 (7.8%); 65-79 (11.7%); >80 (18.1%)

5.6: Abnormal detrusor contractions can be, at times, observed during filling cystometry without the patient being symptomatic.

5.7: Prevalence of urodynamic stress incontinence (USI): Prevalence of stress (urinary) incontinence in men by age:<sup>115</sup> 19-44 (0.7%); 45-64 (3.8%); 65-79 (2.7%); >80 (N/A) or overall for men over 18 years<sup>117</sup> (1.4%).

5.8: Men, unlike women, do not develop significant urethral hypermobility (with radical prostatectomy a possible exception), and hence urodynamic stress incontinence is most often associated with intrinsic sphincter deficiency, rather than urethral hypermobility. Sphincter deficiency is most commonly a result of either pelvic trauma or post-prostatectomy, either transurethral or radical, or neurological disorder.

5.9 Prevalence for urinary incontinence after transurethral prostatectomy (TURP) for benign prostatic disease appears between 0.5% and 3%.<sup>118–122</sup>

5.10: Prevalence for post radical prostatectomy: The rates of post radical prostatectomy incontinence varies depending on the definition used and the duration of follow-up. However, the long-term incidence ranges between 4% and 8%.<sup>117–122</sup>

5.11: Prevalence of either detrusor underactivity (DU) or acontractility (DAC): In a study involving a review of urodynamic data of 1179 patients aged 65 and older, Jeong et al. reported the prevalence of DUA of 40.2 % in men.<sup>123</sup>

5.12: Urodynamic BOO can be diagnosed using the ICS Nomogram<sup>89</sup>. The formula used, known as the bladder outlet obstruction index (BOOI) is calculated by detrusor pressure at maximum flow ( $P_{\text{det.Qmax}}$ ) minus two times the maximum urinary flow ( $\text{BOOI} = P_{\text{det.Qmax}} - 2 Q_{\text{max}}$ ). A BOOI with a value of  $>40$  defines BOO, less than 20 defines absence of BOO, and in between denotes equivocal BOO. Alternative classifications for BOO are the Schäfer grades (0–VI)<sup>90,91</sup> and CHES classification.<sup>92</sup>

5.13 The evidence in men regarding PVR and BOO is not clear. Urodynamic studies in adult male patients with clinical BPH demonstrated that approx. 30% of men with PVR  $\geq 50$  mL do not have BOO/BPO, independent on the magnitude of PVR<sup>124</sup> and, vice versa, 24% of men with urodynamically confirmed BOO/BPO have PVR  $<50$  mL or even 0 mL.<sup>124–125</sup>

5.14: The level of obstruction can usually be diagnosed during voiding video cysto-urethrography. It may be aided by sphincter or pelvic floor EMG during voiding.

5.15: Bladder outlet obstruction from an enlarged prostate: BOO where the cause is benign prostatic enlargement (BPE) with clinical or imaging evidence.

5.16: Bladder outlet obstruction from the bladder neck: BOO where the cause is at the level of the bladder neck (clinical or radiological). The pelvic floor electromyogram (EMG) trace should be quiet during voiding in these patients.

5.17: Bladder outlet obstruction from pelvic floor muscular overactivity: Bladder outflow obstruction where the cause is at the level of the pelvic floor musculature (clinical, urodynamic or radiological). The pelvic floor electromyogram (EMG) trace may not be positive during voiding.

5.18: Bladder outlet obstruction from the rhabdosphincter (external urinary sphincter): BOO where the cause is at the level of rhabdosphincter (clinical, urodynamic or radiological). The pelvic floor electromyogram (EMG) trace may not be positive during voiding.

5.19: Bladder outlet obstruction from stenosis of bladder neck or urethra due to fibrosis: Bladder neck stenosis may occur secondary to prostate surgery for benign disease, radical prostate surgery, radiotherapy or trauma.

5.20: Currently, although many experts in this field agree that this entity exists, there is currently no consensus on its

definition because there is currently no consensus on defining detrusor underactivity. There is a Maastricht-Hannover Nomogram<sup>126</sup> may be used to diagnose reduced detrusor contractility in the presence of obstruction (or vice versa).

5.21: Up to 83%<sup>127</sup> of men with urodynamic BOO may have concomitant urodynamic DO. Both BOO-grade and advancing age were independent factors of DO in men. The more severe BOO, the higher the chance of DO.

## AREAS FOR FURTHER RESEARCH

In the preparation of this document, the following “gaps” in knowledge in male LUT/PF dysfunction have been noted compared to the equivalent for female LUT/PF dysfunction:<sup>5</sup>

- Post-void residuals in men with symptoms of LUT/PF dysfunction.
- Male diuresis data.
- Bladder compliance – normal and abnormal values in men.
- Additional large patient series for the prevalence data and the relative frequency of the most common male diagnoses.<sup>64</sup>

## ACKNOWLEDGMENTS/ADDENDUM

No discussion on terminology should fail to acknowledge the fine leadership shown by the ICS over many years. The legacy of that work by many dedicated clinicians and scientists is present in all the Reports by the different Standardization Committees and Working Groups. It is pleasing that the ICS leadership has accepted this vital initiative as a means of progress in this important and most basic area of Terminology and its Standardization.



This document has involved 22 rounds of full review, by co-authors, of an initial draft (BH) with the collation of comments and figures. Included in the review process were as follows: (i) 8 external expert reviewers; (ii) an open ICS website review; (iii) ICS Standardisation Steering Committee review and (iv) ICS Board of Trustees review. The process was subject to live Meetings in Tokyo (Sept 2016 – planning), and Working Group Meetings in Florence (September 2017), Copenhagen (March 2018) and Philadelphia (August 2018). There were also teleconferences in June, July and August 2018. The co-authors acknowledge the input and extensive comments by those external reviewers of

version 18: Craig Comiter, Dirk De Ridder, David Ginsberg, John Heesakkers, Michael Kennelly, Richard Millard, Victor Nitti, and Gommert van Koeveringe. Thanks to Dr Pascal Bou-Haidar for his assistance with the MRI section. Version 19 was subject to ICS website publication and an open public forum discussion at ICS Philadelphia. Thanks to those who provided formal, in particular Werner Schäfer, and informal comments. Version 22 was sent for ICS Board review. As there were no significant changes, Version 22 was submitted to Neurourology and Urodynamics in late October 2018 to appear in the Journal in early 2019.

## AUTHORS' DISCLOSURES

Carlos D'Ancona: Clinical trial – Ipsen. Bernard Haylen: No disclosures. Matthias Oelke: Speaker, consultant and/or trial participant for Apogepha, Astellas, Duchesnay, Glaxo Smith Kline, Ferring, Lilly & Pfizer. Grant from Astellas in 2012 on the investigation of detrusor underactivity. Luis Abranches-Monteiro: Trial participant: Ipsen, Allergan, Bayer, Lilly. Advisory Board: Astellas. Edwin Arnold: No disclosures. Howard Goldman: Medtronic: consultant, study support. Consultant: Allergan, Nuvecra, Axionics, NewUro. Study participant: Cook, Ipsen, Bioness. Rizwan Hamid: Consultant: Allergan, Wellspect. Speaker: Astellas, Allergan, Pfizer, Laborie. Travel/Research grants: Allegan, Astellas, Pfizer, Wellspect. Yukio Homma: Honorarium: Astellas, Pfizer, Kissei, Daiichi-Sankyo, Glaxo-Smith Kline, Nippon Shinyaku. Tom Marcelissen: No disclosures. Kevin Rademakers: No disclosures. Alexis Schizas: No disclosures. Ajay Singla: No disclosures. Irela Soto: No disclosures. Vincent Tse: Consultant: Astellas, Allergan, Ferring. Stefan de Wachter: Research grants: Medtronic, Astellas, Wellspect, Coloplast, Boston Scientific. Consultant: Medtronic, Astellas. Sender Herschorn: Consultant for Astellas, Allergan, Pfizer, Ipsen.

## REFERENCES

1. *Stedman's Medical Dictionary*. 28th edn. Baltimore, USA: Lippincott, Williams and Wilkins; 2006.
2. Abrams P, Blaivas JG, Stanton SL, Andersen JT. The standardisation of terminology of lower urinary tract function. *Scand J Urol Nephrol Suppl*. 1988;114:5–19.
3. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function. Report from the standardisation subcommittee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
4. Haylen BT, Chetty N. International Continence Society 2002 Terminology Report. Have urogynecological diagnoses been overlooked? International continence society 2002 terminology report. have urogynecological diagnoses been overlooked? *Int Urogynecol J*. 2007;18:373–377.
5. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20; International Urogynecology J. 2010;21:5–26.
6. Haylen BT, Freeman RM, Swift SE, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Terminology and Classification of complications related directly to the insertion of prostheses (meshes, implants, tapes) and grafts in female pelvic floor surgery. *Int Urogynecol J*. 2011;22:3–15.
7. Haylen BT, Freeman RM, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related to native tissue female pelvic floor surgery. *Int Urogynecol*. 2012;23:515–526; *Neurourol Urodyn*. 2012; 31 (4):406–414.
8. Toozs-Hobson P, Freeman R, Barber M, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol*. 2012;23:527–535; *Neurourol Urodyn*. 2012;31(4): 415–421.
9. Haylen BT, Maher CF, Barber MD, et al. International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for pelvic organ prolapse (POP). *Int Urogynecol J*. 2016;4:655–684; *Neurourol Urodyn*. 2016;35(2):137–168.
10. Sultan AH, Monga A, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Anorectal Dysfunction in Women. *Int Urogynaecol J*. 2017;28:5–31; *Neurourol Urodyn*. 2017; 36:10–34.
11. Bo K, Frawley H, Haylen BT, et al. International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Report on the Terminology for the Conservative and Non-pharmacological Management of Female Pelvic Floor Dysfunction. *Int Urogynecol J*. 2017;28:191–213; *Neurourol Urodyn*. 2017; 36: 221–244.
12. Rogers R, Thakar R, Petri E, et al. International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the sexual health in women with pelvic floor dysfunction. *Int Urogynecol J*. 2018;29:647–666; *Neurourol Urodyn*. 2018;37: 1220–1240.
13. Gazewski JB, Schurch B, Hamid R, et al. An International Continence Society (ICS) Report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). *Neurourol Urodyn*. 2018;37:1152–1161.
14. Oelke M, Wiese B, Berges R. Nocturia and the impact on health related quality of life and health care seeking behavior in German community-dwelling men aged 50 or older. *World J Urol*. 2014;32:1155–1162.
15. Milsom I, Abrams P, Cardozo L, Roberts RG, Thüroff J, Wein AJ. How widespread are the symptoms of an overactive bladder and how are they managed? A population-based prevalence study. *BJU Int*. 2001;87:760–766.
16. Larsson G, Victor A. Micturition patterns in a healthy female population, studied with a frequency/volume chart. *Scand J Urol Nephrol Suppl*. 1988;114:53–57.
17. Larsson G, Abrams P, Victor A. The frequency/volume chart in detrusor instability. *Neurourol Urodyn*. 1991;10:533–543.
18. Hashim H, Blaker MH, Drake MJ, et al. An International Continence Society (ICS) Report on the terminology for nocturia

- and nocturnal lower urinary tract function. *Neurourol Urodyn*. 2018; For publication in *Neurourol Urodyn*. early 2019.
19. Clavell-Hernandez J, Martin C, Wang R. Orgasmic dysfunction following radical prostatectomy: review of current literature. *Sex Med Rev*. 2018;6:124–134.
  20. Hambrook D, Bream V. Cognitive behaviour therapy for paruresis. *Behav Cogn Psychother*. 2017;45:79–84.
  21. Stoffel JT, Peterson AC, Sandhu JS, Suskind AM, Wei JT, Lightner DJ. AUA white paper on nonneurogenic chronic urinary retention: Consensus definition, treatment algorithm, and outcome end points. *J Urol*. 2017;198:153–160.
  22. Chapple CR, Osman NI, Birder L, et al. Terminology Report from the International Continence Society (ICS) working group on the underactive bladder (UAB). *Neurourol Urodyn*. 2018;37:2928–2931.
  23. Doggweiler R, Whitmore KE, Meijink JM, et al. A standard for terminology in chronic pelvic pain syndromes: a report from the chronic pelvic pain working group of the International Continence Society. *Neurourol Urodyn*. 2017;4:984–1008.
  24. Heytens S, De Sutter A, Coorevits L, et al. Women with symptoms of a urinary tract infection but a negative urine culture: PCR-based quantification of *Escherichia coli* suggests infection in most cases. *Eur Urol*. 2017;23:647–652.
  25. NIH Consensus Conference. Impotence. NIH consensus panel on impotence. *JAMA*. 1993;270:83–90.
  26. Redmon JB, Thomas W, Ma W, et al. Study for future families research group: the study for future families. *Andrology*. 2013;6:806–814.
  27. Norton C, Christiansen J, Butler U, et al. Anal incontinence. In: Abrams P, Khoury CL, Wein A, eds. *Incontinence*. 2nd ed. Plymouth: Health Publications Ltd; 2002:985–1044.
  28. Drossman DA, Hassler WL. Rome IV—Functional GI disorders of gut-brain interaction. *Gastroenterology*. 2016;150:1257–1261.
  29. Burkhard F, Lucas M, Berghmans LC, et al. EAU Guidelines on Urinary Incontinence in Adults. 2016; <http://uroweb.org/wp-content/uploads/EAU-Guidelines-Urinary-Incontinence-2016.pdf>
  30. Gravas S, Bach T, Bachmann A, et al. EAU Guidelines on Management of Non-neurogenic Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO). 2016; <http://uroweb.org/wp-content/uploads/EAU-Guidelines-Management-of-non-neurogenic-male-LUTS-2016.pdf>
  31. Gerber GS, Brendler CB. Evaluation of the urologic patient. In: Wein A, Kavoussi LR, Partin AW, Peters CA, eds. *Campbell-Walsh Urology*. 11th ed. Philadelphia, PA: Elsevier; 2016:1–25.
  32. Link RE, Rosen T. Cutaneous diseases of the external genitalia. In: Wein A, Kavoussi LR, Partin AW, Peters CA, eds. *Campbell-Walsh Urology*. 11th ed. Philadelphia, PA: Elsevier; 2016:387–420.
  33. Palmer LS, Palmer JS. Management of abnormalities of the external genitalia in boys. In: Wein A, Kavoussi LR, Partin AW, Peters CA, eds. *Campbell-Walsh Urology*. 11th ed. Philadelphia, PA: Elsevier; 2016:3368–3398.
  34. Nickel JC. Inflammatory and pain conditions of the male genitourinary tract; prostatitis and related pain conditions, orchitis, and epididymitis. In: Wein A, Kavoussi, Partin AW, Peters CA, eds. *Campbell-Walsh Urology*. 11th ed. Philadelphia, PA: Elsevier; 2016:304–333.
  35. McVary KT, Roehrborn CG, Avins AL, et al. Update on AUA guideline on the management of benign prostatic hyperplasia. *J Urol*. 2011;185:1793–1803.
  36. Roehrborn CG, Girman CJ, Rhodes T, et al. Correlation between prostate size estimated by digital rectal examination and measured by transrectal ultrasound. *Urology*. 1997;49:548–557.
  37. Roehrborn CG, Sech S, Montoya J, Rhodes T, Girman CJ. Interexaminer reliability and validity of a three-dimensional model to assess prostate volume by digital rectal examination. *Urology*. 2001;57:1087–1092.
  38. Agarwal P, Rosenberg ML. Neurological evaluation of urinary incontinence in female patient. *Neurologist*. 2003;9:110–117.
  39. Ertekin C, Reel F. Bulbocavernosus reflex in normal men and in patients with neurogenic bladder and/or impotence. *J Neurol Sci*. 1976;28:1–15.
  40. Moore C. *Definition and Classification of Urinary Incontinence and Other Pelvic Floor Disorders*. AUA University 2016.
  41. Staskin DR, Kelleher CJ, Bosch R, et al. Initial assessment of urinary incontinence in adult males and female patients. In: Abrams P, Cardozo L, Khoury S, Wein A, eds. *Incontinence*. 5th edn. Paris: ICUD-EAU; 2013. 361–428. The ISBN is 978-9953-493-21-3.
  42. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: Report from the Pelvic Floor Clinical Assessment Group of the International Continence Society. *Neurourol Urodyn*. 2005;24:374–380.
  43. Frawley H, Shelley B, Morin M, et al. (2018) An International Continence Society (ICS) Report on the Terminology for Pelvic Floor Muscle Function and Dysfunction. In Committee. For publication in *Neurourol Urodyn* in 2019.
  44. Lazzeri M, Guazzoni G, Montorosi F. Pelvic floor muscle training after prostate surgery. *Lancet*. 2012;379:120–121.
  45. Neumann PB, O'Callaghan M. The role of puborectal muscle function assessed by transperineal ultrasound in urinary incontinence outcomes at 3,6 and 12 months after robotic-assisted radical prostatectomy. *Int Neurol J*. 2018;22:114–122.
  46. Stafford RE, van den Hoorn W, Coughlin G, Hodges PW. Postprostatectomy incontinence is related to pelvic floor displacements observed with trans-perineal ultrasound imaging. *Neurourol Urodyn*. 2018;37:658–665.
  47. Stafford RE, Coughlin G, Lutton NJ, Hodges PW. Validity of estimation of pelvic floor muscle activity from transperineal ultrasound imaging in men. *PLoS ONE*. 2015;10:e0144342.
  48. van Kerrebroeck P, Abrams P, Chaikin D, Donovan J, Fonda D, Jackson S, et al. The standardisation of terminology in nocturia: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:179–183.
  49. Homma Y, Yamaguchi O, Kageyama S, Nishizawa O, Yoshida M, Kawabe K. Nocturia in the adult: classification on the basis of largest voided volume and nocturnal urine production. *J Urol*. 2000;163:777–781.
  50. Blanker MH, Bernsen RM, Bosch JL, Thomas S, Groeneveld FP, Prins A, et al. Relation between nocturnal voiding frequency and nocturnal urine production in older men: a population-based study. *Urology*. 2002;60:612–616.
  51. van Doorn B, Blanker MH, Kok ET, Westers P, Bosch JL. Prevalence, incidence, and resolution of nocturnal polyuria in a

- longitudinal community-based study in older men: the Krimpen study. *Eur Urol*. 2013;63:542–547.
52. Hofmeester I, Kollen BJ, Steffens MG, et al. Impact of the International Continence Society (ICS) report on the standardisation of terminology in nocturia on the quality of reports on nocturia and nocturnal polyuria: a systematic review. *BJU Int*. 2015;115:520–536.
  53. Burton C, Weiss JP, Parsons M, Blaivas JG, Coats AC. Reference values for the nocturnal bladder capacity index. *Neurourol Urodyn*. 2011;30:52–57.
  54. Groutz A, Blaivas JG, Chaikin DC, et al. Noninvasive outcome measures of urinary incontinence and lower urinary tract symptoms: a multicenter study of micturition diary and pad tests. *J Urol Sept*. 2000;164:698–701.
  55. Mouritsen L, Berild G, Hertz J. Comparison of different methods for quantification of urinary leakage in incontinent women. *Neurourol Urodyn*. 1989;8:579–587.
  56. Schäfer W, Abrams P, Liao L, et al. Good Urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
  57. Rosier PFWM, Schaefer W, Lose G, et al. International Continence Society Good Urodynamic Practices and Terms 2: Urodynamics, uroflowmetry, cystometry and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
  58. Bates P, Glen ES, Griffiths D, et al. For the International Continence Society. Second report on the standardization of terminology of lower urinary tract function. Procedures related to the evaluation of micturition—flow rate, pressure measurement, symbols. *Scand J Urol Nephrol*. 1977;11:197–199.
  59. Drake WM, Jr. The uroflowmeter: an aid to the study of the urinary tract. *J Urol*. 1948;59:650–658.
  60. Haylen BT, Ashby D, Sutherst JR, Frazer MI, West CR. Maximum and average urine flow rates in normal male and female populations—the Liverpool Nomograms. *Brit J Urol*. 1989;64:30–38.
  61. Siroky MB, Olssen CA, Krane RJ. The flow rate nomogram. I. development. *J Urol*. 1980;122:665–668.
  62. Siroky MB, Olssen CA, Krane RJ. The flow rate nomogram. I. Clinical Correlation. *J Urol*. 1980;123:208–216.
  63. Agarwal MM, Choudhury S, Mandal AK, Mavuduru R, Singh SK. Are urine flow-volume nomograms developed on Caucasian men optimally applicable for Indian men? Need for appraisal of flow-volume relations in local population. *Indian J Urol*. 2010;26:338–344.
  64. Haylen BT, Parys BT, Ashby D, West CR. Urine flow rates in male and female urodynamic patients compared with the Liverpool nomograms. *Brit J Urol*. 1990;65:483–488.
  65. Haylen BT, Frazer MI, Sutherst JR. Diuretic response to fluid load in women with urinary incontinence: an optimum pad test duration. *Brit J Urol*. 1988;62:331–333.
  66. Haylen BT, Frazer MI, MacDonald JH. Assessing the effectiveness of different urinary catheters in emptying the bladder – an application of transvaginal ultrasound. *Neurourol Urodyn*. 1989;8:331–333; Br J Urology. 1989, 64: 353–356.
  67. Whitfield HN. *Textbook of Genitourinary Surgery*. Oxford: Blackwell; 1998. 485.
  68. Kok ET, Schouten BW, Bohnen AM, Groeneveld FB, Thomas S, Bosch JL. Risk factors for lower urinary tract symptoms suggestive of benign prostatic hyperplasia in a community based population of healthy aging men: the Krimpen Study. *J Urol*. 2009;181:710–716.
  69. Berges R, Oelke M. Age-stratified normal values for prostate volume, PSA, maximum urinary flow rate, IPSS, and other LUTS/ BPH indicators in the German male community-dwelling population aged 50 years or older. *World J Urol*. 2011;29:171–178.
  70. Cerqui AJ, Haylen BT, O'Shea P. Residual urine volumes in a normal male population. *Urodynamic*. 2001;11:9–12.
  71. D'Ancona CA, Gomes MJ, Rosier PF. ICS teaching module: cystometry (basic module). *Neurourol Urodyn*. 2016;36:1673.
  72. Gelhrich AP, Hill MJ, McWilliams GD, Larsen W, McCartin T. Comparison of urodynamic volume measurements using room and body temperature saline: a double-blinded randomized crossover study design. *Female Pelvic Med Reconstr Surg*. 2012;18:170–174.
  73. Al-Hayek S, Belal M, Abrams P. Does the patient's position influence the detection of detrusor overactivity? *Neurourol Urodyn*. 2008;27:279–286.
  74. Klevmark B. Natural pressure-volume curves and conventional cystometry. *Scand J Urol Nephrol Suppl*. 1999;201:1–4.
  75. Wyndaele JJ, De Wachter S. Cystometrical sensory data from a normal population. Comparison of two groups of young healthy volunteers examined with a 5 year interval. *Eur Urol*. 2002;42:34–38.
  76. Wyndaele JJ. Normality in urodynamics studied in healthy adults. *J Urol*. 1999;161:899–902.
  77. Wyndaele JJ, Gammie A, Bruschini H, et al. Compliance—what does it represent: can we measure it or is it clinically relevant? *Neurourol Urodyn*. 2011;30:714–722.
  78. Toppercer A, Tetreault JP. Compliance of the bladder: an attempt to establish normal values. *Urology*. 1979;14:204–205.
  79. Musco S, Padilla-Fernández B, Del Popolo G, et al. Value of urodynamic findings in predicting upper urinary tract damage in neuro-urological patients: a systematic review. *Neurourol Urodyn*. 2018;37:1522–1540.
  80. Lose G, Griffith D, Hosker D, et al. Standardization of urethral pressure measurement: report from the Standardization Subcommittee of the International Continence Society. *Neurourol Urodyn*. 2002;21:258–260.
  81. Tarcan T, Demirkesen O, Plata M, Castro-Diaz D. ICS teaching module: detrusor leak point pressures in patients with relevant neurological abnormalities. *Neurourol Urodyn*. 2017;36:259–262.
  82. McGuire EJ, Cespedes RD, O'Connell HE. Leak-point pressures. *Urol Clin North Amer*. 1996;23:253–262.
  83. Oelke M, Rademakers KL, van Koeveinge GA. Detrusor contraction power parameters (BCI and  $W_{max}$ ) rise with increasing bladder outlet obstruction grade in men with lower urinary tract symptoms: results from a urodynamic database analysis. *World J Urol*. 2014;32:1177–1183.
  84. Stöhrer M, Goepel M, Kondo A, et al. The standardization of terminology in neurogenic lower urinary tract dysfunction. *Neurourol Urodyn*. 1999;18:139–158.
  85. Tanagho EA, Miller ER. The initiation of voiding. *Brit J Urol*. 1970;42:175–183.
  86. Gajewski JB, Rosier PFWM, Rahnama'I S, Abrams P. Do we assess urethral function adequately in lower urinary tract dysfunction and neurogenic lower urinary tract dysfunction? *Neurourol Urodyn*. 2017;36:935–942.



87. Griffiths D, Höfner K, von Mastrigt R, et al. The standardization of lower urinary tract function: pressure-flow studies of voiding, urethral resistance and urethral obstruction. *Neurol Urodyn*. 1997;16:521–532.
88. Ahmed HU, Shergill IS, Arya M, Shah PJ. Management of detrusor-external sphincter dyssynergia. *Nat Clin Pract Urol*. 2006;3:368–380.
89. Lim CS, Abrams P. The Abrams-Griffiths Nomogram. *World J Urol*. 1995;13:34–39.
90. Schäfer W. Analysis of bladder outlet function with the linearized passive urethral resistance relation (lin-PURR) and a disease specific approach for grading obstruction from complex to simple. *World J Urol*. 1995;13:47–58.
91. Schäfer W. Principles and clinical applications of advanced urodynamic analysis of voiding function. *Urol Clin Nth Am*. 1995;17:553–566.
92. Höfner K, Kramer AE, Tan HK, Krah H, Jonas U. CHES Classification of bladder outlet obstruction: a consequence in the discussion of current concepts. *World J Urol*. 1995;13:59–64.
93. Bacsu C-D, Chan L, Tse V. Diagnosing detrusor-sphincter dyssynergia in the neurological patient. *BJU Int*. 2012;109:31–34.
94. Schurch B, Schmid DM, Karsenty G, Reitz A. Can neurologic examination predict type of detrusor sphincter- dyssynergia in patients with spinal cord injury. *J Urol*. 2004;65:243–246.
95. Griffiths CJ, Rix D, Mac Donald AM, Drinnan MJ, Pickard RS, Ramsden PD. Noninvasive measurement of bladder pressure by controlled inflation of penile cuff. *J Urol*. 2002;167:1344–1347.
96. Van Mastrigt R, de Zeeuw S, Boeve ER, Groen J. Diagnostic Power of the non-invasive condom catheter method in patients eligible for transurethral resection of the prostate. *Neurourol Urodyn*. 2014;33:40–43.
97. D'Ancona CA, Bassani JW, Querne FA, Carvalho J, Oliveira RR, Netto NR, Jr. New method for minimally invasive urodynamic assessment in men with lower urinary tract symptoms. *Urology*. 2008;71:75–78.
98. Hakenberg OW, Ryall RI, Langlois SI, Marshall VR. The estimation of bladder volume by sonocystography. *J Urol*. 1983;130:249–252.
99. Hvamess H, Skjoldbye B, Jakobsen H. Urinary bladder measurements: comparison of three ultrasound calculation methods. *Scand J Urol Nephrol*. 2002;36:177–181.
100. Haylen BT, Parys BT, West CR. Transrectal ultrasound in the measurement of residual urine volumes in men. *Neurourol Urodyn*. 1989;8:327–328.
101. Oelke M, Höfner K, Jonas U, et al. Ultrasound measurements of detrusor wall thickness in healthy adults. *Neurourol Urodyn*. 2006;25:308–317.
102. Oelke M, Höfner K, Wiese B, Grünwald V, Jonas U. Increase in detrusor wall thickness indicates bladder outlet obstruction (BOO) in men. *World J Urol*. 2002;19:443–452.
103. Oelke M, Höfner K, Jonas U, dela Rosette JJ, Ubbink DT, Wijkstra H. Diagnostic accuracy of non-invasive tests to evaluate bladder outlet obstruction in men: detrusor wall thickness, post-void residual urine and prostate volume. *Eur Urol*. 2007;52:827–835.
104. Elsaid W, Mosharafa A, Elfayoumy H, et al. Detrusor wall thickness compared to other non-invasive methods with bladder outlet obstruction: a prospective controlled study. *African J Urol*. 2013;19:160–164.
105. Manieri C, Carter SS, Romano G, Trucchi A, Valenti M, Tubaro A. The diagnosis of bladder outflow obstruction in men by ultrasound measurement of bladder wall thickness. *J Urol*. 1998;159:761–765.
106. Kojima M, Inui E, Orchiai E, et al. Ultrasound estimation of bladder weight as a measure of bladder hypertrophy in men with infravesical obstruction: a preliminary report. *Urology*. 1996;47:942–947.
107. Ukimura OI, Kojima M, Iwata T, Inaba M, Miki T. Ultrasound measurement of bladder weight as a novel urodynamic modality. *Adv Exp Med Biol*. 2003;539:311–315.
108. Yuen JS, Ngai JT, Cheng CW, Foo KT. Effect of bladder volume on transabdominal measurements of intravesical prostatic protrusion and volume. *Int J Urol*. 2002;9:225–229.
109. Chia SJ, Heng CT, Chan SP, Koo KT. Correlation of intravesical prostatic protrusion with bladder outlet obstruction. *BJU Int*. 2003;91:371–374.
110. Abdool Z, Sultan A, Thakar R. Ultrasound imaging of the anal sphincter complex: a review. *Brit J Radiology*. 2012;85:865–875.
111. Schizas AMP, Ahmad AN, Emmanuel AV, Williams AB. Synchronized functional anal sphincter assessment: maximizing the potential of anal vector manometry and 3-D anal endosonography. *Neurogastroenterol Motil*. 2016;28:1075–1082.
112. Whiteside G, Bates P. Synchronous video pressure-flow cystourethrography. *Urol Clin Nth Am*. 1979;6:93–102.
113. Harisinghani M. The male pelvis. In: Harisinghani MG, ed. *Magnetic resonance imaging clinics of North America*. Vol. 22. Elsevier; 2014:129–262. PMID 24792681.
114. Mungovan SF, Sandhu JS, Akin O, Smart NA, Graham PL, Patel MI. Preoperative membranous urethral length measurement and continence recovery following radical prostatectomy: a systematic review and meta-analysis. *Eur Urol*. 2017;71:368–378.
115. Irwin DE, Abrams P, Milsom I, Kopp Z, Reilly K. EPIC Study Group Understanding the elements of overactive bladder: questions raised by the EPIC study. *BJU Int*. 2008;101:1381–1387.
116. Herschorn S, Gajewski J, Schulz J, Corcos J. A population-based study of urinary symptoms and incontinence: the Canadian Urinary Bladder Survey. *BJU Int*. 2008;101:52–58.
117. Shamlivan TA, Wyman JF, Ping R, Wilt TJ, Kane RL. Male urinary incontinence: prevalence, risk factors, and preventive interventions. *Rev Urol*. 2009;11:145–165.
118. Rassweiler J, Teber D, Kuntz R, Hofmann R. Complications of transurethral resection of the prostate (TURP)-incidence, management, and prevention. *Eur. Urol*. 2018;50:969–979.
119. American Urological Association. Guideline on the Management of Benign Prostatic Hyperplasia (BPH) [online], <http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines>, 2010.
120. Wilson LC, Gilling PJ. Post-prostatectomy urinary incontinence: a review of surgical treatment options. *BJU Int*. 2011;107:7–10.
121. Herschorn S. Challenges in lower urinary tract and pelvic floor disorders: where do we go from here?. *Can Urol Assoc J*. 2013;7:S189–S191.
122. Walsh PC, Partin AW, Epstein JI. Cancer control and quality of life following anatomical radical retropubic prostatectomy: results at 10 years. *J Urol*. 1994;152:1831–1836.
123. Jeong SJ, Kim HJ, Lee YJ, et al. Prevalence and clinical features of detrusor underactivity among elderly with lower urinary tract





- symptoms: a comparison between men and women. *Korean J Urol*. 2012;53:342–348.
124. Leblanc G, Tessier J, Schick E. The importance and significance of post-micturitional bladder residue in the evaluation of prostatism. *Prog Urol*. 1995;5:511–514.
  125. Griffiths HJ, Castro J. An evaluation of the importance of residual urine. *Br J Radiol*. 1970;43:3–409.
  126. Oelke M, Baard J, Wijkstra H, de la Rosette JJ, Jonas U, Höfner K. Age and bladder outlet obstruction are independently associated with detrusor overactivity in patients with benign prostatic hyperplasia. *Eur Urol*. 2008;54:419–429.
  127. Oelke M, Rademakers KLJ, Van Koeveringe GA, FORCE Research Group, Maastricht & Hannover. Development of a

bladder outlet resistance-bladder contractility nomogram for adult male patients with lower urinary tract symptoms (LUTS). *Neurol Urodyn*. 2016;35:980–986.

**How to cite this article:** D'Ancona C, Haylen B, Oelke M, et al. The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction. *Neurourology and Urodynamics*. 2019;1–45. <https://doi.org/10.1002/nau.23897>



## An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD)

Jerzy B. Gajewski<sup>1</sup>  | Brigitte Schurch<sup>2</sup>  | Rizwan Hamid<sup>3</sup> |  
Márcio Averbek<sup>4</sup>  | Ryuji Sakakibara<sup>5</sup>  | Enrico F. Agrò<sup>6</sup> |  
Tamara Dickinson<sup>7</sup> | Christopher K. Payne<sup>8</sup> | Marcus J. Drake<sup>9</sup> | Bernie T. Haylen<sup>10</sup>

<sup>1</sup>Dalhousie University, Halifax, Nova Scotia, Canada

<sup>2</sup>Neurourology Unit, Department of Clinical Neurosciences, CHUV, University Hospital, Lausanne, Switzerland

<sup>3</sup>Department of Neuro-Urology, Spinal Injuries Unit, RNOH, Stanmore/London, United Kingdom

<sup>4</sup>Department of Urology, Moinhos de Vento Hospital, Porto Alegre, Brazil

<sup>5</sup>Neurology, Internal Medicine, Sakura Medical Center, Toho University, Sakura, Japan

<sup>6</sup>Department of Experimental Medicine and Surgery, Tor Vergata University, Rome, Italy

<sup>7</sup>Department of Urology, UT Southwestern Medical Center Dallas, Texas

<sup>8</sup>Vista Urology & Pelvic Pain Partners, San Jose, California

<sup>9</sup>Bristol Urological Institute, Southmead Hospital, Westbury-on-Trym Bristol, United Kingdom

<sup>10</sup>University of New South Wales, Sydney, New South Wales, Australia

### Correspondence

Jerzy B. Gajewski, Urology Consultants,  
620-5991 Spring Garden Road, Halifax.  
B3H 1Y6, Nova Scotia, Canada.  
Email: jgajew@dal.ca

**Introduction:** The terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD) should be defined and organized in a clinically based consensus Report.

**Methods:** This Report has been created by a Working Group under the auspices and guidelines of the International Continence Society (ICS) Standardization Steering Committee (SSC) assisted at intervals by external referees. All relevant definitions for ANLUTD were updated on the basis of research over the last 14 years. An extensive process of 18 rounds of internal and external review was involved to exhaustively examine each definition, with decision-making by collective opinion (consensus).

**Results:** A Terminology Report for ANLUTD, encompassing 97 definitions (42 NEW and 8 CHANGED, has been developed. It is clinically based with the most common diagnoses defined. Clarity and user-friendliness have been key aims to make it interpretable by practitioners and trainees in all the different groups involved not only in lower urinary tract dysfunction but additionally in many other medical specialties.

**Conclusion:** A consensus-based Terminology Report for ANLUTD has been produced to aid clinical practice and research.

### KEYWORDS

adult, dysfunction, neurogenic, terminology, urinary tract

Rizwan Hamid, Marcus J. Drake, and Bernie Haylen belongs to Standardization Steering Committee ICS.

Jerzy B. Gajewski, Brigitte Schurch, Rizwan Hamid, Márcio Averbek, Ryuji Sakakibara, Enrico Finazz Agrò, Tamara Dickinson, Christopher K. Payne, Marcus J. Drake, Bernie Haylen belongs to ICS SSC Working Group on Adult Neurogenic Lower Urinary Tract Dysfunction.

## 1 | INTRODUCTION

“Adult” refers to “a fully grown and physically mature individual”<sup>1,2</sup> “Neurogenic” refers to “originating in the nervous system.”<sup>2</sup> “Lower Urinary Tract (LUT)” refers to the bladder, urethra (and prostate in men).<sup>2</sup> “Dysfunction”

refers to abnormal or difficult function. “Adult neurogenic lower urinary tract dysfunction (ANLUTD)” refers to abnormal or difficult function of the bladder, urethra (and/or prostate in men) in mature individuals in the context of clinically confirmed relevant neurologic disorder. There is currently no single document focusing on the definitions related to ANLUTD. Many ANLUTD symptoms and signs have been defined in core current terminology reports for lower urinary tract and pelvic floor dysfunction.<sup>3,4,5</sup> With the advantage of ongoing research into ANLUTD epidemiology, pathophysiology as well as pharmacological initiatives by generalist and specialist medical practitioners, it is timely to reconsider the different definitions.

## 2 | METHODOLOGY

This document was developed according to the published methodology of the International Continence Society Standardization Steering Committee.<sup>6</sup> This document aligns with the previous standardizations of the ICS on lower urinary tract dysfunction and is adapted to a group of patients with ANLUTD. Thus, ANLUTD can be diagnosed in the presence of neurological disease only. The intent is to supersede older terminology of “Neurogenic Bladder” or “Neurogenic Bladder Dysfunction”: these definitions are misleading, because the dysfunction(s) may involve not only the bladder but also the urethral sphincter competence or relaxation. Furthermore, using a single term to indicate a broad spectrum of dysfunctions is restrictive and unclear. For instance, there are many differences, in terms of investigations needed, treatment and prognosis, between a male patient with spinal cord injury (SCI) at cervical level and a female patient with Parkinson's disease, both complaining of Lower Urinary Tract Symptoms (LUTS) and “labeled” as having a “Neurogenic Bladder.” Finally, these definitions could lead to the conviction that the dysfunction may be due to a problem of the bladder, whilst the primary defect is in the central or peripheral nervous system. The document contains some original standardization of LUTS-related definitions, some modified with designation “CHANGED” and some newly defined — “NEW.”

This Terminology Report is inherently and appropriately a definitional document, collating the definitions of those terms, that is, “words used to express a defined concept in a particular branch of study,”<sup>7</sup> here ANLUTD. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. The definitions of those terms will be reviewed with all available evidence. The aim is to assist clinical practice and research. Some new and revised terms have been included. Explanatory notes on definitions have been referred, where

possible, to the “Footnotes” section. Like all the other joint ICS terminology reports, every effort has been made to ensure this Report is:

1. User-friendly: It should be able to be understood by all clinical and research users.
2. Clinically based: Refers to the relevant clinical practice.
3. Origin: Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition will remain and be duly referenced. A large number of these, because of their long-term use, have now become generic, as apparent by their listing in medical dictionaries.
4. Able to provide explanations: Where a specific explanation is deemed appropriate to describe a change from earlier definitions or to qualify the current definition, this will be included as Footnote to this paper. Wherever possible, evidence-based medical principles will be followed.

This document has involved 18 rounds of full review, by co-authors, of an initial draft (Version 1) completed 16.09.2014. Comments for each round of review were collated and debated as necessary in order to form a subsequent version. Live meetings on the document took place in Zurich and Tokyo.\*

This document covers symptoms, signs, urodynamic observations and definitions, clinical diagnoses, and treatment.

## 3 | RESULTS

### 1 ANLUTD SYMPTOMS:

Symptom: Any morbid phenomenon or departure from the normal in structure, function, or sensation, experienced by individual and indicative of disease or a health problem.<sup>2</sup> Symptoms are either volunteered by, or elicited from the individual or may be described by the patient's caregiver.<sup>3,4,5</sup> LUTS are classified as neurogenic in the presence of a relevant neurological disease ONLY. Symptoms are a subjective indicator of, or change in disease as perceived by the patient, carer, or partner that may lead the patient to seek help from healthcare professionals. They are usually qualitative. In general, LUTS cannot be used to make a definitive diagnosis. LUTS in people with neurological disease can also indicate pathologies other than NLUTD, such as urinary infection.

\*14th International Neuro-Urology Meeting, Zürich 2016 and International Continence Society Meeting, Tokyo, 2016.

Three groups of LUTS are: storage, voiding, and post micturition symptoms.

**1.1. Storage Symptoms** are experienced during the storage phase of the bladder, (CHANGED).<sup>†</sup>

**1.1.1. Increased daytime urinary frequency:** Complaint that micturition occurs more frequently during waking hours than previously deemed normal.<sup>5</sup>

**1.1.2. Nocturia** is waking to pass urine during the main sleep period.<sup>8</sup> (CHANGED)

**1.1.3. Urgency** is the complaint of a sudden compelling desire to pass urine, which is difficult to defer.<sup>4</sup>

**1.1.4. Urinary incontinence:** Complaint of involuntary loss of urine.<sup>5,‡</sup>

**1.1.4.1. Stress Urinary Incontinence** is the complaint of involuntary leakage on effort or exertion, or on sneezing or coughing.<sup>4</sup>

**1.1.4.2. Urgency Urinary Incontinence** is the complaint of involuntary loss of urine associated with urgency.<sup>5</sup>

**1.1.4.3. Mixed Urinary Incontinence** is the complaint of involuntary leakage associated with urgency and also with exertion, effort, sneezing, or coughing.<sup>5</sup>

**1.1.4.4. Enuresis:** Complaint of intermittent incontinence that occurs during periods of sleep<sup>8</sup> (NEW).

**1.1.4.4.1. Primary enuresis** has been present lifelong (NEW).

**1.1.4.4.2. Acquired enuresis** is an enuresis developed in adults (NEW).<sup>§</sup>

**1.1.4.5. Continuous (urinary) incontinence:** Complaint of continuous involuntary loss of urine<sup>5</sup>

**1.1.4.6. Impaired cognition urinary incontinence:** Complaint of periodic urinary incontinence that the individual with cognitive impairment

reports to have occurred without being aware of it. (NEW)

**1.1.4.7. Impaired mobility urinary incontinence:** Complaint of inability to reach the toilet on time for voiding because of physical or medical disability (NEW).<sup>||</sup>

**1.1.4.8. Sexual activity urinary incontinence** is the individual report of urinary incontinence associated with or during sexual activity (NEW).<sup>¶</sup>

**1.1.4.9. Other situational types of urinary incontinence** may exist, for example giggle incontinence, or incontinence associated with epileptic seizures, sphincter denervation in cauda equina and in the Onuf's nuclei lesions in Multiple system atrophy (NEW).

**1.1.5. Bladder Sensation** can be defined, during history taking by following categories.

**1.1.5.1. Normal:** the individual is aware of bladder filling and increasing sensation up to a strong desire to void.<sup>4</sup>

**1.1.5.2. Increased:** Increased bladder sensation: complaint that the desire to void during bladder filling occurs earlier or is more persistent to that previous experienced. N.B. This differs from urgency by the fact that micturition can be postponed despite the desire to void.<sup>5</sup>

**1.1.5.3. Reduced:** Reduced bladder sensation: complaint that the definite desire to void occurs later to that previously experienced despite an awareness that the bladder is filling.<sup>5</sup>

**1.1.5.4. Absent:** the individual reports no sensation of bladder filling or desire to void.<sup>4</sup>

**1.1.5.5. Non-specific bladder awareness:** the individual reports no specific bladder sensation, but may perceive, for example, abdominal fullness,

<sup>†</sup>Some symptoms in NLUTD cannot be defined properly when there is a significant reduction in motor and/or sensory function. "Complaint" is intended to mean the patient (or sometimes caregiver) expresses the symptom is present, regardless of whether it also causes them bother.

<sup>‡</sup>Loss of urine can result from: (a) incontinence; (b) involuntary passing of urine; (c) incontinence that is not derived from an abnormality in the lower urinary tract or its innervation, but from immobility, cognitive disability, and decreased motivation impaired patient's mobility enhances likelihood of being incontinent.

<sup>§</sup>Mature CNS regulation ensures voiding (detrusor contraction with outlet relaxation) is under voluntary control. Abnormal voiding reflexes, or disinhibition, may result in the person passing urine without voluntary control. Confirming the precise underlying mechanism(s) is often not possible in routine clinical practice. Enuresis is considered different from urgency urinary incontinence.

<sup>||</sup>This inability includes (any combination of) the individual's physical as well as social causes or reasons. Other signs or symptoms of LUTD should not be present, or should be reported by the professional (as primary or as accessory) (eg, "Urgency urinary incontinence" with "mobility impairment"; or "Mobility impairment urinary incontinence" with "stress urinary incontinence."

<sup>¶</sup>Sexual activity urinary incontinence may be reported as a single symptom, but may also be reported in association with other LUTD. Sexual activity urinary incontinence is documented (in combination with other symptoms) as being the primary or the as the associated symptom (or vice versa) based on the individual's expression of predominance.

vegetative symptoms, urethral sensations or spasticity as bladder filling awareness or a sign of bladder fullness. (CHANGED).

**1.1.5.6. Abnormal sensations:** awareness of sensation in the bladder, urethra or pelvis, described with words like “tingling,” “burning,” or “electric shock,” in the setting of a clinically relevant neurologic disorder (eg, incomplete spinal cord lesion) (NEW).

**1.1.5.7. Bladder Pain:** Complaint of suprapubic or retropubic pain, pressure or discomfort, related to the bladder, and usually increasing with bladder filling. It may persist or be relieved after voiding.<sup>4</sup>

**1.2. Voiding symptoms:** A departure from normal sensation or function, experienced by a person during the act of micturition.<sup>2 #</sup>

**1.2.1. Slow stream:** Complaint of a urinary stream perceived as slower compared to previous performance or in comparison with others.<sup>5</sup>

**1.2.2. Spraying (splitting)** of the urinary stream: Complaint that the urine passage is a spray or split rather than a single discrete stream.<sup>5</sup>

**1.2.3. Intermittent stream (Intermittency)** is the term used when the individual describes urine flow, which stops and starts on one or more occasions, during micturition.<sup>4</sup>

**1.2.4. Hesitancy:** Complaint of a delay in initiating micturition.<sup>5</sup>

**1.2.5. Straining to void:** Complaint of the need to make an intensive effort (by abdominal straining, Valsalva or suprapubic pressure) to either initiate, maintain or improve the urinary stream.<sup>5</sup>

**1.2.6. Terminal dribble** is the term used when an individual describes a prolonged final part of micturition, when the flow has slowed to a trickle/dribble.<sup>4</sup>

**1.3. Post Micturition Symptoms** are experienced immediately after micturition.<sup>4</sup>

**1.3.1. Feeling of incomplete emptying:** Complaint that the bladder does not feel empty after micturition.<sup>5</sup>

**1.3.2. Post micturition leakage:** Complaint of a further involuntary passage of urine following the completion of micturition.<sup>4,5</sup>

<sup>#</sup>Some symptoms in NLUTD cannot be defined properly when there is a significant reduction in motor and/or sensory function.

## 2 ANLUTD SIGNS

**Sign:** Any abnormality indicative of disease or a health problem, discoverable on examination of the patient; an objective indication of disease<sup>2</sup> or a health problem. Signs are observed by the physician including simple means to verify symptoms and quantify them.

Measuring the frequency, severity and impact of lower urinary tract symptoms by asking the patient to record micturitions and symptoms for a period of days provides invaluable information. The recording of “micturition events” can be in three main forms.<sup>\*\*</sup>

**2.1. Micturition Time Chart:** this records only the times of micturitions, day and night, for at least 24 h.<sup>4</sup>

**2.2. Frequency Volume Chart (FVC):** this records the volumes voided as well as the time of each micturition, day and night, for at least 24 h.<sup>4</sup>

**2.3. Bladder Diary:** this records the times of micturitions and voided volumes, incontinence episodes, pad usage, and other information such as fluid intake, the degree of urgency, and the degree of incontinence.<sup>4,9 ††</sup>

## 3 ANLUTD URODYNAMIC OBSERVATIONS AND DEFINITIONS

### 3.1 Filling cystometry definitions

Bladder storage function should be described according to bladder sensation, detrusor activity, bladder compliance and bladder capacity. Storage abnormalities identified may or may not be the result of a clinically relevant neurologic disorder.

#### 3.1.1. Bladder sensation during filling cystometry

**3.1.1.1. Normal bladder sensation** can be judged by three defined points (as per ICS recommendations) noted during filling cystometry: First sensation of bladder filling, First desire to void and Strong desire to void, and evaluated in relation to the bladder volume at that moment and in relation to the patient's symptomatic complaints.<sup>4,7</sup>

**3.1.1.2. Reduced Bladder Sensation:** Bladder sensation perceived to be diminished during filling cystometry.<sup>5</sup>

<sup>\*\*</sup>Validated questionnaires are useful for recording symptoms, their frequency, severity and bother, and the impact of LUTS on QoL. The instrument used should be specified. Some instruments were not validated in NLUTD or are impossible to implement because of sensory or motor deficiency in NLUTD.

<sup>††</sup>Recommended minimum duration of 3 days.<sup>9</sup> Some information could be difficult or impossible to collect because of sensory or motor deficiency in NLUTD.

**3.1.1.3. Absent Bladder Sensation:** The patient reports no bladder sensation during filling cystometry.<sup>5</sup>

**3.1.1.4. Bladder oversensitivity:** Increased perceived bladder sensation during bladder filling with: an early first desire to void; an early strong desire to void, which occurs at low bladder volume; a low maximum cystometric bladder capacity and no abnormal increases in detrusor pressure.<sup>5</sup>

**3.1.1.5. Abnormal sensations:** awareness of sensation in the bladder, urethra or pelvis, described with words like “tingling,” “burning,” or “electric shock,” in the setting of a clinically relevant neurologic disorder (eg, incomplete spinal cord lesion) (NEW).

**3.1.1.6. Non-specific bladder awareness:** perception of bladder filling as abdominal fullness, vegetative symptoms, spasticity or other “non-bladder awareness,” in the setting of a clinically relevant neurologic disorder (eg, incomplete spinal cord lesion) (NEW).

**3.1.1.7. Bladder Pain:** An unpleasant sensation (pain, pressure, discomfort) perceived to be related to the urinary bladder. (CHANGED).<sup>‡‡</sup>

### 3.1.2. Bladder capacity during filling cystometry

**3.1.2.1. Cystometric capacity** is the bladder volume at the end of the filling cystometry, when “permission to void or to empty the bladder” is usually given. The end point should be specified, for example, if filling is stopped when the patient has a normal desire to void. The cystometric capacity is the volume voided together with any residual urine.<sup>4§§</sup>

<sup>‡‡</sup>The pain may be felt suprapubically or retropubically. It usually increases with bladder filling, and may persist after voiding. Bladder pain may or may not relate to clinically relevant neurologic disorder.

<sup>§§</sup>In certain types of dysfunction including neurogenic LUTD, the cystometric capacity cannot be defined in the same terms. In the absence of sensation, the cystometric capacity is the volume at which the clinician decides to terminate filling. The reason(s) for terminating filling should be defined in the report, for example, high detrusor filling pressure, large infused volume or pain. If there is uncontrollable voiding/bladder emptying, it is the volume at which this begins. In the presence of sphincter incompetence the cystometric capacity may be significantly increased by occlusion of the urethra, for example, by a Foley catheter balloon.<sup>4</sup>

### 3.1.3. Detrusor function during filling cystometry

**3.1.3.1. Neurogenic detrusor overactivity** is an urodynamic observation characterized by involuntary detrusor contractions during the filling phase which may be spontaneous or provoked in the setting of a clinically relevant neurologic disease.<sup>4</sup> <sup>||||</sup>

Specific types of neurogenic detrusor overactivity include:

**3.1.3.1.1. Phasic detrusor overactivity** is defined by a characteristic wave form, and may or may not lead to urinary incontinence.<sup>4</sup> <sup>¶¶</sup>

**3.1.3.1.2. Terminal detrusor overactivity** is defined as involuntary detrusor contraction occurring near or at the maximum cystometric capacity, which cannot be suppressed, and results in incontinence or even reflex bladder emptying (reflex voiding) (CHANGED).<sup>##</sup>

**3.1.3.1.3. Sustained detrusor overactivity** is defined as a continuous detrusor contraction without returning to the detrusor resting pressure (NEW).

**3.1.3.1.4. Compound detrusor contraction** is defined as a phasic detrusor contraction with a subsequent increase in detrusor and base pressure with each subsequent contraction (NEW).

**3.1.3.1.5. High pressure detrusor overactivity** is defined as a phasic, terminal, sustained or compound high maximal detrusor overactivity with the high detrusor pressure perceived by investigator to be potentially detrimental to the patient's renal function and/or health and the value should be defined in the report (NEW).

<sup>||||</sup>Provoked contraction may be elicited by cough, change of position etc., or by urethral/sphincter to bladder reflex.

<sup>¶¶</sup>Phasic detrusor contractions are not always accompanied by any sensation, or may be interpreted as a first sensation of bladder filling, or as a normal desire to void. In neurogenic LUTD phasic detrusor contraction may elicit autonomic dysreflexia or abnormal bladder sensation.

<sup>##</sup>Terminal detrusor overactivity is typically associated with reduced bladder sensation, for example in the elderly stroke patient when urgency may be felt as the voiding contraction occurs. However, in neurogenic LUTD phasic detrusor contraction may elicit autonomic dysreflexia or abnormal bladder sensation and in complete spinal cord injury patients there may be no sensation whatsoever.

**3.1.3.1.6. Neurogenic Detrusor Overactivity Incontinence** is incontinence due to involuntary neurogenic detrusor overactivity (NEW).<sup>\*\*\*</sup>

**3.1.3.2. Leak point pressures:**

**3.1.3.2.1. Detrusor Leak Point Pressure (DLPP)** is defined as the lowest detrusor pressure at which urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure.<sup>4</sup>

**3.1.3.2.2. Detrusor Overactivity Leak Point Pressure (DOLPP)** is defined as the lowest detrusor pressure rise with detrusor overactivity at which urine leakage first occurs in the absence of voluntary detrusor contraction or increased abdominal pressure (NEW).

**3.1.3.2.3. Detrusor Leak Point Volume (DLPV)** is defined as a bladder volume at which first urine leakage occurs, either with detrusor overactivity or low compliance (NEW).

**3.1.3.2.4. Abdominal Leak Point Pressure (ALPP)** is the intravesical pressure at which urine leakage occurs due to increased abdominal pressure in the absence of a detrusor contraction.<sup>4 †††</sup>

**3.1.3.2.5. Bladder compliance** during filling cystometry describes the relationship between change in bladder volume

and change in detrusor pressure.<sup>4 †††</sup>

## 3.2. Pressure Flow Study Definitions

**3.2.1. Detrusor function** during the voiding phase in people that can initiate voluntary voiding

**3.1.3.2.1. Normal detrusor function** is a voluntarily initiated continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in the absence of obstruction. For a given detrusor contraction, magnitude of the recorded pressure rise will depend on the degree of outlet resistance.<sup>4</sup>

**3.1.3.2.2. Neurogenic detrusor underactivity** is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span in the setting of a clinically relevant neurologic disorder (NEW).

**3.1.3.2.3. Neurogenic acontractile detrusor** is one that cannot be demonstrated to contract during urodynamic studies in the setting of a clinically relevant neurologic lesion (NEW).

**3.1.3.2.4. Balanced bladder emptying** is a bladder emptying with physiological detrusor pressure and low residual as perceived by the investigator, and should be defined in the report (NEW).

<sup>†††</sup>Compliance is calculated by dividing the volume change ( $\Delta V$ ) by the change in detrusor pressure ( $\Delta p_{det}$ ) during that change in bladder volume ( $C = \Delta V / \Delta p_{det}$ ). It is expressed in mL/cm H<sub>2</sub>O. The normal value are not well defined however any report on compliance must include reference to the rate of filling and position of patient. A variety of means of calculating bladder compliance has been described. The ICS recommends that three standard points should be used for compliance calculations: the investigator may wish to define additional points. These points are measured excluding any detrusor contraction. The standards points are: (1) The detrusor pressure at the start of bladder filling and the corresponding bladder volume (usually zero). (2) The detrusor pressure at the bladder volume when the bladder pressure rises significantly and decreased compliance commences (Low compliance starting volume). (3) The detrusor pressure (and corresponding bladder volume) at cystometric capacity or immediately before the start of any detrusor contraction that causes significant leakage (and therefore causes the bladder volume to decrease, affecting compliance calculation).

<sup>\*\*\*</sup>Incontinence can occur with or without any sensation of urgency or awareness.

<sup>†††</sup>This test can be applied to both neurogenic and non-neurogenic patients with stress urinary incontinence.

**3.2.2.** Detrusor function during pressure flow studies in people that cannot initiate voluntary voiding.

**3.2.2.1. Initiated reflex bladder emptying** is an artificially elicited LUT reflex comprised of various manoeuvres (exogenous stimuli) performed by the patient or the therapist, resulting in complete or incomplete bladder emptying (NEW).<sup>§§§</sup>

**3.2.3** Sphincter function during pressure flow studies

**3.2.3.1. Detrusor-Sphincter Dyssynergia (DSD):** describes a detrusor contraction concurrent with an involuntary contraction of the urethral and/or periurethral striated muscle. Occasionally flow may be prevented altogether.<sup>|||||</sup>

**3.2.3.2. Non-relaxing urethral sphincter** is characterized by a non-relaxing, obstructing urethral sphincter resulting in reduced urine flow.<sup>|||||</sup>

**3.2.3.3. Delayed relaxation of the urethral sphincter** is characterized by impaired and hindered relaxation of the sphincter during voiding attempt resulting in delay of urine flow (NEW).<sup>###</sup>

#### 4 ANLUTD CLINICAL DIAGNOSES

Clinical diagnoses are the clinical manifestation of symptoms and signs, which are characterized by specific urodynamic findings and/or non-urodynamic evidence defined by the presence of urodynamic observations associated with characteristic symptoms or signs and/or non-urodynamic evidence of relevant pathological process.

<sup>§§§</sup>Spontaneous reflex bladder emptying is termed Detrusor Overactivity Incontinence

<sup>|||||</sup>Neurological disease that impairs the ability of the PMC or its pathways to co-ordinate function of the LUT spinal centres, leading to detrusor contraction against a contracting outlet. Detrusor sphincter dyssynergia (DSD) typically occurs in patients with a supra-sacral lesion, and is uncommon in lesions of the lower cord. DSD is responsible for bladder outlet obstruction and occasionally flow may be prevented altogether.

<sup>|||||</sup>Non-relaxing sphincter obstruction is found in individuals with a neurological lesion (sacral and infra-sacral lesions such as meningomyelocele) and after radical pelvic surgery. It may relate to both smooth and striated muscle sphincter.

<sup>###</sup>This can occur in some patients with Parkinson's disease or muscular dystrophy

This depends on the extent of loss of neurological function and depends on which part(s) of the nervous system is affected. Neural lesions are described according to time of onset, risk of neurological progression, completeness, and neurological level.

**4.1. Spinal Shock Phase** is usually temporary following acute neurologic insult or SCI that is characterized by loss of sensory, motor and reflex activity below the level of injury. NLUTD in Spinal Shock: is usually a temporary complete painless urinary retention (NEW).

**4.2. Suprapontine Lesion (SPL)** is a neurological lesion above the pons (forebrain or midbrain). NLUTD in SPL: there is a reflex contraction of the detrusor with impaired cerebral regulation and central inhibition and usually synergistic voiding/bladder emptying (NEW).<sup>\*\*\*\*</sup>

**4.3. Suprasacral spinal cord/pontine lesion (SSL)** is a neurological lesion in suprasacral spine and/or pons. NLUTD in SSL: Detrusor overactivity (DO) and DO incontinence are common, with or without detrusor-urethral sphincter dyssynergia (DSD), often resulting in a significant post void residual (PVR) and "high pressure" bladder (NEW).<sup>††††</sup>

**4.4. Sacral Spinal Cord Lesion (SSCL)** is a neurological lesion in the sacral spinal cord. NLUTD in SSCL; findings include acontractile detrusor with or without decreased bladder compliance and usually with impaired sphincter activity. (NEW).<sup>\*\*\*\*</sup>

<sup>\*\*\*\*</sup>Lesions resulting from cerebral or brainstem lesion with preservation of the pontine micturition center (PMC), that is, cerebrovascular disease, degenerative disease, hydrocephalus, intracranial neoplasms, traumatic brain injury (the list is incomplete). This may lead to inability to initiate voiding, inappropriate timing of bladder emptying, detrusor overactivity (DO), and DO incontinence.

<sup>††††</sup>Lesion persists after resolution of the spinal shock. Bladder sensation may be somewhat preserved (incomplete lesions) but voluntary control of the micturition reflex arc is lost. Altered function of the sympathetic spinal centre in the thoraco-lumbar spinal cord may alter blood pressure control. Complete SSL above T6 may be associated with autonomic dysreflexia when there is residual sympathetic nucleus function; this should be included in the description of the lesion.

<sup>\*\*\*\*</sup>There is a loss of parasympathetic control of the detrusor and a somatic denervation of the external urethral sphincter. Sensory impairment is typically associated with a complete lesion. Some afferent pathways remain intact due to potential preservation of hypogastric afferents. Some patients may have stress urinary incontinence (SUI) due to sphincter deficiency (loss of Onuf's nuclei).



- 4.5. Infrasacral (cauda equina and peripheral nerves) Lesion (CEPNL)** is a neurological lesion affecting the cauda equina and/or peripheral nerves. NLUTD in CEPNL: acontractile detrusor and/or SUI may be present. In diabetic neuropathy, detrusor overactivity can be seen in combination with the above (NEW).<sup>§§§§</sup>
- 4.6. Mixed Neuronal Lesion** is resulting from lesions of the neural pathway at different levels of the central nervous system concurrently (NEW)
- 4.7. Autonomic Dysreflexia** is a syndrome resulting from upper thoracic or cervical spinal cord injury above T6, elicited by a stimulus in the field of distribution of the autonomous sympathetic nucleus, characterized by unregulated sympathetic function below the lesion and compensatory autonomic responses (NEW).<sup>|||||</sup>
- 4.7.1. Asymptomatic Autonomic Dysreflexia:** increase of blood pressure without any other symptoms (NEW).<sup>¶¶¶¶</sup>
- 4.8. Neurogenic Overactive Bladder** is characterized by urgency, with or without urgency urinary incontinence, usually with increased daytime frequency and nocturia in the setting of a clinically relevant neurologic disorder with at least partially preserved sensation (NEW).<sup>####</sup>
- 4.9. Voiding dysregulation** is urination in situations which are generally regarded as socially inappropriate, such as while still fully dressed, or in a public setting away from toilet facilities (NEW).
- 4.10. Involuntary voiding** is both a symptom and a diagnosis of sporadic bladder emptying

<sup>§§§§</sup>The peripheral nerves and the lower spinal centres are often grouped under the term “lower motor neurones,” as damage to these structures causes loss of contractile function. Elsewhere, the neurological lesions are termed “upper motor neuron lesions,” where the consequences are impaired co-ordination and reflex function. This is a considerable simplification, and anatomically inaccurate, so the committee considers categorization into lower versus upper motor neuron lesions should no longer be supported.

<sup>|||||</sup>It is potentially a medical emergency characterized by hypertension, bradycardia, severe headaches, and flushing above, with pallor below the cord lesion, and sometimes convulsions.<sup>10</sup>

<sup>¶¶¶¶</sup>This can happen during routine urodynamic bladder studies or bowel program.<sup>11</sup>

<sup>####</sup>These symptom combinations in case of preserved sensation, are suggestive of urodynamically demonstrable detrusor overactivity, but can be due to other forms of LUTD. These terms can be used if there is no proven infection or other obvious non neurological disease.

when awake, without intention to void (NEW).<sup>\*\*\*\*\*</sup>

- 4.11. Urinary retention** is an inability to properly empty the bladder and can be divided into acute, chronic, complete and incomplete (NEW).

**4.11.1. Acute retention** of urine is defined as an acute event of painful, palpable or percussable bladder, when the patient is unable to pass any urine when the bladder is full.<sup>5 †††††</sup>

**4.11.2. Chronic retention** of urine is defined as a non-painful bladder, which remains palpable or percussable after the patient has passed urine. Such patients may be incontinent.<sup>4†††††</sup>

**4.11.3. Complete urinary retention** is an inability to empty any amount of bladder volume (or the requirement for use of a catheter, consciously or unconsciously due to anatomical or functional bladder outlet obstruction, detrusor underactivity or both (NEW).

**4.11.4. Incomplete urinary retention** is impaired bladder emptying due to anatomical or functional bladder outlet obstruction, detrusor underactivity or both, when the voided volume is smaller than Post Void Residual.

**4.11.5. Post void residual (PVR)** is defined as the volume of urine left in the bladder at the end of micturition.<sup>4</sup>

<sup>\*\*\*\*\*</sup>Usually the voiding reflex is preserved, and there is only lack of proper inhibition of the voiding reflex. If that happens when asleep it is called Acquired Enuresis.

<sup>†††††</sup>Although acute retention is usually thought of as painful, in certain circumstances pain may not be a presenting feature, for example, when due to prolapsed intervertebral disc, post-partum, or after regional anaesthesia such as an epidural anaesthetic. The retention volume should be significantly greater than the expected normal bladder capacity. In patients after surgery, due to bandaging of the lower abdomen or abdominal wall pain, it may be difficult to detect a painful, palpable, or percussable bladder.<sup>4</sup>

<sup>†††††</sup>The ICS no longer recommends the term “overflow incontinence” This term is considered confusing and lacking a convincing definition. If used, a precise definition and any associated pathophysiology, such as reduced urethral function, or detrusor overactivity/low bladder compliance, should be stated. The term chronic retention, excludes transient voiding difficulty, for example, after surgery for stress incontinence, and implies a significant residual urine; a minimum figure of 300 mls has been previously mentioned.<sup>4</sup>

## 5 ANLUTD TREATMENTS DEFINITIONS

**5.1 Bladder Reflex Triggering** comprises various manoeuvres performed by the patient or the therapist to elicit reflex bladder emptying by exteroceptive stimuli (relating to, being, or activated by stimuli received from outside of the bladder).<sup>4</sup> §§§§§

**5.2 Bladder Expression** refers to various compression manoeuvres aimed at increasing intravesical pressure to facilitate bladder emptying with or without obvious sensation from the bladder. (CHANGED).<sup>|||||||</sup>

**5.3 Catheterization** is a technique for bladder emptying employing a catheter to drain the bladder or a urinary reservoir.<sup>4</sup>

**5.3.1. Indwelling catheterization;** an indwelling catheter remains in the bladder, urinary reservoir or urinary conduit for a period longer than one emptying.<sup>4</sup> ¶¶¶¶¶

**5.3.2. Intermittent Catheterization (IC)** is defined as drainage of the bladder or a urinary reservoir with subsequent removal of the catheter mostly at regular intervals. (CHANGED)

**5.3.2.1. Clean IC (CIC):** use of a clean technique. This implies ordinary hand and genitals washing techniques and use of disposable or cleansed reusable catheters. (CHANGED)

**5.3.2.2. Aseptic IC:** This implies genital antiseptic preparation and the use of sterile (single-use) catheters and instruments/gloves in a designated clean area. (NEW)

**5.3.2.3. Sterile IC:** Complete sterile setting, including genital skin antiseptis, sterile gloves, forceps, gown and mask (NEW).<sup>#####</sup>

**5.3.2.4. No-touch technique IC:** This was introduced as an easier way for the patient to perform self-intermittent catheterization with a ready-to-use catheter (pre-lubricated catheter, usually a hydrophilic catheter). A pull-in aid or special packages

are used to handle the catheter without directly touching the sliding surface of the hydrophilic catheter (NEW).<sup>\*\*\*\*\*</sup>

## 5.4 Electrostimulation

**5.4.1. Direct electrical neurostimulations** a direct stimulation of the nerves or neural tissue to effect function of the end organ. It is done through electrodes implanted directly or near the nerve or neural tissue (NEW).<sup>†††††</sup>

**5.4.2. Electrical neuromodulation** is the stimulation of the nerves or neural tissue to modulate function and induce therapeutic response of the LUT (NEW).<sup>§§§§§</sup>

**5.4.3. Transcutaneous electrical nerve stimulation (TENS)** is electrical stimulation of the nerves through intact skin to modulate function and induce therapeutic response of the LUT (NEW).<sup>§§§§§</sup>

**5.4.4. Pelvic electrical stimulation** is the application of electrical current to stimulate the pelvic viscera or their nerve supply (NEW).<sup>|||||||</sup>

## 4 | CONCLUSIONS

Standardized terminology is an important aspect on research and communication in NLUTD. The International Continence Society (ICS) continues to have a key role in standardizing terminology related to lower urinary tract and pelvic organ dysfunction.

\*\*\*\*\*The ICS Working Group recognizes that there is a lack of uniformity and consensus on the classification of aseptic technique in previously published studies, especially with regard to genital hygiene. Thus, it is strongly recommended that all aspects related to the technique of intermittent catheterization are described as completely as possible in the context of clinical research, including the environment in which catheterization is performed, the type of lubricant, the catheter characteristics, the use of gloves, as well as the genital hygiene mode.

†††††For example, stimulation of the anterior sacral roots, that is, Brindley's stimulator.

§§§§§It is done through electrodes implanted directly on or near the nerves or neural tissue: Sacral Neuromodulation (SNM), Pudendal Nerve Stimulation (PNS), Percutaneous Tibial Nerve Stimulation (PTNS), Spinal cord stimulation (SCS), Deep brain stimulation (DBS).

§§§§§This is done by skin surface electrode(s), as touch plate(s) or superficial needle(s). Long-term or chronic electrical stimulation is delivered below the sensory threshold. Maximal electrical stimulation is using a high-intensity stimulus (just below the pain threshold). This can be done intermittently.

|||||||The aim of electrical stimulation may be to directly induce a therapeutic response or to modulate lower urinary tract, bowel, or sexual dysfunction through transvaginal or transrectal stimulation.

§§§§§The most commonly used manoeuvres are; suprapubic tapping, thigh scratching, and anal/rectal manipulation.

|||||||The most commonly used manoeuvres are; abdominal straining (Valsalva's manoeuvre) and exerting manual suprapubic pressure (Crede's manoeuvre).

¶¶¶¶¶Indwelling catheterization may be performed transurethral, suprapubic or trans-conduit.

#####Usually performed in the surgical theatre or during diagnostic procedures.

## ACKNOWLEDGMENTS

We would like to thanks ICS Standardization Steering Committee for reviewing the manuscript and ICS Office for helping our subcommittee administratively.

## ORCID






Jerzy B. Gajewski  <http://orcid.org/0000-0003-0769-583X>  
 Brigitte Schurch  <http://orcid.org/0000-0003-4965-6898>  
 Márcio Averbek  <http://orcid.org/0000-0002-8127-7153>  
 Ryuji Sakakibara  <http://orcid.org/0000-0002-5803-169X>

## REFERENCES

1. *Concise Oxford English Dictionary*. 9th Edition. Oxford: Clarendon Press; 1995. 1438.
2. *Stedman's Medical Dictionary*. 28th Edition Maryland USA: Lippincott William and Wilkins Baltimore; 2006. 1884.
3. Abrams P, Blaivas JG, Stanton SL, et al. Sixth Report on the Standardisation of Terminology of Lower Urinary Tract Function. Procedures related to neurophysiological investigations: electromyography, nerve conduction studies, reflex latencies, evoked potentials and sensory testing. The International Continence Society. *Br J Urol*. 1987;59:300–304.
4. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Am J Obstet Gynecol*. 2002;187:116–126.
5. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J*. 2010;21:5–26.
6. Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31:621–624.
7. D'Ancona CA, Gomes MJ, Rosier PF. ICS teaching module: cystometry (basic module). *Neurourol Urodyn*. 2016;9999:1–4.
8. Hashim H, Blanker MH, Drake MJ, et al. An International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function. *Neurourol Urodyn*. Submitted in 2017.
9. Bright E, Cotterill N, Drake M, Abrams P. Developing a validated urinary diary: phase 1. *Neurourol Urodyn*. 2012;31: 625–633.
10. Curt A, Nitsche B, Rodic B, Schurch B, Dietz V. Assessment of autonomic dysreflexia in patients with spinal cord injury. *J Neurol Neurosurg Psychiatry*. 1997;62:473–477.
11. Kirshblum SC, House JG, O'Connor KC. Silent autonomic dysreflexia during a routine bowel program in persons with traumatic spinal cord injury: a preliminary study. *Arch Phys Med Rehabil*. 2002;83:1774–1776.

**How to cite this article:** Gajewski JB, Schurch B, Hamid R, et al. An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). *Neurourology and Urodynamics*. 2017;1–10. <https://doi.org/10.1002/nau.23397>

## International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function

Hashim Hashim<sup>1</sup>  | Marco H. Blanker<sup>2</sup>  | Marcus J. Drake<sup>3</sup>  |  
Jens Christian Djurhuus<sup>4</sup> | Jane Meijlink<sup>5</sup> | Vikky Morris<sup>6</sup> | Peter Petros<sup>7</sup>  |  
Jian Guo Wen<sup>8</sup>  | Alan Wein<sup>9</sup>

<sup>1</sup> Bristol Urological Institute, Bristol, United Kingdom

<sup>2</sup> University of Groningen, University Medical Center Groningen, Groningen, The Netherlands

<sup>3</sup> University of Bristol and Bristol Urological Institute, Bristol, United Kingdom

<sup>4</sup> University of Aarhus, Aarhus, Denmark

<sup>5</sup> International Painful Bladder Foundation, The Netherlands

<sup>6</sup> Musgrove Park Hospital, Taunton, United Kingdom

<sup>7</sup> University of New South Wales, Sydney, Australia

<sup>8</sup> First Affiliated Hospital of Zhengzhou University, Zhengzhou, China

<sup>9</sup> University of Pennsylvania, Philadelphia, Pennsylvania

### Correspondence

Hashim Hashim, Bristol Urological Institute, Brunel Building, Southmead Hospital, Bristol, BS10 5NB, United Kingdom.  
Email: h.hashim@gmail.com

**Introduction:** The terminology for nocturia and nocturnal lower urinary tract function is reviewed and updated in a clinically and practically-based consensus report.

**Methods:** This report has been created by a Working Group under the auspices and guidelines of the International Continence Society (ICS) Standardisation Steering Committee (SSC). All relevant definitions were updated on the basis of research over the last 16 years since the publication of the first nocturia standardization document in 2002. An extensive process of 16 rounds of internal and external reviews was involved to examine each definition exhaustively, with decision-making by collective opinion (consensus).

**Results:** A clinically-based terminology report for nocturia and nocturnal lower urinary tract function, encompassing five key definitions divided into signs and symptoms has been developed. Clarity and user-friendliness have been key aims to make it interpretable by healthcare professionals and allied healthcare practitioners involved in the care of individuals with nocturnal lower urinary tract function.

**Conclusion:** A consensus-based terminology report for nocturia and nocturnal lower urinary tract function has been produced to aid clinical practice and research.

### KEYWORDS

enuresis, International Continence Society, nocturia, nocturnal polyuria, terminology

## 1 | INTRODUCTION

In 2002, the International Continence Society (ICS) defined nocturia as the complaint that the individual has to wake at night one or more times to void.<sup>1</sup> Since that original

publication, several studies have been conducted looking at the epidemiology, pathophysiology and treatment of nocturia, leading to a wealth of new information.<sup>2,3</sup> The time has now come to review the terminology in the original publication since it has been established that nocturia may not be a

Hashim Hashim, Marco H. Blanker, Marcus J. Drake, Jens Christian Djurhuus, Jane Meijlink, Vikky Morris, Peter Petros, Jian Guo Wen, and Alan Wein: ICS Terminology Working Group on Nocturia and Nocturnal Lower Urinary Tract Function.

Marcus J. Drake and Jane Meijlink: Standardisation Steering Committee ICS. At time of publication, Marcus Drake was an ICS Trustee.

*Neurourology and Urodynamics*. 2019;1–10.

wileyonlinelibrary.com/journal/nau

© 2019 Wiley Periodicals, Inc. | 1

complaint and that people can get up at night to void for various reasons which may or may not be pathological.<sup>4</sup> Nocturia can also occur as a clinical entity in its own right due to non-medical reasons such as a baby crying, or a partner snoring, causing the individual to wake up at night to pass urine. In these latter scenarios, nocturia would have been excluded in the 2002 definition as the person would have not woken up to void due to a complaint, but rather due to a convenience void.

Nocturia may also be present as part of other conditions which may or may not be directly related to the urinary tract, for example, heart failure or sleep apnea. Therefore, patients can present to and consult not only urologists but also other clinicians such as gynecologists, geriatricians, neurologists, sleep experts, endocrinologists, cardiologists, immunologists, rheumatologists, and/or general practitioners. Each specialist is likely to approach nocturia in a different way depending on the presentation. However, it is important that all healthcare providers speak the same “language” and refer to the same condition using specific definitions, in order to avoid confusion and any misunderstandings.

The ICS therefore formed a new working group to revise and update the 2002 standardization document on nocturia and make new recommendations on terminology based on the published literature over the last 16 years. This terminology report is inherently and appropriately a definitional document, collating the definitions of those terms, that is, “words or phrases used to describe a thing or to express a concept, especially in a particular kind of language or branch of study,”<sup>5</sup> here nocturia and nocturnal lower urinary tract function. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. The definitions of those terms will be reviewed with all available evidence and aim to assist clinical practice and research. Some new and revised terms have been included. Explanatory notes on definitions have been referred, where possible, to the “footnotes” section. This document does not address the epidemiology, pathophysiology or treatment of nocturia or any of its sub-categories, as that is not the main aim of the Standardisation Steering Committee (SSC) or the nocturia working group, is beyond the scope of this article, and is covered in several other publications.<sup>2,3,6–11</sup>

Like all other joint ICS terminology reports, every effort has been made to ensure this report is:

*User-friendly:* It should be understandable by all clinical and research users.

*Clinically-based:* The definitions should be applicable to clinical practice.

*Original:* Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition will remain and be duly referenced.

*Able to provide explanations:* Where a specific explanation is deemed appropriate to describe a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (*Footnote [FN] 1,2,3...*). Wherever possible, evidence-based medical principles will be followed.

It is suggested that acknowledgement of these standards in written publications related to nocturia and nocturnal lower urinary tract function be indicated by a footnote to the section “Methods and Materials” or its equivalent, to read as follows: “Methods, definitions and units conform to the standards recommended by the International Continence Society Nocturia and Nocturnal Lower Urinary Tract Function Terminology Standard 2018, except where specifically noted”.

Relevant ICS 2002 and 2010 definitions are highlighted for ease of reference and comparison. The 2018 definitions (Table 1) will be added if there are any changes to the previous definitions.

## 2 | GENERAL DEFINITIONS

### 2.1 | Symptom(s)

**2002:** The subjective indicator of a disease or change in a condition as perceived by the patient, carer or partner, and may lead him/her to seek help from healthcare professionals. Symptoms may either be volunteered or described during the patient interview. They are usually qualitative. In general, Lower Urinary Tract Symptoms (LUTS) cannot be used to make a definitive diagnosis. LUTS can also indicate pathologies other than lower urinary tract dysfunction (LUTD), such as urinary tract infection.<sup>12</sup>

**2010:** Any morbid phenomenon or departure from the normal in structure, function, or sensation; experienced by the person and indicative of disease or a health problem. Symptoms are either volunteered by, or elicited from the person, or may be described by the person's caregiver.<sup>13,14</sup>

**2018:** The previous definitions have not been changed.

### 2.2 | Sign(s)

**2002:** Signs are observed by the physician including simple means, to verify symptoms and quantify them. For example, a classic sign is the observation of leakage on coughing. Observations from frequency/volume charts, pad tests and validated symptom and quality of life questionnaires are examples of other instruments that can be used to verify and quantify symptoms.<sup>12</sup>

**2010:** Any abnormality indicative of disease or a health problem, discoverable on examination of the

**TABLE 1** Definitions of terms related to nocturia and nocturnal lower urinary tract function (2018)

Term	Definition
Main sleep period (new)	The period from the time of falling asleep to the time of intending to rise for the next “day.”
First morning void (changed)	The first void after the main sleep period.
Enuresis (changed)	Symptom: complaint of intermittent incontinence that occurs during periods of sleep. If it occurs during the main sleep period, then it could be qualified by the adjective “nocturnal.” Sign: Intermittent incontinence (“wetting”) that occurs during periods of sleep (while asleep). If it occurs during the main sleep period then it could be preceded by the adjective “nocturnal.”
Night-time (changed)	Commences at the time of going to bed with the intention of sleeping and concludes when the individual decides they will no longer attempt to sleep and rise for the next “day.” It is defined by the individual's sleep cycle, rather than the solar cycle (from sunset to sunrise).
Night-time frequency (changed)	The number of voids recorded from the time the individual goes to bed with the intention of going to sleep, to the time the individual ends their main sleep period with the intention of rising.
Nocturia (changed)	Symptom: The number of times urine is passed during the main sleep period. Having woken to pass urine for the first time, each urination must be followed by sleep or the intention to sleep. This should be quantified using a bladder diary. Sign: The number of times an individual passes urine during their main sleep period, from the time they have fallen asleep up to the intention to rise from that period. This is derived from the bladder diary.
Nocturnal polyuria (changed)	Symptom: Passing large volumes of urine during the main sleep period. This should be quantified using a bladder diary. Sign: Excessive production of urine during the individual's main sleep period. This should be quantified using a bladder diary.
Nocturnal urine volume (changed)	Sign: Total volume of urine produced during the individual's main sleep period including the first void after the main sleep period. This should be quantified using a bladder diary.
24-h voided volume (changed)	Sign: Total volume of urine passed during a 24-h period excluding the first morning void of the period. The first void after rising is discarded and the 24-h period begins at the time of the next void and is completed by including the first void, after rising, the following day.
24-h polyuria (not changed)	Excessive excretion of urine resulting in profuse and frequent micturition. Defined as >40 mL per kg body weight per 24-h.

patient; an objective indication of disease or a health problem.<sup>14</sup>

These can be quantified by a questionnaire or bladder diary.

**2018:** The previous definitions have not been changed.

*Nocturnal:* Refers to “Done, occurring, or active at night.”<sup>5</sup> Therefore, “nocturnal” will refer to signs and symptoms that occur during the night-time.

*Night-time (Changed):* For the purposes of the nocturia 2018 terminology, night-time will be defined by the individual's sleep cycle, rather than the solar cycle (from sunset to sunrise). Thus, some shift workers may have their “night-time” period during the daylight hours, as it is the time of their main sleep period. It commences at the time of going to bed with the *intention* of sleeping and concludes when the individual decides they will no longer attempt to sleep and rise for the next “day.”

*Main sleep period (New):* The period from the time of *falling asleep* to the time of *intending to rise* for the next “day.”

*Frequency:* The frequency is the number of times an event occurs during a stated period.

### 3 | NOCTURNAL SYMPTOMS

#### 3.1 | Nocturia

**2002:** The complaint that the individual has to wake at night one or more times to void.<sup>1</sup>

**2010:** Complaint of interruption of sleep one or more times because of the need to micturate.<sup>14</sup> Each void is preceded and followed by sleep.

**2018:** The number of times urine is passed during the main sleep period. Having woken to pass urine for the first time, each urination must be followed by sleep or the intention to sleep. This should be quantified using a bladder diary.<sup>a</sup>

#### 3.2 | Core reasons for change

The 2002 and 2010 definitions of nocturia have caused much debate and controversy, including the fact that getting up once at night to void may not be bothersome and is therefore not a “complaint.” Furthermore, it can be difficult to determine the “reason for waking” and to confirm that waking was indeed in order to pass urine. What clinicians and researchers wanted



was to define a clinical condition. Also, the previous ICS definitions of nocturia did not take into account the voiding episodes at night during the main sleep period of several groups of people, including but not limited to:

1. those who need to void multiple times in the night after falling asleep, often several times in a row, small amounts at a time, and may not be able to get back to sleep again,
2. those whose bladder does not empty fully, and who consequently need to void again several times soon after going to sleep,
3. those who suffer from insomnia or have difficulty going back to sleep due to causes other than their bladder problem,
4. those who wake up and then are unable to sleep due to painful or sensitive bladders.

Furthermore, while various studies have been published on nocturia, only few have critically discussed the definition of nocturia. In fact, nocturia has not been defined at all in many studies. The new definition reflects the fact that nocturia is first a symptom, which may or may not be a complaint (ie, of an abnormality), with mixed and multiple etiologies and a prevalence in the general population which is well described for men and women of different ages worldwide.<sup>2,15,16</sup>

Night-time frequency can sometimes be confused with nocturia. However night-time frequency includes voids when an individual goes to bed, with the intention of sleeping, but cannot sleep and needs to void at least once before falling asleep (2002 nocturia document). For example, if an

individual goes to bed at 10 pm and passes urine three times before falling asleep at 11 pm, then the three episodes are not part of nocturia, as nocturia starts when the person falls asleep but these are part of night-time frequency (Figure 1).

Another, scenario that may cause confusion is if an individual wakes up at, for example, 3 am from sleep and could not sleep although they want to sleep, and passes urine at 4 and 6 am, and then decides to end his/her sleep period at 7 am, then these voids are part of nocturia episodes.

In other words, nocturia episodes begins when the individual falls asleep and ends with the intention of getting up for the day. These, and other scenarios, will be highlighted by careful analysis of the bladder diary, which is a mandatory first-line investigation tool for the management of patients with LUTS (Figure 2). This document aims to generalize the definitions to apply to all groups of patients with the symptom of nocturia.<sup>b</sup>

### 3.3 | Analysis of bladder diary

1. Nocturia by 2002/2010 definition: 1 (the only void that was preceded and followed by sleep was the one at 23.00). It could also be argued that nocturia could be three episodes as the voids at 1.00am and 3.00am were preceded and followed by sleep but the return to sleep was delayed. This depends on whether the definition is strictly applied or not. Either way, the definition misses out on nocturia episodes.
2. Nocturia by 2018 definition: 4 (the total number of voids after falling asleep at 22.30 and before the individual decides to get up for the day at 08.00).

Scenario					
	1	2	3	4	5
Time					
10pm	Bed & Sleep	Bed	Bed	Bed	Bed
11pm		X	X	X	X
12am		Sleep	Sleep	Sleep	Sleep
1am					
2am	Wake to void X Sleep after Void	Wake to Void X Sleep after Void	Wake to Void X	Wake to Void X	Wake to Void X Sleep after Void
3am				X	
4am	Wake to Void X Sleep after Void	Wake to Void X Sleep after Void	X Sleep after Void	X Sleep after Void	Wake to Void X
5am					X Intention to Sleep but not able to
6am					
7am	Wake & Rise for the day	Wake & Rise for the day	Wake & Rise for the day	Wake & Rise for the day	Rise for the day
	NF: 2 N2002: 2 N2018: 2	NF: 3 N2002: 2 N2018: 2	NF: 3 N2002: 0 N2018: 2	NF: 4 N2002: 0 N2018: 3	NF: 4 N2002: 1 N2018: 3

**FIGURE 1** Different scenarios highlighting difference between the different definitions of night-time frequency (NF), previous nocturia definition (N2002), and new nocturia definition (N2018). (X denotes micturition)

Time	Notes (volume, etc.)
22:00	Woke up to go to bed (100 ml)
23:00	Woke up to go to bed (100 ml)
00:00	Woke up to go to bed (100 ml)
01:00	Woke up to go to bed (100 ml)
02:00	Woke up to go to bed (100 ml)
03:00	Woke up to go to bed (100 ml)
04:00	Woke up to go to bed (100 ml)
05:00	Woke up to go to bed (100 ml)
06:00	Woke up to go to bed (100 ml)

**FIGURE 2** Example of nocturia using a single night extracted from a bladder diary<sup>c</sup>

### 3.4 | Nocturnal polyuria (NP)

**2002:** Not defined as a symptom.

**2010:** Not defined as a symptom.

**2018:** Passing large volumes of urine during the main sleep period. This should be quantified using a bladder diary.

### 3.5 | Core reasons for change

The previous standardization reports have not highlighted nocturnal polyuria as a symptom, but looked at it as a sign. However, we know from clinical practice that patients can report passing large volumes of urine at night, especially relative to the day, and hence we have defined the symptom of nocturnal polyuria.

### 3.6 | Enuresis

**2002:** Any involuntary loss of urine. If it is used to denote incontinence during sleep, it should always be qualified with the adjective “nocturnal.”<sup>1</sup>

**2010:** Complaint of involuntary loss of urine which occurs during sleep.<sup>14</sup>

**2018:** Complaint of intermittent incontinence that occurs during periods of sleep. If it occurs during the main sleep period, then it could be qualified by the adjective “nocturnal.” The patient has to be asleep when enuresis happens and is usually unaware of it. If the patient is woken from sleep and then leaks or has incontinence then this would be classified according to the pathophysiology of incontinence while awake, for example, stress urinary incontinence, urgency urinary incontinence, mixed urinary

incontinence, etc. The timing of leakage, whether during sleep or after being woken up and then leaking, is established when taking a detailed clinical history from the patient by asking them, for example, “Does the wetting/leakage occur while you are asleep and unaware of it or do you get woken up and then leak?”<sup>d</sup>

### 3.7 | Core reasons for change

Enuresis is a symptom reflecting several different pathologies, previously believed to be a complete emptying of the bladder, but later identified as both complete and incomplete emptying of the bladder. The International Children's Continence Society (ICCS) defined nocturnal enuresis as both a symptom and a condition of intermittent incontinence that occurs during periods of sleep.<sup>17–19</sup> Previously it was wetting in discrete portions while asleep after the age of five. To ensure consistency between the ICCS and the ICS definitions, the ICS has adapted the ICCS definition.

## 4 | NOCTURNAL SIGNS

### 4.1 | Nocturia

**2002:** Not specifically defined.

**2010:** Not specifically defined.

**2018:** The number of times an individual passes urine during their main sleep period, from the time they have fallen asleep up to the intention to rise from that period. This is derived from the bladder diary.

In order to capture the frequency of nocturia, a bladder diary is needed on which the patient indicates the time of

falling asleep, the time when they decided they would no longer attempt to sleep, and all intervening voids. A bladder diary is needed to ascertain nocturnal urine production, with complete recording of all volumes voided during the main sleep period. Measurement of the frequency of nocturia begins after sleep and concludes before the first void following intention of getting up for the day.<sup>c</sup> The individual can also note why they went to void, for example, due to urgency, pain, etc.

## 4.2 | Nocturnal polyuria (NP)<sup>3–5</sup>

**2002:** Nocturnal urine volume output greater than 20% of the daily total urine output in the young and 33% in the elderly, with the value for middle age probably falling somewhere in the middle. Increased proportion of a 24-h urine output occurring at night (normally during the 8 h while the patient is in bed).<sup>12</sup>

**2010:** Excess (over 20–30%—age dependent) proportion (nocturnal voided volume/total 24 h voided volume  $\times$  100%) occurs at night (or when patient is sleeping).<sup>14</sup>

**2018:** Excessive production of urine during the individual's main sleep period. The definition used by the health-care provider to quantify “excessive” will need to be highlighted in both clinical and research settings and should be derived from a bladder diary.

## 4.3 | Core reasons for change

There have been numerous ways of classifying nocturnal polyuria.<sup>20</sup> From clinical practice, we have learned that the 20% and 33% numbers (the nocturnal polyuria index) are not well supported, as they were not based on normal distributions and were not properly validated. They also assumed that the index person is 70 kg and sleeps 8 h a day, irrespective of gender or age. Regardless of what definition is applied, the diagnosis of NP includes a differential diagnosis encompassing congestive heart failure, diabetes mellitus, obstructive sleep apnea, peripheral edema, excessive night-time fluid intake and “normal” ageing. Other factors which have been implicated in the causation of nocturnal polyuria are an abnormality in nocturnal secretion or action of arginine vasopressin (AVP) (this describes the classical nocturnal polyuria syndrome) and any edema-forming state (in addition to congestive heart failure, chronic renal disease, nephrotic syndrome, hypoalbuminemia, liver failure), co-morbidities such as autonomic nervous system dysfunction, Alzheimer's disease, multisystem atrophy, stroke, and Parkinsonism. Hence the need for standardization!

Terms that can be used to define urine production at night include:

1. 24-h urine production rate (mLs/h): volume of urine produced per hour in a 24 h period.
2. nocturnal urine production rate (mLs/h): nocturnal urine volume/length of time of main sleep period (mLs/h).
3. nocturnal urine production rate index: nocturnal urine production rate/24-h urine production rate.

Absolute and normal values are yet to be defined for the above terms, but will be dependent on fluid input, the population defined, and the gender. There are several definitions in the literature that could be used to indicate nocturnal polyuria<sup>f</sup> including:

1. Nocturnal urine production based on body weight of greater than 10 mLs/kg.<sup>21</sup>
2. Rate of nocturnal urine production >90 mLs/h.<sup>22</sup> This figure is suggestive of nocturnal polyuria in *men* only (about 450 mLs per 8 h sleep).<sup>23</sup> There are no studies looking at the rate of nocturnal urine production in women and this may well be different from that in men.
3. Nocturnal polyuria index is the most commonly used definition for nocturnal polyuria<sup>20</sup> (nocturnal urine volume/24-h voided volume)<sup>1</sup> based on nocturnal urine volume as part of total 24-h urine volume. It is age dependent; however the age groups have not been clearly defined:
  - a. 33% in elderly, for example, >65.
  - b. >20% in younger individuals.
  - c. 20–33% in “middle age.”
4. Nocturia index (nocturnal urine volume/maximum voided volume).<sup>24</sup>
  - a. >1: nocturia occurs because maximum voided volume is smaller than nocturnal urine volume.
  - b. >1.5: nocturia secondary to nocturnal urine overproduction in excess of maximum bladder capacity, that is, nocturnal polyuria.

One confounding issue is that if one uses an amount or volume as the indicator for nocturnal polyuria, then even with a normal distribution of day and night output, virtually all people with 24-h polyuria will have nocturnal polyuria. If one uses a percentage of total 24-h urine output, and if the normal circadian rhythm is preserved, they will not all have nocturnal polyuria. Whatever definition is used, it has to be clearly indicated in both clinical practice and research settings (Figure 3).

## 4.4 | Enuresis

**2002:** Not defined as a sign in previous terminology documents.

**2010:** Not defined as a sign in previous terminology documents.



**FIGURE 3** Example of Nocturnal Polyuria using a one-day bladder diary<sup>c</sup>

**2018:** Intermittent incontinence (“wetting”) that occurs during periods of sleep (while asleep).

NB. As in the symptoms section previously, this occurs while the patient is asleep and has not been woken up from sleep and then leaks. If it occurs during the main sleep period then it could be preceded by the adjective “nocturnal.”

**4.5 | Core reasons for change**

Previous definitions were not available for enuresis as a sign. Enuresis as a symptom has been defined as a complaint of intermittent incontinence that occurs during periods of sleep. As a sign, enuresis could be related to or be a manifestation of several different pathologies that the healthcare provider

would need to investigate, for example, high pressure urinary retention, overactive bladder, or neurogenic causes. Depending on the severity, it could be “wetting” the underclothes, outer clothes, or the bed.

#### 4.6 | Nocturnal urine volume

**2002:** The total volume of urine passed during the night, including the first morning void.<sup>1</sup>

**2010:** Cumulative urine volume from voids after going to bed with the intention of sleeping to include the first void at the time of waking with the intention of rising (excludes last void before sleep).<sup>14</sup>

**2018:** Total volume of urine produced during the individual's main sleep period, including the first void after the main sleep period.

Volume measurement begins after the last void preceding sleep and concludes after the first morning void. The first morning void follows the individual's decision they will no longer attempt to sleep.

#### 4.7 | Core reasons for change

Wording of previous definitions has been confusing. The new definition is practical and takes into account the fact that if an individual does not empty his/her bladder before falling asleep, then for pragmatic reasons it would be reasonable to include any volume produced after the last void before falling asleep as part of nocturnal urine produced. Alternatively, it would be best to advise individuals who are filling out a bladder diary or frequency/volume chart to void before going to sleep to make assessment of volumes passed easier by the healthcare provider when analyzing the diary or chart.

#### 4.8 | 24-h voided volume

**2002:** Total volume of urine voided during a 24 h period (1st void to be discarded; 24 h begin at the time of the next void).<sup>1</sup>

**2010:** Summation of all urine volumes voided in 24 h.<sup>14</sup>

**2018:** Total volume of urine passed during a 24-h period excluding the first morning void of the period. The first void after rising is discarded and the 24-h period begins at the time of the next void and is completed by including the first void, after rising, the following day.

#### 4.9 | Core reasons for change

Previous definitions needed further clarification to avoid confusion with regard to when the 24-h period begins and when it ends. The new definition clarifies this matter.

#### 4.10 | 24-h polyuria

**2002:** 24-h urine output >40 mL/kg, in men and women, causing daytime urinary frequency and nocturia occasioned by a general increase in urine output, outstripping even normal bladder capacity.<sup>1</sup>

**2010:** Excessive excretion of urine resulting in profuse and frequent micturition. It has been defined as over 40 mL/kg body weight during 24 h or 2.8 L urine for an individual weighing 70 kg.<sup>14</sup>

**2018:** The previous definitions have not been changed.

#### 4.11 | Core reasons for change

Since there was no new research or information on defining polyuria, the working group has decided to retain the previous definitions as volumes passed daily vary considerably, and are influenced by environmental, physiological, and pathological factors; which can affect the amount of fluid loss by other means, such as perspiration, and the amount of fluid intake.

### 5 | CONCLUSION

This standardization document on nocturia and nocturnal lower urinary tract function aimed to update previous standardization documents with emphasis on pragmatism and practicality when coming up with new definitions. These new definitions can be used both clinically and in research, allowing better communication and understanding between healthcare providers and researchers.



This document has involved 16 rounds of full review by co-authors of an initial draft (Version 1) completed on 3 October, 2014. Comments for each round of review were collated and debated as necessary in order to form a subsequent version. Live meetings on the document took place at the ICS annual meetings in Brazil (2014) and Tokyo (2016). The document was then sent to six experts for comments before the final version was produced. The document was also subject to general ICS membership review and reviews by the SSC and ICS Board.

### ACKNOWLEDGEMENTS

No discussion on terminology should fail to acknowledge the fine leadership shown by the ICS over many years. The legacy

of that work by many dedicated clinicians and scientists is present in all the reports by the different Standardisation Committees.

1. Bernard T. Haylen, University of New South Wales, Sydney. N.S.W. Australia: Chair of SSC at the time of publication.
2. Stergios Doumouchtsis, Epsom and St Helier University Hospitals NHS Trust, United Kingdom: SSC mentor.
3. Jeffrey Weiss, SUNY Downstate College of Medicine, New York, USA: Input into an early version (version 4) of the document.

#### External Reviewers

1. Paul Abrams, Bristol Urological Institute, Southmead Hospital, United Kingdom
2. Roger Dmochowski, Vanderbilt University School of Medicine, USA
3. Philip van Kerrebroeck, University Hospital Maastricht, Maastricht, The Netherlands
4. Dudley Robinson, King's College Hospital, London, United Kingdom
5. Ruud Bosch, University Medical Centre Utrecht, Utrecht, The Netherlands
6. Karel Everaert, Ghent University Hospital, Ghent, Belgium

#### ENDNOTES

<sup>a</sup> The first nocturia episode must be preceded by sleep. Subsequent nocturia episodes must be followed by the intention of getting back to sleep. The quality of life impact of nocturia is not an element in its definition but will be appropriately evaluated during its assessment by fully validated quality of life questionnaires.

<sup>b</sup> Definition of nocturia does not take into account whether this is bothersome or not, whether it is affecting quality of life or whether it needs treatment. The aim is to have a global pragmatic definition, rather than defining or suggesting a clinical pathological entity. For the healthcare provider, it is prudent that they state the cause of nocturia when reporting it clinically or for research purposes for each individual, in other words it has to be reported why the nocturia occurred, for example, due to urgency, pain, habit, etc.

<sup>c</sup> A 3-day bladder diary is the standard of care for the assessment of patients with lower urinary tract symptoms including nocturia and nocturnal polyuria.

<sup>d</sup> Enuresis can be primary (has been present lifelong) or acquired (developed in adults).

<sup>e</sup> The frequency with which a person passes urine during their main sleep period can be used as an indicator of the severity of their nocturia. It is known that this does not necessarily correspond with the quality of life impact of nocturia. The first void after the main sleep period follows the individual's decision that they will no longer attempt to sleep.

<sup>f</sup> The working group recognizes the limitations and difficulties that exist in defining nocturnal polyuria. It believes that there is not enough data in the literature to make a recommendation to adopt a new definition of nocturnal polyuria as a "sign" or to recommend one method of calculation over the other. Further research is needed into this field before adopting one of the methods of calculation as every definition above has limitations. However, the working group believes that the way forward for new research is to have an absolute number based on rate of urine production during the main sleep period or when the patient has gone to sleep, relative to the urine production rate in 24 h, for the various age groups and both genders. Ultimately, the definition will be used to aid treatment of a bothersome condition and the treatment will target the cause rather than the definition. The definition should also be easily usable in research. Whichever definition is used, the healthcare provider or researcher should specify exactly which parameter and method of calculation they have used to diagnose nocturnal polyuria.

#### ORCID

Hashim Hashim  <http://orcid.org/0000-0003-2467-407X>

Marco H. Blanker  <http://orcid.org/0000-0002-1086-8730>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

Peter Petros  <http://orcid.org/0000-0002-9611-3258>

Jian Guo Wen  <http://orcid.org/0000-0003-0952-118X>

#### REFERENCES

1. van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology in nocturia: report from the Standardisation Subcommittee of the International Continence Society. *Neurourol Urodyn*. 2002;21:179–183.
2. Irwin DE, Milsom I, Hunskaar S, et al. Population-based survey of urinary incontinence, overactive bladder, and other lower urinary tract symptoms in five countries: results of the EPIC study. *Eur Urol*. 2006;50:1306–114. discussion 14–5.
3. Cornu JN, Abrams P, Chapple CR, et al. A contemporary assessment of nocturia: definition, epidemiology, pathophysiology, and management—a systematic review and meta-analysis. *Eur Urol*. 2012;62:877–890.
4. Bing MH, Moller LA, Jennum P, Mortensen S, Lose G. Pathophysiological aspects of nocturia in a danish population of men and women age 60 to 80 years. *J Urol*. 2007;178:552–557.
5. Concise Oxford English dictionary [electronic resource] Oxford: Oxford University Press; 2011 [12th ed.= 1.0.]. <https://en.oxforddictionaries.com/definition/term>
6. Irwin DE, Kopp ZS, Agatep B, Milsom I, Abrams P. Worldwide prevalence estimates of lower urinary tract symptoms, overactive bladder, urinary incontinence and bladder outlet obstruction. *BJU Int*. 2011;108:1132–1138.
7. Gratzke C, Bachmann A, Descaseaud A, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *Eur Urol*. 2015;67:1099–1109.



8. Marshall SD, Raskolnikov D, Blanker MH, et al. Nocturia: current levels of evidence and recommendations from the international consultation on male lower urinary tract symptoms. *Urology*. 2015;85:1291–1299.
9. Bosch JL, Everaert K, Weiss JP, et al. Would a new definition and classification of nocturia and nocturnal polyuria improve our management of patients? ICI-RS 2014. *Neurourol Urodyn*. 2016; 35:283–287.
10. Pesonen JS, Cartwright R, Mangera A, et al. Incidence and remission of nocturia: a systematic review and meta-analysis. *Eur Urol*. 2016;70:372–381.
11. Bower WF, Rose GE, Ervin CF, Goldin J, Whishaw DM, Khan F. TANGO—a screening tool to identify comorbidities on the causal pathway of nocturia. *BJU Int*. 2017;119:933–941.
12. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
13. Stedman TL. *Stedman's Medical Dictionary*. 28th ed. Philadelphia: Lippincott Williams & Wilkins; 2006. xlix, 2169 p. p.
14. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
15. Tikkinen KA, Johnson TM, Tammela TL, et al. Nocturia frequency, bother, and quality of life: how often is too often? A population-based study in Finland. *Eur Urol*. 2010;57:488–496.
16. Zumrutbas AE, Bozkurt AI, Alkis O, Toktas C, Cetinel B, Aybek Z. The prevalence of nocturia and nocturnal polyuria: can new cutoff values be suggested according to age and sex? *Int Neurourol J*. 2016;20:304–310.
17. Franco I, von Gontard A, De Gennaro M. Society ICsC. Evaluation and treatment of nonmonosymptomatic nocturnal enuresis: a standardization document from the International Children's Continence Society. *J Pediatr Urol* 2013;9:234–243.
18. Austin PF, Bauer SB, Bower W, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the Standardization Committee of the International Children's Continence Society. *J Urol*. 2014;191:1863–5.e13.
19. Austin PF, Bauer SB, Bower W, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the standardization committee of the International Children's Continence Society. *Neurourol Urodyn*. 2016;35:471–481.
20. Hofmeester I, Kollen BJ, Steffens MG, et al. Impact of the International Continence Society (ICS) report on the standardisation of terminology in nocturia on the quality of reports on nocturia and nocturnal polyuria: a systematic review. *BJU Int*. 2015;115: 520–536.
21. Homma Y, Yamaguchi O, Kageyama S, Nishizawa O, Yoshida M, Kawabe K. Nocturia in the adult: classification on the basis of largest voided volume and nocturnal urine production. *J Urol*. 2000;163:777–781.
22. Blanker MH, Bernsen RM, Bosch JL, et al. Relation between nocturnal voiding frequency and nocturnal urine production in older men: a population-based study. *Urology*. 2002;60: 612–616.
23. van Doorn B, Blanker MH, Kok ET, Westers P, Bosch JL. Prevalence, incidence, and resolution of nocturnal polyuria in a longitudinal community-based study in older men: the Krimpen study. *Eur Urol*. 2013;63:542–547.
24. Burton C, Weiss JP, Parsons M, Blaivas JG, Coats AC. Reference values for the nocturnal bladder capacity index. *Neurourol Urodyn*. 2011;30:52–57.

**How to cite this article:** Hashim H, Blanker MH, Drake MJ, et al. International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function. *Neurourology and Urodynamics*. 2019;1–10.  
<https://doi.org/10.1002/nau.23917>



## A Standard for Terminology in Chronic Pelvic Pain Syndromes: A Report From the Chronic Pelvic Pain Working Group of the International Continence Society

Regula Doggweiler,<sup>1</sup> Kristene E. Whitmore,<sup>2\*</sup> Jane M. Meijlink,<sup>3</sup> Marcus J. Drake,<sup>4</sup> Helena Frawley,<sup>5</sup> Jørgen Nordling,<sup>6</sup> Philip Hanno,<sup>7</sup> Matthew O. Fraser,<sup>8</sup> Yukio Homma,<sup>9</sup> Gustavo Garrido,<sup>10</sup> Mario J. Gomes,<sup>11</sup> Sohler Elneil,<sup>12</sup> Joop P. van de Merwe,<sup>13</sup> Alex T.L. Lin,<sup>14</sup> and Hikaru Tomoe<sup>15</sup>

<sup>1</sup>Department of Urology, Hirslanden Klinik, Zürich, Switzerland

<sup>2</sup>Chair of Urology and Female Pelvic Medicine and Reconstructive Surgery, Drexel University College of Medicine, Philadelphia, Pennsylvania

<sup>3</sup>International Painful Bladder Foundation, Naarden, Netherlands

<sup>4</sup>Department of Urology, School of Clinical Sciences, University of Bristol, Bristol, United Kingdom

<sup>5</sup>Physiotherapy at La Trobe University, Melbourne, Cabrini Health, Melbourne, Australia

<sup>6</sup>Department of Urology, University of Copenhagen, Herlev Hospital, Herlev, Denmark

<sup>7</sup>Department of Urology, Division of Urology, University of Pennsylvania, Philadelphia, Pennsylvania

<sup>8</sup>Department of Urology Surgery, Duke University and Durham Veterans Affairs Medical Centers, Durham, North Carolina

<sup>9</sup>Department of Urology, The University of Tokyo, Tokyo, Japan

<sup>10</sup>Head of Voiding Dysfunctions and Urodynamics Section, Urology Division, Hospital de Clínicas, University of Buenos Aires, Argentina

<sup>11</sup>Department of Urology, St. António Hospital, Oporto, Portugal

<sup>12</sup>Department of Urogynecology, University College Hospital, National Hospital for Neurology and Neurosurgery, GB

<sup>13</sup>Department of Immunology, Erasmus MC, Rotterdam, Netherlands

<sup>14</sup>Department of Urology, Taipei Veterans General Hospital, National Yang Ming University, Taipei, Taiwan

<sup>15</sup>Department of Urogynecology, Chair of Pelvic Reconstructive Surgery and Urology, Tokyo Women's Medical University Medical Center East, Japan

**Aims:** Terms used in the field of chronic pelvic pain (CPP) are poorly defined and often confusing. An International Continence Society (ICS) Standard for Terminology in chronic pelvic pain syndromes (CPPS) has been developed with the aim of improving diagnosis and treatment of patients affected by chronic pelvic pain syndromes. The standard aims to facilitate research, enhance therapy development and support healthcare delivery, for healthcare providers, and patients. This document looks at the whole person and all the domains (organ systems) in a systematic way. **Methods:** A dedicated working group (WG) was instituted by the ICS Standardisation Steering Committee according to published procedures. The WG extracted information from existing relevant guidelines, consensus documents, and scientific publications. Medline and other databases were searched in relation to each chronic pelvic pain domain from 1980 to 2014. Existing ICS Standards for terminology were utilized where appropriate to ensure transparency, accessibility, flexibility, and evolution. Consensus was based on majority agreement. **Results:** The multidisciplinary CPPS Standard reports updated consensus terminology in nine domains; lower urinary tract, female genital, male genital, gastrointestinal, musculoskeletal, neurological aspects, psychological aspects, sexual aspects, and comorbidities. Each is described in terms of symptoms, signs and further evaluation. **Conclusion:** The document presents preferred terms and definitions for symptoms, signs, and evaluation (diagnostic work-up) of female and male patients with chronic pelvic pain syndromes, serving as a platform for ongoing development in this field. *Neurourol. Urodynam.* © 2016 Wiley Periodicals, Inc.

**Key words:** bladder pain syndrome; chronic pelvic pain syndromes; comorbidities; condition; disease; domain; female genital pain; gastrointestinal pain; Hunner lesion; hypersensitive bladder; interstitial cystitis; lower urinary tract pain; male genital pain; musculoskeletal pain; neurological aspects; phenotype; psychological aspects; sign; sexual aspects; symptom; syndrome

Dr. Alan Wein led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Regula Doggweiler: Consultant Astellas, Consultant Bene-Arneimittel GmbH. Kristene Whitmore: Research for Allergan, Coloplast. Sohler Elneil: Speaker Bureau for Allergan and Medtronic. Matthew O. Fraser: President at NeuroUroGastro Preclinical Research Consulting, LLC; Research for Astellas, Medtronic, Pfizer; SAB for Amphora Medical; Ad Board for Astellas, Synergy Pharmaceuticals; Consultant for InVivo Therapeutics, Circuit Therapeutics, Sanofi. Helena Frawley, Alex Lin, Jane Meijlink, Jørgen Nordling, and Hikaru Tomoe: no disclosure. Gustavo Garrido: Speaker for Allergan, Glaxo Smith Kline, American Medical Systems, Ferring, Research for Pfizer. Mario Gomes: posthumous no disclosure. Philip Hanno: Afferent, Astellas, Trillium, and Taris. Yukio Homma: Consultant for Astellas, Integral, Pfizer, Speaker Honorarium from Astellas, Pfizer, Taiho. Joop P. van de Merwe: speaker for ThermoFisher Scientific Benelux. Marcus J. Drake: speaker/research/Ad Boards for Allergan, Apogepha, Astellas, Ferring, Pfizer.

\*Correspondence to: Kristene Whitmore, Chair of Urology and Female Pelvic Medicine and Reconstructive Surgery, Drexel University College of Medicine, Philadelphia, PA. E-mail: bladder1@aol.com

Received 7 May 2016; Accepted 23 May 2016

Published online in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.23072

© 2016 Wiley Periodicals, Inc.

## INTRODUCTION

This is the first International Continence Society (ICS) published Standard of Chronic Pelvic Pain Syndromes (CPPS). Global standardization of terms and clear definitions are essential for scientific and clinical progress. Furthermore, meaningful coding of diseases, nationally and internationally, depends on accepted terminology. Inappropriate and unclear coding and definitions have negative effects not only on diagnosis, but also on the patient's ability to obtain appropriate treatment, reimbursement, and social benefits. The International Continence Society (ICS) has led the way in the development of Standards for terminology of lower urinary tract function and dysfunction,<sup>1</sup> and the need for a Standard in CPPS was identified by the ICS Standardisation Steering Committee (SSC).

Chronic pelvic pain (CPP) is the most common indication for referral to women's health services, and accounts for 20% of all outpatient appointments in secondary care.<sup>2</sup> This leads to a substantial burden on limited health care resources. For example, \$881.5 million are spent per year on its outpatient management in the USA, while an estimated £158 million are spent annually on management in the United Kingdom National Health Service.<sup>2</sup> CPPS are multifactorial and multidisciplinary conditions, and terminology can vary according to which specialist is looking at the patient. This document is an endeavour to look at the whole person and to consider all the domains involved. Each domain is described separately.

Pain in the pelvic area potentially includes urologic, gynecologic, gastrointestinal, musculoskeletal, neurologic and/or rheumatologic etiology, with psycho-social aspects, and hence must be regarded as a multidisciplinary issue. A taxonomy of the relevant elements of CPP was provided by the International Association for the Study of Pain (IASP).<sup>3,4</sup> Complementing the taxonomy, the European Association of Urology (EAU) Guidelines on Chronic Pelvic Pain provide a comprehensive overview of basic science pertaining to pelvic pain, clinical workup and management of CPPS.<sup>5</sup> This ICS Standard should be seen as complementary to other CPPS standards and guidelines. Its aims are to:

1. Describe the nine clinical domains involved in CPPS (summarized in Tables I–XI).
2. Define terminology.
3. Develop an evaluation guideline for each domain.
4. Establish a process for evolving terminology in response to scientific and clinical development and patient need.

This Standard for CPPS Terminology should facilitate future research and therapy development, improve cost effectiveness, and ensure access by the patient to appropriate treatment, reimbursement, and social benefits.

## METHODS

The CPPS Standard was developed according to the published methodology of the ICS Standardisation Steering Committee (SSC).<sup>6</sup> The Working Group (WG) and Chairperson were selected by an independent SSC sub-committee following an open advertisement. The WG comprised a multi-disciplinary group of health care providers, a basic science researcher, and a patient advocate. Activities of the WG and contributions of individual members were recorded in an open forum on the ICS website. The WG developed an outline of proposed content at an open workshop at the ICS annual scientific meeting in Beijing (2012). Successive iterations of the draft standard involved electronic communications, teleconferences, and face-to-face meetings. The WG reviewed documents that provided historical and research insight into the multidisciplinary approach to the evaluation of female and male CPPS.

A literature review covered the period 1980–2015 and extracted sources from electronic database searches, including MEDLINE and Cochrane. In addition, cross-referencing was done for existing relevant guidelines and consensus documents, notably:

- The EAU Guidelines on Chronic Pelvic Pain,<sup>5,7</sup> which place CPP in the clinical context.
- The American Urological Association (AUA) guidelines for the diagnosis and the treatment of IC/BPS.<sup>8,9</sup>
- The International Continence Society (ICS) joint/ICS joint report on the terminology for female pelvic floor dysfunction,<sup>10</sup> which covers terminology for female sexual dysfunction, genital pain, and pudendal neuralgia.
- The IASP Taxonomy, which classified pain on the basis of “organ + pain + syndrome” and applied it to pain of urogenital origin.<sup>3</sup>
- In 2008, the International Society for the Study of Bladder Pain Syndrome (ESSIC) published diagnostic criteria, classification, and nomenclature for bladder pain syndrome (BPS).<sup>11</sup>
- The East Asian IC Study Group/Society of Interstitial Cystitis of Japan (SICJ) guidelines, which revived the concept of hypersensitive bladder.<sup>12</sup>
- The Functional Gastro-Intestinal Disorder Society (FGIDS) Rome III Diagnostic Criteria<sup>13</sup> for gastro-intestinal disorders.

## RESULTS

The WG identified the following nine domains, each of which are considered in terms of symptoms, signs, and further evaluation.

### I. Lower Urinary Tract Domain

- A. Bladder.
- B. Urethra.

**II. Female Genital Domain**

- A. Vulva, vestibule, and clitoris.
- B. Intra-abdominal female genital pain.
- C. Pelvic floor muscle pain.

**III. Male Genital Domain**

- A. Prostate.
- B. Scrotum.
- C. Epididymis.
- D. Testicle.
- E. Penis.
- F. Urethra.
- G. Sexual Pain.

**IV. Gastro-Intestinal Domain**

- A. Anorectum.
- B. Colorectum.

**V. Musculoskeletal Domain**

- A. Pelvic muscle pain.
- B. Coccyx pain syndrome.
- C. Pelvic Joint, ligament, or bony pain.

**VI. Neurological Domain**

- A. Complex Regional Pain Syndrome (CRPS).
- B. Somatic neuropathic pain.
- C. Pain following mesh surgery.

**VII. Psychological Domain**

- A. Worry, anxiety, and fear.
- B. Depression and depressed mood.
- C. Catastrophizing.

**VIII. Sexual Domain**

- A. Sexual desire disorder.
- B. Sexual arousal disorder.
- C. Orgasmic disorder.
- D. Sexual pain disorder.

**IX. Comorbidities**

- A. Allergies.
- B. Chronic pain and fatigue syndromes.
- C. Systemic autoimmune syndromes/disease.
- D. Extraintestinal manifestations of inflammatory bowel disease.

**TAXONOMY**

**A. Pain**—A subjective phenomenon described as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.<sup>14</sup>

- a. Nociceptive pain: arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors.
- b. Somatic pain: arises from bone, joints, muscles, skin, or connective tissue and is normally achy or throbbing and well localized.
- c. Visceral pain: arises from visceral organs, with involvement of the organ capsule with aching, and is localized. There is obstruction of hollow viscus, causing intermittent cramping, which is poorly localized.<sup>15</sup>
  - i. Nociceptive: direct injury or lesion of an internal organ such as: bladder stone, surgical injury.
  - ii. Inflammatory: acute/chronic inflammation of an internal organ such as urinary tract infection, pelvic inflammatory disease, colitis, endometriosis.
  - iii. Neuropathic: primary lesion of visceral nerves such as neuritis following mesh placement.

*Neurourology and Urodynamics* DOI 10.1002/nau

#### 4 Doggweiler et al.

- d. Centrally generated pain/deafferentation pain: may result from injury to either the peripheral or central nervous system, leading to burning pain below the level of the lesion. It can be sympathetic-nervous system maintained pain, which may result in chronic regional pain syndrome (CRPS). There is increased responsiveness of nociceptive neurons in the central nervous system to normal or sub-threshold afferent input.
- e. Hypersensitivity: increased nerve activity from a standardized stimulus with an expected tissue/clinical response. The underlying mechanism remains to be defined.
- f. Central sensitization:<sup>16</sup> nociceptor sensitization results in synaptic strengthening by incoming afferent volleys (sensitization) and is expressed as hyperalgesia (a form of non-associative learning characterized by an increase in responsiveness upon repeated exposure to a stimulus).<sup>17</sup>

**B. Pain Experience**—According to the most common views, pain constitutes the internal perception of bodily damage. It is unknown whether chronic pelvic pain syndromes (CPPS) are primarily an abnormal perception of a normal stimulus or a normal perception of an abnormal physiologic sensory stimulus.<sup>14 FN1</sup>

**C. Psychology of Pain**—Pain is modulated by cognitive factors and emotional experience, memory, attention, and context represented in descending modulation of pain, affecting pain experience from moment to moment and longer term. Pain has an impact on many aspects of daily life, affecting mood, sleep, relationships, and activities. Therefore, attention to the psychological aspects of pain is an important part of effective assessment and treatment.<sup>18,19</sup>

**D. Neurobiology of Pain**—Alterations in gut and bladder motility, visceral perception and central processing of pain and motor function due to abnormalities in the visceral and central nervous systems may account for the symptoms.<sup>18 FN2</sup>

**E. Chronic Pelvic Pain**—Chronic pelvic pain is characterized by persistent pain lasting longer than 6 months or recurrent episodes of abdominal/pelvic pain, hypersensitivity or discomfort often associated with elimination changes, and sexual dysfunction often in the absence of organic etiology.<sup>20</sup>

#### F. Symptoms and Signs of Chronic Pelvic Pain Syndromes

- a. Symptoms: The subjective indicator of a disease or change in condition/syndrome/phenotype as perceived by the patient, caregiver or partner which may lead him/her to seek help from healthcare professionals.<sup>21</sup> The main symptom in CPPS is pain and will be described in relation to its domain and its perception. Complaint: what the patient describes when prompted by the physician.
- b. Signs are observed by the physician including simple means to verify symptoms and quantify them. To evaluate and discover all the signs, a full evaluation of the pelvis and body is necessary as multiple intra and extra-pelvic domains (organ systems) are commonly involved. It is necessary to attempt to identify all of the pain generators.<sup>11,21</sup>

#### G. Condition, Disease, Syndrome

- a. A condition is defined by the presence of observations associated with characteristic symptoms or signs and/or evidence of relevant pathological processes.<sup>7</sup>
- b. A disease is a disordered or incorrectly functioning organ, part, structure, or system of the body resulting from the effect of genetic or developmental errors, infection, poisons, nutritional deficiency or imbalance, toxicity, or unfavourable environmental factors; illness; sickness; ailment.
- c. A syndrome is a complex of concurrent symptoms and signs that is collectively indicative of a disease, dysfunction or disorder in the absence of obvious pathology. (NEW) Example: Interstitial Cystitis/Bladder Pain Syndrome (IC/BPS) is one of the Chronic Pelvic Pain Syndromes.<sup>1 FN3</sup>

#### H. Characteristics

- a. Duration of pain: Six months or more of persistent pain.<sup>FN4</sup>
- b. Location of pain: Pelvis, lower abdomen, low back, medial aspect of thigh, inguinal area, perineum.
- c. Perception of pain: Patients may describe the pain as sharp, burning, aching, shooting, stabbing, pressure or discomfort, sexual pain (dyspareunia).<sup>22 FN5</sup>
- d. Modality of pain (7): Persistent and/or continuous, recurrent and/or episodic and/or cyclic (related to menstrual cycle).

<sup>FN1</sup> Diagnosis is often based on the presence of clinical symptoms. The diagnosis of CPP is confirmed by applying symptom-based criteria and pursuing further diagnostic evaluation to exclude organic disease. Validation of symptom-based criteria is a process; it is not carved in stone and is easy to change as new data on its underlying pathophysiology emerge.<sup>3</sup>

<sup>FN2</sup> The brain-visceral axis and biopsychosocial model have been used to explain how intrinsic and extrinsic stimuli modulate disease expression.<sup>14,18</sup>

<sup>FN3</sup> This is an update of the ICS Standardisation Sub-committee report on the Standardisation of Lower Urinary Tract Function.<sup>1</sup>

<sup>FN4</sup> In different guidelines and standardisation documents, the duration varies from 6 weeks to 6 months.

<sup>FN5</sup> Some patients describe pain as an ache, soreness or simply discomfort, while cultural differences may influence perception of pain. For example, some patients describe an unpleasant sensation or pressure or discomfort, but do not consider these to be true pain. Memories, emotions, thoughts, expectations and culture are now believed to influence how people perceive pain.<sup>22</sup>

**I. Phenotype**—Subgroup of patients within a condition, disease, or syndrome that share similar expression of specific symptoms, signs and diagnostic parameters: Example: Irritable bowel syndrome has three phenotypes: constipation, diarrhea, or mixed constipation/diarrhea.<sup>5,23,24 FN6</sup>

Phenotyping is currently in its infancy with regard to evidence and will increase in importance in the future to aid in identifying specific patient pools for research and treatment.<sup>5,23</sup>

**J. Domain (organ system)**—Lower urinary tract, female genital, male genital, gastro-intestinal, musculoskeletal, neurological, psychological, sexual, and comorbidities are domains involved in chronic pelvic pain syndromes (CPPS).

Tables I–IX are a summary of the appropriate domain for domains I–IX and appear in the Symptoms section.<sup>25 FN7</sup>

## INDIVIDUAL PATIENT ASSESSMENT

### Section 1: Symptoms

The first and most important step is to obtain a thorough history of the patient's perception of her/his pain or discomfort. The common complaints are the most prevalent symptoms.

Ask about duration (at least 6 months), perception (identify inciting event and/or triggers), and modality (persistent/recurrent).

#### I. Lower Urinary Tract Domain (Table I)

##### A. Bladder

Common complaints include: increased urinary frequency day and night, urgency, hypersensitivity, pain, pressure, discomfort, pain with filling, hesitancy, intermittency, feeling of incomplete emptying. Pain/hypersensitivity related to the bladder provides an umbrella for hypersensitive bladder, interstitial cystitis/bladder pain syndrome, and interstitial cystitis with Hunner lesion.<sup>26–28</sup> Urgency: A compelling need to urinate which is difficult to defer (pain, pressure, discomfort).<sup>1,5,11,21,30–33 FN8 FN9</sup> The Working Group identified the following adjustments as applying more descriptively, for example, to Interstitial Cystitis/Bladder Pain Syndrome patients: a compelling need to urinate, due to pain or an unpleasant sensation, that is difficult to defer.<sup>FN10 FN11 FN12</sup>

As there are differences in symptoms as well as in the perception and experience of pain, the WG agreed to distinguish:

- Hypersensitive Bladder (HSB)(Japanese and East Asian guidelines). Hypersensitive bladder symptoms (increased bladder sensation, usually associated with increased urinary frequency day and night, with or without bladder pain) in the absence of pathology explaining the symptoms.<sup>29,30 FN13</sup>
- Interstitial Cystitis/Bladder Pain Syndrome (IC/BPS). Persistent or recurrent chronic pelvic pain, pressure or discomfort perceived to be related to the urinary bladder accompanied by at least one other urinary symptom such as an urgent need to void or urinary frequency.<sup>11</sup>
- Interstitial Cystitis (IC) with Hunner lesion has the same symptoms as IC/BPS.<sup>31 FN14 FN15</sup> Pain in IC/BPS and IC with Hunner lesion may be pain, pressure or discomfort, which may increase with bladder filling. Possible locations of perceived discomfort and pain are the pelvis, lower abdomen/suprapubic area, low back, medial aspects of the thigh, inguinal area, or multiple pain sites.<sup>11</sup> Descriptors/Perception of pain<sup>5</sup> include: "Sharp, burning, ache, shooting, stabbing, pressure, discomfort."

##### B. Urethra

Urethral pain is perceived to be in the urethra, usually when voiding, with increased day- and night-time frequency. It may be combined with a feeling of dull pressure, and sometimes radiates toward the groin, sacrum and perineum.<sup>1,7</sup> The terms "chronic urethritis" and "urethral syndrome" are no longer recommended.<sup>5,23</sup>

- Persistent or recurrent pain.
- No history of current infection or other obvious pathology.
- May be subsequent to a previous urinary tract infection.

<sup>FN6</sup>This has been adapted from the European Association of Urology Guidelines on Chronic Pelvic Pain.<sup>5</sup>

<sup>FN7</sup>Domains I–V involve intrapelvic organs, VI–IX involve overlying aspects including comorbidities.

<sup>FN8</sup>In the previous ICS LUTS document of 2002, urgency was defined as: the sudden complaint of a compelling desire to pass urine, which is difficult to defer.<sup>1</sup>

<sup>FN9</sup>This was a change from a previous definition in 1988 which stated that urgency may be associated with two types of dysfunction: (i) Overactive detrusor function (motor urgency), and (ii) Hypersensitivity (sensory urgency).<sup>30</sup>

<sup>FN10</sup>The change in definition in 2002 with introduction of the word "sudden" effectively restricted this term to overactive bladder syndrome and there was no mention of another sensation of urgency (urgent need to void) due to pain or hypersensitivity.

<sup>FN11</sup>The term hypersensitive bladder is a revival of an earlier ICS Document.<sup>30</sup>

<sup>FN12</sup>Hunner lesion is preferable to Hunner's ulcer.

<sup>FN13</sup>There is currently global discussion as to whether Hunner lesion should/could be completely separated from IC/BPS and if so what it should be called. It is felt that more research is needed to provide sufficient evidence for such a step.<sup>31</sup>

<sup>FN14</sup>The term vulvodynia is no longer recommended.<sup>3</sup>

<sup>FN15</sup>The terms Dyesthetic vulvodynia and Essential vulvodynia are no longer recommended.<sup>3,34</sup>



TABLE I. Lower Urinary Tract Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Increased daytime frequency Increased night-time frequency	Suprapubic tenderness Tenderness of the bladder	Questionnaires Voiding diary	Hypersensitive bladder Interstitial cystitis/bladder pain syndrome
Urgency	Tenderness of the pelvic floor muscles	Urine analysis	Interstitial cystitis/hunner lesion
Hypersensitivity		Optional: urine culture/cytology	
Pain, pressure, discomfort with bladder filling		Intravesical anesthetic challenge	
Hesitancy		Urodynamics	
Intermittency		Cystoscopy (biopsy)	
Feeling of incomplete bladder emptying			
Frequency/urgency painful urination	Tenderness of the urethra	Urine analysis	Urethral pain

II. Female Genital (Table II)

Common complaints: painful menstruation, abnormal bleeding, pain with intercourse (dyspareunia), discharge, burning, itching, stabbing pain, voiding/defecatory pain, abdominal/pelvic pain (unilateral or bilateral, persistent or cyclic).

Female genital pain is defined as pain perceived in the pelvis, pelvic organs, the vagina and/or the female external genitals.<sup>5,34</sup>

A. Vagina (Vulva, Vestibule, and Clitoris)

- 1. Pain in the vagina or the external genital organs (vulva, which includes the labia, clitoris and entrance to the vagina).<sup>5 FN14</sup>
- 2. Generalized vulvar pain syndrome.<sup>4</sup>
  - i. Diffuse vulvar pain perceived to be in the vestibule or beyond.
  - ii. Dyspareunia.
  - iii. Provocation of pain with touch, pressure or friction.<sup>3,34 FN15</sup>

- 3. Localized vulvar pain syndrome.<sup>4</sup>

Pain is usually provoked with touch, pressure, or friction; example: tight clothing, bicycle riding, tampon use, sexual activity.

- i. Vestibular pain syndrome—Pain localized to one or more portions of the vulvar vestibule.<sup>3,34 FN16 FN17</sup>
- ii. Clitoral pain syndrome—Pain localized to or perceived in the clitoris.

B. Intra-Abdominal Female Genital

- 1. Ovary
  - i. Unilateral or bilateral abdominal/pelvic pain.
  - ii. Persistent.
  - iii. Cyclic.
- 2. Pelvic Congestion Syndrome
  - i. Pressure, heaviness, dull aching pain in the pelvis and/or in the back.
  - ii. Dysmenorrhea.

C. Pelvic Floor Muscle<sup>5</sup> (See Domain V Musculoskeletal Pain)

- i. Urinary/defecatory dysfunction.
- ii. Dyspareunia (see also VIII sexual aspects).
- iii. Pain with sitting.
- iv. Bulging sensation.

D. Female Sexual Pain (See Domain VIII)

<sup>FN16</sup> The terms vulvar vestibulitis, vestibulodynia, and focal vulvitis are no longer recommended.<sup>34</sup>

<sup>FN17</sup> Differential diagnosis and treatable diseases: A history of infection (Pelvic Inflammatory Disease, sexually transmitted diseases, endometriosis, adenomyosis or fibroids, and Mullerian abnormalities should be excluded.

TABLE II. Female Genital Domain

Dyspareunia	Tenderness	Pain Mapping	Vaginal/vulvar/perineal pain
Sharp burning and/or stabbing Provocation of pain with touch Dysmenorrhea Abnormal menstrual bleeding Dyspareunia Itching, stabbing, burning pain Cyclic, (episodic or persistent)	Erythema  Tenderness: uterine, adnexal	Q-tip touch sensitivity test  Laboratory testing Pelvic ultrasound Laparoscopy/biopsy CT-scan	Intra-abdominal: Ovarian Pain Pelvic congestion Uterine pain Tubal pain

**III Male Genital Domain (Table III)**

Male genital pain syndromes are often associated with symptoms suggestive of lower urinary tract and sexual dysfunction. Common complaints: genital pain, uncomfortable urination, dysuria, sensation of residual urine, increased daytime frequency, slow stream, urgency, dyspareunia.<sup>4,5</sup> Absence of infection, previous operations, or other obvious pathology.

**A. Prostate**

Persistent or recurrent prostate pain, associated with symptoms suggestive of urinary tract and/or sexual dysfunction. No proven infection or other obvious pathology is present to account for the symptoms.<sup>3,35 FN18 FN19 FN20</sup>

Bladder, perineal, testicular, penile and/or groin pain.

- Perception of pain: variable.
- Persistent or recurrent.
- Dyspareunia or erectile dysfunction.
- Voiding and post micturition symptoms (for example: hesitancy, intermittency, feeling of incomplete emptying).

**B. Scrotum**

Chronic scrotal pain (generic term used when site of pain is not clearly in the testis or epididymis).<sup>23 FN21</sup>

- Persistent or recurrent episodic pain, unilateral or bilateral.
- Spontaneous, or reproduced by digital pressure and physical activities.
- Pain is not in the skin of the scrotum but perceived within its contents.
- Lower urinary tract symptoms or sexual dysfunction.

**C. Epididymis**

Pain is specific/localized to the epididymis.<sup>FN22</sup>

- Persistent or recurrent episodic pain.
- Spontaneous, or reproduced by digital pressure and physical activities.
- Lower urinary tract symptoms or sexual dysfunction.

**D. Testicle**<sup>23 FN23</sup>

- Persistent or recurrent episodic pain.
- Spontaneous, or reproduced by digital pressure and physical activities.
- Lower urinary tract symptoms or sexual dysfunction.

**E. Penis**

Pain within the penis that is not primarily in the urethra<sup>FN24</sup> and may be:

- Persistent or recurrent.
- Spontaneous, or reproduced by digital pressure and physical activities.
- Lower urinary tract symptoms or sexual dysfunction.

**F. Urethra**

(See Domain I Lower Urinary Tract)

<sup>FN18</sup> Using the National Institutes of Health classification system, prostate pain syndrome may be subdivided into type A (inflammatory) and type B (non-inflammatory).<sup>35</sup> Nickel JC. Prostatitis and related conditions, orchitis and epididymitis. In: Campbell-Walsh, editor. Urology. Philadelphia: Elsevier; 2012.

<sup>FN19</sup> Based on a more general definition, the term prostate pain syndrome (PPS) is used by the European Association of Urology (EAU) instead of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) term chronic prostatitis/chronic pelvic pain syndrome.

<sup>FN20</sup> The terms "Chronic Prostatitis" and "Prostatodynia" are no longer recommended.

<sup>FN21</sup> It may be associated with a congestive epididymitis. Example: after vasectomy. It can result from a mechanical pressure more often than an inflammatory process.

<sup>FN22</sup> It may occur at any age, but the majority of cases are in the mid to late thirties and it may be disabling and associated with anxiety about cancer.<sup>36</sup>

<sup>FN23</sup> Pain is localized to the testis and could be explained by neural plasticity when subsequent to a trauma or disease and this phenomenon can result from the amplification of the pain messages at all levels of nervous system.<sup>22</sup> The previous terms "Chronic Orchitis," "Orchalgia," or "Orchiodynia" are no longer recommended.

<sup>FN24</sup> The most common site for referral to the penis is from the bladder outlet.

TABLE III. Male Genital Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Pain	Tenderness on rectal/genital examination	Questionnaires	Prostate pain
LUTS	Urethral discharge	Culture	
Dyspareunia		PSA/biopsy	
Erectile dysfunction		Cystoscopy/biopsy	
Persistent or episodic		Ultrasound	
	Tenderness on physical examination	Questionnaires	Scrotal pain
	Scars	Ultrasound	Epididymal pain
			Testicular pain
			Penile pain

**G. Sexual Pain**  
(dyspareunia; (see Domain VIII)  
i. Penile

- 1. Prior to penetration (example: pain with erection).
- 2. With penetration.
- 3. Post coital.

ii. Perineal

- 1. During intercourse.
- 2. After intercourse.

iii. Orgasmic Pain (during ejaculation)

- 1. Penile.
- 2. Anorectal.
- 3. Pelvic.

**IV Gastro-Intestinal (Table IV)**

Common complaints: constipation, diarrhea and obstructive defecation, pain with defecation, bleeding, discharge, cramping abdominal pain, recurrent rectal pain, rectal pressure, burning sensation or aching episodes.<sup>37 FN25</sup>

**A. Anorectum (7) (4)**

- 1. Chronic Proctalgia—rectal pain, more than 20 min of duration per episode, for at least 3 months with symptom onset at least 6 months prior to diagnosis.
  - i. Persistent or recurrent rectal pain.
  - ii. Rectal pressure or aching episodes.
  - iii. In the absence of other causes of rectal pain.
- 2. Levator Ani Syndrome (the term may refer to the same syndrome as “pelvic floor muscle pain syndrome”/“tension myalgia of the PFM”—see Domain V).
  - i. Pain with sitting.
  - ii. Pain with defecation.
- 3. Proctalgia Fugax
  - i. Severe recurrent episodic pain localized in the anus or lower rectum.
  - ii. Duration seconds to minutes.
  - iii. No pain between episodes.

**Consider the Symptoms of the Following Treatable Diseases, as They Need to Be Excluded**

- 4. Anal Fissure<sup>38</sup>
  - i. Bright red bleeding with bowel movements.
  - ii. Anal pain or spasms that can last hours after bowel movements.<sup>38</sup>
  - iii. Pain with sitting.
- 5. Abscess
  - i. Pelvic rectal pain.

<sup>FN25</sup>Chronic Gastro-Intestinal pain includes syndromes and diseases that have obvious pathologies, but similar symptoms.

TABLE IV. Gastro-Intestinal Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Pain with defecation	Tenderness on rectal examination	Questionnaire	Ano-rectal pain
Evacuation dysfunction		Culture	
Pain/pressure with sitting		Colonoscopy/biopsy	
Abdominal pain	Abdominal tenderness		Colo-rectal pain
Nausea	Bloating	Ultrasound	
Constipation/diarrhea		CT/barium enema/MRI	
Persistent or episodic			

ii. Tenesmus<sup>39</sup> (persistent painful need to defecate despite an empty colon).

iii. Pain with sitting.

#### 6. Hemorrhoids<sup>40–42</sup>

i. Anal discomfort with engorgement.

ii. Pain and itching.

iii. Lump in perianal area.

iv. Pain with defecation.

v. Internal hemorrhoids—Painless bleeding, mucus discharge, incomplete evacuation.

vi. External hemorrhoids—Anal discomfort with engorgement, pain, and itching.

vii. Thrombosed External Hemorrhoids- Exquisitely painful lump in the perianal area. The pain tends to be acute at onset. Typically following straining at the time of bowel movement or physical exertion.

7. Anorectal Crohn's Disease—May be asymptomatic, with possible anal pain during flare.<sup>43</sup>

### B. Colorectum (ROME III Criteria)

Rome III Criteria are a standard for functional gastrointestinal disorders. The Rome III Criteria are a system developed to classify the **functional gastrointestinal disorders (FGIDs)** of the digestive system, in which symptoms cannot be explained by the presence of structural or tissue abnormality, based on clinical symptoms. Some examples of FGIDs include irritable bowel syndrome, functional dyspepsia, functional constipation, and functional heartburn.<sup>13</sup>

#### 1. Irritable Bowel Syndrome (IBS) Functional (non-inflammatory)

i. Recurrent episodes of abdominal pain.

ii. Changes in frequency, form or consistency of the stool.

iii. Sensation of incomplete evacuation, straining, fecal urgency.<sup>44</sup>

iv. Sensation of nausea, fatigue, fullness, vomiting.

v. Recurrent abdominal pain or discomfort at least 3 days/month in the last 3 months associated with two or more of the following:

1. Improvement of pain with defecation.

2. Onset associated with change in frequency of stool.

3. Onset associated with a change in the form (appearance) of stool.<sup>45</sup>

### Note: Consider the Symptoms of the Following Disease

Inflammatory Bowel Disease (IBD)—Complaint of recurrent abdominal pain and discomfort of at least 3 days per month in the last 3 months. The majority of IBD patients experience periods of flares and remission.

i. Abdominal and anal pain, diarrhea which may be associated with blood, suggestive of ulcerative colitis.

ii. Abdominal pain, fatigue, prolonged diarrhea with crampy abdominal pain, weight loss, and fever, with or without gross bleeding. Irregular bowel habits, with possible blood in the stool, are suggestive of Crohn's disease.<sup>45</sup>

### V. Musculoskeletal Domain (Table V)

Musculoskeletal pain may originate from muscles, fascia, ligaments, joints, or bones.

TABLE V. Musculoskeletal Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Abdomino-pelvic-perineal pain	Altered muscle tone Tension; muscle spasms and muscle compliance	Questionnaires Pain mapping	Pelvic muscle pain syndrome Coccyx pain syndrome
Pain at rest, with movement, with sitting, with sexual activity	Stiffness muscle tightness	Ultrasound	Pelvic joint, ligament or bony pain
Pain with voiding or bowel evacuation	Trigger point tenderness		
Unilateral or bilateral pain	Tender taut band		
Persistent or episodic	Twitch response, referred pain		

Neurourology and Urodynamics DOI 10.1002/nau

## 10 Doggweiler et al.

Common complaints: abdominal/pelvic pain, pain with sitting or with movement or with change of posture, with sexual activity, unilateral or bilateral pain. Possible pain with voiding or bowel evacuation.

### A. Pelvic Muscle Pain<sup>10,46</sup> (See also Domain IV)

1. Pelvic Floor Muscle Pain (Pelvic Floor Myalgia)<sup>FN26</sup>
  - i. Pain in the muscles of the pelvic floor (perineal or levator ani).
2. Intra-pelvic Muscle Pain
  - i. Pain in the pelvic side wall muscles (obturator internus, piriformis, coccygeus).
3. Anterior Pelvic/Lower Abdominal Muscle Pain
  - i. Pain in the rectus abdominus, oblique or transverse abdominus muscles, described below the umbilicus.
4. Posterior Pelvic/Buttock Muscle Pain
  - i. Pain in the gluteal muscles.

### B. Coccyx Pain Syndrome

- i. Complaint of chronic or recurrent pain in the coccyx or sacro-coccygeal joint.

### C. Pelvic Joint, Ligament, or Bony Pain

1. Joint pain
  - i. Sacroiliac or pubic symphysis joint.
2. Ligament pain
  - i. Sacro-spinous or Sacro-tuberous ligament.
3. Bony pain
  - i. Pain described in or along the margins of the pubic ramus, ilium, ischial spine or ischial tuberosity.

## VI Neurological Aspects Domain<sup>47</sup> (Table VI)

Common complaints: Burning, throbbing, stabbing, electric shock-like sensation, tingling, stinging and/or paresthesia pain in the pelvis and/or perineal region.

### A. Complex Regional Pain Syndrome<sup>48</sup> (CRPS)

Sympathetic, centrally generated pain.

1. CRPS 1- Triggered by tissue injury with no underlying nerve injury.
2. CRPS 2- Associated with nerve injury.
  - i. Burning pain.
  - ii. Increased skin sensitivity.
  - iii. Changes in skin temperature, color, and/or texture.

### Note: Consider Differential Diagnosis:

#### B. Somatic Neuropathic Pain—Nerve injury (stretching, blunt trauma, compression, entrapment, suture ligature).

1. Sacral nerve (disease)<sup>49</sup>
- iv. Pudendal neuralgia is a disabling form of pelvic pain. It is related to a ligamentous nerve compression mechanism. This pain is associated with the second stage of labor, sacrospinous vault suspension, vaginal laceration repairs, prostatectomy, straddle injuries, prolonged motorcycle riding, and laser treatment to the vulva, scrotum and/or perineum.
  1. Unilateral or bilateral.
  2. Lancing burning pain in the clitoris, penis, urethra, labia, scrotum, perineum and/or anus.
  3. Worse with sitting.
  4. Relieved by standing or supine position.
3. Thoracolumbar nerve (disease)<sup>50 FN27</sup>

<sup>FN26</sup> International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the conservative management of female pelvic floor dysfunction (under review).<sup>51</sup>

<sup>FN27</sup> Irritation of the thoracolumbar facet joints causes pain referred to the distribution of nerves T12, L1, and L2. This results in pain to the iliac crest and buttock. Frequently seen after abdominal and/or pelvic surgery.<sup>50</sup>

TABLE VI. Neurological Aspects Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Characteristic sensation descriptions: burning, throbbing, stabbing, tingling, stinging, shooting, electric shock-like sensation paresthesia, atrophy, persistent or episodic	Tenderness (nerve distribution)	Questionnaires	Somatic neuropathic pain
	Referred pain	Quantitative sensory testing	Complex regional pain syndrome
	Possible skin change (color, temp, texture)	Pain mapping	
		Nerve block imaging Ultrasound MRI	

## i. Ilioinguinal nerve.

1. Pulling or throbbing that limits physical activity (groin, labia scrotum inner thigh).

## ii. Iliohypogastric nerve.

1. Pulling or throbbing sensation that limits physical activity (suprapubic area and groin).

iii. Genitofemoral nerve<sup>52</sup>

1. Burning, paresthesia and pain (groin, labia or scrotum, medial thigh).

## iv. Obturator nerve

1. Medial thigh or groin pain.
2. Weakness with adduction of the thigh.

**C. Pain Following Mesh Surgery<sup>34,53</sup>**

- i. Pain during physical activity.
- ii. Dyspareunia.
- iii. Vaginal discharge.
- iv. Exposure of mesh in vagina or elsewhere.

**VII Psychological Aspects Domain** (Table VII)

Common complaints: worry, anxiety, low mood, frustration, sleep disturbance, helplessness, hopelessness, difficulty in concentrating, pain impairing enjoyment. These all have biopsychosocial aspects.<sup>54</sup>

The **biopsychosocial model** in pain medicine was introduced with the publication of the Gate Control Theory of Pain. It is suggested that in the perception of pain three different inputs are involved: the sensory-nociceptive, the affective-motivational and the cognitive-evaluation input. These could differ within individuals, but all of these are involved in the human experience of pain.<sup>55</sup>

Psychological distress as a biopsychological aspect is most often a consequence of persistent pain, although existing distress is likely to exacerbate the experience of pain and difficulties dealing with it. Findings support growing evidence that the negative affective, cognitive and psychosocial state of chronic pain is universal, regardless of a neuropathic, or nociceptive nature. Emotions, thoughts and behavior involve many different locations in the brain and multiple psychological processes are involved in neuromodulation of pain.<sup>18,54</sup>

**A. Worry, anxiety, fear:** Pain is interpreted as a message of something seriously wrong with the body at the point where the pain is felt, consistent with models of severe acute pain. Without an explanation for chronic pain, anxiety is likely to persist and results in attempts to avoid activities which exacerbate the pain or are expected to do so.

**B. Depression and depressed mood:** This is predominantly pain-related and concerns loss of valued activities and roles as a result of pain. Difficulty sleeping, difficulty concentrating, helplessness, and hopelessness about finding a solution to the pain or a way of living a worthwhile life despite pain are common.

**C. Catastrophizing:** a tendency to overattend (magnification) to pain stimuli, with overestimation of the threat value and underestimation (hopelessness and helplessness) of the capacity to deal with the threat.

TABLE VII. Psychological Aspects Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Worry, anxiety, fear	Helplessness	Formal psychological assessment	Worry/anxiety/fear
Catastrophizing	Hopelessness	Asking the patient what is wrong and what worries her/him about pain	Depression
Persistent or episodic	Avoidance of certain activities	Questionnaires	

Neurourology and Urodynamics DOI 10.1002/nau



12 Doggweiler et al.

VIII Sexual Aspects Domain (Table VIII)

Common Complaints: Low sex drive, inability to become aroused, pain with intercourse, difficulty reaching orgasm. Sexual dysfunction is a disturbance in the sexual response cycle or pain associated with sexual intercourse, and can take a heavy psychological toll; it is associated with depression, anxiety, and debilitating feelings of inadequacy.<sup>56</sup> It is appropriate to investigate for possible history of sexual/physical abuse. Dyspareunia is a biopsychosocial phenomenon that can have physical and psychosocial implications for the individual as well for the relationship.<sup>57</sup> Decrease in self-esteem, depression, anxiety, fatigue, and the need to use pain medication and other medications increase the likelihood of one or more of the disorders. Superficial or entry dyspareunia is often associated with provoked vaginal-vulvar pain syndrome. Deep or thrusting dyspareunia often occurs in association with lower urinary tract pain, musculoskeletal pain, gastrointestinal pain, as well as abdominal/pelvic pain.<sup>58,59</sup> Female and male sexual function is adversely affected in most patients with chronic pelvic pain, resulting in more than one comorbid disorder. More than 50% of partners are significantly affected and develop sexual dysfunction.

A. Sexual Desire Disorder

The following definitions form part of the DSM IV TR<sup>60,61</sup> FN28

- 1. Hypoactive Sexual Desire Disorder (HSDD)
  - i. Low sex drive.
  - ii. An absence of sexual fantasizing or erotic thoughts.
  - iii. No longer feeling aroused or excited during sex.
  - iv. A substantial decrease in sexual activity with partner, persisting for more than 6 months.
- 2. Sexual aversion disorder
  - i. Persistent or recurrent aversion to, or avoidance of, sexual activity.
  - ii. When presented with a sexual opportunity, the individual may experience panic attacks or extreme anxiety.

B. Sexual Arousal Disorder

- i. Persistent or recurrent inability to become sexually aroused.
- ii. Often characterized by inadequate vaginal lubrication for penetration (female).
- iii. Inability to achieve or maintain an adequate erection for penetration (male).
- iv. Symptoms present for more than 6 months.

C. Orgasmic Disorder

- i. Difficulty or delay in reaching orgasm, after sufficient sexual stimulation (female).
- ii. Premature or delayed ejaculation (male).
- iii. Present for more than 6 months.

D. Sexual Pain Disorder

- 1. Dyspareunia
  - i. Female sexual pain: Burning, ripping, tearing, or aching sensation associated with penetration. The pain can be at the vaginal opening, deep in the pelvis, or anywhere between. It may also be felt throughout the entire pelvic area and the sexual organs and may occur only with deep thrusting.
  - ii. Male sexual pain: Sexual activity may induce a central sensitization process characterized by hypersensitivity or hyperalgesia.

History should include duration of symptoms, identification of disorder, impact on quality of life, and partner relationship. Partner interviews may be very helpful as erectile dysfunction, delayed or premature ejaculation in males with hypoactive sexual desire disorder result in a 4–30 times increased risk of female partner desire, arousal or orgasmic disorder.

TABLE VIII. Sexual Aspects Domain

Symptoms	Signs	Evaluation	Syndrome/disease
Lack of desire, arousal, orgasm Dyspareunia Persistent or episodic	Depression Relationship issues	Questionnaires Laboratory (hormonal and complete metabolic panel) Doppler ultrasound	Sexual dysfunction

IX Comorbidities (Table IX)

Patients with chronic pelvic pain syndromes, and in particular those with interstitial cystitis/bladder pain syndrome (IC/BPS), have a higher prevalence of one or multiple comorbid syndromes and diseases than the general population. These include: allergies, non-cancer chronic pain, fatigue syndromes and systemic autoimmune diseases. The risk of a comorbidity in patients

FN28 Minimal data are available utilizing DSM 5 criteria, DSM IV TR was thus utilized. The Diagnostic and Statistical Manual of Mental Disorders, published by the American Psychiatric Association, offers a common language and standard criteria for the classification of mental disorders.<sup>60</sup>

TABLE IX. Comorbidities

Symptoms	Signs	Evaluation	Syndrome/disease
Allergies	Fatigue	General medical evaluation	Allergies
Fatigue	Skin lesions	Laboratory	Chronic pain and fatigue syndrome
Widespread muscular and joint pain	Dry eye	Imaging	Systemic autoimmune diseases
Irritation of the eyes	Muscular skeletal tenderness		
Dryness			
Sleep disorder			

affected by IC/BPS is usually between two and ten times higher than in a healthy population. However, data from studies on comorbidities in chronic pelvic pain patients are difficult to interpret as the composition of study populations and methodology are highly variable. Information on the prevalence of comorbidities is therefore often obtained from studies on IC/BPS.<sup>62–66</sup>

#### A. Allergies

Allergies are a heterogeneous group of diseases with involvement of the airways, skin, and sometimes of other organs. Symptoms are caused by an immunologic reaction to some kind of trigger (e.g., inhaled allergens such as dust mite allergen, pet dander, pollen, mold, food, drugs). Nonallergic reactions to drugs or food may cause symptoms similar to allergic reactions.<sup>67</sup> Examples include allergic asthma, allergic rhinitis (hay fever), atopic dermatitis (eczema), allergic drug reactions and allergic food reactions (tingling mouth, swelling of the lips, tongue, face or throat), hives, anaphylaxis, and atopic dermatitis.<sup>68</sup>

#### B. Chronic Pain and Fatigue Syndromes

Chronic pain and fatigue syndromes are characterized by pain, often widespread; fatigue; sleep disturbances; and disability. The symptoms are usually medically unexplained, have no known pathophysiology or organic basis and show no abnormal laboratory or imaging investigations. The literature suggests that many of these conditions share demographic characteristics, clinical course and psychosocial profiles.<sup>69</sup> Examples are:

1. Fibromyalgia: symptoms are widespread musculoskeletal pain, fatigue, non-restorative sleep, psychological distress, and regions of localized tenderness.
2. Temporomandibular Joint Disorders: symptoms consist of complaints of facial, jaw, neck, or shoulder pain. The pain is experienced in or around the ear with chewing, speaking, or opening the mouth, with or without migraine.
3. Chronic Fatigue Syndrome: is defined as clinically evaluated, unexplained, persistent or relapsing fatigue plus four or more specifically defined associated symptoms (self-reported impairment in short term memory or concentration; sore throat; tender cervical or axillary nodes; muscle pain; pain in multiple joints without redness or swelling; headaches of a new pattern or severity; unrefreshing sleep).<sup>70</sup>

#### C. Systemic Autoimmune Syndromes/Diseases

Systemic or generalized autoimmune diseases are a heterogeneous group of diseases with multi-organ involvement and evidence indicating a role played by the immune system in the pathogenesis. Examples are systemic lupus erythematosus (SLE), Sjögren's syndrome, and rheumatoid arthritis (RA). Many patients can be diagnosed with more than one of these diseases, or also with fibromyalgia and irritable bowel syndrome.

1. Systemic Lupus Erythematosus (SLE). Most frequent symptoms are debilitating fatigue, arthritis, red skin lesions after sun exposure such as a red butterfly lesion of the face, pericarditis and pleuritis, glomerulonephritis. The prevalence is 10× higher in females than in males and 2× more frequent in non-white people.
2. Sjögren's Syndrome is a systemic autoimmune disease characterized by a functional disorder of the tear and salivary glands, with or without signs of inflammation. The most common symptoms are irritation of the eyes, a dry mouth, muscle and joint pain, (debilitating) fatigue and Raynaud phenomenon.
3. Rheumatoid Arthritis (RA) is a disease characterized by chronic symmetric polyarthritis resulting in painful swelling of the joints. Other symptoms are morning stiffness, rheumatoid nodules and typical changes on hand and wrist radiographs.

**D. Extraintestinal Manifestations of Inflammatory bowel disease (IBD)** include non-destructive arthritis of large joints or axial arthritis such as sacroiliitis, inflammation of the eyes (uveitis, scleritis), or inflammation of the skin (erythema nodosum, pyoderma gangrenosum).<sup>71</sup>

### Section 2: Signs

#### Generalized Physical Examination

A comprehensive physical examination should be performed, including palpation of the lower abdomen for bladder fullness and tenderness, and a complete pelvic exam to identify pain generators and referred pain patterns:

1. Observe posture, gait and protective behavior (avoiding sitting on flat surface or standing to avoid sitting, neck folding posture).
2. Standing: kyphosis, scars, hernia.
3. Supine: abduction/adduction of the hips, hyperaesthetic areas, scars, hernia.
4. Comprehensive pelvic examination for female and male.
5. Pain mapping (identification of pain generators/trigger points and referred pain).<sup>72</sup>

## 14 Doggweiler et al.

**I Lower Urinary Tract****A. Bladder/Urethra**

1. Suprapubic tenderness.
2. Tenderness of the bladder.
3. Tenderness of the urethra.
4. Tenderness of the pelvic floor muscles and identification of trigger points.<sup>46</sup> (See Domain V).

**II Female Genital<sup>5</sup>****A. Vulva, Vestibule, and Clitoris**

Generalized vulvar pain syndrome refers to a vulvar pain syndrome where the pain/burning cannot be consistently and precisely localized by point-pressure “mapping” via probing with a cotton-tipped applicator or similar instrument. Tenderness is diffuse and may affect all locations of the vulva.<sup>FN29</sup>

## 1. Localized and Generalized Vulvar Pain Syndrome

- i. Tenderness, Q-Tip touch sensitivity test.<sup>72</sup>
- ii. Erythema (localized or generalized).
- iii. Fissures.
- iv. Ulcers.

**B. Intra-Abdominal Female Genital**

1. Uterus and Fallopian Tube
  - i. Uterine tenderness.
  - ii. Cervical discharge, cervical excoriation, tenderness, adnexal tenderness, erythema.
  - iii. Extrauterine tenderness, decreased uterine mobility, adnexal mass.
  - iv. Enlarged uterus, nonspecific tenderness.
  - v. Abdominal or pelvic scars, neuroma.
2. Ovary; adnexal mass, tenderness, abdomino-pelvic scar.
3. Pelvic Congestion Syndrome: Labia varicosities, non-specific abdominal tenderness.
4. Cervix: Erosion, Nabothian follicles, discharge, bleeding.

**C. Pelvic Floor Muscle** (See Domain V)

1. Perineal scarring, neuroma, dermal cutaneous allodynia.
2. Tenderness (local and/or referred to another pelvic location).
3. Vaginal discharge, mesh extrusion.<sup>53</sup>
4. Bulging.
5. Mass, radiation changes.

**III Male Genital**

A comprehensive physical examination should be performed in standing (example: exclusion of varicocele) and supine positions, including observation and palpation with pain mapping (identification of pain generators) of the external male genitals, and rectal examination.<sup>FN30</sup>

**A. Prostate**

1. Prostate tenderness on rectal examination.
2. Possible urethral discharge.

**B. Scrotum**

1. Tenderness on physical examination.
2. Change in color.
3. Masses on palpation.
4. Scars post-vasectomy.
5. Allodynia (increased perception of pain).

**C. Epididymis**

1. Tenderness.

<sup>FN29</sup> The vulvar vestibule (part of the vulva which lies between the labia minora into which the urethral meatus and vaginal introitus open) may be involved, (but the discomfort is not limited to the vestibule and may include referred pain from the other CPPS domains).

<sup>FN30</sup> Tenderness might be graded as mild, moderate, or severe.

2. Masses, nodules.

#### D. Testicle

1. Tenderness.
2. Masses, nodules.

#### E. Penis

1. Tenderness.
2. Curvature.
3. Nodules/plaque.

#### F. Urethra

1. Tenderness.
2. Discharge.

### IV Gastro-Intestinal

#### A. Anorectum

1. Chronic Proctalgia—Identification of tenderness on rectal exam<sup>3</sup>
2. Levator Ani Syndrome—Identification of tenderness during posterior traction on the puborectalis.
3. Proctalgia Fugax—Usually there is no evident sign on physical examination.<sup>40</sup>
4. Anal Fissure—Identification of separation of the anoderm, sentinel tag at the external apex, exposed internal sphincter muscle, hypertrophic anal papilla at the internal apex.<sup>38</sup>
5. Abscess—Identification of fluctuant collections in the perianal tissues, drainage (fistula).<sup>39</sup>
6. Hemorrhoids—Identification of skin tags, thrombosis, prolapse on straining (reducible and irreducible).
  - i. Internal: Located proximal to the dentate line and covered by columnar epithelium.
  - ii. External: Located distal to the dentate line and covered by modified Squamous epithelium (anoderm)
  - iii. Thrombosed: Painful lump in the perianal area.<sup>41,42</sup>
7. Anorectal Crohn's Disease—Identification of skin tags, hemorrhoids, fissures, anal ulcers, strictures, abscess, fistula, severe proctitis.<sup>43</sup>

#### B. Colorectum (IBS, IBD)

1. Abdominal tenderness.
2. Watery or bloody diarrhea.
3. Rectal bleeding.
4. Weight loss.
5. Fever.

### V. Musculoskeletal

The musculoskeletal structures are examined for signs of tenderness and altered tension or abnormal movement.<sup>73–76</sup> FN31

1. Muscle tone: State of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement. Muscle tone has two components: (i) the contractile component, created by a low-frequency activation of a small number of motor units; (ii) the viscoelastic component, which is independent of neural activity and reflects the passive physical properties of the elastic tension of the muscle fiber elements and the osmotic pressure of cells.<sup>46</sup> In normally innervated skeletal muscle, tone is comprised of both “active” (contractile) and “passive” (viscoelastic) components.<sup>46,77,78</sup> FN32
  - a. Hypertonicity is a general increase in muscle tone that can be associated with either elevated contractile activity and/or passive stiffness in the muscle.<sup>5,77–79</sup> FN33
  - b. Hypotonicity is a general decrease in muscle tone that can be associated with either reduced contractile activity and/or passive stiffness in the muscle.<sup>FN34</sup> As the cause is often unknown, the terms neurogenic hypotonicity and non-neurogenic hypotonicity are recommended.

FN31 Varying reliability has been found from pelvic floor muscle (PFM) studies assessing pain and tension using digital palpation scales.<sup>73–76</sup> Patients who present with alteration in the musculoskeletal structure need to be referred to a Physical Therapist well trained in the treatment of CPPS.

FN32 Muscle tone is evaluated clinically as the resistance provided by a muscle when a pressure/deformation or a stretch is applied to it.<sup>46,77,78</sup> Muscle tone may be altered in the presence or absence of pain. There is no single accepted or standardized way of measuring muscle tone, and there are no normative values.

FN33 As “hypertonicity” can also be used to describe increased muscle tone of neurogenic origin, the term “increased tone” is preferred when the cause is non-neurogenic.

FN34 As “hypotonicity” can also be used to describe decreased muscle tone of neurogenic origin, the term “decreased tone” is preferred when the cause is non-neurogenic.

- 16 Doggweiler et al.
- 2. Stiffness: Stiffness is the resistance to deformation.<sup>80,81 FN35</sup>
  - 3. Compliance: Passive compliance is defined as the reciprocal of muscle stiffness.<sup>80,81 FN36</sup>
  - 4. Tension: may have a similar meaning to tone and stiffness.<sup>FN37</sup>
  - 5. Spasm: persistent contraction of striated muscle that cannot be released voluntarily.<sup>82 FN38</sup>
    - a. Contracture: is an involuntary tightening of a muscle. Clinically, a muscle cramp and contracture may appear similar, however contractures are electrically silent.<sup>83</sup>
  - 6. Cramp: a muscle cramp is a painful involuntary muscle contraction that occurs suddenly and can be temporarily debilitating.<sup>83,84 FN39</sup>
  - 7. Fasciculation: A fasciculation is a single, spontaneous, involuntary discharge of an individual motor unit.<sup>83 FN40</sup>
  - 8. Tender point: tenderness to palpation at soft tissue body sites.<sup>46</sup>
  - 9. Trigger point (TrP): a tender, taut band of muscle that can be painful spontaneously or when stimulated.<sup>85</sup> The taut band is electrically silent. Local or referred pain may be reproduced.<sup>86 FN41</sup>

VI Neurological Aspects<sup>4</sup>

- 1. Tenderness on palpation corresponding to the nerve distribution.
- 2. Pain mapping (reproduce pain on palpation).
- 3. Identify referred pain by palpation.
- 4. Possible skin changes (color, blistering, temperature).

VII Psychological Aspects

Observation by the provider may reveal:

- 1. Anxiety and/or depressed mood, and avoidance or reduction of activities which exacerbate pain, or are believed by the patient to carry a risk of increasing the pain or causing harm.
- 2. Expression of helplessness and hopelessness (feeling of despair and representing ‘the internal belief that one cannot manage one’s pain’).<sup>18,54</sup>

VIII Sexual Aspects (59)

A patient with sexual pain often has one or more other sexual dysfunctions including desire disorder, arousal disorder or orgasm disorder.

In most cases the physical examination will not identify the specific etiology of sexual dysfunction. However, a focused and comprehensive pelvic examination in females and males is mandated. In addition, assessment of the secondary sexual characteristics should be performed.<sup>60 FN42</sup> For the specific assessment, see the relevant Domains.

Section 3: Further Evaluation

Pain Evaluation and Measurement (7)

Pain rating(s) are essential in patient evaluation, including; Baseline and ongoing regular evaluation of severity, quality of life, questions about thoughts, emotions and behavior associated with the pain (questionnaires).

Pain Measurement

1. One of the most commonly used tools is the visual analogue scale (VAS)(85), which is a 10 cm line from “0” no pain to “10” extreme pain.<sup>5 FN43</sup>

0	1	2	3	4	5	6	7	8	9	10
No pain										Extreme pain
Not unpleasant										Extremely unpleasant

<sup>FN35</sup> Passive elastic stiffness is defined as the ratio of the change in the passive resistance or passive force ( $\Delta F$ ) to the change in the length displacement ( $\Delta L$ ) or  $\Delta F/\Delta L$ .<sup>81</sup> The term should only be used if stiffness is measured quantitatively such as with instruments like dynamometry or myotonometry.

<sup>FN36</sup> It represents the compressibility of a muscle, clinically assessed by pressing a finger into it (palpation) to determine how easily it is indented and how “springy” it is.

<sup>FN37</sup> Muscle tension can be increased or decreased due to exogenous factors such as the amount of pressure applied and endogenous factors such as thickness/ cross sectional area of the muscle itself, fluid present within the muscle (swelling, inflammation), position (e.g., standing vs. sitting) or increased neural activity.

<sup>FN38</sup> Occurs at irregular intervals with variable frequency and extent. Spasm over days or weeks may lead to a contracture.

<sup>FN39</sup> Pain is intense and localized. It tends to occur when the muscle is in the shortened position and contracting, is generated by the motor unit, and displays a high firing rate (20–150 Hz).<sup>83</sup> Muscle cramp either during or immediately after exercise is commonly referred to as “exercise- associated muscle cramping.”<sup>84</sup> However, cramps are not specific to exercise.

<sup>FN40</sup> The source generator is the motor unit or its axon, prior to its terminal branches. Fasciculations display an irregular firing pattern of low frequency (0.1–10 Hz).<sup>83</sup> Clinically, fasciculations are recognized as individual brief twitches. They may occur at rest or after muscle contraction and may last several minutes.

<sup>FN41</sup> An active TrP is said to have a characteristic “twitch” response when stimulated; however, the twitch response to palpation has been shown to be unreliable.

<sup>FN42</sup> The most reliable sign of a TrP is sensitivity to applied pressure.<sup>86</sup>

<sup>FN42</sup> Blood pressure, heart rate, peripheral pulses, edema, lower extremity strength, and vibratory sensation is almost always helpful.<sup>60</sup>

<sup>FN43</sup> A simple verbal rating scale can also be used, for example, “none,” “mild,” “moderate,” “severe.”

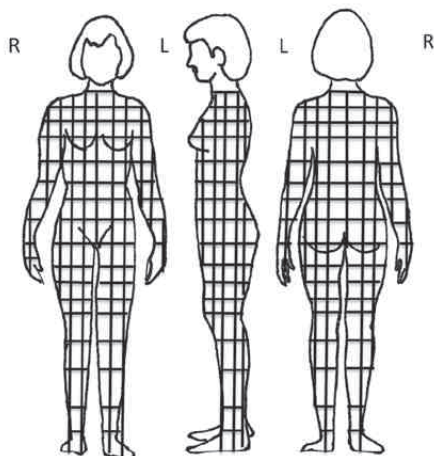
2. Pain Mapping Utilizing a Pain Body Chart<sup>87 FN44</sup>

## PAIN MAPPING

## Instructions

Put highest intensity in each square that is applicable

May use color codes for different pains



Pain evaluation involves additional pain mapping by identifying pain generators through diagnostic procedures.<sup>FN45</sup> These include EMG, Q-tip touch sensitivity testing,<sup>88,89</sup> trigger point injections, nerve blocks and imaging.<sup>88 FN46</sup>

**I Lower Urinary Tract****A. Questionnaires**<sup>FN47</sup>

- a. Voiding diary with volume intake and output for 3 days at initial evaluation. Patient sensation at voiding might be recorded. At follow-up only the number of voids during day and night time is necessary. Morning volume might be recorded as a help to monitor highest functional capacity.<sup>90</sup>
- b. Basic symptom severity Questionnaires (condition specific):
  - i. The O'Leary–Sant Symptom Index.<sup>91</sup>
  - ii. International Prostate Symptom Score.<sup>92</sup>
- c. Visual Analogue Scale (VAS)<sup>87</sup> or a Likert scale for pain during the last 24 hr and over the last month (to fit with the voiding diary).<sup>FN48</sup>

**B. Laboratory Testing**

- a. Urine Dipstick (red blood cells, pH, leucocytes, nitrite).
- b. Urine Culture.<sup>FN49</sup>
- c. Urine Cytology in high risk patients.
- d. Investigations for Ureaplasma and Chlamydia are optional.

<sup>FN44</sup> Patients color the pain sites on the body chart.

<sup>FN45</sup> As pain is multidimensional, it can be helpful to assess separately pain intensity, pain distress, and interference of pain with activities of daily life.

<sup>FN46</sup> Kaufman Q-tip touch sensitivity test. This involves touching all four quadrants of the vulvar and vestibular Skene's gland ostia to evaluate for vestibulodynia, using a visual analog scale to document the level of pain and sensitivity the patient is experiencing.<sup>89</sup>

<sup>FN47</sup> Many of the questionnaires have not been studied and validated in patients with CPPS. The main assessment is still a thorough history and a full and accurate physical examination followed by pain mapping and other studies as indicated.

<sup>FN48</sup> Separate scores for the average, mildest and worst pain might be obtained.

<sup>FN49</sup> If sterile pyuria, culture for tuberculosis, in high risk patients.



## 18 Doggweiler et al.

- e. C.T. Urogram for Hematuria.

### C. Intravesical Anesthetic Challenge

An Anesthetic Challenge may be useful in pain mapping to identify the bladder and/or the urethra as a pain generator.<sup>93</sup> FN50

### D. Urodynamic Evaluation (1)

- a. Flowmetry and Post-void Residual
- b. Filling Cystometry<sup>94,95</sup> FN51
- c. Pressure-Flow Study

It is recommended to perform filling cystometry and pressure flow study if the flowmetry suggests voiding dysfunction. The demonstration of pain may identify the bladder and/or urethra as a pain generator.

In males, bladder outlet obstruction might be a differential diagnosis<sup>96</sup> and it is recommended to perform flowmetry in all males and consider pressure-flow studies. In males with a peak flow below 20 ml/second. In females, flowmetry and post void residual urine volume should be considered, and pressure-flow study is optional.

### E. Cystoscopy

Needs to be done for patients with hematuria<sup>97</sup> and to identify Hunner lesions.

- a. ESSIC standardized the procedure for cystoscopy and hydrodistension.<sup>11</sup> FN52

**Cystoscopic findings** by hydrodistension are important in subclassification of IC/BPS, see for example the ESSIC classification.<sup>11,31,98,99</sup> FN53

- i. Glomerulation  
During cystoscopy with hydrodistension, glomerulations, with or without waterfall lesions (blood trickling downwards), may often be observed.<sup>100</sup> FN54
- ii. Hunner Lesion Figure 1

A Hunner lesion is not an ulcer, but an inflammatory infiltrate.<sup>11,101</sup> FN55

- i. Morphologic findings in Hunner Lesion

1. Inflammatory infiltrate on examination of biopsy taken with electro-resection or by cold cup biopsy.
2. Lymphocyte-like cells dominate in the infiltrate, but neutrophilic and eosinophilic granulocytes as well as plasma cells and mast cells are also found.
3. Perineural and perivascular arrangement of lymphocyte-like cell infiltrates
4. Granulation tissue.<sup>101–104</sup> FN56

### F. Differential Diagnosis (Confusable, treatable diseases):

Criteria for diagnosis are needed as the target disease may be confused with other treatable diseases (confusable diseases) because of similar features.<sup>11</sup>

- a. Ketamine Cystitis

FN50 A solution of lidocaine and sodium bicarbonate administered intravesically results in reduction of pain. Alkalinized lidocaine instillation has not been validated, but may be useful.<sup>93</sup>

FN51 The NIDDK criteria excluded patients with detrusor overactivity at filling cystometry in order not to confuse the picture in clinical trials.<sup>94</sup> However, this does not mean that detrusor overactivity cannot coexist with interstitial cystitis/bladder pain syndrome. In the interstitial cystitis database, approximately 14% of IC/BPS patients had detrusor overactivity.<sup>95</sup>

FN52 A rigid cystoscope is preferred to facilitate taking adequate biopsies. Glycine or corresponding filling fluid should be used to allow for coagulation after biopsies. Infusion height should be approximately 80 cm above the Symphysis Pubis. A dripping chamber is used and the bladder is filled until fluid dribbling stops. If necessary, a digital block is applied around the urethra to prevent leakage. Pre-distension inspection includes observation for radiating vessels, coagulum or fibrin deposits, white spots, hyperaemia, edema, cracks, scars or any other mucosal changes. Continuous inspection while filling the bladder is advised. When maximum capacity is reached, the distension is maintained for 1–3 min. The bladder is emptied and the color of the fluid checked for the degree of bleeding. The total volume drained is the measured maximum bladder capacity. During a second filling, the bladder is filled to approximately 1/3rd to 2/3rds of the bladder capacity to achieve optimal vision for inspection and biopsies. The bladder should not be filled to maximum capacity or distended again to avoid further provocation of changes with doubtful reproducibility.<sup>33</sup>

FN53 The finding of a Hunner lesion is important because effective treatment is available.<sup>98,99</sup> The presence of Hunner lesions may be the diagnostic finding of the proposed disease "Interstitial Cystitis."<sup>31</sup>

FN54 The significance of the presence of glomerulation remains to be determined.<sup>100</sup>

FN55 A Hunner lesion is a distinct cystoscopic finding and typically presents as a circumscribed, reddened mucosal area with small vessels radiating towards a central scar, with a fibrin deposit or coagulum attached to this area. This site ruptures with increasing bladder distension, with petechial oozing of blood from the lesion and the mucosal margins in a waterfall manner. A rather typical edema may develop post-distension with varying peripheral extension. Usually, lesions are multiple but occasionally they may be single. It is not unusual for more lesions to be detected at re-inspection than seen at the initial phase of distension.<sup>11</sup>

FN56 To a large extent, the detection rate and the findings on distribution of mast cells have been dependent on laboratory routines and staining as well as fixation techniques. Tryptase staining methods provide a stable result that is not sensitive to laboratory variations.<sup>103,104</sup>

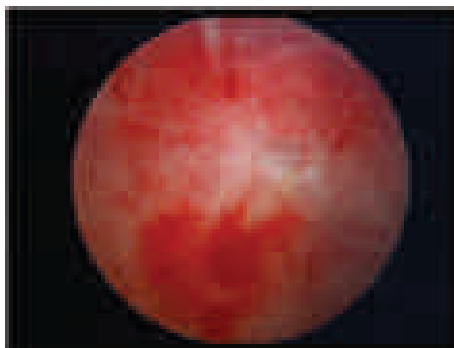


Fig. 1. Hunner lesion.

Ketamine Cystitis is a new condition not previously described. Caused by recreational ketamine abuse, ketamine cystitis includes increased voiding, frequency, dysuria, bladder pain and hematuria.<sup>105,106 FN57</sup>

## II Female Genital

### A. Vulva, Vestibule and Clitoris

1. Questionnaires
  - i. Visual Analog Scale for pain.<sup>86</sup>
  - ii. Female Sexual Function Index (FSFI).<sup>61</sup>
  - iii. Female Sexual Distress Scale (FSDS).<sup>107</sup>
2. Laboratory Testing
  - i. Culture.
  - ii. Biopsy.
3. Diagnostic Testing
  - i. Vulvoscopy, with or without biopsy.
  - ii. Quantitative Sensory Testing (Q-tip touch sensitivity test).<sup>72,89,108</sup>

### B. Intra-abdominal Female Genital

1. Questionnaires
  - i. Visual Analog Scale(85) for pain.
2. Laboratory Testing
  - i. Culture.
  - ii. Complete blood count.
3. Laparoscopy (with or without biopsy)
4. Ultrasound (US)
5. MRI
6. Venography (to rule out Pelvic Congestive Syndrome)<sup>109</sup>

### C. Pelvic Floor Muscle

1. Questionnaires.
  - i. Visual Analog Scale for pain.<sup>86</sup>
  - ii. Pelvic Floor Distress Inventory (PFDI).<sup>110</sup>

<sup>FN57</sup> The molecular mechanism for ketamine-induced cystitis is unknown. The affected bladder exhibits a denudation of the urothelium with inflammatory cell infiltration. The upper urinary tract is also damaged in patients who use a higher dose and with a longer duration. Attention by both medical organizations and social workers for this increasing social phenomenon particularly among young people is now urgently needed.<sup>105,106</sup>

- 20 Doggweiler et al.
  - iii. Prolapse and Incontinence Sexual Questionnaire (PISQ).<sup>111</sup>
2. Laboratory Testing
  - i. Wet Mount, Culture.
  - ii. Biopsy.
3. Imaging References
  - i. Ultrasound (4D if available for visualization of mesh, where applicable).
  - ii. MRI (with or without defecography).
  - iii. Defecography.

### III Male Genital

#### A. Prostate Pain

1. Quantitative assessments.
  - i. Bladder diary.<sup>90,112</sup>
  - ii. CPSI (Chronic Prostatitis Symptom Index).<sup>113</sup>
  - iii. Visual Analog Scale for Pain (VAS).<sup>86</sup>
2. Laboratory Testing
  - i. Urinalysis (including post prostate massage).
  - ii. Urine Culture post prostate massage.
  - iii. Semen Culture.
3. Uroflowmetry, Post voiding residual volume, pressure flow study
4. Cystoscopy
5. Ultrasonography, with or without biopsy.

#### B. Scrotum, Epididymis, Testicle, Penis

1. Quantitative assessments
  - i. VAS for Pain.<sup>86</sup>
2. Ultrasonography

#### C. Urethra Pain

1. Quantitative assessments
  - i. Bladder diary.
  - ii. VAS for Pain.<sup>86</sup>
2. Laboratory Testing
  - i. Urinalysis (including post prostate massage, Ureaplasma/Chlamydia as appropriate).
3. Urethroscopy/Urethrography
4. Ultrasonography

#### D. Sexual Pain (See Domain VIII)

1. Questionnaires
  - i. VAS for Pain.<sup>86</sup>
  - ii. International Index of Erectile Function (IIEF).<sup>114</sup>

### IV Gastro-Intestinal (40)

1. Questionnaires
  - i. Rome III Criteria Questionnaire.<sup>115</sup>
  - ii. Colorectal Rectal Distress Inventory.<sup>116</sup>
2. Laboratory Testing
  - i. Culture.

*Neurourology and Urodynamics* DOI 10.1002/nau

- ii. Stool Evaluation for ova and parasites.
  - iii. Antibody testing.
  - iv. Biopsy.
- 3. Diagnostic Testing
  - i. Anorectal Manometry (paradoxical contraction of the pelvic floor muscles when instructed to strain during defecation).
  - ii. Rigid or flexible endoscopy (Anorectal sigmoidoscopy) with or without biopsy.
  - iii. Anorectal/Pelvic US, 3D.
  - iv. Barium Enema.
  - v. CT Scan, Defecography, MRI defecography.

## V Musculoskeletal<sup>117</sup>

- 1. Questionnaires
  - i. McGill Pain Questionnaire.<sup>118</sup>
  - ii. Pelvic Floor Distress Inventory (PFDI).<sup>110</sup>
  - iii. Female Sexual Function Index (FSFI).<sup>61</sup>
  - iv. Female Sexual Distress Scale (FSDS).<sup>107</sup>
- 2. Pain Location Drawing (Pain Mapping)
  - i. Pain Chart body map.<sup>87</sup>
- 3. Evaluation of Muscle Tension There is no single tool which is able to measure all components of muscle tone. Some tools may be able to measure aspects of tone such as contractility, stiffness or elasticity. Instrumented methods may have a role in the valid and reliable evaluation of muscle tone, for example, surface electromyography, dynamometry, real-time ultrasound, elastometry, myotonometry.
  - i. Pressure manometry is the measurement of resting pressure or pressure rise generated during contraction of the pelvic floor muscles using a pressure device (a manometer) inserted into the urethra, vagina or anus.<sup>119,120 FN58</sup>
  - ii. Surface electromyography (sEMG) refers to the bioelectrical activity generated by muscle fibres.<sup>121,122 FN59</sup>
  - iii. Dynamometry is the measurement of pelvic floor muscle resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina.<sup>123</sup>
  - iv. Real-time ultrasound measures pelvic floor muscle morphology and function via a non-invasive (trans-abdominal or trans-perineal) probe.<sup>124 FN60</sup>
  - v. Elastometry measures the elasticity of a tissue.<sup>125 FN61</sup>
- 4. Trigger point injection or needling has been used as a diagnostic test to identify pain generators.<sup>125 FN62</sup>
- 5. Imaging
  - i. X-Ray.
  - ii. Ultrasound.
  - iii. MRI.

## VI Neurological Aspects

### A. Neuropathic Pain Questionnaires

- 1. VAS Pain Score.<sup>86</sup>
- 2. Pain DETECT (Validated for CPPS evaluation).<sup>129</sup>
- 3. Leeds Assessment for neuropathic symptoms and signs (not validated for chronic pelvic pain).<sup>130</sup>
- 4. Douleur Neuropathique 4 Questionnaire.<sup>131</sup>

<sup>FN58</sup> The tool has been used as an outcome measure in intervention studies of pelvic floor pain.<sup>119,120</sup> However, the tool has not been tested for reliability in this population.

<sup>FN59</sup> Pelvic floor muscle surface electrodes use either flat interface perineal electrodes or intra-vaginal/intra-anal probes to record sEMG either at rest or during a PFM contraction. Surface EMG is considered to be non-specific to the PFM. Because of the large surface area covered by the electrode, cross-talk from adjacent muscles often occurs.<sup>121,122</sup> It is therefore not considered reliable as a measure.

<sup>FN60</sup> Trans-perineal measures of ano-rectal angle and levator plate angle have been tested for reliability in a male pelvic pain population.<sup>124</sup> Therefore, this tool shows promise as an instrumented method to evaluate pelvic floor muscle changes in pelvic pain.

<sup>FN61</sup> It has recently been applied to measure the passive stiffness of puborectalis in asymptomatic women and shown to be reliable in this pilot study.<sup>125</sup> However, it requires testing to establish application in a pelvic pain cohort.

<sup>FN62</sup> The taut band(s) of sarcomeres within the TrP can be identified by ultrasonography.<sup>126</sup> and magnetic resonance elastography.<sup>127</sup> A tissue compliance meter which measures stiffness in the taut band has been shown to confirm the hardness of the discrete band of muscle that harbors the tender region in peripheral skeletal muscle.<sup>128</sup>

22 Doggweiler et al.

### **B. Quantitative Sensory Testing**

1. 1Q-tip touch sensitivity.
2. Sensory pain mapping.<sup>72</sup>
3. Reflex evaluation.
4. Electromyography.

### **C. Nerve Blocks**

1. May/may not be done under Computed Tomography, Ultrasound or EMG guidance.<sup>132,133</sup>

### **D. Imaging**

1. Ultrasound
2. Magnetic resonance Imaging (MRI)

### **VII Psychological Aspects<sup>18,54</sup>**

The chief purpose of psychological assessment is to get a complete picture of the pain syndrome with all affected dimensions: somatic, affective, cognitive and behavioral, and the individual consequences for the patient. Direct questioning about the patient's view of what is wrong or what worries him/her is more helpful than questionnaires.<sup>FN63</sup>

1. Questionnaires
  - i. SF-12 or SF-36.<sup>134</sup>
  - ii. Brief Pain Inventory.<sup>135</sup>
  - iii. Catastrophizing Questionnaire can be considered in certain cases.<sup>136</sup>

### **VIII Sexual Aspects**

1. Questionnaires.
  - i. Female Sexual Function Index (FSFI).<sup>61</sup>
  - ii. Female Sexual Distress Scale (FSDS).<sup>107</sup>
  - iii. International Index of Erectile Function (IIEF).<sup>137</sup>
2. Laboratory Testing
  - i. Hormone Panel.
  - ii. Complete Metabolic Panel.
  - iii. Culture.
3. Imaging
  - i. Doppler US to assess blood flow.

It is also particularly important to work up the partner's potential sexual dysfunction. Early referral to a sexual counsellor is optimal.

### **IX Evaluation of Comorbidities**

If patients have symptoms and signs of comorbidities, evaluation should be undertaken according to relevant guidance, and may be appropriate to refer to the relevant specialist.

## **SUMMARY**

This first ICS Standard for Terminology in Chronic Pelvic Pain Syndromes aims to improve understanding of these syndromes and patient diagnosis. It is hoped that this will help develop the field, through facilitating phenotyping of patients, development of pertinent animal models and new preclinical development of therapeutic strategies.

Evaluation of patients based on the nine domains should be individualized, taking into consideration the patient's personal perception of pain, and also the biopsychosocial aspects of CPPS.

Discussions on nomenclature partly focused on the risk of inadequate patient care if diagnostic terminology is changed without taking into account the practical impact of its application on the patient's access to appropriate treatment, reimbursement, and social benefits.

This Standard for Terminology in CPPS will be reviewed in the future as continuing research, such as the Multidisciplinary Approach to the Study of Chronic Pelvic Pain (MAPP) Research Network, generates new insights.<sup>138–140</sup> Working with the guideline bodies, such as the AUA, East Asian IC Study Group/SICJ, EAU, ESSIC, FGIDS, and IASP, the ultimate aim should be to achieve international consensus.

## **CONSULTANTS**

Ursula Wesselmann, Professor of Anesthesiology and Neurology, University of Alabama, Birmingham, AL, USA. Peter Rosier, Department of Urology, University Medical Center Utrecht, Utrecht, Netherlands. Fernando Cervero, Anaesthesia Research Unit,

<sup>FN63</sup> Early referral to a psychological healthcare provider should be considered. Patients with sexual dysfunction may need sexual counseling.

McGill University, Montreal, QC, Canada. Alain Watier, Gastroenterology, Sherbrooke, QC, Canada. Kari Bø, Professor of Physical Therapy, Norwegian School of Sport Sciences, Department of Sports Medicine, Oslo, Norway.

Any products/companies referred to in this document are not necessarily recommended or endorsed by the ICS.

## REFERENCES

- Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: Report from the Standardisation Sub-Committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
- Latthe P, Latthe M, Say L, et al. WHO systematic review of prevalence of chronic pelvic pain: A neglected reproductive health morbidity. *BMC Public Health* 2006;6:177.
- Baranowski AP, Berger R, Buffington T, et al. International Association for the Study of Pain (IASP) Classification of Chronic Pain. Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms, Second Edition (Revised 2011). Cited 21/09/2014. Available from: [http://www.iasp-pain.org/files/Content/ContentFolders/Publications2/ClassificationofChronicPain/Part\\_II-F.pdf](http://www.iasp-pain.org/files/Content/ContentFolders/Publications2/ClassificationofChronicPain/Part_II-F.pdf)
- Merskey H, Bogduk N, International Association for the Study of Pain. Task force on taxonomy. Classification of chronic pain: Descriptions of chronic pain syndromes and definitions of pain terms. 2nd ed. Seattle: IASP Press; 1994.
- Engeler DS, Baranowski AP, Dinis-Oliveira P, et al. The 2013 EAU guidelines on chronic pelvic pain: Is management of chronic pelvic pain a habit, a philosophy, or a science? 10 years of development. *Eur Urol* 2013;64:431–9.
- Rosier PF, de Ridder D, Meijlink J, et al. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn* 2012;31:621–4.
- Fall M, Baranowski AP, Elneli S, et al. EAU guidelines on chronic pelvic pain. *Eur Urol* 2010;57:35–48.
- Hanno PM, Burks DA, Clemens JQ, et al. AUA guideline for the diagnosis and treatment of interstitial cystitis/bladder pain syndrome. *J Urol* 2011;185:2162–70.
- Hanno PM, Erickson D, Moldwin R, et al. Diagnosis and treatment of interstitial cystitis/bladder pain syndrome: AUA guideline amendment. *J Urol* 2015;193:1545–53.
- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010;29:4–20.
- Van de Merwe JP, Nordling J, Bouchelouche P, et al. Diagnostic criteria, classification, and nomenclature for painful bladder syndrome/interstitial cystitis: An ESSIC proposal. *Eur Urol* 2008;53:60–7. Epub 2007 Sep 20.
- Homma Y, Ueda T, Tomoe H, et al. Clinical guidelines for interstitial cystitis and hypersensitive bladder syndrome. *Int J Urol* 2009;16:597–615.
- Drossman DA, Dumitrascu DL. Rome III: New standard for functional gastrointestinal disorders. *J Gastrointest Liver Dis* 2006;15:237–41.
- Merskey H. Classification of chronic pain. 2nd ed. In: Merskey H, editor. Seattle: IASP Press; 1994.
- Cervero F, Laird JM. Visceral pain. *Lancet* 1999;353:2145–8.
- Cervero F. Spinal cord hyperexcitability and its role in pain and hyperalgesia. *Exp Brain Res* 2009;196:129–37.
- Cervero F, Laird JMA. Spinal mechanisms of visceral pain and hyperalgesia. In: Malcangio M, editor. *Synaptic plasticity in pain*. Heidelberg, London, New York: Springer; 2009. 289–306.
- Flor H, McGrath PA, Turner J, et al. Curriculum outline on pain for psychology. IASP. Washington, DC: [updated May 2012; cited 21/09/2015]. Available from: <http://www.iasp-pain.org/Education/CurriculumDetail.aspx?ItemNumber=2054>
- Tripp DA, Nickel JC, Shoskes D, et al. A 2-year follow-up of quality of life, pain, and psychosocial factors in patients with chronic prostatitis/chronic pelvic pain syndrome and their spouses. *World J Urol* 2013;31:733–9.
- Nickel JC, Shoskes DA, Wagenlehner FH. Management of chronic prostatitis/chronic pelvic pain syndrome (CP/CPPS): The studies, the evidence, and the impact. *World J Urol* 2013;31:747–53.
- Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology in lower urinary tract function: Report from the Standardisation Sub-Committee of the International Continence Society. *Urology* 2003;61:37–49.
- Khoshnejad M, Fortin MC, Rohani F, et al. Remembering the dynamic changes in pain intensity and unpleasantness: A psychophysical study. *Pain* 2014;155:581–90.
- Baranowski AP, Abrams P, Berger RE, et al. Urogenital pain-time to accept a new approach to phenotyping and, as a consequence, management. *Eur Urol* 2008;53:33–6. Epub 2007 Oct 15.
- Bullones Rodriguez M, Afari N, Buchwald DS, National Institute of Diabetes and Digestive Kidney Diseases Working Group on Urological Chronic Pelvic Pain. Evidence for overlap between urological and nonurological unexplained clinical conditions. *J Urol* 2013;189:S66–74.
- Doggeweiler R, Whitmore K, Nordling J, et al. The Standard of Terminology in Chronic Pelvic Pain: Preliminary report from the working group on chronic pelvic pain of the Standardisation Steering Committee of the International Continence Society. 1st World Congress on Abdominal and Pelvic Pain; May 31–June 1, 2013; Amsterdam.
- Homma Y, Ueda T, Ito T, et al. Japanese guideline for diagnosis and treatment of interstitial cystitis. *Int J Urol* 2009;16:4–16.
- Homma Y, Ueda T, Tomoe H, et al. Clinical guidelines for interstitial cystitis and hypersensitive bladder syndrome. *Int J Urol* 2009;16:597–615.
- Homma Y. Hypersensitive bladder: A solution to confused terminology and ignorance concerning interstitial cystitis. *Int J Urol* 2014;21:43–7.
- Homma Y. Hypersensitive bladder: Towards clear taxonomy surrounding interstitial cystitis. *Int J Urol* 2013;20:742–3.
- Abrams P, Blaivas JG, Stanton SL, et al. The standardisation of terminology of lower urinary tract function. The International Continence Society Committee on Standardisation of Terminology. *Scand J Urol Nephrol Suppl* 1988;114:5–19.
- Fall M, Logadottir Y, Pecker R. Interstitial cystitis is bladder pain syndrome with Hunner's lesion. *Int J Urol* 2014;21:79–82.
- Castro-Diaz D, Cardozo L, Chapple CR, et al. Urgency and pain in patients with overactive bladder and bladder pain syndrome. What are the differences? *Int J Clin Pract* 2014;68:356–62.
- Nordling J, Anjum FH, Bade JJ, et al. Primary evaluation of patients suspected of having interstitial cystitis (IC). *Eur Urol* 2004;45:662–9.
- Bornstein J, Goldstein A, Coady D. 2015 consensus terminology and classification of persistent vulvar pain. 2015. Available from <http://www.issvd.org/resources/terminology>
- Nickel JC. Prostatitis and related conditions, orchitis, and epididymitis. chapter 11. In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA, editors. *Campbell-Walsh urology*. Philadelphia, PA: Elsevier; 2012. 327–356.
- Wesselmann U, Burnett AL, Heinberg LJ. The urogenital and rectal pain syndromes. *Pain* 1997;73:269–94.
- Drossman DA. The functional gastrointestinal disorders and the Rome III process. *Gastroenterology* 2006;130:1377–90.
- Herzig DO, Lu KC. Anal fissure. *Surg Clin North Am* 2010;90:33–44.
- Rizzo JA, Naig AL, Johnson EK. Anorectal abscess and fistula-in-ano: Evidence-based management. *Surg Clin North Am* 2010;90:45–68, Table of Contents.
- Friedman LS, Feldman M, Brandt LJ. Sleisenger and Fordtran's Gastrointestinal and Liver Disease. 9th ed. Philadelphia: Elsevier Saunders; 2010. 475–490.
- Welton ML, Chang GJ, Shelton AA. Hemorrhoids. In: Doherty GM, editor. *Current surgical diagnosis and treatment*. 12th ed. New York: Lange; 2006. 738–764.
- Corman ML. Hemorrhoids. In: Brown B, McMillan E, LaPlante MM, editors. *Colon and rectal surgery*. 5th ed. New York: Lippincott Williams and Wilkins, Inc; 2002. 177–248.
- Lewis RT, Maron DJ. Anorectal Crohn's disease. *Surg Clin North Am* 2010;90:83–97. Table of Contents.
- Yale SH, Musana AK, Kieke A, et al. Applying case definition criteria to irritable bowel syndrome. *Clin Med Res* 2008;6:9–16.
- Drossman DA, Corazzari E, Delvaux M, et al. Rome III: The Functional Gastrointestinal Disorder. 3rd ed. In: Drossman DA, editor. McLean VA: Degnon Associates; 2006. 295–368.
- Mense S, Simons DG, Russell II. Pain associated with increased muscle tension. In: Mense S, Simons DG, Russell II, editors. *Muscle pain: understanding its nature, diagnosis and treatment*. Philadelphia: Lippincott Williams & Wilkins; 2001. 99–130.
- Haanpää M, Treede R. Diagnosis and Classification of Neuropathic Pain. *Pain: Clinical Updates* 2010; 18(7): [1–6 pp.] Cited 22/09/2015. Available from: [http://iasp.files.cms-plus.com/Content/ContentFolders/Publications2/PainClinicalUpdates/Archives/PC\\_U\\_18-7\\_final\\_1390260761555\\_9.pdf](http://iasp.files.cms-plus.com/Content/ContentFolders/Publications2/PainClinicalUpdates/Archives/PC_U_18-7_final_1390260761555_9.pdf)
- Harden RN, Oaklander AL, Burton AW, et al. Complex regional pain syndrome: Practical diagnostic and treatment guidelines, 4th edition. *Pain Med* 2013;14:180–229.
- Chiarioni G, Asteria C, Whitehead WE, et al. Chronic proctalgia and chronic pelvic pain syndromes: New etiologic insights and treatment options. *World J Gastroenterol* 2011;17:4447–55.
- Radcliff KE, Kepler CK, Delasotta LA, et al. Current management review of thoracolumbar cord syndromes. *Spine J* 2011;11:884–92.

*Neurourology and Urodynamics* DOI 10.1002/nau

## 24 Doggweiler et al.

51. Bø K, Frawley H, Haylen BT, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint report on the terminology for the conservative management of pelvic floor dysfunction. *Int Urogyn J/Neurourol Urodyn* 2016. (under review).
52. Parnell BA, Johnson EA, Zolnoun DA. Genitofemoral and perineal neuralgia after transobturator midurethral sling. *Obstet Gynecol* 2012;119:428–31.
53. Haylen BT, Freeman RM, Swift SE, et al. International Urogynecological Association International Continence Society Joint IUGA/ICS Working Group on Complications Terminology. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related directly to the insertion of prostheses (meshes, implants, tapes) and grafts in female pelvic floor surgery. *Neurourol Urodyn* 2011;30:2–12.
54. Schulz-Gibbins C. Psychological evaluation of the patient with chronic pain. Seattle: IASP-Press; 2010.
55. Roth RS, Geisser ME, Williams DA. Interventional pain medicine: Retreat from the biopsychosocial model of pain. *Transl Behav Med* 2012;2:106–16.
56. Basson R, Berman J, Burnett A, et al. Report of the international consensus development conference on female sexual dysfunction: Definitions and classifications. *J Urol* 2000;163:888–93.
57. Levy RL, Olden KW, Naliboff BD, et al. Psychosocial aspects of the functional gastrointestinal disorders. *Gastroenterology* 2006;130:1447–58.
58. Meston CM, Bradford A. Sexual dysfunctions in women. *Annu Rev Clin Psychol* 2007;3:233–56.
59. Kingsberg SA, Janata JW. Female sexual disorders: Assessment, diagnosis, and treatment. *Urol Clin North Am* 2007;34:497–506, v–vi.
60. Sungur MZ, Gündüz A. A comparison of DSM-IV-TR and DSM-5 definitions for sexual dysfunctions: Critiques and challenges. *J Sex Med* 2014;11:364–73.
61. Gerstenberger EP, Rosen RC, Brewer JV, et al. Sexual desire and the female sexual function index (FSFI): A sexual desire cutpoint for clinical interpretation of the FSFI in women with and without hypoactive sexual desire disorder. *J Sex Med* 2010;7:3096–103.
62. Chelmsky G, Heller E, Buffington CA, et al. Co-morbidities of interstitial cystitis. *Front Neurosci* 2012;6:114.
63. Nickel JC, Tripp DA, Pontari M, et al. Interstitial cystitis/painful bladder syndrome and associated medical conditions with an emphasis on irritable bowel syndrome, fibromyalgia and chronic fatigue syndrome. *J Urol* 2010;184:1358–63.
64. Rodríguez MA, Afari N, Buchwald DS, Pain NLoDaDaKDWGoUCP. Evidence for overlap between urological and nonurological unexplained clinical conditions. *J Urol* 2009;182:2123–31.
65. Clemens JQ, Meenan RT, O’Keeffe Rosetti MC, et al. Case-control study of medical comorbidities in women with interstitial cystitis. *J Urol* 2008;179:2222–5.
66. Warren JW, van de Merwe JP, Nickel JC. Interstitial cystitis/bladder pain syndrome and nonbladder syndromes: Facts and hypotheses. *Urology* 2011;78:727–32.
67. Farnam K, Chang C, Teuber S, et al. Nonallergic drug hypersensitivity reactions. *Int Arch Allergy Immunol* 2012;159:327–45.
68. Ho MH, Wong WH, Chang C. Clinical spectrum of food allergies: A comprehensive review. *Clin Rev Allergy Immunol* 2014;46:225–40.
69. Wessely S, Nimnuan C, Sharpe M. Functional somatic syndromes: One or many? *Lancet* 1999;354:936–9.
70. Fukuda K, Straus SE, Hickie I, et al. The chronic fatigue syndrome: A comprehensive approach to its definition and study. International Chronic Fatigue Syndrome Study Group. *Ann Intern Med* 1994;121:953–9.
71. Levine JS, Burakoff R. Extraintestinal manifestations of inflammatory bowel disease. *Gastroenterol Hepatol (NY)* 2011;7:235–41.
72. Baumgärtner U, Magerl W, Klein T, et al. Neurogenic hyperalgesia versus painful hypoalgesia: Two distinct mechanisms of neuropathic pain. *Pain* 2002;96:141–51.
73. Kavvadias T, Pelikan S, Roth P, et al. Pelvic floor muscle tenderness in asymptomatic, nulliparous women: Topographical distribution and reliability of a visual analogue scale. *Int Urogynecol J* 2013;24:281–6.
74. Montenegro ML, Mateus-Vasconcelos EC, Rosa e Silva JC, et al. Importance of pelvic muscle tenderness evaluation in women with chronic pelvic pain. *Pain Med* 2010;11:224–8.
75. Sliker-ten Hove MC, Pool-Goudzwaard AL, Bijkemans MJ, et al. Face validity and reliability of the first digital assessment scheme of pelvic floor muscle function conform the new standardized terminology of the International Continence Society. *Neurourol Urodyn* 2009;28:295–300.
76. Tu FF, Fitzgerald CM, Kuiken T, et al. Vaginal pressure-pain thresholds: Initial validation and reliability assessment in healthy women. *Clin J Pain* 2008;24:45–50.
77. Simons DG, Mense S. Understanding and measurement of muscle tone as related to clinical muscle pain. *Pain* 1998;75:1–7.
78. Enoka RM. *Neuromechanics of human movement*. 4th ed. Champaign, IL: Human Kinetics; 2008. 309–347.
79. Masi AT, Hannon JC. Human resting muscle tone (HRMT): Narrative introduction and modern concepts. *J Bodyw Mov Ther* 2008;12:320–32.
80. Nordin M, Frankel V. *Basic biomechanics of the musculoskeletal system*. 4th ed. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins Health; 2012. 24–36.
81. Gajdosik RL. Passive extensibility of skeletal muscle: Review of the literature with clinical implications. *Clin Biomech (Bristol, Avon)* 2001;16:87–101.
82. Mumenthaler M, Appenzeller O. *Neurologic differential diagnosis*. 2nd ed. New York: Thieme; 1992. 122.
83. Preston DC, Shapiro BE. *Electromyography and neuromuscular disorders: Clinical- electro- physiologic correlations*. 4th ed. Newton, MA: Butterworth-Heinemann; 1998. 181–187.
84. Brukner P, Khan K. *Clinical sports medicine*. 4th ed. North Ryde, NSW: McGraw- Hill Australia; 2012. 22.
85. Jarrell JF, Vilos GA, Allaire C, et al. Consensus guidelines for the management of chronic pelvic pain. *J Obstet Gynaecol Can* 2005;27:781–801.
86. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain* 1983;16:87–101.
87. Carter JE. A systematic history for the patient with chronic pelvic pain. *JSL* 1999;3:245–52.
88. Lucas N, Macaskill P, Irwig L, et al. Reliability of physical examination for diagnosis of myofascial trigger points: A systematic review of the literature. *Clin J Pain* 2009;25:80–9.
89. Kaufman RH, Friedrich EG, Gardner HL. Benign diseases of the vulva and vagina. In: Kaufman RH, Friedrich EG, Gardner HL, editors. *Non-neoplastic epithelial disorders of the vulvar skin and mucosa; miscellaneous vulvar disorders*. Chicago IL: Chicago Yearbook; 1989. 299–360.
90. Bright E, Cotterill N, Drake M, et al. Developing and validating the international consultation on incontinence questionnaire bladder diary. *Eur Urol* 2014;66:294–300.
91. O’Leary MP, Sant GR, Fowler FJ, et al. The interstitial cystitis symptom index and problem index. *Urology* 1997;49:58–63.
92. Barry MJ, Fowler FJ, O’Leary MP, et al. The american urological association symptom index for benign prostatic hyperplasia. The measurement committee of the american urological association. *J Urol* 1992;148:1549–57; discussion 1564.
93. Nickel JC, Moldwin R, Lee S, et al. Intravesical alkalinized lidocaine (PSD597) offers sustained relief from symptoms of interstitial cystitis and painful bladder syndrome. *BJU Int* 2009;103:910–8. Epub 2008 Nov 13.
94. Wein AJ, Hanno PM, Gillenwater JY. Interstitial cystitis: an introduction to the problem. In: Hanno PM, Staskin D, Krane RJ, Wein AJ, editors. *Interstitial cystitis*. London: Springer- Verlag; 1990. 3–15.
95. Nigro DA, Wein AJ, Foy M, et al. Associations among cystoscopic and urodynamic findings for women enrolled in the Interstitial Cystitis Data Base (ICDB) Study. *Urology* 1997;49:86–92.
96. Kaplan SA, Ikeguchi EF, Santarosa RP, et al. Etiology of voiding dysfunction in men less than 50 years of age. *Urology* 1996;47:836–9.
97. Davis R, Jones JS, Barocas DA, et al. Diagnosis, evaluation and follow-up of asymptomatic microhematuria (AMH) in adults: AUA guideline. *J Urol* 2012;188:2473–81.
98. Peeker R, Aldenborg F, Fall M. Complete transurethral resection of ulcers in classic interstitial cystitis. *Int Urogynecol J Pelvic Floor Dysfunct* 2000;11:290–5.
99. Payne RA, O’Connor RC, Kressin M, et al. Endoscopic ablation of Hunner’s lesions in interstitial cystitis patients. *Can Urol Assoc J* 2009;3:473–7.
100. Wennevik GE, Meijlink JM, Hanno P, et al. The role of glomerulations in bladder pain syndrome—A review. *J Urol* 2015;26. [Epub ahead of print].
101. Johansson SL, Fall M. Clinical features and spectrum of light microscopic changes in interstitial cystitis. *J Urol* 1990;143:1118–24.
102. Theoharides TC, Kempuraj D, Sant GR. Mast cell involvement in interstitial cystitis: A review of human and experimental evidence. *Urology* 2001;57:47–55.
103. Peeker R, Enerbäck L, Fall M, et al. Recruitment, distribution and phenotypes of mast cells in interstitial cystitis. *J Urol* 2000;163:1009–15.
104. Larsen MS, Mortensen S, Nordling J, et al. Quantifying mast cells in bladder pain syndrome by immunohistochemical analysis. *BJU Int* 2008;102:204–7; discussion 7.
105. Chen CH, Lee MH, Chen YC, et al. Ketamine-snorting associated cystitis. *J Formos Med Assoc* 2011;110:787–91.
106. Winstock AR, Mitcheson L, Gillatt DA, et al. The prevalence and natural history of urinary symptoms among recreational ketamine users. *BJU Int* 2012;110:1762–6.
107. Derogatis LR, Rosen R, Leiblum S, et al. The Female Sexual Distress Scale (FSDS): Initial validation of a standardized scale for assessment of sexually related personal distress in women. *J Sex Marital Ther* 2002;28:317–30.
108. Haefner HK, Collins ME, Davis GD, et al. The vulvodynia guideline. *J Low Genit Tract Dis* 2005;9:40–51.
109. Kies DD, Kim HS. Pelvic congestion syndrome: A review of current diagnostic and minimally invasive treatment modalities. *Phlebology* 2012;27:52–7.
110. Barber MD, Chen Z, Lukacz E, et al. Further validation of the short form versions of the Pelvic Floor Distress Inventory (PFDI) and Pelvic Floor Impact Questionnaire (PFIQ). *Neurourol Urodyn* 2011;30:541–6.
111. Parnell BA, Dunivan GC, Connolly A, et al. Validation of web-based administration of the Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire (PISQ-12). *Int Urogynecol J* 2011;22:357–61.

*Neurourology and Urodynamics* DOI 10.1002/nau



112. Bright E, Cotterill N, Drake M, et al. Developing a validated urinary diary: Phase 1. *Neurourol Urodyn* 2012;31:625–33.
113. Turner JA, Ciol MA, Von Korff M, et al. Validity and responsiveness of the national institutes of health chronic prostatitis symptom index. *J Urol* 2003;169:580–3.
114. Abraham L, Symonds T, Morris MF. Psychometric validation of a sexual quality of life questionnaire for use in men with premature ejaculation or erectile dysfunction. *J Sex Med* 2008;5:595–601.
115. Ford AC, Berck P, Morgan DG, et al. Validation of the Rome III criteria for the diagnosis of irritable bowel syndrome in secondary care. *Gastroenterology* 2013;145:1262–70.e1.
116. Colwell HH, Mathias SD, Turner MP, et al. Psychometric evaluation of the FACT Colorectal Cancer Symptom Index (FCSI-9): Reliability, validity, responsiveness, and clinical meaningfulness. *Oncologist* 2010;15:308–16.
117. Simons DG, Travell JG. Myofascial origins of low back pain 3. Pelvic and lower extremity muscles. *Postgrad Med* 1983;73:99–105, 108.
118. Droz J, Howard FM. Use of the Short-Form McGill Pain Questionnaire as a diagnostic tool in women with chronic pelvic pain. *J Minim Invasive Gynecol* 2011;18:211–7.
119. Thomson AJ, Jarvis SK, Lenart M, et al. The use of botulinum toxin type A (BOTOX) as treatment for intractable chronic pelvic pain associated with spasm of the levator ani muscles. *BJOG* 2005;112:247–9.
120. Abbott JA, Jarvis SK, Lyons SD, et al. Botulinum toxin type A for chronic pain and pelvic floor spasm in women: A randomized controlled trial. *Obstet Gynecol* 2006;108:915–23.
121. Messelink B, Benson T, Berghmans Bø BK, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: Report from the pelvic floor clinical assessment group of the International Continence Society. *Neurourol Urodyn* 2005;24:374–80.
122. Vodusek DB. The role of clinical neurophysiology in urogynecology. *Int Urogynecol J* 2011;22:1473–7.
123. Morin M, Gravel D, Bourbonnais D, et al. Application of a new method in the study of pelvic floor muscle passive properties in continent women. *J Electromyogr Kinesiol* 2010;20:795–803.
124. Davis SN, Morin M, Binik YM, et al. Use of pelvic floor ultrasound to assess pelvic floor muscle function in Urological Chronic Pelvic Pain Syndrome in men. *J Sex Med* 2011;8:3173–80.
125. Kruger J, Nielsen P, Dietz HP, et al. Test-retest reliability of an instrumented elastometer for measuring passive stiffness of the levator ani muscle. 41st Annual meeting of the International Continence Society 2011.
126. Sikdar S, Shah JP, Gebreab T, et al. Novel applications of ultrasound technology to visualize and characterize myofascial trigger points and surrounding soft tissue. *Arch Phys Med Rehabil* 2009;90:1829–38.
127. Chen Q, Bensamoun S, Basford JR, et al. An identification and quantification of myofascial taut bands with magnetic resonance elastography. *Arch Phys Med Rehabil* 2007;88:1658–61.
128. Fischer AA. Tissue compliance meter for objective, quantitative documentation of soft tissue consistency and pathology. *Arch Phys Med Rehabil* 1987;68:122–5.
129. Freynhagen R, Baron R, Gockel U, et al. PainDETECT: A new screening questionnaire to identify neuropathic components in patients with back pain. *Curr Med Res Opin* 2006;22:1911–20.
130. Bennett MI, Smith BH, Torrance N, et al. The S-LANSS score for identifying pain of predominantly neuropathic origin: Validation for use in clinical and postal research. *J Pain* 2005;6:149–58.
131. Madani SP, Fateh HR, Forogh B, et al. Validity and reliability of the persian (Farsi) version of the DN4 (Douleur Neuropathique 4 Questions) questionnaire for differential diagnosis of neuropathic from non-neuropathic pains. *Pain Pract* 2014;14:427–36.
132. Peng PW, Tumber PS. Ultrasound-guided interventional procedures for patients with chronic pelvic pain – a description of techniques and review of literature. *Pain Physician* 2008;11:215–24.
133. Filler AG. Diagnosis and treatment of pudendal nerve entrapment syndrome subtypes: Imaging, injections, and minimal access surgery. *Neurosurg Focus* 2009;26:E9.
134. Weijenborg PT, Ter Kuile MM, Gopie JP, et al. Predictors of outcome in a cohort of women with chronic pelvic pain—A follow-up study. *Eur J Pain* 2009;13:769–75.
135. Tan G, Jensen MP, Thornby JJ, et al. Validation of the Brief Pain Inventory for chronic nonmalignant pain. *J Pain* 2004;5:133–7.
136. Walton DM, Wideman TH, Sullivan MJ. A Rasch analysis of the pain catastrophizing scale supports its use as an interval-level measure. *Clin J Pain* 2013;29:499–506.
137. Rosen RC, Cappelleri JC. The sexual health inventory for men (IIEF-5): Reply to Vroeghe. *Int J Impot Res* 2000;12:342–3.
138. Kilpatrick LA, Kutch JJ, Tillisch K, et al. Alterations in resting state oscillations and connectivity in sensory and motor networks in women with interstitial Cystitis/Painful bladder syndrome. *J Urol* 2014;192:947–55.
139. Lai HH, North CS, Andriole GL, et al. Polysymptomatic, polysyndromic presentation of patients with urological chronic pelvic pain syndrome. *J Urol* 2012;187:2106–12. Epub 2012 Apr 12.
140. Sutcliffe S, Colditz GA, Pakpahan R, et al. Changes in symptoms during urologic chronic pelvic pain syndrome symptom flares: Findings from one site of the MAPP Research Network. *Neurourol Urodyn* 2015;34:188–95.



## An International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Organ Prolapse (POP)

Bernard T. Haylen,<sup>1,2\*</sup> Christopher F. Maher,<sup>1,2</sup> Matthew D. Barber,<sup>2</sup> Sérgio Camargo,<sup>2</sup>  
Vani Dandolu,<sup>2</sup> Alex Digesu,<sup>2</sup> Howard B. Goldman,<sup>2</sup> Martin Huser,<sup>2</sup> Alfredo L. Milani,<sup>2</sup>  
Paul A. Moran,<sup>1,2</sup> Gabriel N. Schaer,<sup>1,2</sup> and Mariëlla I.J. Withagen<sup>2</sup>

<sup>1</sup>Standardization and Terminology Committees IUGA & ICS

<sup>2</sup>Joint IUGA / ICS Working Group on Female POP Terminology

**Introduction:** The terminology for female pelvic floor prolapse (POP) should be defined and organized in a clinically-based consensus Report. **Methods:** This Report combines the input of members of two International Organizations, the International Urogynecological Association (IUGA) and the International Continence Society (ICS), assisted at intervals by external referees. Appropriate core clinical categories and a sub-classification were developed to give a coding to definitions. An extensive process of fourteen rounds of internal and external review was involved to exhaustively examine each definition, with decision-making by collective opinion (consensus). **Results:** A Terminology Report for female POP, encompassing over 230 separate definitions, has been developed. It is clinically-based with the most common diagnoses defined. Clarity and user-friendliness have been key aims to make it interpretable by practitioners and trainees in all the different specialty groups involved in female pelvic floor dysfunction and POP. Female-specific imaging (ultrasound, radiology and MRI) and conservative and surgical managements are major additions and appropriate figures have been included to supplement and clarify the text. Emerging concepts and measurements, in use in the literature and offering further research potential, but requiring further validation, have been included as an appendix. Interval (5-10 year) review is anticipated to keep the document updated and as widely acceptable as possible. **Conclusion:** A consensus-based Terminology Report for female POP has been produced to aid clinical practice and research. *Neurourol. Urodynam.* 35:137–168, 2016. © 2016 Wiley Periodicals, Inc., and The International Urogynecological Association

**Key words:** female; pelvic organ prolapse; standardization report; terminology report

### INTRODUCTION

**Prolapse** (Latin: *Prolapsus* – “a slipping forth”) refers to a falling, slipping or downward displacement of a part or organ. **Pelvic organ** refers most commonly to the uterus and/or the different vaginal compartments and their neighboring organs such as bladder, rectum or bowel. **Pelvic organ prolapse (POP)** is thus, primarily, a definition of anatomical change. Some such changes may well be considered within the range of normality for certain women. A **diagnosis of POP** ideally demands clear clinical evidence, starting with a woman having symptoms related to the “downward displacement” of a pelvic organ.

There is currently no single document encompassing all elements required for diagnoses in the area of female POP. Such a report would require a full outline of the terminology for symptoms, signs, clinical assessments, functional investigations for female POP, the imaging associated with those investigations, the most common diagnoses and terminology for the different conservative and surgical treatment modalities.

Bernard T. Haylen, University of New South Wales, Sydney, N.S.W. Australia. bernard@haylen.co  
Christopher F. Maher, University of Queensland, Brisbane, Australia. chrismaher@urogynaecology.com.au  
Matthew D. Barber, Cleveland Clinic, Cleveland, Ohio, U.S.A. barberm2@ccf.org  
Sérgio FM Camargo, Hospital Presidente Varga, Porto-Alegre-RS, Brazil. sergiocamargo47@gmail.com  
Vani Dandolu, University of Nevada, Las Vegas, U.S.A. vdandolu@medicine.nevada.edu  
Alex Digesu, St Mary's Hospital, London, United Kingdom. a.digesu@imperial.ac.uk  
Howard B Goldman, Cleveland Clinic, Cleveland, Ohio, U.S.A. goldmah@ccf.org  
Martin Huser, Brno University Hospital, Brno, Czech Republic. martin.huser@gmail.com  
Alfredo L. Milani, Reimier de Graaf Gasthuis, Delft, Netherlands. fredmilani@me.com  
Paul A. Moran, Worcestershire Royal Hospital, Worcester, United Kingdom. moranpa@doctors.org.uk  
Gabriel N. Schaer, Kantonsspital, Aarau, Switzerland. Gabriel.Schaer@ksa.ch  
Mariëlla I.J. Withagen, University Medical Centre, Utrecht, Netherlands. m.i.j.withagen@umcutrecht.nl

**DISCLOSURES:** **BT Haylen:** No disclosures; **CF Maher:** No disclosures; **MD Barber:** No disclosures; **SFM Camargo:** No disclosures; **V Dandolu:** Research grant–Allergan, Consultant–Pfizer; **A Digesu:** Honorarium for lectures or sponsorship to cover travel expenses at Meetings from: Astellas, Pfizer, Allergan, AMS, Medtronic, Uroplasty; **HB Goldman:** Consultant – Allergan, Medtronic, Uroplasty; Speaker – Astellas, Allergan, Medtronic, Uroplasty; **M Huser:** No disclosures; **AL Milani:** No disclosures; **PA Moran:** Speaker & consultant: Astellas and Ethicon Women's Health and Urology. Consultant: Boston Scientific. **GN Schaer:** Advisor (in Switzerland) for Astellas, Novartis, Pfizer; **MIJ Withagen:** Research Grant 2010–Ethicon Women's Health & Urology

\*Correspondence to: Associate Professor B.T. Haylen, Suite 904, St Vincent's Clinic, 438 Victoria Street, Darlinghurst, 2010. Ph: ## 61 - 2 - 83826983, Fax: ## 61 - 2 - 83826984. N.S.W. AUSTRALIA. bernard@haylen.co

Published online 7 January 2016 in Wiley Online Library (wileyonlinelibrary.com).

DOI 10.1002/nau.22922

© 2016 Wiley Periodicals, Inc., and The International Urogynecological Association

There will be a need to reference considerably the 2010 IUGA-ICS Joint Terminology Report on Female Pelvic Floor Dysfunction<sup>1</sup>. An original aim of that report<sup>1</sup> had been to provide a general terminology, forming a “backbone” or “core” terminology to which more specific terminologies can be attached. Reference can also be made to three other published Standardization Reports<sup>2-4</sup> and 6 joint IUGA-ICS Female Terminology Reports<sup>5-10</sup> subsequent to the 2010 Report<sup>1</sup>, three published<sup>5-7</sup>, three<sup>8-10</sup> advanced in development.

In terms of the previous standardization document on female POP<sup>4</sup>, now 20 years old, there has been much discussion and debate<sup>11-14</sup> on the possible need to update its classification POP-Q, or at least to present it in a refreshed version. The POP Working Group has opted for the latter, with major upgrades to symptoms, signs, investigations and diagnoses, but a conservative approach to the classification itself (apart from adding a validated simplified version), due to the longevity of its use and the lack of any validated, clearly superior alternative classification. Female-specific imaging (ultrasound, radiology and MRI) and conservative and surgical managements are major additions and appropriate figures have been included to supplement and clarify the text. Emerging concepts and measurements, in use in the literature and offering further research potential, but requiring further validation, have been included as an Appendix. This Report acknowledges that POP is often not a diagnosis in isolation but may be associated with POP-related and unrelated voiding, defecatory and/or sexual dysfunctions and/or other diagnoses of pelvic floor dysfunction.

This Terminology Report is inherently and appropriately a definitional document, collating the definitions of those terms, i.e. “words used to express a defined concept in a particular branch of study”<sup>15</sup>, here POP. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. The aim is to assist clinical practice and research. Some new and revised terms have been included. Explanatory notes on definitions have been referred, where possible, to the “Footnotes” section.

Like all the other joint IUGA-ICS female-specific terminology reports, every effort has been made to ensure this Report is:

**(1) User-friendly:** It should be able to be understood by all clinical and research users.

**(2) Clinically-based:** Symptoms, signs and validated assessments/investigations should be presented for use in forming workable diagnoses for POP and associated dysfunctions. Sections 1-5 will address symptoms, signs, POP quantification, investigations for associated dysfunctions and current POP imaging modalities that may be used to make those diagnoses. A number of related radiological investigations including Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) have also been incorporated. Section 6 will address POP diagnoses, possible POP-related diagnoses and co-existing diagnoses. The scope of the Report will exclude more invasive investigations requiring an anesthetic. Sections 7 and 8 will list the terminology for evidence-based conservative and surgical treatments for POP.

**(3) Origin:** Where a term’s existing definition (from one of multiple sources used) is deemed appropriate, that definition will be included and duly referenced. A large number of terms in female pelvic floor prolapse and dysfunction, because of their long-term use, have now become generic, as apparent by their listing in medical dictionaries.

**(4) Able to provide explanations:** Where a specific explanation is deemed appropriate to describe a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (*Footnote [FN] 1,2,3...*). Wherever possible, evidence-based medical principles will be followed.

It is suggested that acknowledgement of these standards in written publications related to female POP, be indicated by a footnote to the section “Methods and Materials” or its equivalent, to read as follows: “Methods, definitions and units conform to the standards jointly recommended by the International Urogynecological Association and the International Continence Society except where specifically noted”.

## SECTION 1: SYMPTOMS:

**Symptom:** Any morbid phenomenon or departure from the normal in structure, function or sensation, experienced by the woman and indicative of disease or a health problem<sup>16</sup>. Symptoms are either volunteered by, or elicited from the woman or may be described by the woman’s caregiver<sup>1-3</sup>.

<sup>1</sup>: In the era of advanced cellphone camera technology, a woman, at times, will bring photographic evidence of the prolapse at its worst. This can add to other clinical evidence, particularly if there is a discrepancy between symptoms and signs.

<sup>2</sup>: The more formal classification of constipation is as follows:

Rome II diagnostic criteria for constipation:

- At least 12 weeks, which need not be consecutive, in the previous 12 months, of two or more of:
  - (i) Straining in > 1 in 4 defecations.
  - (ii) Lumpy or hard stools in > 1 in 4 defecations.
  - (iii) Sensation of incomplete evacuation in > 1 in 4 defecations.
  - (iv) Sensation of anorectal obstruction/ blockage in > 1 in 4 defecations.
  - (v) Manual manoeuvres to facilitate > 1 in 4 defecations (e.g. digital evacuation, support of the pelvic floor).
  - (vi) Less than 3 defecations per week.
- Loose stools are not present and there is insufficient evidence for IBS (irritable bowel syndrome)

<sup>3</sup>: A symptomatic-based subdivision of Stage II (see Appendix A) was overlooked at this time in favor of maintaining the current strictly anatomical definition of the “sign of POP”.

### Pelvic Organ Prolapse (POP) Symptoms

**Prolapse symptoms<sup>1</sup>:** A departure from normal sensation, structure or function, experienced by the woman in reference to the position of her pelvic organs. Symptoms are generally worse in situations when gravity might make the prolapse worse (e.g. after long periods of standing or exercise) and better when gravity is not a factor e.g. lying supine. Again symptoms may be more noticeable at times of abdominal straining e.g. defecation.

#### A: Vaginal Prolapse Symptoms

**(i) Vaginal bulging<sup>1</sup>:** Complaint of a “bulge”, lump or “something coming down” or “falling out” through the vaginal introitus. The woman may state she can either feel the bulge by direct palpation or see it, perhaps aided with a mirror. FN1

**(ii) Pelvic pressure<sup>1</sup>:** Complaint of increased heaviness or dragging (pain or discomfort) in the suprapubic area and/or pelvis.

**(iii) Bleeding, discharge, infection<sup>1</sup>:** Complaint of abnormal vaginal bleeding, discharge or infection which may be related to ulceration of the prolapse.

**(iv) Splinting / Digitation<sup>1</sup>:** Complaint of the need to digitally replace the prolapse or to otherwise apply manual pressure, e.g. to the vagina, perineum or perianal area (splinting), or rectally (digitation) to assist voiding or defecation.

**(v) Low backache<sup>1</sup> (POP-related):** Complaint of low, sacral (or “menstrual-like”) backache associated temporally with vaginal POP and relieved when prolapse is reduced.

#### B: Urinary Tract Prolapse Symptoms

**(i) Urethral Prolapse:** Complaint of a “lump” at the external urethral meatus.

#### C: Anorectal prolapse symptoms

**(i) Anorectal prolapse:** Complaint of a “bulge” or “something coming down” towards or through the anus/rectum. The woman may state she can either feel the bulge by direct palpation or see it perhaps aided with a mirror. FN1

**(ii) Rectal prolapse:** Complaint of external protrusion of the rectum.

#### Effects of Pelvic Organ Prolapse on Bladder, Bowel and Sexual Function.

As demonstrated in Figure 1, higher stage utero-vaginal prolapse will usually cause anatomical distortion to surrounding organs, bladder and rectum most commonly. This can lead to abnormal function, most commonly difficulty with bladder and bowel emptying. Commonly, symptoms related to those surrounding organs are the most bothersome leading to the eventual diagnosis of the POP.



Figure 1. Utero-vaginal prolapse.

#### D: Potential prolapse-related lower urinary tract symptoms:

**(i) Hesitancy<sup>1</sup>:** Complaint of a delay in initiating micturition.

**(ii) Slow stream<sup>1</sup>:** Complaint of a urinary stream perceived as slower compared to previous performance (particularly prior to the development of POP) or in comparison with others.

**(iii) Intermittency<sup>1</sup>:** Complaint of urine flow that stops and starts on one or more occasions during voiding.

**(iv) Straining to void<sup>1</sup>:** Complaint of the need to make an intensive effort (by abdominal straining, Valsalva or suprapubic pressure) to either initiate, maintain or improve the urinary stream.

Neurourology and Urodynamics DOI 10.1002/nau

140 Haylen et al.

(v) **Spraying (splitting) of urinary stream<sup>1</sup>**: Complaint that the urine stream is a spray or split rather than a single discrete stream.

(vi) **Feeling of incomplete (bladder) emptying<sup>1</sup>**: Complaint that the bladder does not feel empty after micturition.

(vii) **Need to immediately re-void<sup>1</sup>**: Complaint that further micturition is necessary soon after passing urine.

(viii) **Post-micturition leakage<sup>1</sup>**: Complaint of a further involuntary passage of urine following the completion of micturition.

(ix) **Position-dependent micturition<sup>1</sup>**: Complaint of having to take specific positions to be able to micturate spontaneously or to improve bladder emptying e.g. leaning forwards or backwards on the toilet seat or voiding in the semi-standing position.

(x) **Splinting to micturate**: as above A (iv).

(xi) **Dysuria<sup>1</sup>**: Complaint of burning or other discomfort during micturition. Discomfort may be intrinsic to the lower urinary tract or external (vulvar dysuria).

(xii) **(Urinary) retention<sup>1</sup>**: Complaint of the inability to pass urine despite persistent effort.

(xiii) **Increased daytime urinary frequency<sup>1</sup>**: Complaint that micturition occurs more frequently during waking hours than previously deemed normal by the woman.

(xiv) **Urgency<sup>1</sup>**: Complaint of a sudden, compelling desire to pass urine which is difficult to defer.

#### E: Potential prolapse-related anorectal dysfunction symptoms<sup>1,8</sup>

(i) **Constipation<sup>8</sup>**: Complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate. FN2

(ii) **Feeling of incomplete bowel evacuation<sup>1,8</sup>**: Complaint that the rectum does not feel empty after defecation and may be accompanied by a desire to defecate again.

(iii) **Straining to defecate<sup>1,8</sup>**: Complaint of the need to make an intensive effort (by abdominal straining or Valsalva) to either initiate, maintain or improve defecation.

(v) **Sensation of anorectal blockage<sup>8</sup>**: Complaint suggestive of anorectal obstruction.

(vi) **Splinting / Digitation<sup>1,8</sup>**: Defined above in A (iv).

(vii) **Fecal (rectal) urgency<sup>1,8</sup>**: Complaint of a sudden compelling desire to defecate that is difficult to defer.

(viii) **Post-defecatory soiling (NEW)**: Soiling occurring after defecation.

#### F: Potential prolapse-related Sexual dysfunction symptoms<sup>1,10,17</sup>

(i) **Dyspareunia**: Complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration.

(ii) **Obstructed intercourse**: Complaint that vaginal penetration is impeded. Possible causes include narrowing or a bulge.

(iii) **Vaginal laxity**: Complaint of excessive vaginal looseness.

(iv) **Libido – loss or decrease**: Complaint of loss or decrease of sexual desire

#### G: Other Possible Associated Symptoms<sup>1</sup>

(i) **Urinary incontinence symptoms<sup>1</sup>**: Urinary incontinence (symptom); stress (urinary) incontinence; urgency (urinary) incontinence; postural (urinary) incontinence; nocturnal enuresis; mixed (urinary) incontinence; continuous (urinary) incontinence; insensible (urinary) incontinence; coital (urinary) incontinence.

(ii) **Bladder storage symptoms<sup>1</sup>**: nocturia; overactive bladder syndrome.

(iii) **Bladder sensory symptoms<sup>1</sup>**: Increased bladder sensation; reduced bladder sensation; absent bladder sensation.

(iv) **Lower Urinary Tract Infection<sup>1</sup>**: Urinary tract infection (UTI); recurrent urinary tract infections (UTIs); other related history.

**H: More common POP-related symptoms**: Table I gives a consensus view of the authors of the more common POP-related symptoms

TABLE I. The symptoms that women with POP would more\* and most commonly\*\* describe.

<b>Potential prolapse-related symptoms</b>	
<u>Vaginal prolapse</u>	Bulge sensation /visualization**, pelvic pressure**, low (sacral) backache*
<u>Urinary tract</u>	Frequency**, recurrent UTI**, incomplete emptying/urinary retention*, slow stream*
<u>Ano-rectal</u>	Incomplete defecation**, digitation/splinting*, rectal urgency*, post-defecatory soiling
<u>Sexual</u>	Dyspareunia*, vaginal laxity*
<b>Other possible associated symptoms</b>	
<u>Urinary incontinence**</u>	Stress, urge, postural, nocturnal, coital
<u>Bladder storage*</u>	Urgency, nocturia,

Neurourology and Urodynamics DOI 10.1002/nau

## SECTION 2: SIGNS

**Sign:** Any abnormality indicative of disease or a health problem, discoverable on examination of the patient; an objective indication of disease<sup>16</sup> or a health problem.

**A: Signs of Pelvic Organ Prolapse:** All examinations for POP should be performed with the woman's bladder empty (and if possible an empty rectum). An increasing bladder volume has been shown to restrict the degree of descent of the prolapse<sup>18</sup>. The choice of the woman's position during examination, e.g. left lateral (Sims), supine, standing or lithotomy is that which can best demonstrate POP in that patient and which the woman can confirm as the maximal extent she has perceived e.g. by use of a mirror or digital palpation. The degree of prolapse may be worse after a lengthy time in the upright position. FN1

**(i) Pelvic organ prolapse (anatomical definition of the sign of POP)<sup>1</sup>:** The descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix) or the apex of the vagina (vaginal vault or cuff scar after hysterectomy). **The presence of any such sign should be correlated with relevant POP symptoms<sup>13,19-21</sup>**, i.e., patient report of maximal prolapse. More commonly, this correlation would occur at the level of the hymen or beyond<sup>19-21</sup>.

**(ii) Pelvic organ prolapse – (POPO) - (staging<sup>1,3,4</sup>):**

**Stage 0:** No prolapse is demonstrated.

**Stage I:** Most distal portion of the prolapse is more than 1cm above the level of the hymen.

**Stage II:** The most distal portion of the prolapse is situated between 1 cm above the hymen and 1cm below the hymen. FN3. See also Appendix.

**Stage III:** The most distal portion of the prolapse is more than 1cm beyond the plane of the hymen but everted at least 2cm less than the total vaginal length.

**Stage IV:** Complete eversion or eversion at least within 2 cm of the total length of the lower genital tract is demonstrated.

**(iii) Uterine/ cervical prolapse:** Observation of descent of the uterus or uterine cervix.

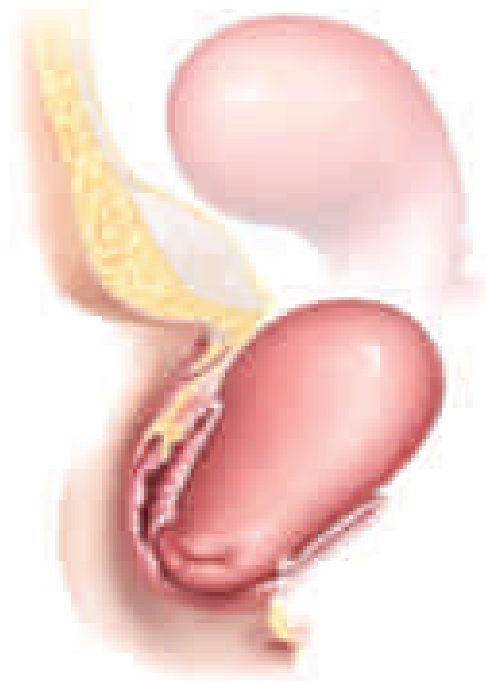


Figure 2. Uterine Prolapse.

**(iv) Anterior vaginal wall (compartment) prolapse:** Observation of descent of the anterior vaginal wall (compartment). Most commonly this might represent bladder prolapse (cystocele). Higher stage anterior vaginal wall prolapse will generally involve descent of uterus or vaginal vault (if uterus is absent). Occasionally, there might be an anterior enterocele (hernia of peritoneum and possibly abdominal contents), most commonly after prior reconstructive surgery.



Figure 3. Anterior vaginal wall (compartment) prolapse.

**(v) Posterior vaginal wall (compartment) prolapse:** Observation of descent of the posterior vaginal wall. Commonly, this would represent rectal protrusion into the vagina (rectocele). Higher stage posterior vaginal wall prolapse after prior hysterectomy will generally involve some vaginal vault (cuff scar) descent and possible enterocele formation. Enterocele formation can also occur in the presence of an intact uterus.



Figure 4. Posterior vaginal (compartment) wall prolapse.

**(vi) Vaginal vault (cuff scar) prolapse:** Observation of descent of the vaginal vault (cuff scar after hysterectomy).



Figure 5. Vaginal vault prolapse.

Neurourology and Urodynamics DOI 10.1002/nau



**B: Clinical Staging<sup>4</sup>:**

Each aspect of POP, uterine (cervical) prolapse, anterior vaginal wall (compartment), posterior vaginal wall (compartment), vaginal vault (cuff scar) prolapse can and should be subject to a clinical staging.

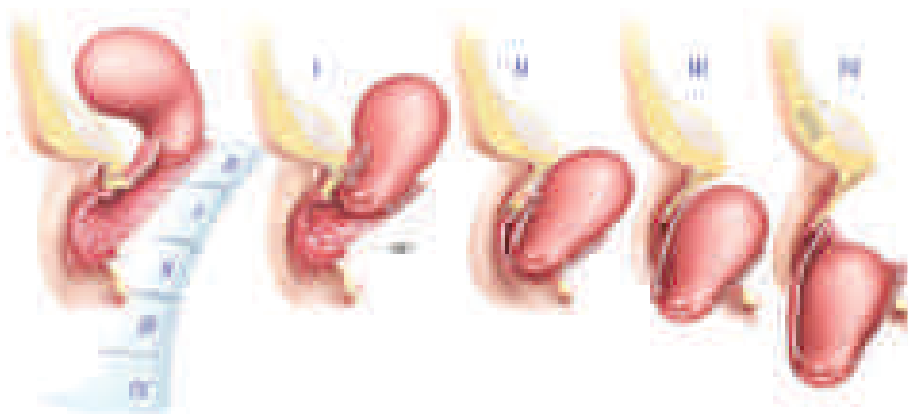


Figure 6. shows prolapse staging<sup>4</sup> – 0, I, II, III, IV. (uterine – by the position of the leading edge of the cervix).

**C: Supplementary Physical Examination Techniques**

(i) **Digital rectal-vaginal examination<sup>4</sup>:** While the patient is straining and the prolapse is maximally developed. The aim is to try to differentiate between a high rectocele and an enterocele.

(ii) **Q-tip (urethral) testing<sup>4</sup>:** Measurement of urethral axial mobility at rest and straining to assess degree of mobility.

**D: Clinical Assessment of Associations of POP**

(i) **Levator Defects / Trauma<sup>22</sup>:** Per-vaginal palpation for levator injury/defect/ “avulsion”.

(ii) **Uterine retroversion<sup>23,24</sup>:** (Turning backward) The axis of the uterus is directed backwards towards the hollow of the sacrum, away from its anteverted position overlying the bladder. Cervix is noted in/ towards the anterior fornix with fundus perhaps palpable in the posterior fornix. FN4

**E: Other Possible Signs.**

(i) **Urinary incontinence signs<sup>1</sup>:** Urinary incontinence; stress (urinary) incontinence; urgency (urinary) incontinence; extraurethral incontinence; stress incontinence on prolapse reduction (occult or latent stress incontinence)

(ii) **Other pelvic examinations/signs<sup>1</sup>:** Vulvar examination; urethral inspection/palpation (urethral mucosal prolapse, urethral caruncle; urethral diverticulum); vaginal examination; bimanual pelvic examination; pelvic floor muscle function (normal pelvic floor muscles, overactive pelvic floor muscles, underactive pelvic floor muscles, non-functioning pelvic floor muscles); examination for levator (puborectalis) injury; perineal examination (perineal elevation, perineal descent); rectal examination (anal sphincter tone and strength, anal sphincter tear, fecal impaction present/absent, other rectal lesions, anal lesions, other perianal lesions), vaginal atrophy.

(iii) **Other relevant examinations/Signs<sup>1</sup>:** Neurological signs, abdominal signs (bladder fullness/retention; abdominal masses or distension; scars from previous relevant surgery or trauma; renal tenderness or masses).

(iv) **Frequency volume chart / Bladder diary<sup>1</sup>**

(v) **Pad testing<sup>1</sup>**

**SECTION 3: PROLAPSE QUANTIFICATION****A: Pelvic Organ Prolapse Quantification (POP-Q)<sup>4</sup>**

(i) **Fixed Point of Reference.** The hymen is the fixed point of reference used throughout the POP-Q system of quantitative prolapse description.

<sup>4</sup>: The axis of the retroverted uterus is parallel to that of the vaginal axis with less impediment to uterine (cervical) descent. In contrast, the anteverted uterus is perpendicular to the vaginal axis with impediment to descent by the posterior vaginal wall and behind that the rectum.

**(ii) Defined Points.** The anatomic position of the six defined points (two on the anterior vaginal wall, two in the superior vagina, and two on the posterior vaginal wall) for measurement should be centimeters (cm) above or proximal to the hymen (negative number) or cm below or distal to the hymen (positive number) with the plane of the hymen being defined as zero (0). For example, a cervix that protruded 3 cm distal to the hymen would be +3 cm. All points are measured on maximal straining (except total vaginal length).

**(iii) Anterior Vaginal Wall.**

(a) **Point Aa.** A point located in the midline of the anterior vaginal wall three (3) cm proximal to the external urethral meatus. By definition, the range of position of Point Aa relative to the hymen is -3 to +3 cm.

(b) **Point Ba.** A point that represents the most distal (i.e., most dependent) position of any part of the upper anterior vaginal wall from the vaginal cuff or anterior vaginal fornix to Point Aa. By definition, Point Ba is at -3 cm in the absence of prolapse and would have a positive value equal to the position of the cuff (Point C) in women with total uterine prolapse or post-hysterectomy vaginal eversion.

**(iv) Superior Vagina.** These points represent the most proximal locations of the normally positioned lower reproductive tract. The two superior sites are as follows:

(c) **Point C.** A point that represents either the most distal (i.e., most dependent) edge of the cervix or the leading edge of the vaginal cuff (hysterectomy scar) after total hysterectomy.

(d) **Point D.** A point that represents the location of the posterior fornix in a woman who still has a cervix. It is included as a point of measurement to differentiate suspensory failure of the uterosacral-cardinal ligament "complex" from cervical elongation. When the location of Point C is significantly more positive than the location of Point D, this is indicative of cervical elongation which may be symmetrical or eccentric. Point D is omitted in the absence of the cervix.

**(v) Posterior Vaginal Wall.**

(e) **Point Ap.** A point located in the midline of the posterior vaginal wall three (3) cm proximal to the hymen. By definition, the range of position of Point Ap relative to the hymen is -3 to +3 cm.

(f) **Point Bp.** A point that represents the most distal (i.e., most dependent) position of any part of the upper posterior vaginal wall from the vaginal cuff or posterior vaginal fornix to Point Ap. By definition, Point Bp is at -3 cm in the absence of prolapse and would have a positive value equal to the position of the cuff in a women with total post-hysterectomy vaginal eversion.

**(vii) Other Landmarks and Measurements.**

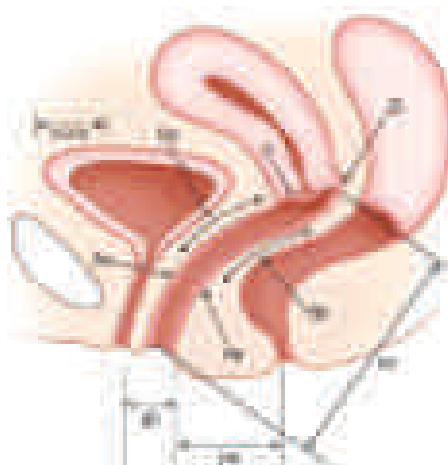
(g) The **genital hiatus** (GH) is measured from the middle of the external urethral meatus to the posterior margin of the hymen.

(h) The **total vaginal length** (TVL) is the length of the vagina (cm) from posterior fornix to hymen when Point C or D is reduced to its full normal position. (See Figure 40 - Appendix).

(i) The **perineal body** (PB) is measured from the posterior margin of the hymen to the mid-anal opening.

**(viii) Recording Measurements:** (NB: Intraoperative measurements with traction can be quite different from measurements made during Valsalva in clinic, both in regards to cervical location and the vaginal walls). Measurements directly after removing a vaginal pessary are unreliable and will tend to understage the degree of POP.

The position of Points Aa, Ba, Ap, Bp, C, and (if applicable) D with reference to the hymen should be measured (cm) and recorded.



**Figure 7.** The six sites (Aa, Ba, C, D, Bp and Bp), the genital hiatus (gh), perineal body (pb) and total vaginal length (tv) used cm above or proximal to the hymen (negative number) or cm below or distal to the hymen (positive number) with the plane of the hymen being defined as zero (0). Alternatively, a three by three grid can be used to organize concisely the measurements as noted in Figure 8.

Anterior wall	Anterior wall	Cervix or Cuff
Aa	Ba	C
Genital hiatus	Perineal Body	Total Vaginal Length
gH	pB	TVL
Posterior wall	Posterior wall	Posterior Fornix
Ap	Bp	D

Figure 8. Grid presentation of POP-Q measurements.

B: Simplified POP-Q<sup>25,26</sup>

This is based on the POP-Q with similar ordinal staging but with only four points measured instead of nine. There is no Stage 0; it is combined with Stage 1. It is undertaken in the dorsal lithotomy position with patient forcefully bearing down, performing Valsalva or coughing.

(i) Four points used:

- . Anterior vaginal segment: point Ba (estimated around 3cm proximal to hymenal remnants).
- . Posterior vaginal segment: point Bp (estimated around 3cm proximal to hymenal remnants).
- . Cervix point C
- . Apex/posterior fornix: point D (non-hysterectomized); point C (hysterectomized)

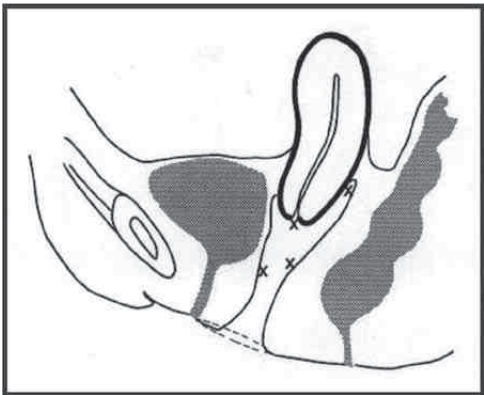


Figure 9. Simplified POP-Q.

(ii) Staging:

I, II, III, IV as for POP-Q above.

C: Additional available measurements awaiting further validation

These have been included as an Appendix after the References

(i): Vaginal Anatomical Levels and Lengths.

(ii): Perineal measurements.

(iii): Vaginal measurements.

## SECTION 4: INVESTIGATIONS

**Urodynamics<sup>1</sup>:** Functional study of the lower urinary tract.

**Clinical sequence of testing<sup>2</sup>:** Urodynamic investigations generally involve a woman attending with a comfortably full bladder for free (no catheter) uroflowmetry and post void residual urine volume (PVR) measurement prior to filling and voiding (with catheter) cystometry.

**A: Assessment of Impact of Prolapse on Voiding Function**

POP can have a negative impact on voiding function, screening for which importantly involves a postvoid residual and ideally uroflowmetry. Voiding cystometry may clarify the cause of any voiding dysfunction.

**(i) Postvoid Residual<sup>1-3</sup>:** Volume of urine left in the bladder at the completion of micturition. **Conditions for PVR measurement:** PVR reading is erroneously elevated by delayed measurement due to additional urine production (1-14 mls/min). Ultrasonic techniques (transvaginal, translabial most accurately) allow immediate<sup>27</sup> (within 60 seconds of micturition) measurement and possible repeat measurement (Figure 10). A short plastic female catheter provides the most effective bladder drainage for PVR measurement by catheterization.

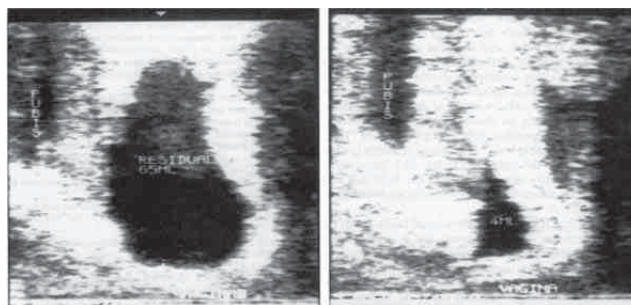


Figure 10. An image of postvoid residual of 65ml by transvaginal ultrasound, reducing to 4ml with a subsequent attempt at voiding.

**(ii) Uroflowmetry<sup>1-3</sup>:** Measurement of urine flow rates during micturition<sup>16</sup>

. **Flow rate:** Volume of urine expelled via the urethra per unit time. It is expressed in ml/sec.

. **Voided volume (ml):** Total volume of urine expelled via the urethra.

. **Maximum (urine) flow rate (MUFR - ml/sec) - Q<sub>max</sub>:** Maximum measured value of the flow rate.

. **Flow time (sec):** The time over which measurable flow actually occurs.

. **Average (urine) flow rate (AUFR - ml/sec) - Q<sub>ave</sub>:** Voided volume divided by the flow time.

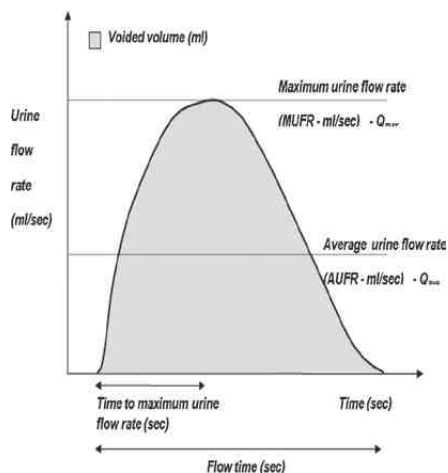


Figure 11. A schematic representation of urine flow over time.

The dependence of urine flow rates on voided volume<sup>28</sup> makes it desirable to reference raw urine flow rate data to established normative data.

Neurourology and Urodynamics DOI 10.1002/nau

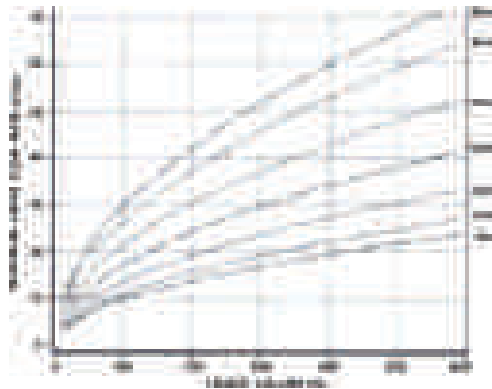


Figure 12. The Liverpool nomogram<sup>29</sup> for the maximum urine flow rate in women (under the 10<sup>th</sup> centile on repeat measurement can be regarded as abnormally slow<sup>30</sup>).

(iii) **Pressure- Flow studies**<sup>1-3,31</sup>  
**Cystometry:** Measurement of the pressure/volume relationship of the bladder during filling and/or pressure flow study during voiding. Higher voiding detrusor pressures and slower urine flow during voiding may point an element of bladder outflow obstruction<sup>1-3,32</sup>, though other patterns of pressure-flow data are possible.

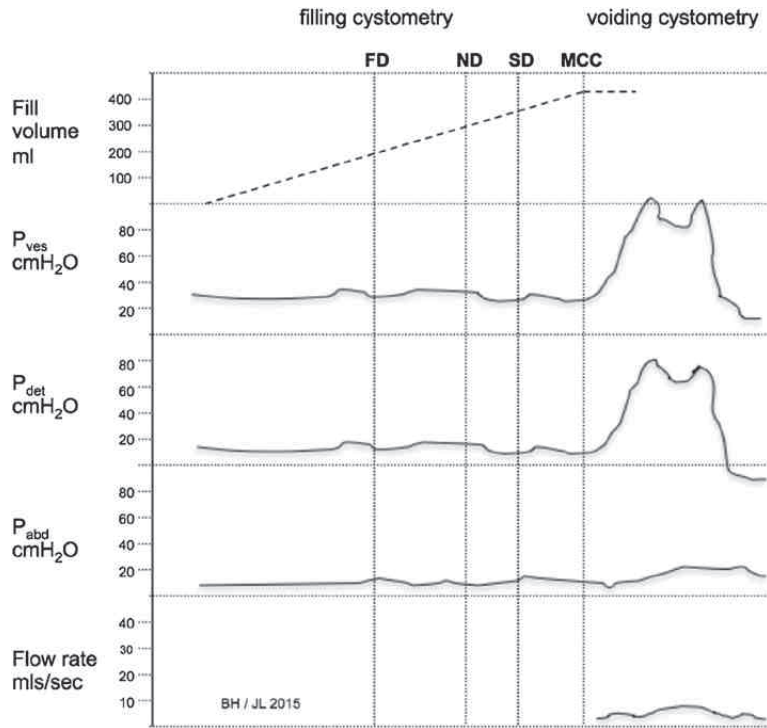


Figure 13. Filling and voiding cystometric trace, the latter part showing evidence of an element of bladder outflow obstruction. Normal bladder capacity, stable detrusor: no phasic activity seen. Voided with low urine flow rate and elevated detrusor pressure. Bladder outflow obstruction is thus demonstrated.

## B: Assessment of Impact on Prolapse on Defecatory Function

(i) **Ultrasound Assessment:** See imaging section.

(ii) **Radiological Assessment:** See imaging section.

C: Other urodynamic investigations for intercurrent diagnoses<sup>1–3,31</sup>

(i) **Filling cystometry:** The pressure/volume relationship of the bladder during filling can evaluate the presence of intercurrent diagnoses (ii–iv).

(ii) **Urodynamic stress incontinence<sup>1</sup>:**

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

(iii) **Detrusor Overactivity<sup>1</sup>:**

The occurrence of involuntary detrusor contractions during filling cystometry. These contractions, which may be spontaneous or provoked, produce a wave form on the cystometrogram, of variable duration and amplitude (Figure 14).

(iv) **Bladder Oversensitivity<sup>2</sup>:**

Increased perceived bladder sensation during bladder filling with: an early first desire to void; an early strong desire to void, which occurs at a low bladder volume; a low maximum cystometric bladder capacity. No abnormal increases in detrusor pressure are noted.

(v) **Detrusor underactivity<sup>1</sup>FN5 and Acontractile detrusor<sup>1</sup>FN6**

Can also be diagnosed at voiding cystometry.

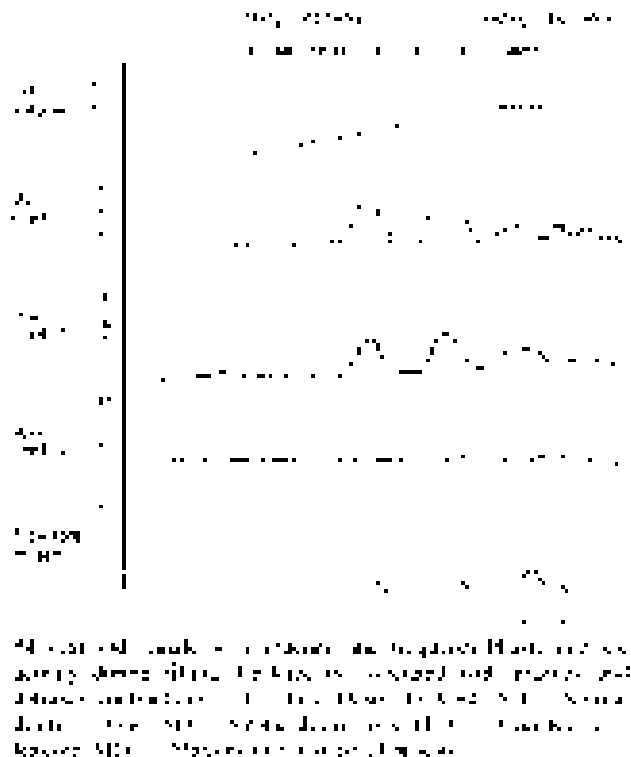


Figure 14. Cystometric trace showing detrusor overactivity<sup>1</sup>.

<sup>5</sup>. *Detrusor underactivity*: Detrusor contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.

<sup>6</sup>. *Acontractile detrusor*: The detrusor cannot be observed to contract during urodynamic studies resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. The term “areflexia” has been used where there is a neurological cause but should be replaced by *neurogenic acontractile detrusor*.

## SECTION 5: PROLAPSE IMAGING

**Imaging may assist the clinical assessment of POP or intercurrent pelvic floor diagnoses. Use of any of the different imaging modalities is, however, entirely optional.**

**A: Prolapse-related ultrasound imaging – 2-D**

**(i) Modalities**

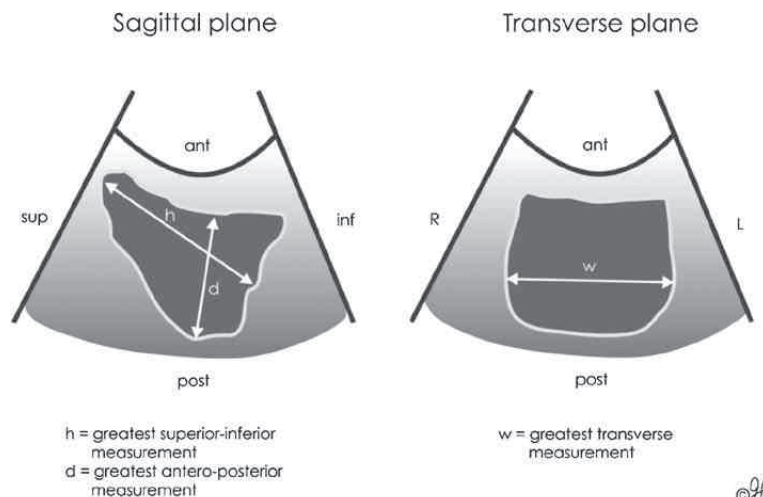
Transabdominal, perineal, introital and transvaginal ultrasound<sup>1</sup>.

- Transabdominal (T-A): curvilinear scanning applied to the abdomen.
- Perineal: curved array probe applied to the perineum. This term incorporates transperineal and translabial ultrasound.
- Introital: sector probe applied to the vaginal introitus.
- Transvaginal (T-V): intravaginal curvilinear, linear array, or sector scanning.

**(ii) Clinical applications:**

- Bladder neck descent/mobility. The position of the bladder neck at rest and on Valsalva.
- Urethral funnelling: i.e., opening of the proximal third of the urethra during coughing or on Valsalva.
- Post void residual: Several formulas have been described in the literature to measure the bladder volume by ultrasound<sup>33–35</sup>. An early formula  $[(h \times d \times w) \times 0.7]$  has been demonstrated to give reproducible results with a percentage error of 21%<sup>33</sup> (see Figure 15 for definitions of h,d,w).
- Bladder abnormalities: e.g., tumor, foreign body.
- Urethral abnormality: e.g., diverticulum.
- Intercurrent uterine and/or pelvic abnormality: dependent on probe range.
- Postoperative findings: e.g., bladder neck position and mobility, position of meshes, tapes, or implants.
- Descent of pelvic organs: visualization of descent of the bladder, uterine cervix, and rectum during coughing or on Valsalva.
- Assessment of voluntary pelvic floor muscle contractility.
- Pelvic floor/levator ani muscle defect (“avulsion”) and hiatal ballooning<sup>36</sup>.
- Ultrasound measurements of bladder and detrusor wall thickness, and ultrasound estimated bladder weight (UEBW) are potential noninvasive clinical tools for assessing the lower urinary tract. UEBW is higher in women with overactive bladder and detrusor overactivity<sup>37,38</sup>. FN7.

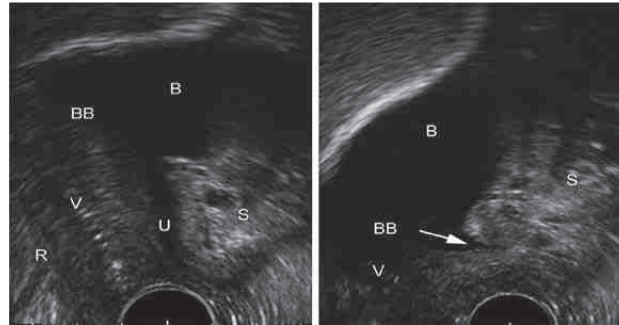
Figures 16 and 17 show examples of 2-D introital ultrasound in patients with POP symptoms.



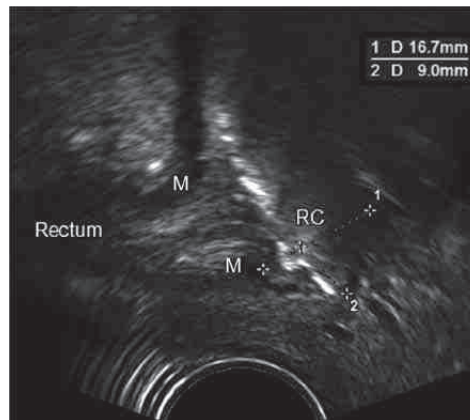
**Figure 15.** Ultrasound measurement of the bladder volume from Poston GJ et al. 1983<sup>33</sup>(redrawn).

<sup>7</sup>: Women with detrusor overactivity have a median UEBW of 48.0 g (95% CI 46-51), with urodynamic stress incontinence a median UEBW of 30 g (95% CI 29-31) and those who have associated detrusor overactivity and urodynamic stress incontinence have a median UEBW of 37.3 g (95% CI 33-41) ( $p < 0.001$ )<sup>37,38</sup>.





**Figure 16. (above):** 56 year old female with stage II cystocele and urodynamic stress incontinence. Left: at rest. Right: during Valsalva. B = Bladder, BB = bladder base, U = urethra, S = symphysis pubis, arrow = bladder neck during Valsalva, V = vagina, R = rectum. Arrow = bladder neck during Valsalva with bladder neck funneling as a sign of urethral incompetence.



**Figure 17. (above):** 72 year old female with stage II rectocele. Measurement of rectocele (RC) width (1) and depth (2) during Valsalva. M = muscularis of rectum.

### **B: Prolapse-related ultrasound imaging – 3-D**

#### **(i) Modalities: Endovaginal, transanal, and translabial/transperineal**

- Endovaginal ultrasound imaging may inadvertently compress tissues thus distorting the anatomy.
- Transanal ultrasound approach requires an expensive and dedicated transducer, and it is a more uncomfortable and embarrassing test for the woman. Its most common clinical indication is the assessment of sphincter integrity following obstetric trauma.
- Translabial/transperineal approach overcomes the limitations of endovaginal and transrectal techniques providing minimal pressure on local structures and it is least likely to alter surrounding anatomy.

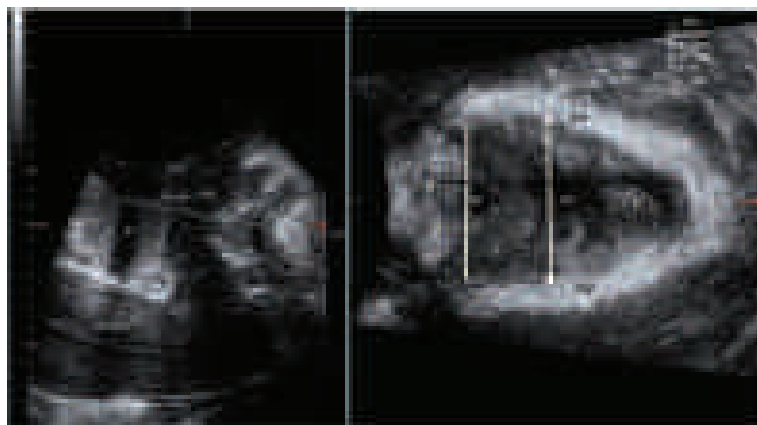
#### **(ii) Evaluations:**

The following pelvic floor abnormalities/ surgical sequelae can be evaluated:

- Trauma (injury/damage) of the levator ani muscle (LAM).
- Excessive distensibility of the puborectalis muscle and levator hiatus (“ballooning”).
- Pathologies of the anterior vaginal compartment like urethral diverticula.
- Bladder tumours or foreign bodies (sling, mesh, bulking agents).
  - Polypropylene meshes: highly echogenic and thus easily identified in the coronal and axial plane, unless they are obscured by vaginal prolapse.
  - Periurethral bulking agents, used as a continence procedure, can also be depicted with 3D pelvic floor ultrasound. FN8

<sup>8</sup>: Synthetic implant such as macroplastique, are hyperechogenic whereas collagen injections are hypoechoic and can be seen as spherical structures surrounding the bladder neck.

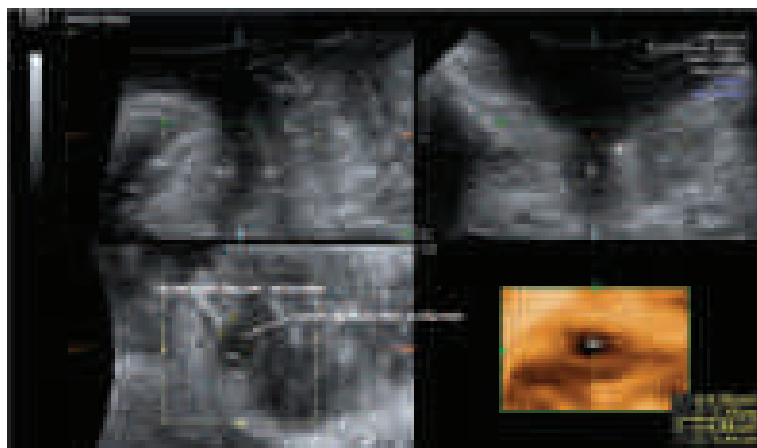
Figure 18 shows 3D ultrasound imaging of the pelvic floor anatomy.



**Figure 18. (above): 3D ultrasound image of levator ani muscle of an asymptomatic nulliparous woman at rest.** 3D ultrasound image of the pelvic floor at rest showing the anatomy and the reference plane of measurements. Left: sagittal view; PB: pubic bone; U: urethra; V: vagina; ARA: anorectal angle; white line: plane of minimal hiatal dimensions (plane of all measurements). Right: axial view; PB: pubic bone; U: urethra; V: vagina; R: rectum; PV: pubovisceralis muscle; black line: antero-posterior diameter of the levator hiatus; white line: transverse diameter of the levator hiatus at the level of pubourethralis, white double-headed line: transverse diameter of the levator hiatus at the level of pubovaginalis.

### (iii) 3D ultrasound imaging of the female urethra

3D ultrasound imaging of the rhabdosphincter overcomes the limits of MRI and two-dimensional (2D) ultrasound imaging that incorrectly measure the urethral sphincter volume using mathematical formulas based upon assumptions that the shape of the urethra is similar to that of an ellipse. Since the urethral shape is neither elliptical nor spherical, but rather an atypical geometric shape, equations should not be used<sup>39</sup>. FN9. Figure 19 shows 3D ultrasound imaging of the urethral sphincter



**Figure 19. (above): 3D translabial image of the female urethra.** The urethra lumen is shown clearly in the rendered volume image (bottom right). (U, urethra; UL, urethra lumen; RS, rhabdosphincter).

### (iv) 3D ultrasound imaging of the levator ani trauma

The presence of levator ani trauma has been postulated to be associated to an increased risk of pelvic organ prolapse<sup>40</sup>. This can be evaluated using a tomographic ultrasound imaging assessment of the levator ani muscles (Figure 20).

<sup>39</sup>: The importance of precise structural assessment of the urethral sphincter using multiple axial cross-sectional areas at set distances can assist the evaluation of women with stress urinary incontinence. It has been suggested that it may predict the severity of incontinence as well as the outcome of continence surgery since a weak sphincter will have a lower volume compared to a competent/continent urethral sphincter<sup>39</sup>.

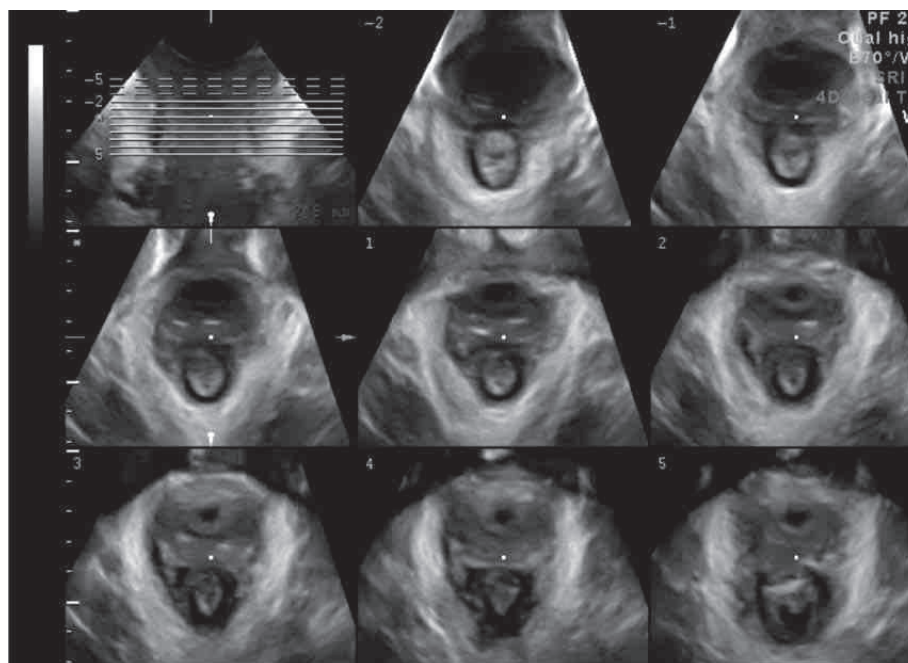


Figure 20. (above): Tomographic ultrasound imaging assessment of the levator ani muscles Intact LAM.

**(v) 3D ultrasound imaging of ballooning of the genital hiatus**

The presence of ballooning of the genital hiatus (= excessive distensibility of the levator hiatus) on Valsalva manoeuvre has also been associated to the severity of urogenital prolapse. An area of more than 25 cm<sup>2</sup>, 30 cm<sup>2</sup>, 35 cm<sup>2</sup> and 40 cm<sup>2</sup> has been defined as mild, moderate, marked and severe ballooning respectively (Figure 21)<sup>41</sup>.

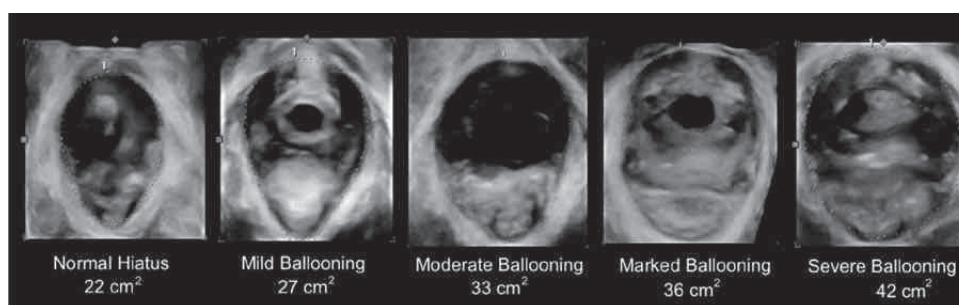


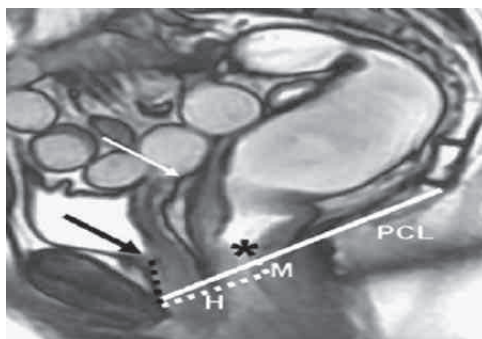
Figure 21. (above): Ballooning of the genital hiatus on Valsalva manoeuvre – levator defect.

**C: Magnetic resonance imaging (MRI) of the pelvic floor**

Magnetic resonance imaging (MRI) allows the detection of ligamentous and muscular pelvic floor structures in fine detail. Although it does not use ionising radiation, it is a high cost technique. Static MRI relies on static sequences and high spatial resolution images, to delineate the passive and active elements of the pelvic organ support system. Most commonly, images are acquired in axial, sagittal and coronal planes.

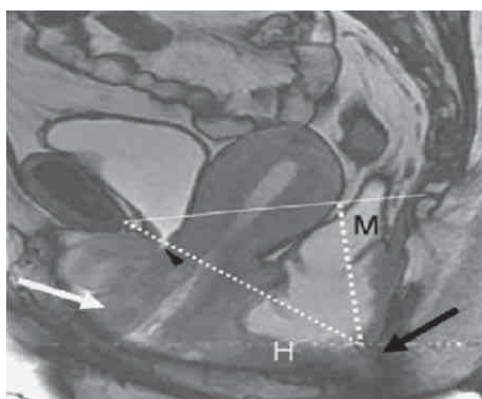
MRI has been proposed to be a useful method for diagnosing and staging POP. Several lines and levels of reference have been described in the literature. The most commonly used ones are either a line drawn from the inferior margin of the pubis symphysis to the last coccygeal joint (pubococcygeal line—PCL) or a line extending caudally along the longitudinal axis of the symphysis pubis in the sagittal plane, noted as midpubic line (MPL)<sup>42,43</sup> (Figures 22 and 23).

Neurourology and Urodynamics DOI 10.1002/nau



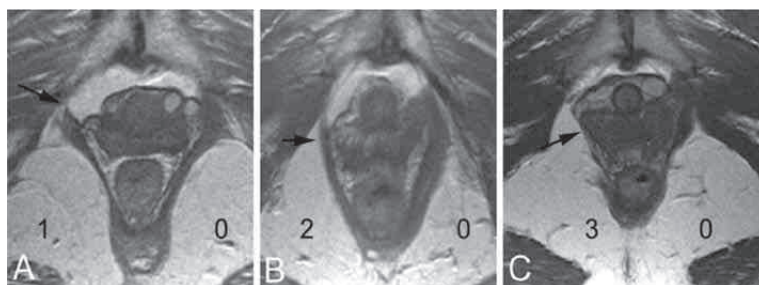
**Figure 22. (above):** Sagittal MRI image of the pelvic floor obtained at rest in a 50-year-old normal volunteer woman. The H line is drawn from the inferior border of the pubic symphysis to the posterior wall of the rectum at the level of the anorectal junction.

The M line is drawn perpendicularly from the PCL to the most posterior aspect of the H line. (PCL: pubococcygeal line, black arrow: bladder base, white arrow: vaginal vault, \*: anorectal junction, from Colaiacomo MC<sup>42</sup> et al. 2009).



**Figure 23. (above):** Severe uterine prolapse in a 41-year-old woman. Sagittal function MRI image obtained during defaecation shows the uterus moving downward inside the vagina and the cervix exits the vaginal introitus (white arrow). H and M lines are abnormally elongated. Urethral funnelling without hypermobility (arrowhead) and severe posterior compartment descent (black arrow) are also noted (from Colaiacomo<sup>42</sup> et al. 2009).

Other applications of MRI are the assessment of the LAM morphology (size, thickness volume) and detection of LAM injuries/defects/ ("avulsion") (figure 24)<sup>44–46</sup>.



**Figure 24. (above):** Examples of grades of unilateral defects in the pubovisceral portion of the LAM in axial magnetic resonance images at the level of the mid urethra. The score for each side is indicated on the figure, and the black arrows indicate the location of the missing muscle (A. grade 1 defect; B. grade 2 defect; and C. grade 3 defect, from Delancey. *Levator Ani Impairment in Prolapse. Obstet Gynecol* 2007).

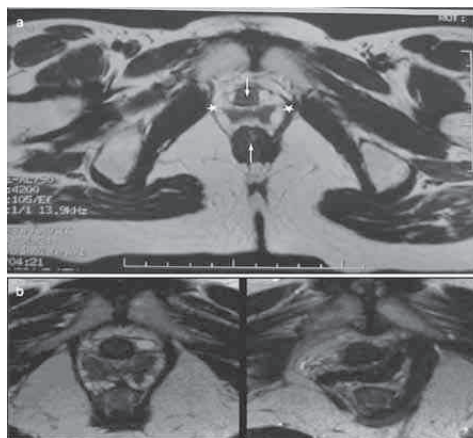
*Neurourology and Urodynamics* DOI 10.1002/nau

154 Haylen et al.

**D: Current possible measurements using MRI in urogynecology**

**(i) Bladder neck and cervical descent / mobility:**

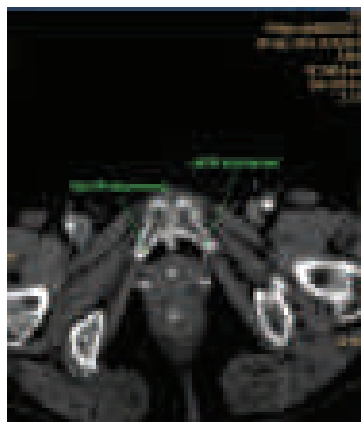
- Position of bladder neck and cervix at rest and on Valsalva
- Pubo-coccygeal line: A line extending from the inferior border of the pubic symphysis to last coccygeal joint (pubococcygeal line—PCL) Bladder neck or cervical descent > 2 cm below this line with straining indicates weakness of the pelvic floor. If alternative landmarks are used in scientific papers they should be clearly described.



**Figure 25. (above):** shows a number of possible measurements using MRI imaging. (a) Axial T2-weighted image of the pelvic floor of a healthy nulliparous Caucasian woman showing measurement of the anteroposterior diameter of the genital hiatus between the arrows from midurethra to mid-anus at the level of the lower border of the pubic symphysis. Transverse diameter (width) of the levator hiatus was measured between the stars at the point of maximum extension of the levator muscles at the level of the urinary bladder and proximal urethra. Reproduced from Am J Obstet Gynecol with permission from the Publisher. (b) An example of a unilateral levator defect of the pubococcygeus muscle (right image) seen on MRI imaging. Reproduced with kind permission from Mr. Olubenga Adekanmi; image reviewed by Professor John DeLancey.

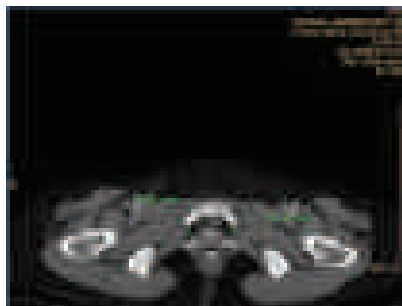
**E: Computed tomography (CT) of the pelvic floor**

Computed tomography (CT) is not routinely recommended for imaging the pelvic floor mainly due to irradiation and poor soft tissue contrast. However multiplanar spiral CT may offer an accurate visualization of the pelvic floor soft and bony structures by reconstruction of axial images using 1 mm thick slices without gaps thus increasing the diagnostic accuracy of pelvic floor anatomical disorders (ie. LAM trauma) (Figures 26 and 27).



**Figure 26. (above):** Computed tomography (CT) of the LAM. Axial view of CT multiplanar 3-dimensional data volume, with 1 mm slice thickness without gaps, showing an intact pubovisceral muscle arising from the body of the pubic bone and forming a sling around the rectum (U: urethra, V: vagina, R: rectum, PM: pubovisceral muscle, PR: puborectalis muscle).

Neurourology and Urodynamics DOI 10.1002/nau



**Figure 27. (above):** Computed tomography (CT) of the LAM. Axial view of CT scan of a woman with bilateral injury of the pubovisceral muscle. Measurement of levator symphysis gap (LSG) is denoted bilaterally (U: urethra, V: vagina, R: rectum, PM: pubovisceral muscle).

#### **F: Associated POP-related Radiology<sup>8</sup>**

Defecography demonstrates normal anatomy of the anorectum as well as disorders of rectal evacuation. With barium paste inserted rectally prior to defecation, measurement of the anorectal angle is allowed with evidence of the presence, size or emptying of any rectocele.

Enteroceles, rectal intussusception and mucosal prolapse might be diagnosed as well as a spastic pelvic floor (anismus).

### **6: DIAGNOSES**

This Report highlights the need to base diagnoses for female pelvic organ prolapse on the **correlation between a woman's symptoms, signs and any relevant diagnostic investigations.**

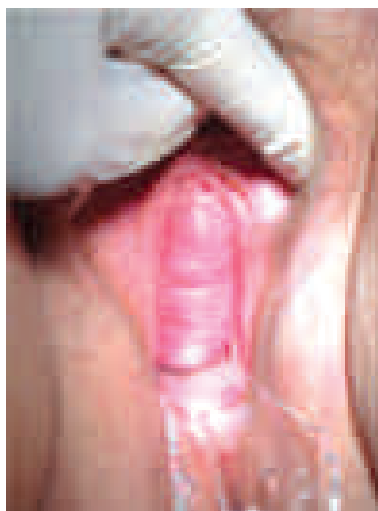
#### **A: Pelvic Organ Prolapse**

Diagnosis by **symptoms and clinical examination, assisted at times by any relevant imaging (i.e. clinically evident):**

- (i) **Uterine/ cervical prolapse:** Clinically evident descent of the uterus or uterine cervix.
- (ii) **Anterior vaginal wall (compartment) prolapse:** Clinically evident descent of the anterior vaginal wall (compartment).
- (iii) **Posterior vaginal wall (compartment) prolapse:** Clinically evident descent of the posterior vaginal wall (compartment).
- (iv) **Vaginal vault (cuff scar) prolapse:** Clinically evident descent of the vaginal vault (cuff scar after hysterectomy).

Clinical staging (see Figures 6 and 28-30) assists in description.

**Figures 28–30:** Different types and stages of pelvic organ prolapse.



**Figure 28. (above): Stage II Anterior vaginal wall (compartment) prolapse.**

Neurourology and Urodynamics DOI 10.1002/nau

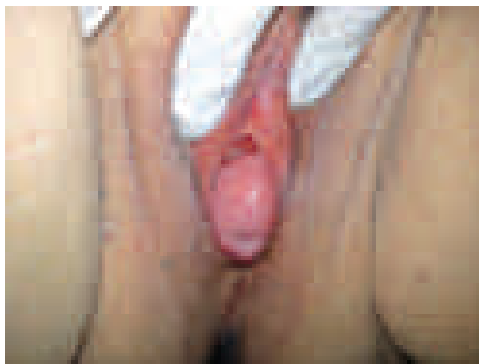


Figure 29. (above): Stage III Uterine prolapse.

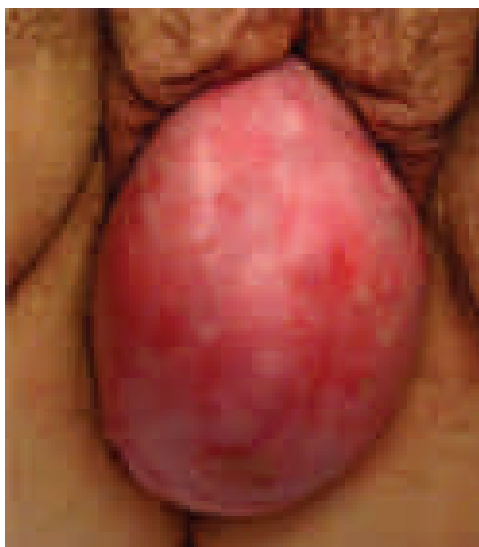


Figure 30. (above): Stage IV Vaginal prolapse (complete eversion).

**B: Possible prolapse-related diagnoses:**

**(i) Voiding dysfunction:** A diagnosis by **symptoms and urodynamic investigations** is defined as abnormally slow and/or incomplete micturition, based on abnormal slow urine flow rates and/or abnormally high post void residuals, ideally on repeated measurement to confirm abnormality. (Voiding cystometry can be required to determine the cause of the voiding dysfunction). *FN10*

**(ii) Recurrent urinary tract infections (UTI):** A diagnosis by **clinical history** assisted by **the results of diagnostic tests** involves the determination of the occurrence of at least three symptomatic and medically diagnosed urinary tract infections (UTI) over the previous 12 months. One possible POP-related cause is a chronically elevated postvoid residual.

**(iii) Defecatory dysfunction:** A diagnosis by **clinical history** assisted, at times, by **the results of diagnostic tests** involving the confirmation of abnormal or difficult function in the initiation, passage or completion of defecation.

**(iv) Sexual dysfunction:** A diagnosis by **clinical history** (including specific questionnaires) involving the confirmation of abnormal function and/or difficulty with sexual intercourse.

<sup>10</sup>: It is acknowledged this definition may not encompass cases of (i) symptoms of voiding dysfunction without abnormality of voiding parameters; (ii) abnormality of voiding parameters without symptoms of voiding dysfunction.



**C: Intercurrent diagnoses:**

**(i) Urodynamic stress incontinence:** Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction. In the circumstances where this diagnosis is only made when the POP is reduced, the additional term **“occult”** is appropriate.

**(ii) Detrusor overactivity:** The occurrence of involuntary detrusor contractions during filling cystometry.

**(iii) Bladder oversensitivity:** Increased perceived bladder sensation during bladder filling with: an early first desire to void; an early strong desire to void, which occurs at a low bladder volume; a low maximum cystometric bladder capacity. No abnormal increases in detrusor pressure are noted.

**(iv) Detrusor underactivity<sup>1</sup>FN5 and Acontractile detrusor<sup>1</sup>FN6**

**7: CONSERVATIVE TREATMENTS**

**Conservative:** restricted to non-surgical and non-pharmacological treatments.

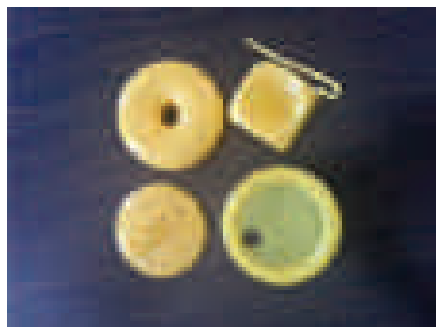
**A: Lifestyle interventions:** Interventions that intentionally change the way a person lives in order to improve health status (e.g. weight loss and avoiding heavy lifting or coughing, e.g. by ceasing tobacco smoking), to avoid exacerbation of POP by decreasing intra-abdominal pressure.

**B: Devices**

**Device:** An object or instrument that has been invented/created for a particular purpose.

**(i) Pessary:** A device that is inserted into the vagina to provide structural support to one or more of descending vaginal compartments, i.e.; the uterus, anterior vaginal wall (and bladder), posterior vaginal wall (and rectum) and/or vaginal apex (with or without small intestine after a prior hysterectomy)<sup>47</sup>.

**Types of pessary:** Vaginal pessaries can be broadly divided into two types: support pessaries (ring, ring with support, Gehrung, Hodge) and space filling pessaries (doughnut, gellhorn, cube, inflatable pessaries).



**Figure 31.** Pessaries (clockwise from top left) donut, cube, ring with central support, gellhorn.



**Figure 32.** Shelf pessary.

158 Haylen et al.

The most frequently used pessaries are listed below, as shown in figure 31<sup>47</sup>.

- a. Ring pessary with or without central support
- b. Gellhorn pessary; round solid pessary with a central stem
- c. Donut pessary FN11
- d. Cuboid pessary FN12
- e. Shelf pessary: Similar to a Gellhorn but asymmetric

#### C: Physical Therapies<sup>9</sup>

**Pelvic physiotherapy:** Assessment, prevention and/or treatment of pelvic floor dysfunction, performed by a pelvic physiotherapist. The therapy aims at reducing POP symptoms and related bother as well as improvement of pelvic floor function. Pelvic physiotherapy covers many specialized therapies that can be used to train the pelvic floor: physical activity, cognitive behavioural therapy, bladder training, bowel habit training, muscle training (endurance, power), coordination training, biofeedback, and electrical muscle stimulation<sup>9</sup>. The role of continence nurses amongst other health professionals in performing some of these specialized therapies is acknowledged.

Other therapies: Refer to the terminology document of Bo et al<sup>9</sup>.

### 8: SURGICAL TREATMENTS

#### A: General POP Surgical Terminology

- (i) **Prosthesis**<sup>5</sup>: A fabricated substitute to assist a damaged body part or to augment or stabilize a hypoplastic structure.
- (ii) **Mesh**<sup>5</sup>: A (prosthetic) network fabric or structure; open spaces or interstices between the strands of the net. The use of this term would be for POP surgery with synthetic materials.
- (iii) **Mesh kit**<sup>5</sup>: A set of articles or equipment utilized for POP surgery containing mesh with a system of trocars designed to achieve mesh fixation or allow mesh passage to or through specific areas within the pelvis.
- (iv) **Implant**<sup>5</sup>: A surgically inserted or embedded prosthesis or graft. (*Explant*: a surgically excised prosthesis or graft).
- (v) **Tape (Sling)**<sup>5</sup>: A flat strip of synthetic material. The use of this term would be for incontinence surgery with synthetic materials.
- (vi) **Graft**<sup>5</sup>: Any tissue or organ for transplantation. This term will be used to refer to biological materials inserted.

Autologous grafts: From patient's own tissues e.g. rectus sheath or fascia lata. Allografts: From post-mortem tissue banks. Xenografts: From other species e.g. modified porcine dermis, porcine small intestine and bovine pericardium.

Terminology for grafts has not been separated into the different applications for POP and continence surgery.

- (vii) **Trocar**<sup>5</sup>: A surgical instrument with either a pyramidal, conical or needle-type cutting or dissecting point.
- (viii) **Tissue**<sup>6</sup>: A collection of similar cells and the intercellular substances surrounding them.
- (ix) **Native**<sup>6</sup>: Pertaining to birth - "in situ autologous".

#### B: Specific Surgeries

The following classification of surgical procedure subtypes is proposed when describing specific surgeries. It is acknowledged that more complex cases may require two or more procedures in addition to other non-POP related surgical interventions. Each surgical procedure should be described with respect to site specificity and either as primary surgery or further surgery<sup>7</sup>. All surgical procedures are primarily divided by surgical approach as follows:

##### I. Vaginal repairs:

- (i) Anterior vaginal wall repair with native tissue.
- (ii) Anterior vaginal wall repair with mesh or graft reinforcement.
- (iii) Posterior vaginal wall repair with native tissue.
- (iv) Posterior vaginal wall repair with mesh or graft reinforcement.
- (v) Vaginal vault repair involving uterus.
- (vi) Vaginal vault repair (post-hysterectomy).

##### II. Abdominal repairs:

- (i) Abdominal Repair with Mesh or Graft.
- (ii) Abdominal Repair without Mesh or Graft.

<sup>11</sup>: A more space occupying pessary.

<sup>12</sup>: A cuboid pessary does deliver 'support' by suction of the vaginal walls.

## III. Obliterative Procedures:

- (i) Colpocleisis.
- (ii) Total colectomy.

**I: Vaginal Repairs** (*colporrhaphy*): (Greek: *kolpō* vagina + *raphē* suture)

**(i) Anterior vaginal wall repair with native tissue:** Repair the vagina by excision and suturing of the edges of any defect. Native tissue repair may be further sub-classified depending on the type of associated fascial repair:

- (a): Midline fascial plication: This represents perhaps the most common procedure currently performed for anterior wall prolapse [Fig 33 below]. FN13
- (b) Site specific repair: Paravaginal – bilateral vaginal reattachment of the lateral edge of damaged fascia to the Arcus Tendineus Fasciae Pelvis (Alt: White line).
- (c) Other site specific repair: Transverse, distal, combined.
- (d) Anterior enterocele repair.



Figure 33. (above): Midline native tissue anterior vaginal repair.

**(ii) Anterior Vaginal Wall Repair with mesh or graft reinforcement** (a structural addition or inclusion used to give additional strength in function). It should be noted whether the graft is biologic, absorbable synthetic or permanent synthetic.

This may be further sub-classified into:

- (a) Mesh or graft placement **without** additional vault/uterine support with or without concurrent fascial plication.
- (b) Mesh or graft placement **with** additional vault/uterine support. This may be sub-divided into:
  - **Transobturator mesh kit:** Normally involves two needle passes through the obturator membrane bilaterally to retrieve and secure mesh arms through the area of the Arcus Tendineus Fasciae Pelvis (ATFP) and thus stabilize a central mesh support to the anterior vaginal wall.

<sup>13</sup>: It was first described by Kelly in 1913 and involves dissection under the full thickness of the vaginal epithelium followed by central plication of the pubocervical fascia over the bulging bladder with excision of the 'excess' vaginal wall skin. The Kelly-Kennedy plication suture (Alt: bladder neck buttress) is an extrapolation of midline fascial plication involving placement of sutures under the proximal urethra and bladder neck to try and treat or prevent stress incontinence.

160 Haylen et al.

- **Mesh kit with bilateral fixation to Sacrospinous Ligament [SSL]:** Anterior vaginal wall mesh or graft with concurrent vault/uterine suspension employing either bilateral iliococcygeal fixation or fixation to the SSL.

**(iii) Posterior vaginal wall repair with native tissue:** Repair the vagina by excision and suturing of the edges of any defect. Native tissue repair may be further sub-classified depending on the type of associated fascial repair:

- Midline fascial plication - This represents perhaps the commonest procedure currently performed for posterior wall prolapse and involves dissection under the full thickness of the vaginal epithelium followed by central plication of the pre-rectal fascia over the bulging rectum with excision of the 'excess' vaginal wall skin. [Fig 34 below]
- Site specific repair: Lateral (Uni- or Bilateral), Transverse (upper and/or lower), Combined
- Closure and/or excision of enterocele vaginally with or without concurrent posterior wall repair.

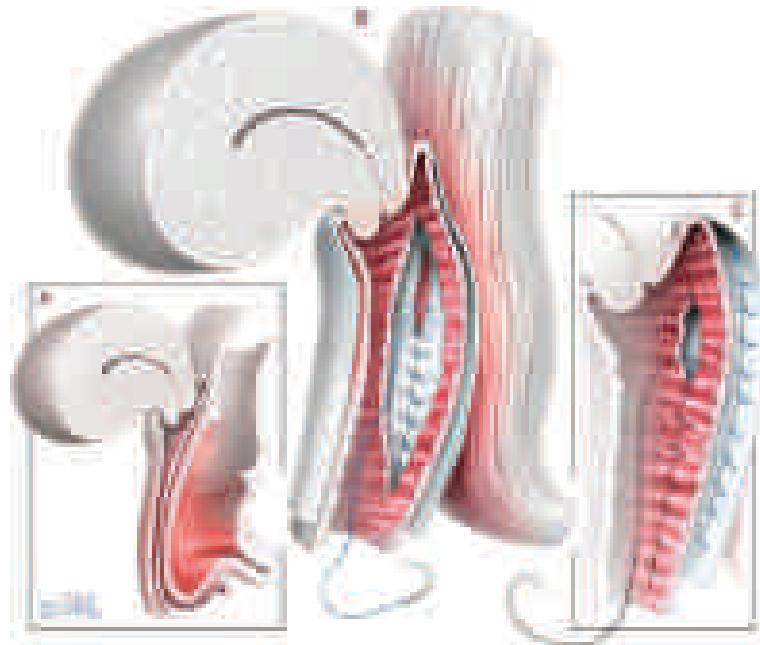


Figure 34. **(above):** Midline native tissue posterior vaginal repair.

**(iv) Posterior Vaginal Wall Repair with mesh or graft reinforcement** (a structural addition or inclusion used to give additional strength in function. It should be noted whether the graft is biologic, absorbable synthetic or permanent synthetic.

This may be further sub-classified into:

- Mesh or graft placement **without** additional vault/uterine support with or without concurrent fascial plication.
- Mesh or graft placement **with** additional vault/uterine support. This may be sub-divided into:
  - Mesh kit with bilateral mesh fixation to the SSL.
  - Mesh suspension kit with ischio-anal needle pass.
  - Posterior vaginal wall mesh/graft with concurrent vault/uterine suspension employing either bilateral iliococcygeal fixation or fixation to the SSL.
  - Transperineal mesh/graft insertion.

**Concurrent surgery performed in addition to vaginal posterior wall repairs:**

- Perineal Repair (alternatives; Perineorrhaphy, Perineoplasty).
- Levator ani muscle plication.
- Repair/closure of enterocele.
- Anal sphincter repair.

Neurourology and Urodynamics DOI 10.1002/nau

**(v): Vaginal Vault Repairs (involving uterus)**

**(a) Vaginal hysterectomy** – removal of the uterus and cervix vaginally.

**(b) Vaginal hysterectomy with adjunctive McCall Culdoplasty** – Culdoplasty sutures incorporate the uterosacral ligaments into the posterior vaginal vault to obliterate the cul-de-sac and support and suspend the vaginal apex after vaginal hysterectomy.

**(c) (Modified) Manchester Repair (Fothergill operation)** – This procedure combines anterior vaginal wall repair with amputation of the cervix and uterosacral ligament suspension with or without concurrent vaginal posterior wall repair. FN14

**(d) Sacrospinous hysteropexy** - fixation of the uterus to the SSL. Variations of this technique to include:

- (a) Unilateral or bilateral procedure.
- (b) Anterior or posterior approach.
- (c) Permanent or absorbable suture and number of 'bites' taken.
- (d) Type of suture placement device employed.
- (e) Direct vision or with the use of a specific instrument (tactile feedback).

**(e) Laparoscopic assisted vaginal hysterectomy** with or without concurrent laparoscopic uterosacral ligament plication.

**(vi) Vaginal Vault Repairs (Post-hysterectomy)**

**(a) Sacrospinous colpopexy** – Fixation of the vaginal vault to the SSL. Variations of this technique (as above a-e for sacrospinous hysteropexy).



Figures 35. Sacrospinous colpopexy.



Figure 36. Suture placement around junction of medial third and lateral two-thirds of ligament assisted by retraction (Miya speculum 7 o'clock; narrow Deaver 1 o'clock; Yankauer sucker not shown).

<sup>14</sup>. Its essential feature is suturing the cut cardinal/uterosacral ligament complex in front of the stump of the cervix hence pulling the cervix upwards and backwards, maintaining anteversion and creating anterior vaginal wall length. This procedure can be performed intra- or extra-peritoneally. Concurrent McCall culdoplasty or vaginal vault suspension techniques may be employed dependant on the extent of prolapse<sup>47</sup>.

162 Haylen et al.

**(b) Intraperitoneal uterosacral ligament (USL) vaginal vault fixation:** This is usually associated with posterior wall fascial wall reconstruction and possible concurrent excision and closure of enterocele.

**(c) Extraperitoneal USL vaginal vault fixation:** This is usually combined with posterior wall fascial reconstruction with or without enterocele closure and/or excision.

**(d) Mesh suspension kit with ischio-anal needle pass.** The graft is fixed to the vault and elevation achieved when the upper graft arms are retrieved back through the levator ani muscle bilaterally.

**(e) Vaginal Trachelectomy for Cervical Stump Prolapse** (previous subtotal hysterectomy) The cervical stump is removed in an identical fashion to the initial steps of a vaginal hysterectomy.

## II Abdominal Procedures

### (i) Abdominal Procedures with Mesh or Graft <sup>FN15</sup>

**(a) Open / Laparoscopic / Robotic Sacrocolpopexy** – Suspension of the vagina utilizing mesh or graft to the anterior longitudinal ligament usually at the level of the sacral promontory. (Fig 37 below)

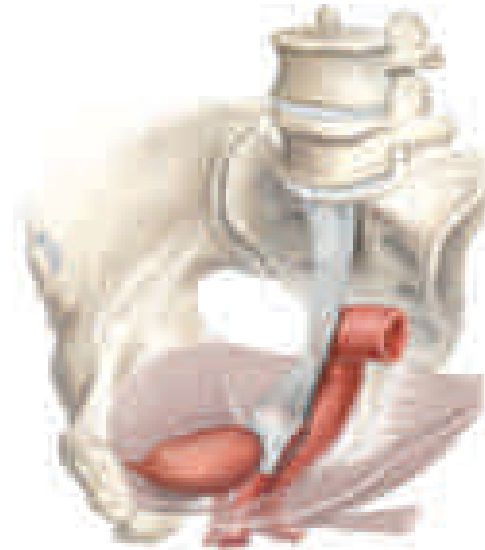


Figure 37. Sacrocolpopexy.

**(b) Open / Laparoscopic / Robotic Sacrocervicocolpopexy** – Suspension of the cervix (and usually vagina) utilizing mesh or graft to the anterior longitudinal ligament usually at the level of the sacral promontory. This procedure is commonly performed as an adjunct following subtotal hysterectomy for advanced utero-cervical prolapse.

**(c) Open / Laparoscopic / Open Sacrohysteropexy**- suspension of the cervix (with or without additional vaginal attachment) utilizing mesh or graft to the anterior longitudinal ligament usually at the level of the sacral promontory. Sacrohysteropexy is performed for women who are keen to preserve their uterus.

### (ii) Abdominal Procedures without Mesh or Graft

**(a) Open / Laparoscopic / Robotic paravaginal repair** – Extraperitoneal bilateral reattachment of the lateral edge of damaged fascia to the Arcus Tendineus Fasciae Pelvis (Alt: White line).

**(b) Laparoscopic / Robotic suture hysteropexy** – The plicated uterosacral ligaments are resutured to the cervix.

**(c) Open / Laparoscopic / Robotic closure of enterocele sac:**

- (a) Moschowitz procedure- Concentric purse string suture(s) are placed around the cul-de-sac to include the posterior vaginal wall, pelvic side-walls and serosa of the sigmoid.
- (b) Halban procedure- Obliteration of the cul-de-sac by using successive sutures placed sagittally between the uterosacral ligaments.
- (c) Uterosacral ligament plication (Fig 38 below) – transverse plication of the uterosacral ligaments to obliterate the cul-de-sac. Successive sutures are placed into the medial portion of one ligament, into the back wall of the vagina and into the medial border of the opposing ligament.

<sup>15</sup>: Variations in technique for all abdominal mesh/graft procedures: (i) Type of mesh or graft used; (ii) Shape of mesh /graft- single piece, 'DIY' two piece 'Y' mesh, Y mesh kit product; (iii) Points and length of attachment to vagina. (iv) Suture material employed / Metal stapling devices; (v) Peritoneal closure over mesh/graft.

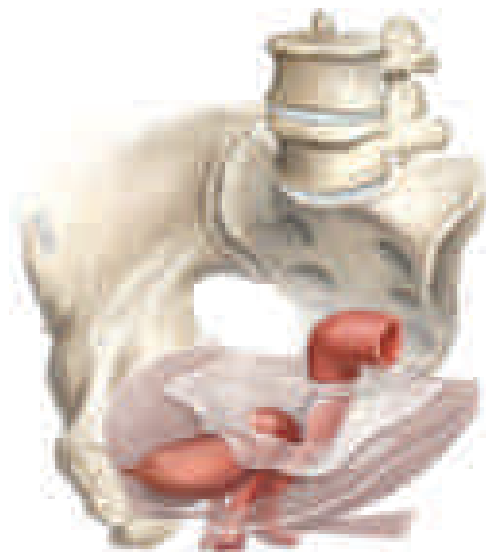


Figure 38. Uterosacral ligament plication.

**(d) Open / Laparoscopic / Robotic Burch Colposuspension** – Elevation or attachment of the upper paraurethral tissue adjacent to the bladder neck region to the iliopectineal ligament bilaterally. Although a recognized treatment for stress incontinence, this procedure will often correct associated anterior wall prolapse symptoms.

### III: Obliterative Procedures

**(i) Colpocleisis:** (Greek: kolpō + kleisis closure) – Operation for obliterating the lumen of the vagina. FN16

**(ii) Total colectomy:** (Greek: kolpō + ektomē excision): Total excision of the vagina in a woman with no uterus and vaginal eversion. FN17

### C: Measuring Outcome in POP surgeries<sup>7</sup>

As per IUGA-ICS Report on outcome measures for POP surgery<sup>7</sup>, every study evaluating POP surgery should report.

**(i) Perioperative data:** i.e. blood loss, operating time, length of hospital stay, return to normal activities and complications.

**(ii) Subjective (patient-reported) outcomes:** At its simplest level this can be reported as the presence or absence of vaginal bulge. Patient satisfaction and quality of life can be measured by validated instruments that cover prolapse, urinary, bowel and sexual function.

**(iii) Objective outcomes:** POP-Q measurement generally and should be tabulated with absolute values and percentages to allow other studies to compare results.

**(iv) Secondary outcomes** (e.g. lower urinary tract symptoms, stress urinary incontinence or bowel and sexual dysfunction) in their studies whenever possible.

**(v) Surgery type and operated compartment:**

(a) **Primary surgery:** indicates the first procedure required for treating POP in any compartment.

(b) **Further surgery:** provides a term for any subsequent procedure relating to primary surgery. Further surgery is subdivided into:

- Primary surgery in a different (new) site/compartment.
- Repeat surgery in the same site/compartment for POP symptom recurrence.
- Surgery for complications e.g. mesh exposure, pain, infection or hemorrhage.
- Surgery for non-POP-related conditions usually urinary or fecal incontinence.

<sup>16</sup>: This is usually performed in a woman with a uterus who is no longer sexually active. It can be performed in the absence of a uterus in a woman with vaginal eversion instead of total colectomy. The Le Fort's procedure involves denuding the vagina of skin both anteriorly and posteriorly, typically in a rectangular shape, avoiding the bladder neck and cervix. The cut edges are sewn together to achieve vaginal closure whilst leaving a bilateral epithelium-lined tunnel behind. The Labhardt procedure involves the removal of a 1 cm horse shoe shape of vaginal epithelium is removed over the posterior fourchette up to just under the urethra. By closing the incision and building up the perineum, an extremely high posterior repair almost closing the vagina is created.

<sup>17</sup>: The vagina is totally denuded of skin, typically in sections, whilst avoiding the bladder neck region. The prolapse is then reduced by a series of successive purse-string sutures and the epithelium at the entrance closed.



**D: Complications of POP surgeries<sup>5,6</sup>**

Complications related to POP native tissue repair and surgeries using prostheses/graft/mesh have been classified separately according to joint IUGA/ICS recommendation<sup>5,6</sup>. The sorting system used in both documents utilizes specific category, time and site taxonomy together referred as *CTS classification system*. Classification is aided by on line calculators at either <http://www.ics.org/complication> or <http://www.ics.org/ntcomplication>.



This document has involved 14 rounds of full review, by co-authors, of an initial draft (Version 1) completed on November 30, 2014. Comments for each round of review were collated and debated as necessary in order to form a subsequent version. Live meetings on the document took place in Washington, Rio, Nice and Montreal.

**ACKNOWLEDGEMENTS**

The assistance of Prof Steven Swift is gratefully acknowledged for the Simplified POP-Q section and other helpful input. Prof John DeLancey also contributed helpful input to Section 3 and the Appendix. We thank our invited external reviewers Prof Steven Swift, Prof Mark Vierhout, Prof Michele Meschia, Prof Doug Tincello and Prof Don Wilson for their constructive contributions. We also thank those who submitted constructive comments following IUGA and ICS website presentation of Version 12: Dr Kiran Ashok, Prof Phil Toozs-Hobson, Dr Kamil Svabik. Further helpful comments were received at an open forum at ICS Montreal from Beth Shelly, Julia Herbert, Kari Bo and Joe Lee. The talents of medical illustrator, Levent Efe were crucial to the development of this document ([levent@leventefe.com.au](mailto:levent@leventefe.com.au)).

**REFERENCES**

- Haylen BT, Freeman RM, de Ridder D, et al. An International Urogynecological Association (IUGA)—International Continence Society (ICS) Joint Report into the Terminology for Female Pelvic Floor Dysfunction. *Neurourology & Urodynamics*, 29:4–20. *International Urogynecology J* 2010;21:5–26.
- Abrams P, Blaivas JG, Stanton SL, et al. The standardisation of terminology of lower urinary tract function. *Scand J Urol Nephrol* 1988;Suppl 114:5–19.
- Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function. Report from the standardisation subcommittee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
- Bump RC, Mattiasson A, Bo K, et al. The standardization of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol* 1996;175:10–1.
- Haylen BT, Freeman RM, Swift SE, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Terminology and Classification of complications related directly to the insertion of prostheses (meshes, implants, tapes) and grafts in female pelvic floor surgery. *International Urogynecology Journal* 2011;22:3–15; *Neurourology and Urodynamics* 30(1):2–12.
- Haylen BT, Freeman RM, Lee J, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) joint terminology and classification of the complications related to native tissue female pelvic floor surgery. *Int Urogynecol* 2012;23:515–26. *Neurourol Urodyn* 31:406–14.
- Toozs-Hobson P, Freeman R, Barber M, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol* 2012;23:527–35. *Neurourol Urodyn* 31:415–26.
- Sultan A, Monga A, Haylen BT, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Report on the Terminology for Anorectal Dysfunction in Women (In Committee Review). 2015.
- Bo K, Frawley H, Haylen BT, et al. An International Urogynecological Association (IUGA) / International Continence Society (ICS) Joint Report on the Terminology for the Conservative Management of Pelvic Floor Dysfunction. (In Committee Review). 2015.
- Rogers R, Thakar R, Petri E, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for the Sexual Health in Women with Pelvic Floor Dysfunction. (In Committee Review) 2015.
- Riss P, Dwyer PL. The POP-Q Classification system: Looking back and looking forward. *Int Urogynecol J* 2014;25:439–40.
- Bump RC. The POP-Q system: Two decades of progress and debate. *Int Urogynecol J* 2014;25:441–3.
- Toozs-Hobson P, Swift S. POP-Q stage 1 prolapse: Is it time to alter our terminology? *Int Urogynecol J* 2014;25:445–6.
- Harmanli O. POP-Q 2.0: Its time has come. *Int Urogynecol J* 2014;25:447–9.
- Concise Oxford English Dictionary. 9th Edition. Oxford: Clarendon Press; 1995. p1438.
- Stedman's Medical Dictionary. 28th Edition Baltimore Maryland USA: Lippincott William and Wilkins. 2006. p 1884.
- Rogers GR, Villarreal A, Kammerer-Doak D, et al. Sexual function in women with/without urinary incontinence and or pelvic organ prolapse. *Int Urogynecol J* 2001;12:361–5.
- Yang A, Mostwin J, Genadry R, et al. Patterns of prolapse demonstrated with dynamic fastscan MRI: reassessment of conventional concepts of pelvic floor weaknesses. *Neurourol Urodyn* 1993;12:310–1.
- Swift SE, Woodman P, O'Boyle A, et al. Pelvic Organ Support Study (POSST): The distribution, clinical definition and epidemiology of pelvic organ support defects. *Am J Obstet Gynecol* 2005;192:795–806.
- Swift SE, Tate SB, Nichols J. Correlation of symptomatology with degree of pelvic organ support in a general population of women: What is pelvic organ prolapse? *Am J Obstet Gynecol* 2003;189:372–9.
- Barber MD, Brubaker L, Nygaard I, et al. Pelvic floor disorders network. *Obstet Gynecol* 2009;114:600–9.
- Dietz HP. Quantification of major morphological abnormalities of the levator ani. *Ultras Obstet Gynecol* 2007;29:329–34.
- Haylen BT. The retroverted uterus: Ignored to date but core to prolapse. *Int Urogynecol J* 2006;17:555–8.
- Symmonds RE. Relaxation of pelvic supports. In: Benson RC, editor. *Current obstetrics and gynaecological diagnosis and treatment*. Los Altos: Lange Medical Publications; 1982. pp 285–91 (chap 12).
- Swift S, Morris S, McKinnie V, et al. Validation of a simplified technique for using the POPQ pelvic organ classification system. *Int Urogynecol J* 2006;17:615–20.
- Parekh M, Swift S, Lemos N, et al. Multicentre inter-examiner trial of the validation of simplified POPQ system. *Int Urogynecol J* 2011;22:645–50.
- Haylen BT, Lee J, Logan V, et al. Immediate postvoid residuals in women with symptoms of pelvic floor dysfunction: Prevalences and associations. *Obstet Gynecol* 2008;111:1305–12.

*Neurourology and Urodynamics* DOI 10.1002/nau

28. Fantl JA, Smith PJ, Schneider V, et al. Fluid weight uroflowmetry in women. *Am J Obstet Gynecol* 1982;145:1017–24.
29. Haylen BT, Ashby D, Sutherst JR, et al. Maximum and average urine flow rates in normal male and female populations - the Liverpool Nomograms. *Brit J Urol* 1989;64:30–8.
30. Haylen BT, Parys BT, Ashby D, et al. Urine flow rates in male and female urodynamic patients compared with the Liverpool nomograms. *Brit J Urol* 1990;65:483–8.
31. Schafer W, Abrams P, Liao L, et al. Good Urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
32. Groutz A, Blaivas JG, Chaikin DC. Bladder outflow obstruction in women: Definition and characteristics. *Neurourol Urodyn* 2000;19:213–20.
33. Poston GJ, Joseph AE, Riddle PR. The accuracy of ultrasound in the measurement of changes in bladder volume. *Br J Urol* 1983;55:361–3.
34. Haylen BT, Frazer MI, Sutherst JR, et al. Transvaginal ultrasound in the assessment of bladder volumes in women. *British Journal of Urology* 1989;63:152–4.
35. Dietz HP, Velez D, Shek KL, et al. Determination of postvoid residuals by translabial ultrasound. *Int Urogynecol J* 2012;23:1749–52.
36. Pineda M, Shek K, Wong V, et al. Can hialat ballooning be determined by two-dimensional translabial ultrasound? *Aust N Z J Obstet Gynaecol* 2013;53:489–93. DOI: 10.1111/ajo.12111. Epub 2013 Aug 2.
37. Bright E, Oelke M, Tubaro A, et al. Ultrasound estimated bladder weight and measurement of bladder wall thickness-useful noninvasive methods for assessing the lower urinary tract? *J Urol* 2010;184:1847–54. DOI: 10.1016/j.juro.2010.06.006.
38. Panayi DC, Khullar V, Digesu GA, et al. Is ultrasound estimation of bladder weight a useful tool in the assessment of patients with lower urinary tract symptoms? *Int Urogynecol J Pelvic Floor Dysfunct* 2009;12:1445–9. DOI: 10.1007/s00192-009-0964-0.
39. Digesu GA, Calandrini N, Derpapas A, et al. Intraobserver and interobserver reliability of the three-dimensional ultrasound imaging of female urethral sphincter using a translabial technique. *Int Urogynecol J* 2012;8:1063–8. DOI: 10.1007/s00192-012-1669-3. Epub 2012 Jan 21.
40. Rodrigo N, Wong V, Shek KL, et al. The use of 3-dimensional ultrasound of the pelvic floor to predict recurrence risk after pelvic reconstructive surgery. *Aust N Z J Obstet Gynaecol* 2014;3:206–11. DOI: 10.1111/ajo.12171. Epub 2014 Feb 18.
41. Dietz HP, Shek C, De Leon J, et al. Ballooning of the levator hiatus. *Ultrasound Obstet Gynecol* 2008;6:676–80. DOI: 10.1002/uog.5355.
42. Colaiacomo MC, et al. Dynamic MR imaging of the pelvic floor: A pictorial review. *Radiographics* 2009;29:e35.
43. DeLancey JO, Morgan DM, Fenner DE, et al. Comparison of levator ani muscle defects and function in women with and without pelvic organ prolapse. *Obstet Gynecol* 2007;109:295–302.
44. Fielding JR. Practical MRI imaging of female pelvic floor weakness. *RadioGraphics* 2002;22:295–304.
45. Torricelli P, Pecchi A, Caruso-Lombardi A, et al. Magnetic resonance imaging in evaluating functional disorders of female pelvic floor. *Radiol Med* 2002;103:488–500.
46. Rizk DE, Czechowski J, Ekelund L. Dynamic assessment of pelvic floor and bony pelvis morphologic condition with the use of magnetic resonance imaging in a multi-ethnic, nulliparous, and healthy female population. *Am J Obstet Gynecol* 2004;191:83–9.
47. Lamers BH, Broekman BM, Milani AL. Pessary treatment for pelvic organ prolapse and health-related quality of life; a review. *Int Urogynecol J* 2011;6:637–44.
48. de Boer TA, Milani AL, Kluivers KB, et al. The effectiveness of surgical correction of uterine prolapse: Cervical amputation with uterosacral ligament plication (modified Manchester) versus vaginal hysterectomy with high uterosacral ligament plication. *Int Urogynecol J* 2009;20:1313–5.
49. DeLancey JO. Anatomical aspects of vaginal eversion after hysterectomy. *Am J Obst Gynecol* 1992;166:117–24.
50. Zemlyn S. The length of the uterine cervix and its significance. *J Clin Ultrasound* 1981;9:267–9.
51. Vu D, Haylen BT, Tse K, et al. Surgical anatomy of the uterosacral ligament. *Int Urogynecol J* 2010;21:1123–8.
52. Haylen BT, Kerr S, Naidoo S, et al. Posterior vaginal compartment repairs: Where are the main anatomical defects? *Neurourol Urodyn* 2015;34(S3):S130–1. *Int Urogynecol J*. DOI 10.1007/s00192-015-2874-7.
53. Haylen BT, Avery D, Chiu T, et al. Posterior repair quantification (PR-Q) using key anatomical indicators (KAI). *International Urogynecol J*, 25(12):1665-1772. *Neurourol Urodyn* 2014;33:900–1.
54. Haylen BT, Younis M, Naidoo S, et al. Perineorrhaphy quantitative assessment. *Int Urogynecol J* 2015;26:539–44.
55. Swenson CW, Simmen AM, Berger MB, et al. The long and short of it: Anterior vaginal wall length before and after anterior repair. *Int Urogynecol J* 2015;26:1035–9.

#### APPENDIX - Concepts and available measurements awaiting further validation.

##### A: Subdivision of Stage II POP-Q:

An optional subdivision of Stage II into IIa (-1 to hymen) and IIb (hymen to +1) was considered at length. Stage IIA would then be defined as -1 to 0 (so the hymen, that is 0, is included in stage IIA) and stage IIB (>0 to +1), meaning the dependent part of prolapse beyond the hymen but no further than +1. It was felt that this might reflect a clinical difference between the two subdivisions in terms of symptoms. That change was not made at this time in part to maintain the current strictly anatomical definition of the “sign of POP”.

##### B: Vaginal Anatomical Levels and Lengths:

- (i) **Level I:** Uterine cervix (if present) and/or upper 2.5cm of vagina. Footnote *FN18*
- (ii) **Level II:** Mid-vagina from distal end of Level I to hymen. *FN19*
- (iii) **Level III (vaginal vestibule):** Vaginal entrance (Latin: “vestibulum” = “a space at the entrance of a canal”) from hymenal ring to just below the clitoris anteriorly (anterior vestibule), labia minora laterally and anterior perineum posteriorly (posterior margin of vestibule) *FN20*

<sup>18</sup>. Refinement of previous classification<sup>49</sup> reflecting the average length of non-gravid uterine cervix<sup>50</sup> and the average length of the supportive influence of the distal segment of the uterosacral ligaments on the posterolateral vaginal wall bilaterally<sup>51</sup>.

<sup>19</sup>. Mean length of Level II in women at posterior colpoperineorrhaphy found to be 5.0cm<sup>52</sup>

<sup>20</sup>. The outer edge of the vestibule is known as Hart's line (see white line in Figure 39 with blue line demarcating anterior and posterior vestibule).



Figure 39. Anterior and posterior vestibule.

Neurourology and Urodynamics DOI 10.1002/nau

166 Haylen et al.

- (iv) **Posterior vestibule:** Posterior hymenal ring to anterior perineum (posterior margin of vestibule). FN21
- (v) **Total vaginal length<sup>21</sup>:** Posterior vaginal vault to hymen (cm), i.e. Levels I and II posteriorly.
- (vi) **Total posterior vaginal length<sup>52-54</sup>:** Posterior vaginal vault to posterior margin of vestibule (anterior perineum - cm), i.e. Levels I, II and III posteriorly.
- (vii) **Anterior vaginal length:** Anterior hymenal ring to the anterior vaginal vault (anterior cervicovaginal junction or anterior cuff post-hysterectomy)<sup>55</sup>.

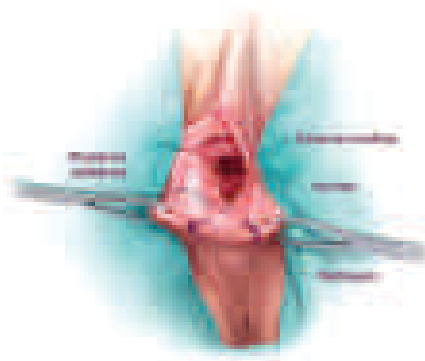


Figure 40. *Posterior vestibule.*



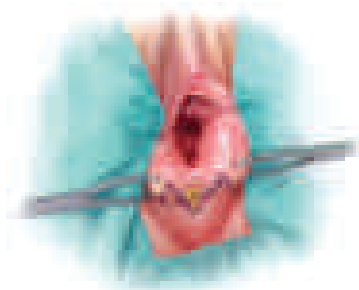
Figure 41. Vaginal Levels (I to III) and Vaginal lengths (Anterior, Total, Total Posterior).

**C: Additional available intraoperative measurements.**

**(i) Perineal measurements:**

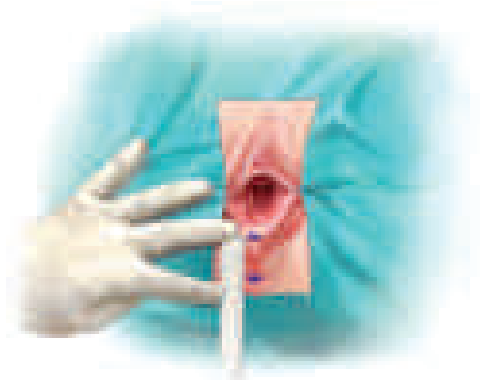
**(a,b) Perineorrhaphy Width (PW) and Depth (PD)<sup>54</sup>:** Width and depth of the excised perineum

<sup>21</sup> : Mean length in women at posterior colporrhaphy was found to be 1.8cm<sup>52</sup>.



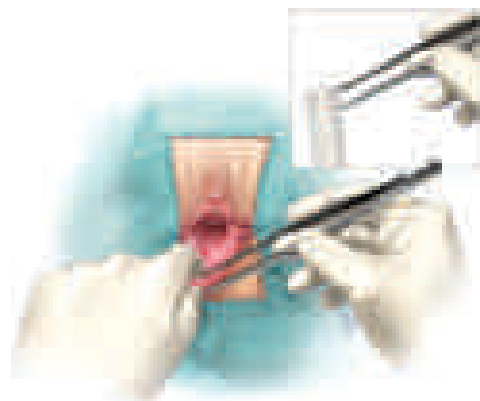
**Figure 42.** Perineorrhaphy width (PW) and perineorrhaphy depth (PD).

**(c) Perineal length (PL)<sup>54</sup>:** Distance from posterior margin of vestibule to anterior anal verge.



**Figure 43.** Perineal length.

**(d) Mid-perineal thickness (MPT)<sup>54</sup>:** Thickness (cm) of the mid-perineum in the midline.



**Figure 44.** Mid-perineal thickness.

**(e) Perineal Gap (PG)<sup>52–54</sup>:** Thinned out medial area (cm) between Moynihan forceps placed bilaterally where the labia minora meet the perineum.

*Neurourology and Urodynamics* DOI 10.1002/nau



Figure 45. Perineal Gap.

**(f) Perineorrhaphy Commencement Position (PCP): NEW** Where in Level III, the perineorrhaphy is commenced, e.g. hymen, mid-vestibule, posterior margin of vestibule.

**(ii) Posterior vaginal measurements<sup>53</sup>:**

**(a) Posterior Vaginal Vault Descent (PVVD)<sup>52,53</sup>:** Descent of the posterior vaginal vault towards the perineal gap obtained by subtracting the inferiorly displaced vaginal vault and the anterior perineum (second figure) from the total posterior vaginal length (TPVL - first figure – posterior vaginal vault to anterior perineum).

**(b) Mid-Vaginal Laxity (MVL) (Undisplaced)<sup>52,53</sup>:** Laxity of the vaginal mucosa (anterior traction) midpoint in the vagina super-posteriorly and in the midline with the vaginal vault held in an undisplaced position (similar to that after vault fixation)



Figure 46. (left): Total posterior vaginal length (TPVL).



Figure 47. (right): Distance from vaginal vault (on traction) to anterior perineum. Posterior vaginal vault descent is the subtraction of this measurement from the TPVL.

**(c) Recto-vaginal Fascial Laxity (RVFL)<sup>52,53</sup>:** Laxity of the rectovaginal fascia (anterior traction) midpoint in the vagina super-posteriorly (mucosa opened) and in the midline with the vaginal vault held in an undisplaced position



Figure 48. (left): Mid-vaginal laxity (vault undisplaced).



Figure 49. (right): Recto-vaginal fascial laxity.



## An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Report on the Terminology for Female Anorectal Dysfunction

Abdul H. Sultan,<sup>1a\*</sup> Ash Monga,<sup>2a,b</sup> Joseph Lee,<sup>3a,c</sup> Anton Emmanuel,<sup>4a</sup> Christine Norton,<sup>5a</sup> Giulio Santoro,<sup>6a</sup>  
Tracy Hull,<sup>7a</sup> Bary Berghmans,<sup>8a,b</sup> Stuart Brody,<sup>9a</sup> and Bernard T. Haylen<sup>10a,c</sup>

<sup>1</sup>Urogynaecologist and Obstetrician, Croydon University Hospital, Croydon, United Kingdom

<sup>2</sup>Urogynaecologist, Princess Anne Hospital, Southampton, United Kingdom

<sup>3</sup>University of Melbourne, Mercy Hospital for Women, Monash Health, Melbourne, Victoria, Australia

<sup>4</sup>Gastroenterologist, University College Hospital, London, United Kingdom

<sup>5</sup>Kings College London, London, United Kingdom

<sup>6</sup>Regional Hospital, Treviso, Italy

<sup>7</sup>Cleveland Clinic Foundation, Cleveland, Ohio

<sup>8</sup>Clinical epidemiologist Pelvic physiotherapist, Health Scientist, Maastricht University Medical Center, Maastricht University, Maastricht, The Netherlands

<sup>9</sup>Department of General Anthropology, Charles University, Prague, Czech Republic

<sup>10</sup>University of New South Wales, Sydney, New South Wales, Australia

**Introduction:** The terminology for anorectal dysfunction in women has long been in need of a specific clinically-based Consensus Report. **Methods:** This Report combines the input of members of the Standardization and Terminology Committees of two International Organizations, the International Urogynecological Association (IUGA) and the International Continence Society (ICS), assisted on Committee by experts in their fields to form a Joint IUGA/ICS Working Group on Female Anorectal Terminology. Appropriate core clinical categories and sub classifications were developed to give an alphanumeric coding to each definition. An extensive process of twenty rounds of internal and external review was developed to exhaustively examine each definition, with decision-making by collective opinion (consensus). **Results:** A Terminology Report for anorectal dysfunction, encompassing over 130 separate definitions, has been developed. It is clinically based with the most common diagnoses defined. Clarity and user-friendliness have been key aims to make it interpretable by practitioners and trainees in all the different specialty groups involved in female pelvic floor dysfunction. Female-specific anorectal investigations and imaging (ultrasound, radiology and MRI) has been included whilst appropriate figures have been included to supplement and help clarify the text. Interval review (5–10 years) is anticipated to keep the document updated and as widely acceptable as possible. **Conclusion:** A consensus-based Terminology Report for female anorectal dysfunction terminology has been produced aimed at being a significant aid to clinical practice and a stimulus for research. *Neurourol. Urodynam.*

© 2016 Wiley Periodicals, Inc., and The International Urogynecological Association.

**Key words:** anorectal; fecal incontinence; female sexual dysfunction; female pelvic floor; imaging; terminology

### INTRODUCTION

The anatomical configuration of the anorectum is complex. The mechanisms that control continence and allow defecation are multifactorial and dependent on many factors such as the consistency of stool, bowel transit, rectal compliance and sensitivity, intact neurological function and integrity of the pelvic floor, and anal sphincters.

This document is being published simultaneously in *Neurourology and Urodynamics* (NAU) (DOI 10.1002/nau.23055) and the *International Urogynecology Journal* (IJU) (DOI 10.1007/s00192-016-3140-3), the respective journals of the sponsoring organizations, the International Continence Society (ICS) and the International Urogynecological Association (IUGA).

\*Standardization and Terminology Committees IUGA.

<sup>a</sup>ICS.

<sup>†</sup>Joint IUGA/ICS Working Group on Female Anorectal Terminology.

Dr. Mickey Karram led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Dr. Sultan has patent on anal sphincter blocks with royalties paid to the Mayday Childbirth Charity fund. He described the Sultan Classification of third degree tears and runs hands-on workshops on Perineal and Anal Sphincter Trauma ([www.perineum.net](http://www.perineum.net)). A Monga: reports being Consultant for Gynecare and AMS and Speaker for Astellas and Pfizer and advisor for Allergan.; Dr. Lee reports personal fees from AMS, personal fees from BSCI, during the conduct of the study; Dr. Emmanuel served on advisory boards for Coloplast, Shire, Pfizer. Honoraria for talks from these companies as well as Ferring and Astra-Zeneca; Dr. Norton reported Consultancy for SCA, Coloplast, Shire, Dr Falk, Clinimed; Dr. Santoro has nothing to disclose; Dr. Hull has nothing to disclose; Dr. Berghmans has nothing to disclose; Dr. Brody has nothing to disclose; Dr. Haylen has nothing to disclose.

\*Correspondence to: Abdul H. Sultan, MB ChB, MD, FRCOG, Urogynaecology and Pelvic Floor Reconstruction Unit, Croydon University Hospital, London Road, Croydon, Surrey, CR7 7YE, United Kingdom. E-mail: [abdulsultan@NHS.net](mailto:abdulsultan@NHS.net)

Received 13 May 2016; Accepted 23 May 2016

Published online in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI 10.1002/nau.23055

© 2016 Wiley Periodicals, Inc., and The International Urogynecological Association.

## 2 Sultan et al.

Historically, anorectal physiological investigations have quite often produced inconsistent results. Until the advent of imaging techniques such as endoanal ultrasound, the etiology of fecal incontinence was largely attributed to pudendal neuropathy.<sup>1</sup> We now better understand the contribution of vaginal delivery to anal sphincter trauma.<sup>2</sup> Imaging has taught us that training in clinical digital assessment can improve detection and repair of obstetric anal sphincter injuries and thereby minimize the risk of developing fecal incontinence.<sup>3</sup> Obstructive defecation is another common embarrassing problem and imaging techniques that attempt to capture the defecation process are often inconclusive.<sup>4</sup> Artificial contrast material replicating normal fecal consistency for defecating proctography is not available and magnetic resonance imaging requires an upright scanner.

When multiple conditions such as fecal incontinence, obstructive defecation, urinary incontinence, neurological diseases, medical conditions etc. co-exist, management becomes increasingly difficult and multidisciplinary assessment becomes important.<sup>5</sup> As the pelvic organs (bowel, bladder, and vagina) are in close proximity to each other, clinicians need to be aware of the impact of dysfunction and surgery of one organ may have on the neighboring structures. It is therefore important for clinicians and pelvic surgeons to have more global knowledge and adopt a holistic approach to pelvic floor dysfunction.

There is a need for standardized terminology in female anorectal dysfunction to accumulate accurate prevalence data, perform the appropriate investigations, institute management, and conduct audit and research. Lack of a unified definition of anal incontinence has resulted in variations in prevalence data from epidemiological data. "Pseudo incontinence" with mucoid leakage (usually caused by organic colonic disease, dietary sensitivity or fecal impaction) is often mistaken as fecal incontinence as questionnaires do not quite differentiate them.<sup>6</sup> There is indeed the need for a general terminology, forming a "backbone" or "core" terminology to which more specific terminologies can be attached.<sup>7</sup>

This Terminology Report is inherently and appropriately a definitional document, collating the definitions of those terms, that is, words used to express a defined concept, in a particular branch of study. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. The aim is to assist clinical practice and research. Some new and revised terms have been included. Explanatory notes on definitions have been referred, where possible, to the "Footnotes section."

Similar to a previous report<sup>7</sup> the female-specific terminology report should be as follows:

(1) **User-friendly:** It should be able to be understood by all clinical and research users.

(2) **Clinically-based:** Symptoms, signs, and validated investigations should be presented for use in forming workable diagnoses. The first three sections will address symptoms, signs, and assessment tools. The next two sections will describe anorectal physiological investigations and currently used pelvic imaging modalities routinely used in the office or anorectal laboratory to make those diagnoses. A number of related radiological investigations as well as magnetic resonance imaging (MRI) have also been included. The value of electromyography and related nerve conduction, reflex latency, and sensory investigations will be outlined.

(3) **Origin:** Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition will be included and duly referenced. A number of terms in female anorectal function and dysfunction, because of their long-term use, have now become generic, as apparent by their listing in medical dictionaries.

(4) **Able to provide explanations:** Where a specific explanation is deemed appropriate to explain a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (*Footnote [FN] 1,2,3 ...*). Wherever possible, evidence-based medical principles will be followed.

It is suggested that acknowledgement of these standards in written publications related to female anorectal dysfunction, be indicated by a footnote to the section "Methods and Materials" or its equivalent, to read as follows: "Methods, definitions and units conform to the standards jointly recommended by the International Urogynecological Association and the International Continence Society, except where specifically noted." It should be noted that the Working Group for this document was formed and started generation of this document prior to the Rosier statement.<sup>8</sup>

## SECTION 1: SYMPTOMS

**Symptom:** Any morbid phenomenon or departure from the normal in structure, function, or sensation, experienced by the woman and indicative of disease<sup>9</sup> or a health problem. Symptoms are either volunteered by, or elicited from the individual, or may be described by the individual's caregiver.<sup>7,10,11</sup>

### 1.1: Anorectal Incontinence Symptoms

**Anal incontinence (symptom<sup>7</sup>).** Complaint of involuntary loss of feces or flatus.

(i) **Fecal incontinence<sup>7</sup>:** Complaint of involuntary loss of feces.

(a) Solid

(b) Liquid

(ii) **Flatus Incontinence<sup>7</sup>:** Complaint of involuntary loss of flatus (gas).

(iii) **Double incontinence (NEW):** Complaint of both anal incontinence and urinary incontinence [<sup>FN1</sup>].

(iv) **Coital fecal (flatal) incontinence (NEW):** Fecal (flatal) incontinence occurring with vaginal intercourse (see related definition "Coital fecal urgency") [<sup>FN2</sup>].

<sup>FN1</sup> In regards to definition of various types of urinary incontinence, the interested reader can refer to (Haylen 2010).<sup>7</sup>

<sup>FN2</sup> A history of receptive anal intercourse has been shown to increase the risk of anal incontinence.<sup>12</sup>



- (v) **Passive fecal leakage (NEW)**: Involuntary soiling of liquid or solid stool without sensation or warning or difficulty wiping clean <sup>[FN3]</sup>.
- (vi) **Overflow fecal incontinence (NEW)**: Seepage of stool due to fecal impaction.

### 1.2: Anorectal Storage Symptoms

- (i) **Increased daytime defecation (NEW)**: Complaint that defecation occurs more frequently during waking hours than previously deemed normal by the woman.
- (ii) **Nocturnal defecation (NEW)**: Complaint of interruption of sleep one or more times because of the need to defecate.
- (iii) **Fecal (rectal) urgency**<sup>7</sup>: Complaint of a sudden compelling desire to defecate that is difficult to defer.
  - (a) Fecal urgency warning time: time from first sensation of urgency to voluntary defecation or fecal incontinence.
  - (iv) **Fecal (flatal) urgency incontinence**<sup>7</sup>: Complaint of involuntary loss of feces (gas) associated with (fecal) urgency.
  - (v) **Tenesmus (NEW)**: A desire to evacuate the bowel, often accompanied by pain, cramping, and straining, in the absence of feces in the rectum.
  - (vi) **Coital fecal urgency (NEW)**: Feeling of impending bowel action during vaginal intercourse.

### 1.3: Anorectal Sensory Symptoms

- (i) **Diminished rectal sensation**<sup>7</sup>: Complaint of diminished or absent sensation in the rectum.
- (ii) **Increased rectal sensation (NEW)**: Complaint of a desire to defecate (during rectal filling) that occurs earlier or more persistent to that previously experienced.

### 1.4: Defecatory and Post-Defecatory Symptoms

- (i) **Constipation**<sup>7</sup> (**Updated**): Complaint that bowel movements are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate <sup>[FN4]</sup>.
  - (a) Slow transit: infrequent bowel motions due to delay in transit of bowel contents to reach rectum.
  - (b) Obstructed defecation: Complaint of difficulty in evacuation <sup>[FN5]</sup>.
  - (ii) **Feeling of incomplete bowel evacuation**<sup>7</sup>: Complaint that the rectum does not feel empty after defecation and may be accompanied by a desire to defecate again.
  - (iii) **Straining to defecate**<sup>7</sup>: Complaint of the need to make an intensive effort (by abdominal straining or Valsalva) to either initiate, maintain, or improve defecation.
  - (iv) **Sensation of blockage (NEW)**: Complaint suggestive of anorectal obstruction.
  - (v) **Digitation (NEW)**: Use of fingers in rectum or vagina to manually assist in evacuation of stool contents.
    - (a) Rectal digitation: Use of fingers in rectum to physically extract stool contents to assist in evacuation.
    - (b) Vaginal digitation: Use of thumb or fingers in the vaginal to assist in evacuation of stool.
  - (vi) **Splinting (NEW)**: Support perineum or buttocks manually (usually with thumb or fingers) to assist in evacuation of stool content.
  - (vii) **Post defecatory soiling (NEW)**: Soiling occurring after defecation.

<sup>FN3</sup> Soiling is a bothersome disorder characterized by continuous or intermittent liquid anal discharge. It should be differentiated from discharge due to fistulae, proctitis, hemorrhoids, and prolapse. Patients complain about staining of underwear and often wear protection.

- The discharge may cause inflammation of the perineal skin with excoriation, perianal discomfort, burning sensation, and itching.
- It often indicates the presence of an impaired internal sphincter function or a solid fecal mass in the rectum but could also be due to the inability to maintain hygiene due to hemorrhoids.

<sup>FN4</sup> Rome III criteria for functional constipation:

1. Must include two or more of the following:
  - a. Straining during at least 25% of defecations.
  - b. Lumpy or hard stools in at least 25% of defecations.
  - c. Sensation of incomplete evacuation for at least 25% of defecations.
  - d. Sensation of anorectal obstruction/ blockage for at least 25% of defecations.
  - e. Manual maneuvers to facilitate at least 25% of defecations (e.g., digital evacuation, support of the pelvic floor).
  - f. Fewer than three defecations per week.
2. Loose stools are rarely present without the use of laxatives.
3. Insufficient criteria for irritable bowel syndrome.

\*Criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis.

<sup>FN5</sup> Difficulty evacuating stool, requiring straining efforts at defecation often associated with lumpy or hard stools, sensation of incomplete evacuation, feeling of anorectal blockage/obstruction or manual assistance to defecate (or inability to relax EAS/dyssynergic defecation).

### 1.5: Anorectal Prolapse Symptoms

(i) **Anorectal prolapse (updated):** Complaint of a “bulge” or “something coming down” towards or through the anus/rectum. The woman may state she can either feel the bulge by direct palpation or see it aided with a mirror [FN6].

### 1.6: Anorectal Pain Symptoms (NEW)[FN7]

- (i) **Pain during straining/defecation:** Complaint of pain during defecation or straining to defecate.
- (ii) **Inflammatory anorectal pain:** Complaint of pain characterized by burning or stinging [FN8] (fissure, inflammation, sepsis).
- (iii) **Non-inflammatory anorectal pain:** Complaint of blunted anorectal pain, as opposed to sharp stinging or burning type of pain (proctalgia fugax, Levator ani syndrome, pudendal neuralgia<sup>13</sup>) See Section Pain Syndromes.

### 1.7: Anorectal Sexual Dysfunction Symptoms[FN9]

**Symptoms of sexual dysfunction<sup>7</sup>.** A departure from normal sensation and/or function experienced by a woman during sexual activity.

**Female sexual dysfunction<sup>22</sup>.** Complaint of dyspareunia or impairment of sexual desire, arousal, or orgasm.

- (i) **Receptive anal intercourse (NEW):** Having a penis penetrating one's anus [FN10].
- (ii) **Other anal sexual practices with body parts:** Stimulation of the anus and/or rectum with bodily parts other than the penis (e.g., finger, fist) for sexual purposes by the recipient and/or a partner.
- (iii) **Other anal sexual practices with non-living objects:** Stimulation of the anus and/or rectum with non-living objects (e.g., dildo) for sexual purposes by the recipient and/or a partner.
- (iv) **Anodyspareunia (NEW):** Complaint of pain or discomfort associated with attempted or complete anal penetration<sup>12</sup>[FN11].
- (v) **Anal laxity (NEW):** Complaint of the feeling of a reduction in anal tone [FN12].

### 1.8: Miscellaneous Anorectal Symptoms

- (i) **Rectal bleeding/mucus<sup>7</sup>:** Complaint of the loss of blood/mucus per rectum [FN11].
- (ii) **Perianal itching/pruritus ani (NEW):** Complaint of itchy anus [FN13].
- (iii) **Flaturia (NEW):** Complaint of passage of gas per urethra.
- (iv) **Fecaluria (NEW):** Complaint of passage of fecal material per urethra.
- (v) **Vaginal flatus/feces (NEW):** Complaint of passage of flatus or feces per vagina.

## SECTION 2: SIGNS

**Sign:** Any abnormality indicative of disease or health problem, discoverable on examination of the patient: an objective indication of disease or health problem.<sup>7</sup>

### 2.1: Vaginal and Anorectal Inspection<sup>23</sup>

- (i) **Excoriation:** Perianal excoriation, skin rashes.
- (ii) **Soiling:** Perianal fecal soiling or vaginal fecal soiling.
- (iii) **Discharge:** Perianal or vaginal bloody or mucus discharge.
- (iv) **Gaping anus:** Non-coaptation of anal mucosa at rest.

<sup>FN6</sup> Anorectal prolapse can be due to hemorrhoidal, mucosal, rectal prolapse, or rectal intussusception. These definitions are further explained under “Signs.”

<sup>FN7</sup> This refers to pain localized to the anorectal region, and may include pain, pressure, or discomfort in the region of the rectum, sacrum, and coccyx that may be associated with pain in the gluteal region and thighs.

<sup>FN8</sup> Fissure pain during, and particularly after, defecation is commonly described as passing razor blades or glass shards See FN10.

<sup>FN9</sup> Receptive anal intercourse is associated with increased risk of both any female sexual dysfunction,<sup>14</sup> as well as with specifically female sexual arousal disorder with distress<sup>15</sup> (“a persistent or recurrent inability to attain [or to maintain until completion of the sexual activity] an adequate wetness and vaginal swelling response of sexual excitement”). The association of receptive anal intercourse with sexual dysfunction might be due to physiological and/or psychological processes. The psychological factors including emotional development problems,<sup>16</sup> poorer mood,<sup>17</sup> poorer intimate attachment<sup>18</sup> as well as general dissatisfaction are associated with women's receptive anal intercourse.<sup>19</sup> Physiologic factors could include that: (1) mechanical stimulation of the anus and rectum during anal intercourse increases hemorrhoid risk; (2) women with hemorrhoidectomy have impaired sexual function; and (3) persons with hemorrhoids who have not yet had hemorrhoidectomy “are more likely to have abnormal perineal descent with pudendal neuropathy.”<sup>20,21</sup> Thus, pudendal nerve dysfunction could be one mechanism leading to sexual dysfunction, and this might be the case even in the absence of diagnosed haemorrhoids.<sup>13</sup>

<sup>FN10</sup> A history of receptive anal intercourse has been shown to increase the risk of anal incontinence, rectal bleeding, and anal fissure.<sup>12</sup>

<sup>FN11</sup> Unlike dyspareunia (from coitus), it might be normal to experience pain or discomfort during receptive anal intercourse.

<sup>FN12</sup> This may be accompanied by a finding of decreased anal resting tone (in some cases, the result of anal intercourse)—see under Signs. Damage to the internal anal sphincter is the likely basis for the laxity. Unlike stool passage, receptive anal intercourse is not likely to elicit reflex relaxation of the internal sphincter.

<sup>FN13</sup> Pruritus ani has been classified into primary and secondary. The primary form is the classic syndrome of idiopathic pruritus ani. The secondary form implies an identifiable cause or a specific diagnosis.

- (v) **Scars, sinuses, deformities, condylomata, papillomata, hematoma:**<sup>[FN14]</sup>.
- (vi) **Deficient perineum/cloacal-like defect:** A spectrum of tissue loss from the perineal body and rectovaginal septum with variable appearance. There can be a common cavity made up of the anterior vagina and posterior rectal walls or just an extremely thin septum between the anorectum and vagina.
- (vii) **Anal fissures:** Longitudinal split in the skin of the anal canal, exposing the internal anal sphincter muscle. The majority of fissures are found in the mid-line posteriorly and there may be a skin tag associated with them.
- (viii) **Hemorrhoids:** Abnormality of the normal cushion of specialized, highly vascular tissue in the anal canal in the submucosal space. Hemorrhoids can be divided into those originating above the dentate line which are termed internal and those originating below the dentate line which are termed external. Internal hemorrhoids are graded as follows:
- Grade I - bleeding without prolapse.
  - Grade II - prolapse with spontaneous reduction.
  - Grade III - prolapse with manual reduction.
  - Grade IV - incarcerated, irreducible prolapse.
- Grade II and Grade III hemorrhoids will become evident on asking the patient to bear down and grade IV hemorrhoids are obvious at the time of the examination. A proctoscopy is essential in examining for hemorrhoids unless they are completely prolapsed.
- (ix) **Anorectal prolapse:** Full thickness eversion of the lower part of the rectum and anal canal. The exposed mucosa is red with circumferential folds around the central pit, which is the lumen of the rectum. Look for associated utero-vaginal prolapse, fistulas, sepsis, and ulcers.
- (x) **Fistula in ano:** An anal fistula is an abnormal connection between the anal canal epithelium (or rarely rectal epithelium) and the skin epithelium. Patients may complain of pain, swelling, intermittent discharge of blood or pus from the fistula, and recurrent abscesses formation.
- (xi) **Rectovaginal fistula:** Is a communication from the rectum to the vagina.
- (xii) **Ano-rectal/vaginal/perineal fistula:** Is an abnormal communication from the anal canal to the vagina or perineal area.

## 2.2: Vaginal Examination

All examinations for pelvic organ prolapse should be performed with the woman's bladder empty (and if possible an empty rectum),<sup>7</sup> straining to maximally reveal the prolapse. All compartments should be examined for prolapse but of particular relevance to ano-rectal dysfunction is posterior vaginal wall prolapse.

(i) **Posterior vaginal wall prolapse:** Observation of descent of the posterior vaginal wall. Commonly, this would represent rectal protrusion into the vagina (rectocele). Higher stage posterior vaginal wall prolapse after prior hysterectomy

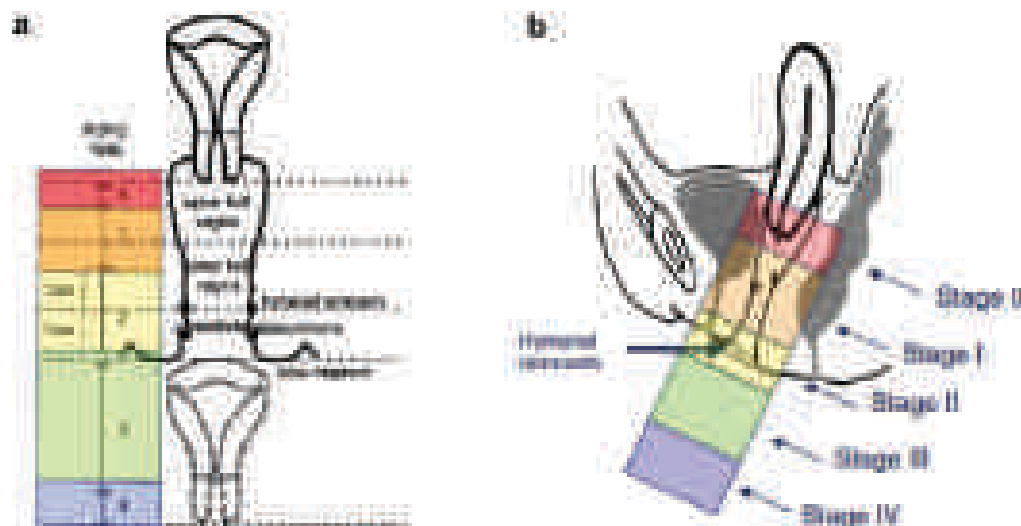


Fig. 1. Figure a and b shows prolapse staging—0, I, II, III, and IV (uterine by the position of the leading edge of the cervix).

<sup>FN14</sup>With perianal hematomas, the lump may be anywhere around the anal margin and may be multiple. Pilonidal sinuses are usually a small mid-line pit with epithelialized edges.

<sup>FN15</sup>Figure used from Pelvic floor dysfunction document<sup>7</sup> (Fig. 1a and b).

6 Sultan et al.

would generally involve some vaginal vault (cuff scar) descent and possible enterocele formation. Posterior vaginal wall prolapse can be a rectocele, enterocele, or a perineocele. Enterocele formation can also occur in the presence of an intact uterus.

- (ii) **Rectocele:** Bulge in posterior vaginal wall associated with herniation of anterior wall of the rectum.
- (iii) **Enterocele:** Bulge of upper wall of the vagina associated with herniation of the peritoneal sac and loops of small bowel.
- (iv) **Perineocele:** Bulge in the perineum associated with herniation of the anterior wall of the rectum.

### 2.3: Anorectal Examination

The patient lies in the left lateral position with hips flexed and ankles away from the examiner. Dorsal lithotomy position could also be used.

(i) **Perianal sensation/reflex:** In patients with possible neurogenic pelvic floor dysfunction there should be particular note of those neurological signs related to S2-4 but these should be complimented by a more general neurological examination as indicated. Specific to ano-rectal dysfunction, assessment of anal reflex, and perianal sensation should be performed.

(ii) **Digital rectal examination:** The gloved finger should be placed in the center of the anus with the finger parallel to the skin of the perineum in the midline. The finger should then be pressed gently into the anal canal but at the same time pressed backwards against the skin of the posterior wall of the anal canal and underlying sling of the puborectalis muscle. This overcomes most of the tone of anal sphincter and allows the finger to straighten and slip into the rectum. This will allow assessment of:

- (a) Resting anal tone, voluntary squeeze of the anal sphincter as well as the levator muscles, sustained squeeze over 5 sec and involuntary contraction elicited during a cough.
- (b) Obvious hemorrhoids can be palpated but grade II and grade III. Hemorrhoids are better assessed by proctoscopy. Painful examination may be associated with fistula in ano, fissure in ano, infection or pilonidal abscess.
- (c) Palpable anal sphincter gap. An assessment can be made of a palpable anal sphincter gap to assess if there has been previous obstetric or surgical damage. The perineal body can be assessed for deficiency.
- (d) Rectal contents. The contents of the rectum can be assessed. The feces may be hard or soft, the rectum may be empty or collapsed and sometimes ballooned out. This allows assessment of fecal impaction.
- (e) Confirmation of presence of rectocele, enterocele, or perineocele. Use of POP-Q for staging of prolapse [See <sup>FN15</sup>].
- (f) Bidigital examination may be carried out with the patient supine in a gynecological examining position. By inserting the index finger in the vagina and the middle finger in the rectum, the rectovaginal septum and any intervening small bowel loops can be palpated to differentiate a rectocele from an enterocele, during a Valsalva maneuver.
- (g) Rectal lesions such as carcinoma, intussusception or recto-vaginal fistula. If a mass is felt on a fingertip, the patient should be asked to strain, and this will often move the mass down to bring it within reach.
- (h) An assessment can be made of the rectovesico/recto uterine pouch to look for extra rectal masses.

### 2.4: Examination of Pelvic Floor Muscle Function<sup>7</sup>

Pelvic floor muscle function can be qualitatively defined by the tone at rest and the strength of a voluntary or reflex contraction as strong, normal, weak, or absent or by a validated grading symptom. Voluntary pelvic floor muscle contraction and relaxation may be assessed by visual inspection, by digital palpation (vaginal or anorectal) (circumferentially), electromyography, dynamometry, manometry, or ultrasound. Factors to be assessed include muscle strength (static and dynamic) (graded as strong, normal, weak or absent), voluntary muscle relaxation (graded as absent, partial, complete, delayed), muscular endurance (ability to sustain maximal or near maximal force), repeatability (the number of times a contraction to maximal or near maximal force can be performed), duration, co-ordination, and displacement.<sup>24</sup> Assessment can be made of each side of the pelvic floor separately to allow for any unilateral defects and asymmetry.<sup>23</sup> Assessment of displacement (perineal elevation or descent) of the pelvic floor can be made during cough or Valsalva. Normally, there is some downward movement of the pelvic floor muscles or there is a ventral movement (perineal elevation, inward (cephalad) and upward movement of vulva, perineum, and anus). Rectal examination observations can include:

- (a) Anal sphincter tone and strength: given the absence of a formal quantitative assessment via the rectal route, assessment of anal tone and strength on digital examination, can be graded using the same convention used when grading transvaginally—as strong, normal, weak, or absent or by a validated grading symptom.
- (b) Anal sphincter tear: may be recognized as a clear “gap” in the anal sphincter on digital examination.

### 2.5: Squeeze Pressure

Measurement of squeeze pressure involves the exertion of pressure, compressing the assessor's finger during digital palpation or using a mechanical device. The patient is asked to squeeze the PFM as hard as possible (maximum strength), to sustain the squeeze contraction (endurance), or to repeat squeeze contractions (repetitions). The measurement can be done in the anorectum using manual muscle testing with digital rectal palpation or pressure manometry in the vagina using manual

*Neurourology and Urodynamics* DOI 10.1002/nau

muscle testing with digital vaginal palpation or pressure manometry, or dynamometry. So far, not all quantitative assessments and scales of pelvic floor squeeze pressure have the same methodological qualities, like validity, reproducibility, and responsiveness.<sup>24–28</sup>

Pelvic floor muscle **spasm** was defined as persistent contraction of striated pelvic floor muscle that cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp.<sup>29</sup> Spasm over days or weeks may lead to a contracture.

Pelvic floor muscle **tenderness**: sensation of discomfort with or without pain; discomfort of pelvic floor muscle elicited through palpation. Tenderness can be scored<sup>30</sup> during a digital rectal (or vaginal) examination of levator ani, piriformis and internal obturator muscles bilaterally, according to each subject's reactions: 0, no pain; 1, painful discomfort; 2, intense pain; with a maximum total score of 12.

Although not universally accepted, pelvic floor muscle **traction** is the use of a pulling force to examine or treat pelvic floor muscles, postulated to end pelvic muscle spasm or relieve pain.<sup>31</sup>

## 2.6: General Examination

Anorectal dysfunction may be associated with systemic disease and intestinal malignancy and a thorough medical examination should observe for signs relating to conditions such as anaemia, jaundice, lymphadenopathy, etc.

## 2.7: Neurological Examination

In patients with possible neurogenic pelvic floor dysfunction there should be particular note of those neurological signs related to S2-4 but these should be complimented by a more general neurological examination as indicated. Specific to ano-rectal dysfunction, assessment of anal reflex, and perianal sensation should be performed.

## 2.8: Abdominal Examination

A thorough abdominal examination should evaluate for the following:

- (i) Abdominal masses or distension.
- (ii) Scars indicating previous relevant surgery or trauma.
- (iii) Tenderness.

# SECTION 3: ASSESSMENT TOOLS AND QUESTIONNAIRES (NON INVASIVE)

## 3.1: Pictorial Stool Chart

It is a pictorial chart of stool consistencies. First described (but not published as a pictorial instrument) by Heaton et al.,<sup>32,33</sup> the “Bristol stool chart” seems to have widespread face validity and recognition and is useful in conversations with patients about their stool consistency, despite little validation work. It has not been validated as an outcome measure and a reported change in category may not represent sufficient degree of precision for use as a trial end point.

## 3.2: Bowel Diary

It is a recording of bowel actions. Bowel diaries have been widely used in diagnostic and intervention studies. Patient recall is less accurate than a diary.<sup>34,35</sup> Patients tend to underestimate symptom frequency, in one study by over 50%.<sup>36</sup> However, there are few published examples and no consensus on what should be included. Elements that might be included:

- Urgency,
- Fecal incontinence (amount, consistency),
- Flatus incontinence,
- Passive staining/soiling (tends not be discrete episodes),
- Pads (changes, degree of soiling),
- Straining/difficulty/time in the toilet,
- Unsuccessful attempts to defecate,
- Assistive measures (e.g., digital stimulation, manual evacuation, irrigation),
- Laxative or rectal evacuant use,
- Diet and fluids (type and/or timing).

Patients often need careful and detailed instructions on how to complete a diary, and still many are poorly completed. An incomplete diary is difficult to interpret and is liable to misinterpretation as a low bowel/event frequency.

## 3.3: Symptom Scores and Questionnaires

(i) **Fecal incontinence (FI)**

The International Consultation on Incontinence (ICI) chapter 5B<sup>37</sup> has reviewed FI questionnaires and found none with a grade A recommendation (validity, reliability, and responsiveness established with rigor). The ICI grades B (validity and reliability established with rigor, or validity, reliability, and responsiveness indicated) and C (early development—further work required) are noted where available in the text below.

The Cleveland Clinic Score,<sup>38</sup> often termed the “Wexner” score, was the first attempt to have a score based on both the frequency and consistency of FI and effect on lifestyle. In the original version it was physician-completed, although in subsequent literature it has also been completed by patients (grade C). The St Mark’s score<sup>39</sup> was an adaptation of the original Wexner score, adding scores for urgency and use of anti-diarrheals (grade C). This has been found to correlate reasonably well to patients’ global assessment of their bowel function.<sup>40</sup>

The Fecal Incontinence Quality of Life Scale<sup>41</sup> (grade B) and Fecal Incontinence Severity Index<sup>42</sup> (FISI) (grade B) were developed using items suggested by experts and then proposed to patients for ranking.

The international consultation on incontinence questionnaire—bowels (ICIQ-B)<sup>43</sup> has 23 items developed by literature review, expert opinion and in-depth qualitative interviews with patients, to include items of greatest importance to both clinicians and people with symptoms.<sup>44</sup> It has been validated up to the point of responsiveness to change, but further work is needed.

(ii) **Constipation**

There has been no exercise similar to the ICI Chapter 5B<sup>37</sup> which has graded constipation questionnaires.

The Patient Assessment of Constipation Quality of Life questionnaire<sup>45</sup> (PAC-QoL) and the PAC-SYM<sup>46</sup> are the best validated and most widely used tools for idiopathic constipation.<sup>47</sup> The PAC-SYM items were developed from the literature and patient focus group interviews. The validation process was robust and the instrument has 12 items grouped into three subscales (stool symptoms, rectal symptoms, and abdominal symptoms), each scored 0–4. It has also been validated for use with constipated older people in a care home environment<sup>47</sup> and opioid-induced constipation.<sup>48</sup>

The Cleveland Clinic constipation score gives a simple numerical total score<sup>49</sup> based on symptoms and physiological findings. Values allocated to symptoms and findings appear to be arbitrary. Validation has been limited.

Altomare has developed a scoring system specifically for the Obstructed Defecation Syndrome,<sup>50</sup> but this has not been formally validated. Table I shows utility of patient reported outcomes questionnaires for female anorectal dysfunction in clinical or research settings.

TABLE I. Patient Reported Outcome Questionnaires for Female Anorectal Dysfunction

Conditions	Tools	Clinical	Research
Bowel dysfunction	Bristol stool chart	R	R
Bowel dysfunction	Bowel diary	R	R
Fecal incontinence	Cleveland clinic score/	R	R
	Wexner	R	R
	St Marks score	R	R
	FI QoL	O	R
	FISI	O	R
Constipation	ICIQ-B	O	R
	PAC-QoL	R	R
	PAC-SYM	R	R
	Altomare	O	R

O, optional; R, recommended.

## SECTION 4: ANORECTAL PHYSIOLOGICAL INVESTIGATIONS

Anorectal physiological assessment is a key part of the assessment of some patients with pelvic floor symptoms<sup>51,52</sup> providing a clinically meaningful, quantitative measure of a specific anorectal function. It is only in the context of the patient’s symptoms, thorough examination and radiological investigations that physiological measurements can be correctly interpreted.

## 4.1: Investigations to Exclude Organic Disease

(i) Anoscopy or proctoscopy is the inspection of the anal canal to identify anal fissure, fistula, or hemorrhoids as a cause of anal symptoms.

(ii) Rigid sigmoidoscopy is a bedside test to inspect the rectal mucosa, with no bowel preparation.

(iii) Flexible sigmoidoscopy refers to the inspection of the distal colonic mucosa, typically up to the splenic flexure, with a 60 cm flexible endoscope following enema preparation. Colonoscopy examines the entire colon following a full oral preparation to clear the bowel to allow this.

## 4.2: Anorectal Physiology Tests

Functional assessment tests of fecal incontinence and evacuatory disorders aim to qualify and quantify function, determine the etiology, guide management, and monitor progress.

#### 4.2.1 Manometry

Anal manometry is a test to assess the mechanical strength of the anal sphincters.<sup>53,54</sup> A range of methods is available, including water perfused, solid state, and micro-balloon systems. The length of the canal is measured either by station pull-through or continuous pull-through. Station pull-through involves inserting the catheter to 6 cm from the anal verge, withdrawing the catheter at 5–10mm intervals and measuring for 1–5 min at each “station” (see Fig. 2). Continuous pull-through involves withdrawing the catheter at a set speed by hand or by a mechanical puller. As normal values can differ substantially between laboratories according to the style of catheter used, each unit is encouraged to generate its own normal data.<sup>51,52</sup>

In patients with fecal incontinence the value of manometry is:

- (a) To define functional weakness of one or both sphincter muscles (as a compliment to anal endosonography).
- (b) To support findings of other tests and to monitor outcome and predict response to biofeedback training.
- (c) In cases where anal endosonography is not available, vector manometry may help identify anatomic defects of the anal sphincter complex.

In constipated patients the value of manometry is:

- (a) To exclude Hirschsprung's disease.
- (b) To identify and predict responses to biofeedback training (pelvic floor dyssynergia = failure to expel a water-filled balloon).

##### 4.2.1.1: Functional anal length

Functional anal canal length is defined as the length of the anal canal over which resting pressure exceeds that of the rectum by greater than 5 mmHg or, alternatively, as the length of the anal canal over which pressures are greater than half of the maximal pressure at rest.

##### 4.2.1.2: Maximum resting pressure

The maximum resting pressure is the maximum resting pressure generated in the anal canal at rest. Strictly speaking, it is defined as the difference between the intrarectal pressure and the highest recorded rectal pressure at rest. However, rectal contents may affect the accuracy of rectal pressure measurements. The internal anal sphincter (IAS) exhibits continuous tonic activity and is responsible for 55–85% of the resting anal canal pressure (see Fig. 2). Its contribution to resting tone is variable along the length of the anal canal with the proximal two thirds being more reliant on IAS tone to maintain adequate resting pressures.<sup>55,56</sup> The range of maximal resting pressure is typically between 60 and 120 cmH<sub>2</sub>O. The EAS has constant tonic activity contributing to the resting anal canal pressure.

##### 4.2.1.3: The maximum squeeze pressure

The maximum squeeze pressure is the maximum pressure generated in the anal canal during a voluntary contraction. Although the EAS contributes to the resting pressure the specific function of the EAS can be assessed during the *squeeze* and *cough* maneuvers. The pressure increment above resting pressures during these maneuvers is a direct representation of EAS function. The normal range, as stated above, varies according to measurement modality in each laboratory, but is approximately above 60 cmH<sub>2</sub>O.<sup>57,58</sup> Typically, higher values are obtained by automated pull-through rather than station withdrawal methodologies.<sup>51</sup>

##### 4.2.1.4: Involuntary maximum squeeze pressure

A common maneuver is a maximal cough to measure this involuntary increment, usually reported as a present or absent response, rather than numerically.

##### 4.2.1.5: Endurance squeeze pressure

The endurance squeeze pressure is the length of time the individual is able to maintain the pressure during a voluntary contraction. To assess the endurance squeeze pressure, measurements are taken during a 5–10 sec squeeze (normal ≥5 sec). Incontinent patients typically have fatigue rate of greater than two-thirds of initial pressure at the end of the sustained squeeze. By calculating fatigability, the fatigue rate (using linear regression on the mean pressure over one second periods throughout the endurance squeeze) can be derived.

##### 4.2.1.6: Rectoanal inhibitory reflex

The recto-anal inhibitory reflex (RAIR) a relaxation response in the IAS following rectal distension. A drop of at least 25% of resting pressure has to occur with subsequent restoration to at least two thirds of resting pressure for it to be deemed present. It is elicited by rapid insufflation and disinflation of 50 mls of air into a balloon positioned in the distal rectum during anal manometry at the level of the proximal high pressure zone.<sup>52</sup> This reflex is absent in Hirschsprung's disease: of greater physiological meaning, this reflex is thought to underlie the sampling response that allows rectal content to be sensed by the anal mucosa, thus ensuring continence of flatus and stool.<sup>59</sup>

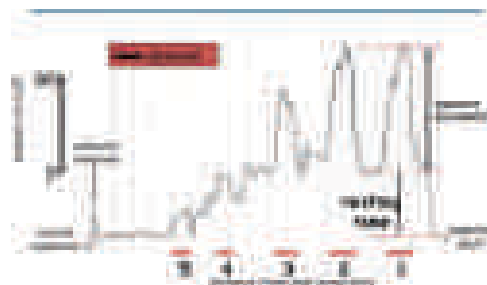


Fig. 2. Typical station pull through manometry trace on a patient, with explanations.

Neurourology and Urodynamics DOI 10.1002/nau



10 Sultan et al.

#### 4.2.1.7: Balloon expulsion pressure

The balloon expulsion pressure is the anal canal pressure during straining with a filled balloon in the rectum. Balloon expulsion can be performed on patients with evacuatory difficulty. An inappropriate increase in sphincter pressure on attempted voiding evacuation is usually reported as a present or absent response, rather than numerically. Such increased pressure is referred to as “anismus” or “paradoxical sphincter contraction.”

#### 4.2.1.8: Advanced manometric techniques

##### 4.2.1.8.1: Vector manometry

Vector manometry is a quantitative measure of radial symmetry and volume of the anal sphincter. It involves withdrawing (commonly using a mechanical puller) a radially arranged multi-channel anorectal manometry catheter through the length of the anal canal.<sup>60,61</sup> The following parameters are identified:

- Radial asymmetry index (RAI) is a quantitative measure of the radial symmetry and can be calculated at any level in the anal canal but most commonly refers to the level at which the highest resting pressure is generated. The principle is that an asymmetrical sphincter is more likely to have a sphincter defect.
- The vector volume is the volume of the 3D shape generated and provides a value which reflects the overall length and symmetry of the sphincter (Fig. 3).

##### 4.2.1.8.2: High resolution manometry

In this technique, a catheter with a large number of pressure sensors spaced less than 0.5 mm apart along the length of the catheter. This allows complete definition of the intra-anal pressure environment. The resulting data is displayed on a topographical three dimensional plot to allow easier pattern recognition. It is a measurement with the variables of pressure (displayed as the color), distance into the anal canal (y-axis) and time (x-axis). Normal ranges are slightly higher than measured with standard manometry, but the readings agree well with each other.<sup>62</sup>

##### 4.2.1.8.3: Ambulatory anorectal manometry

Using solid-state catheters, prolonged ano-rectal motor events have been recorded, including in ambulant subjects. The clinical applicability of these techniques has not been established.<sup>63–65</sup>

#### 4.2.2: Sensory measurements

##### 4.2.2.1: Assessment of rectal sensation to distension

Rectal sensation to distension is most commonly assessed by manually inflating an intrarectal domestic balloon at a rate of approximately 5 ml/second.<sup>56,66</sup> The following are elicited:

- Volume which elicits the first sensation of balloon expansion (threshold) [typical normal range 12–25 ml],
- Volume to get an urge to defecate (typical normal range 35–65 ml),
- Maximal tolerated volume (typical normal range 120–300 ml).

[normal ranges for the latter two sensations are highly variable due to lack of consensus on measurement technique especially of the nature and speed of inflation of the balloon]

The pressure required to elicit these sensations can also be measured using an electro-mechanical barostat and may be more reproducible. The barostat measures the volume and the pressure required to elicit these volumes sensations.<sup>67,68</sup> Typically distension thresholds with a barostat are higher, with larger volumes being required to elicit the same sensation. However, again, the published ranges vary widely between units: typically distension volumes 1.5 to 3 times are published for thresholds with a barostat compared to manual balloon inflation.

Distension sensitivity testing is of proven value in:

(a) Patients with fecal incontinence to help with biofeedback training by normalization of the initial sensation sensory thresholds.

(b) Identifying visceral hypersensitivity, poor rectal compliance, or rectal irritability if maximal tolerated volumes are low.<sup>51,52</sup> There is no evidence to support use of the sensory thresholds for diagnosis and biofeedback training of patients with constipation. Compliance testing has also not proven valuable in identifying candidates for specific therapies.

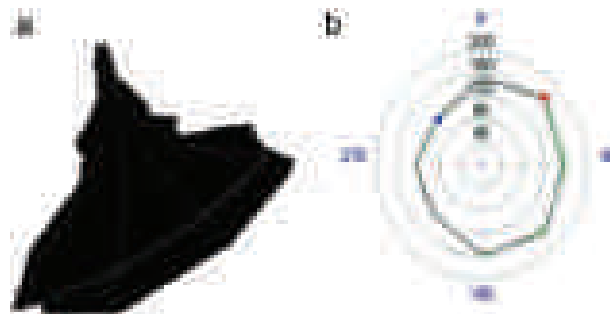


Fig. 3. Vector volume anal manometry trace. The left hand panel illustrates the shape of the contour curve at a fixed point, and the right hand figure shows the integrated whole across the length of the sphincter (from proximal to distal). It is evident that the greatest pressure is exerted in the distal canal.

Neurology and Urodynamics DOI 10.1002/nau

4.2.2.2: Mucosal electrosensitivity

This is test to measure anal and rectal sensory thresholds. Mucosal electrical stimulation is performed using a probe with two ring electrodes between which a small electrical potential is applied generating an alternating square wave with a variable frequency. Normal ranges have been established as anal electrosensation <10 mA, and rectal as <30 mA.<sup>69</sup> In general, prolonged anal electrosensation is suggestive of damage to the sensory fibers of pudendal nerve, and prolonged rectal electrosensation is suggestive of autonomic neuropathy.

4.2.3: Rectal dynamics

4.2.3.1: Rectal compliance

Rectal compliance is the term that describes the relationship between pressure and volume, reflecting the ability of the rectum to act as a reservoir and is assessed using a barostat, inflating the bag within the rectum prior to the recording inflation protocol, known as conditioning, has been shown to improve the precision of compliance testing.<sup>59</sup> Typically, compliance figures between 4 and 11 mmHg/ml are quoted as the normal range.

4.2.3.2: Rectal impedance planimetry

These studies are the preserve of research institutions rather than clinical practice. The rationale is to calculate the diameter or cross sectional area of an intra rectal bag during a distension sequence. Impedance planimetry measures the cross sectional area which enables the circumferential wall tension to be calculated.<sup>70</sup>

4.2.4: Attempted defecation and balloon expulsion

Patients with symptoms of prolapse and elderly patients with a history of constipation who present with passive incontinence should be thoroughly examined for the presence of a full thickness rectal prolapse. Patients are asked to strain as they would to pass stools whilst on a toilet or commode and given enough time to reproduce the prolapsing lump before examination.

Expulsion of a water-filled balloon can be used in the assessment of constipated patients. The ability to expel the balloon within 1 min may be a useful tool in demonstrating the absence of pelvic floor dyssynergia.

4.2.5: Neurophysiology

4.2.5.1: Single fiber EMG

A single fiber needle EMG technique is used to measure the muscle fiber density in the external sphincter and puborectalis. A raised fiber density indicates re-innervation in the muscles, which may occur following partial denervation. Calculating EAS fiber density is another method of assessing denervation and re-innervation of the EAS. It is used almost exclusively as a research tool. Conventional EMG can be used to quantify the re-innervation of the EAS by detecting prolongation in the duration of the motor unit potential.

4.2.5.2: Concentric fiber EMG

Concentric needle EMG can be used to record activity in the external sphincter and puborectalis. The responses of these muscles to voluntary contraction, coughing, and straining can be displayed. The data are qualitative and compared to appearances in these muscles at rest. The muscles can also be studied at several sites to define areas of functioning muscle and identify sites of muscle injury (sphincter mapping) although this is has now been superseded by anal endosonography.

4.2.5.3: Surface EMG

Electrodes placed on the skin of the perineum or inside the vagina or rectum. Surface recordings from the sphincter show increased activity with body actions and decreased activity in sleep. Needle EMG however is regarded as superior.<sup>71</sup> Some centers use surface EMG as an indicator of anal sphincter activity to provide feedback for patients undergoing behavioral biofeedback training for fecal incontinence or constipation.

4.2.5.4: Pudendal nerve terminal motor latencies (PNTMLs)

The PNTML is a measurement of the delay between the electrical stimulation of the pudendal nerve and the EMG activity of the EAS. The pudendal nerve is stimulated as it passes over the ischial spine using a specially designed electrode attached to the index finger of the assessor in the rectum.<sup>71</sup> The surface EMG recording electrode which sits on the base of the assessor's index finger and measures external sphincter activity. The test does not reliably reflect the pudendal nerve damage. This may be because PNTMLs measure the speed of nerve conduction, which involves the fastest nerve fibers that are least susceptible to damage. The latencies are reported as normal if below 2.2 msec, but are also very operator dependent, with poor reproducibility and hence not recommended for general clinical use.<sup>72</sup>

4.3: Clinical Role of Anorectal Physiological Measurements

As can be seen from the above, the reliability, reproducibility, and clinical validity of these tests are unproven, owing to the variety of methodologies of measurement undertaken. Standardization in each individual laboratory, with normal ranges from each laboratory, is therefore the required standard. Table II shows the utility of anorectal physiology tests within clinical or research settings.

TABLE II. Anorectal Physiology Tests for Female Anorectal Dysfunction

Anorectal physiological tests	Conditions	Clinical	Research/optional
Anorectal manometry	Anal sphincter function	R	R
Defecography	Extent of rectal intussusception/rectocele	O	R
Neurophysiological testing	Preoperative before sphincteroplasty or SNM; or in	O	R
PTNML <sup>73</sup>	Patients with possible pudendal neuralgia		
CN-EMG	When USS or MRI equivocal		

O, optional; R, recommended.

Neurourology and Urodynamics DOI 10.1002/nau

## SECTION 5: IMAGING

## 5.1: Ultrasonography (2D/3D/4D) of the Posterior Compartment Including Anal Sphincters, Pelvic Floor Muscles, and Prolapse (Endoanal, Transperineal, Transvaginal)

Ultrasound is increasingly being incorporated as an investigation of posterior compartment disorders<sup>7,74</sup> (Table III). An integrated multi-compartmental pelvic floor ultrasonography with a combination of different modalities has been described to assess pelvic floor dysfunction for a global and multi-compartmental perspective.<sup>75,76</sup>

Modalities in current routine clinical use:

(a) **Endoanal:** intra-anal 360° sector scanning using rotational mechanical probe or radial electronic probe.  
 (b) **Transperineal:** curved array probe applied in the perineum between the mons pubis and the anal margin. This term incorporates trans-labial ultrasound. Introital ultrasound is usually assumed to imply the placement of transducer with smaller footprints (such as end-firing endo-vaginal probe) within the introitus.

(c) **Transvaginal:** intra-vaginal curvilinear, linear array, or 360° sector scanning.

## 5.1.1: Endoanal ultrasonography (EAUS)

The majority of current systems provide **2D & 3D Imaging** which give a 360° axial view of the anal canal and of the rectal wall.<sup>4,77,78</sup> Endoanal ultrasound can be performed with the patient placed in the dorsal lithotomy, left lateral or prone position. Irrespective of the position, the probe should be rotated so that the anterior aspect of the anal canal is superior (12 o'clock) and left lateral is right (3 o'clock) on the screen. The anal canal is divided into three levels of assessment in the axial plane referring to the following anatomical structures:

- **Upper level:** the hyperechoic sling of the puborectals muscle (PR) and the complete ring of the internal anal sphincter (IAS) are visualized (Fig. 4a),

- **Middle level:** corresponds to the superficial part of the EAS (concentric band of mixed echogenicity), the conjoined longitudinal layer, the IAS (concentric hypoechoic ring), and the transverse superficial perinei muscles (Fig. 4b),

- **Lower level:** corresponds to the subcutaneous part of the EAS where the IAS is absent (Fig. 4c).

The acquisition of a three-dimensional data volume (**3D ultrasound**) and the underlying techniques vary. Acquisition may be “free-hand” (low resolution 3D) or “automatic computer-controlled” (high resolution 3D).<sup>79,80</sup>

## 5.1.2: Transperineal Ultrasonography (TPUS)

Conventional convex transducers (frequencies between 3 and 6 MHz and field of view at least 70°) provide 2D imaging of the pelvic floor.<sup>81,82</sup> Transperineal ultrasound is performed with the patient placed in the dorsal lithotomy position, with the hips flexed and abducted. If necessary, the patient can be examined standing, to maximise descent of pelvic organs, especially if the patient finds it difficult to produce an effective Valsalva maneuver. No rectal or vaginal contrast is used. Perineal ultrasound provides sagittal, coronal and oblique sectional imaging, with the mid-sagittal plane being the most commonly used as this gives an overall assessment of all anatomical structures (bladder, urethra, vaginal walls, anal canal, and rectum) between the posterior surface of the symphysis pubis (SP) and the posterior part of the levator ani (LA) (Fig. 5a and b). The imaging is usually performed at rest, on maximal Valsalva maneuver and on pelvic floor muscle contraction (PFMC). The access to the mid-sagittal plane allows the following evaluations<sup>83</sup>:

- Integrity of the perineal body: appearing as a triangular shaped, slightly hyperechoic structure anterior to the anal sphincter,
- Measurement of the anorectal angle (ARA): formed by the longitudinal axis of the anal canal and the posterior rectal wall,
- Dynamic assessment of the posterior compartment. During Valsalva it is possible to visualize descent of an enterocele, to assess the movement of the anterior rectal wall to detect a rectocele, and to evaluate movement of the PR and ARA to diagnose pelvic floor dyssynergy (Fig. 5c).

3D TPUS may be performed with volumetric probes (electronic curved array of 4–8 MHz). An advantage of this technique is the opportunity to obtain tomographic or multi-slice imaging, for example, in the axial plane, in order to assess the entire PR and its attachment to the pubic rami<sup>84</sup> (Fig. 6). It is also possible to measure the diameter and area of the levator hiatus (LH) and determine the degree of hiatal distension on Valsalva. Four dimensional (4D) imaging indicates real-time acquisition of volume ultrasound data.

TABLE III. Imaging Modalities for Female Anorectal Dysfunction

Conditions	Imaging techniques	Levels of evidence	Grade of recommendation
Fecal incontinence	Endoanal US	Level II	Grade B
	Static MRI	Level II	Grade B
	Defecating proctography	Level III	Grade C
Pelvic organ prolapse	Dynamic MRI	Level II	Grade B
	Transperineal US	Level II	Grade B
	Defecating proctography	Level II	Grade B
Obstructed defecation	Dynamic MRI	Level II	Grade B
	Defecating proctography	Level II	Grade B
	Transperineal US	Level III	Grade C
Perianal sepsis	Static MRI	Level II	Grade B
	Endoanal US	Level II	Grade B
	Fistulography	Level III	Grade C
Chronic pelvic pain	Static MRI	Level III	Grade C

Neurourology and Urodynamics DOI 10.1002/nau

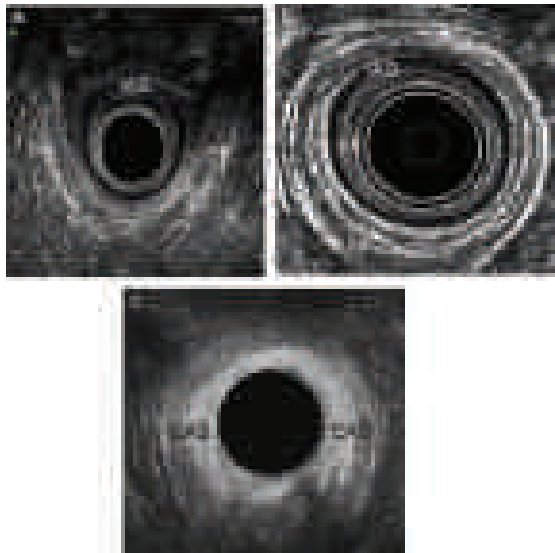


Fig. 4. Endoanal ultrasonography. (a) Upper level of the anal canal; (b) Middle level of the anal canal; (c) Lower level of the anal canal. PR, puborectalis; IAS, internal anal sphincter; EAS, external anal sphincter; LM, longitudinal muscle; SE, sub epithelium.

5.1.3: Transvaginal Ultrasonography (TVUS)

Transvaginal ultrasound is performed with the patient placed in the dorsal lithotomy position. Currently, the transducers used for pelvic floor 3D TVUS are high multi-frequency (9–16 MHz), 360° rotational mechanical probe or radial electronic probe (Fig. 7a). The pelvic floor is divided into four levels of assessment in the axial plane referring to the following anatomical structures<sup>85</sup>: (not to be confused with Delancey's description of vaginal Levels of supports).

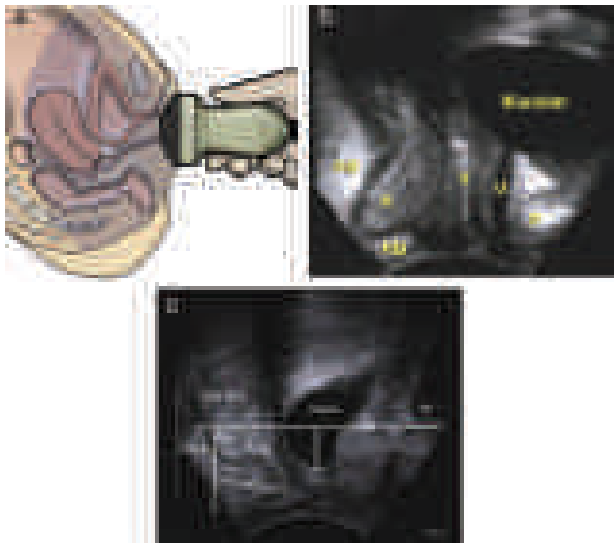


Fig. 5. 2D-Transperineal ultrasound. (a) Schematic drawing; (b) Pelvic organs at rest; (c) Pelvic organs descend below the symphysis pubis line after Valsalva maneuver (cystocele, enterocele, rectocele). PR, puborectalis muscle; A, anal canal; PB, perineal body; V, vagina; U, urethra; P/SP, symphysis pubis.

Neurourology and Urodynamics DOI 10.1002/nau

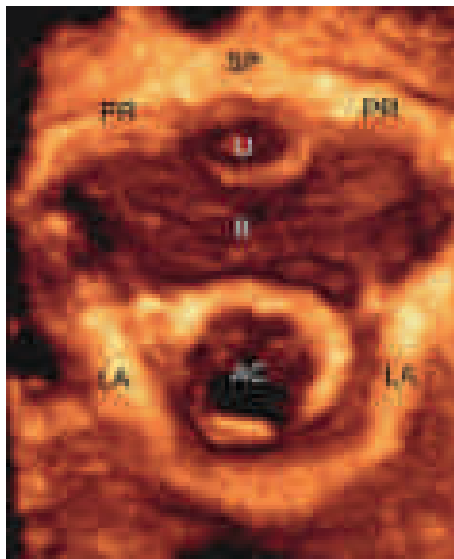


Fig. 6. 3D-Transperineal ultrasound. Axial image of the pelvic floor at rest showing the LA attachment to the pubic rami (PR). AC, anal canal; LA, levator ani; B, bladder; U, urethra; SP, symphysis pubis.

- **Level I:** at the highest level the bladder base is visualized on the screen at 12 o'clock position and the inferior third of the rectum at 6 o'clock position,
  - **Level II:** corresponds to the bladder neck, the intramural region of the urethra and to the anorectal junction. At this level the subdivisions of the LA (pubovaginalis, puboperinealis, puboanalis, puborectalis, and iliococcygeus) may be identified,
  - **Level III:** corresponds to the midurethra and to the upper third of the anal canal. At this level the LA is visualized as a multilayer hyperechoic sling coursing lateral to the vagina and posteriorly to the anal canal and attaching to the inferior pubic ramus (Fig. 7b). In the axial plane of minimal hiatal dimensions, identified as the minimal distance between the inferior edge of the SP and the anterior border of the LA at the ARA, the biometric indices (anteroposterior and transverse diameters, area) of the LH can be determined (Fig. 7c),<sup>86</sup>
  - **Level IV:** at the outer level, the perineal muscles (bulbospongiosus, ischiocavernosus, and superficial transverse perineal muscles), the perineal body, the distal urethra and the middle and inferior third of the anal canal are visualized. The anterior-posterior diameter of the urogenital hiatus (UGH), corresponding to the SP-perineal body distance, can be determined.<sup>87</sup>
- Transvaginal ultrasound may be also performed with electronic probes with linear array, which provide mid-sagittal image of the posterior compartment.<sup>76</sup> The main advantage of this technique is the dynamic assessment of the anorectal region, during Valsalva and pelvic floor muscle contraction (PFMC).

#### 5.1.4: Clinical applications of ultrasonography of the posterior compartment

##### 5.1.4.1: Fecal incontinence

Anal inspection and digital rectal examination can give information about internal and external anal sphincter function but are inaccurate for determining external anal sphincter defects <90 degrees and internal sphincter defects. Therefore, a sufficient diagnostic work-up should comprise at least rectal examination, anal inspection and endoanal ultrasonography.<sup>88</sup> EAUS has become the gold standard for morphological assessment of the anal canal.<sup>75</sup> The International Consultation on Incontinence (ICI)<sup>89</sup> has recommended EAUS as the first line imaging investigation for fecal incontinence to differentiate between those with intact anal sphincters and those with sphincter lesions (defects, scarring, thinning, thickening, and atrophy). Routine use of transperineal, transvaginal and translabial ultrasonography to image the anal sphincter complex are not recommended,<sup>89</sup> although research is ongoing. The operator should identify if there is a combined or isolated lesion of the IAS and EAS and report the number of defects, as well as the extent of the defect circumferentially (radial angle in degrees or in hours of the clock) and longitudinally (proximal, distal or full length).<sup>89–91</sup> Using 3D EAUS, two scoring systems have been proposed to define the severity of anal sphincter damage.<sup>92,93</sup>

EAUS has an important role in detecting undiagnosed anal sphincter injuries following vaginal delivery<sup>2</sup> and can be useful in the management of subsequent pregnancies following OASIS (119). It is also useful to evaluate the results of treatment (anterior sphincter repair, bulking agent injections).<sup>75,89</sup>

##### 5.1.4.2: Levator ani injuries

Levator avulsion is the disconnection of the muscle from its insertion on the inferior pubic ramus and the pelvic sidewall, whereas tears may occur in any part of the muscle. Avulsion is a common consequence of overstretching of the levator ani during the second stage of labor and it is detectable by 3D TVUS and 3D TPUS imaging as the lateral attachments of the levator ani to the

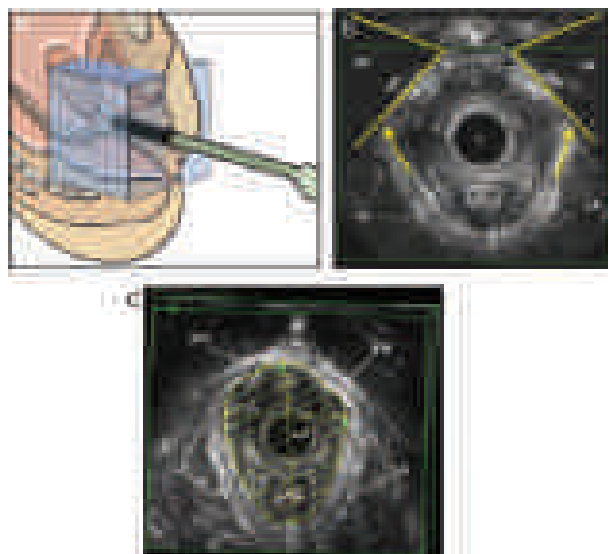


Fig. 7. 3D-Endovaginal ultrasound. (a) Schematic drawing; (b) Axial image of the pelvic floor at Level III, showing the LA attachment to the inferior pubic rami (IPR); and (c) the levator hiatus. AC, anal canal; LA, levator ani; B, bladder; U, urethra; SP, symphysis pubis; OF, obturator foramen; T, transducer; AP, anteroposterior diameter of the levator hiatus; LL, laterolateral diameter of the levator hiatus.

pubic bone are clearly visualized.<sup>94</sup> Defects are usually visualized most clearly on maximal PFMC. Tomographic ultrasound imaging is particularly useful. Levator ani injuries affect the size of the levator hiatus, with a hiatal enlargement to over 25 cm<sup>2</sup> on Valsalva maneuver defined as “ballooning,” and are related to symptoms and signs of prolapse.

#### 5.1.4.3: Obstructed defecation syndrome (ODS)

The term obstructed defecation syndrome (synonym: “outlet obstruction”) encompasses all pelvic floor dysfunctions, which are responsible for an incomplete evacuation of fecal contents from the rectum, straining at stool and vaginal digitations. During maximal Valsalva maneuver, dynamic TPUS and TVUS may be used to demonstrate.<sup>82,95</sup>

- **Rectocele:** herniation of a depth of over 10 mm of the anterior rectal wall,
- **Rectal intussusception:** invagination of the rectal wall into the rectal lumen, into the anal canal or exteriorized beyond the anal canal (rectal prolapse),
- **Enterocoele:** herniation of bowel loops into the vagina. It can be graded as small, when the most distal part descends into the upper third of the vagina, moderate, when it descends into the middle third of the vagina, or large, when it descends into the lower third of the vagina,
- **Dyssynergic defecation:** the ARA becomes narrower, the LH is shortened in the anteroposterior dimension, and the PR muscle thickens as a result of contraction.

#### 5.1.4.4: Perianal abscesses and fistulas

### 5.2: MRI for Anal Sphincters and Pelvic Floor (Static, Dynamic, Endocoil) Upright, Supine, Left Lateral Position

#### 5.2.1: Static MRI

Static MRI provides detailed information of the pelvic floor anatomy.<sup>96</sup> Current state-of-the art MR imaging of the pelvic floor includes imaging at a magnetic field strength of 1.5 Tesla (T), using pelvic or phased-array coils and T2-weighted fast-spin echo (FSE) sequences. The spatial resolution can be enhanced by using endoluminal (endorectal, endovaginal) coils. In combination with T2-weighted FSE sequences, endoluminal coils provide improved signal-to-noise ratio (SNR) and high resolution images.<sup>97</sup> Based on T2-weighted turbo spin-echo sequences, muscles are relative hypointense, ligaments and fascia hypointense while fat and smooth muscle are hyperintense. The prominent pelvic floor structures of the posterior compartment visualized at MRI are (Fig. 8):

- Perineal body and superficial perineal muscles,
- Anal sphincters: the IAS is easily recognized as a circular hyperintense structure. It is approximately 2.9 mm thick on endoluminal MRI. The inter-sphincteric space is seen as a bright line on T2-weighted MRI. The EAS has a thickness of 4.1 mm on endoluminal imaging,
- Puborectalis muscle and levator ani,
- Superficial perineal muscles,
- Rectum and rectal support.

Neurourology and Urodynamics DOI 10.1002/nau

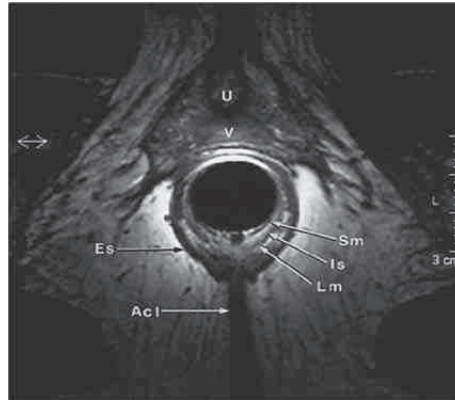


Fig. 8. Static MRI. Axial image of the anal canal. U: urethra; V: vagina; SM: submucosa; IS: internal sphincter; LM: longitudinal muscle; ES: external sphincter; ACL: anococcygeal ligament.

### 5.2.2: Dynamic MRI

With the development of fast multi-slice sequences MR imaging has gained increasing acceptance for dynamic imaging of pelvic floor. Because the posterior compartment is traditionally in the focus of interest, dynamic MR imaging of the pelvic floor is often called “MR defecography.”<sup>98</sup>

Dynamic pelvic imaging may be performed in an open-configuration MR system in the sitting position, or in a closed-configuration MR-system in the supine position. Both techniques are equally effective in identifying most of the clinically relevant abnormalities of the pelvic floor.<sup>98</sup> For evaluation of the posterior compartment of the pelvic floor, the rectum should be filled with a contrast agent (ultrasound gel or mashed potatoes, gadolinium-based MR contrast agent) to study the actual act of defecation.

The use of reference lines for image evaluation is helpful.<sup>99,100</sup> The most used reference line is the pubococcygeal line (PCL), which is defined on mid-sagittal images as the line joining the inferior border of the symphysis pubis to the last or second last coccygeal joint (Fig. 9a). The anorectal junction (ARJ) is defined as the cross point between a line along the posterior wall of the distal part of the rectum and a line along the central axis of the anal canal. To determine pathologic pelvic floor descent, the measurements are made on the images, which show maximal organ descent, usually during maximal straining or during evacuation (Fig. 9b). The anorectal angle (ARA) is defined as the angle between the posterior wall of the distal part of the rectum and the central axis of the anal canal and can be measured at rest, squeezing and straining. The extent of rectoceles and enteroceles are measured.

The degree of pelvic floor relaxation is measured with two reference lines (Fig. 9a): the H line which represents hiatal widening and extends from the inferior aspect of the symphysis pubis to the posterior wall of the rectum at the level of the ARJ and the M line which represents hiatal descent and extends perpendicularly from the PCL to the posterior end of the H line. Lesions of the pelvic musculofascial support result in widening of the hiatus and descent of the levator plate. Thus, the H and M lines tend to elongate

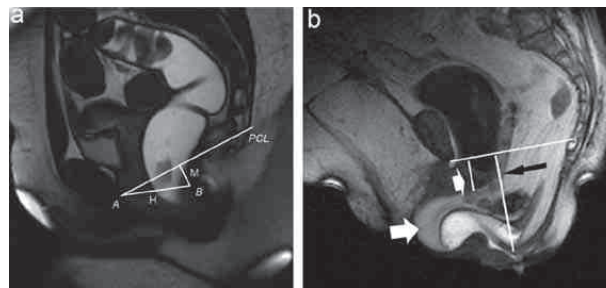


Fig. 9. Dynamic MRI. (a) Mid-sagittal steady state free precession T2-weighted image obtained at straining shows landmarks used in the HMO-system. The landmarks are the inferior aspect of the symphysis pubis (A) and the posterior wall of the rectum at the level of the anorectal junction (B). The H line (H) represents the anteroposterior hiatal width and extends from A to B. The M line (M) represents hiatal descent and extends perpendicularly from the pubococcygeal line (PCL) to the posterior end of the H line. (b) During Valsalva maneuver, there is a bladder descent below the PCL (small white arrow), with a perineal descent (black arrow) and a rectocele developing with a posterior vaginal wall prolapse (long white arrow).

Neurourology and Urodynamics DOI 10.1002/nau



with pelvic floor relaxation, widening the levator plate descent. Abnormal pelvic floor relaxation is present, when the H line exceeds 6 cm, and when the M line exceeds 2 cm in length.

### 5.2.3: Clinical applications of MRI of the posterior compartment

#### 5.2.3.1: Fecal incontinence

Endoanal ultrasound and endoanal magnetic resonance imaging (MRI) have been demonstrated to be comparable in the detection of external sphincter defects.<sup>101</sup> External phased array coil MRI can replace endoluminal MRI with comparable results.<sup>102</sup>

#### 5.2.3.2: Levator ani injuries

Abnormalities of the LA are identified on MRI as present or absent.<sup>103</sup> Defect severity is further scored in each muscle from 0 (no defect) to 3 (complete loss). A summed score for the two sides (0–6) is assigned and grouped as minor (0–3) or major (4–6).

#### 5.2.3.3: Obstructed defecation

During maximal Valsalva maneuver, dynamic MRI may be used to demonstrate:

- **Rectocele:** measured as the depth of wall protrusion beyond the expected margin of the normal anorectal wall. Based on sagittal MR-sections through mid of pelvis, rectoceles are graded as small (<2 cm), moderate (from 2 to 4 cm), and large (>4 cm),
- **Rectal intussusception:** the infolding of the rectal mucosa occurring during defecation. Depending on the location, an intrarectal intussusception, limited to the rectum, is distinguished from an intra-anal intussusception extending into the anal canal. The location of the intussusception may be anteriorly, posteriorly, or circumferentially. The intussusception either involves only the mucosa or the full thickness of the rectal wall,
- **Enterocoele:** defined as a herniation of the peritoneal sac, which contains omental fat (peritoneocoele), small bowel (enterocoele) or sigmoid (sigmoidocoele), into the rectovaginal or rectovesical space below the PCL. The largest distance between the PCL and the most inferior point of the enterocoele is measured with a perpendicular line. Depending on this distance, small (<3 cm), moderate (3–6 cm), and large (>6 cm) enterocoeles are distinguished,
- **Dyssynergic defecation:** different structural imaging findings can be seen on dynamic pelvic MRI, including prominent impression of the puborectal sling, narrow anal canal, prolonged evacuation, a lack of descent of the pelvic floor and thus a failure to increase the ARA.

In comparison with clinical examination (POP-Q), dynamic MRI has no additional value in the prediction of symptoms with increasing degree of POP.<sup>104</sup>

#### 5.2.3.4: Perianal abscesses and fistulas

## 5.3: Defecating Proctography

Evaluates in real time the morphology of rectum and anal canal in correlation with pelvic bony components both statically and dynamically by injection of a thick barium paste into the rectum and its subsequent evacuation.<sup>105</sup> Contrast administration into the bladder and vagina provides a more comprehensive assessment of the pelvic organs and has been labelled “**dynamic cystoproctography**”.<sup>104</sup>

At rest, the anal canal is closed and rectum assumes its normal upright configuration. The position of the pelvic floor is inferred by reference to the PCL (inferior margin of pubic symphysis to the sacro-coccygeal junction) (Fig. 10a). Perineal descent is measured from to this line to the ARJ, and may be up to 1.8 cm at rest. Some pelvic floor descent during evacuation is considered normal, and a descent of up to 3 cm from the rest position to anal canal opening is acceptable. The ARA is defined as the angle between the anal canal axis and the posterior rectal wall, and on average is around 90° (Fig. 10b). The puborectalis length (PRL) can be estimated by measuring the distance between the ARA and symphysis pubis.

A normal emptying phase at the proctogram is described by five elements:

- Increase in the ARA by around 20–30 degrees,
- Obliteration of the puborectalis impression and the PRL should increase by around 3–4 cm,
- Wide opening of the anal canal within a couple of seconds,
- Evacuation of rectal contents proceeding promptly and to completion,
- Lack of significant pelvic floor descent.

After evacuation is complete, the anal canal should close, the ARA recover and the pelvic floor return to its normal baseline position. Post toilet imaging may be required, particularly in those suspected of retained barium within rectoceles (Fig. 10c).

### 5.3.1: Clinical applications of defecating proctography

Assuming that posterior wall prolapse and rectocele can be considered the same anatomic entity, clinical examination is not accurate in diagnosing anatomical defects of posterior vaginal wall and enterocoeles compared to defecography as reference standard. Clinical examination overestimates the presence of the posterior wall defects (large false positive rates) but misses enterocoele in patients with primary POP (large false negative rates).<sup>106,107</sup> The major function of proctography is not merely to document evacuatory abnormalities, but also to classify those abnormalities into those potentially surgically relevant, those likely to benefit from behavioral biofeedback therapy alone, or indeed those which are incidental.<sup>108</sup>

#### 5.3.1.1: Pelvic floor descent

Pelvic floor descent, defined as the distance moved by the ARJ or ARA at rest to the point of anal canal opening, is considered abnormal if it exceeds 3 cm.<sup>105</sup>

#### 5.3.1.2: Intussusception and prolapse

Intussusception refers to infolding of the rectal wall into the rectal lumen. It may be described as intra-rectal, intra-anal or external to form a complete rectal prolapse.

#### 5.3.1.3: Rectocele

Rectocele diagnosis on evacuation proctography is defined as any anterior rectal bulge (Fig. 10c). The depth of a rectocele is measured from the anterior border of the anal canal to the anterior border of the rectocele. A distance of <2 cm is classified as small, 2–4 cm as moderate and >4 cm as large. Of more relevance however is barium trapping at the end of evacuation (defined as retention of >10% of the area, and this itself is related the size of the rectocele).

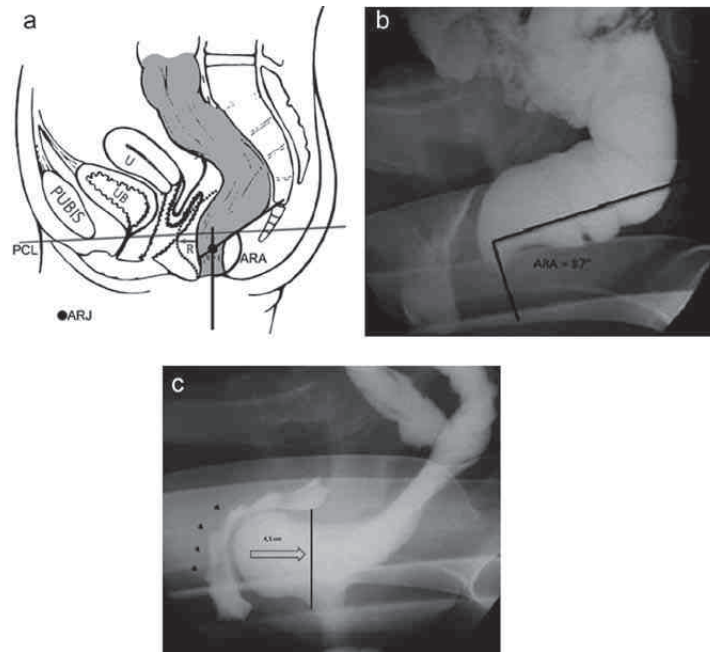


Fig. 10. Defecating proctography. (a) Schematic drawing; (b) Measurement of the anorectal angle at rest (ARA); (c) Image during Valsalva maneuver, showing the displacement of the anterior rectal wall (rectocele) with posterior vaginal wall prolapse (black arrows). PCL, pubococcygeal line; UB, urinary bladder; U, uterus; ARJ, anorectal junction; R, rectocele.

#### 5.3.1.4: Enterocoele

An enterocoele is diagnosed when small bowel loops enter the peritoneal space between the rectum and vagina. Diagnosis of an enterocoele on proctography is only really possible if oral contrast has been administered before the examination.<sup>105</sup> Herniation of the sigmoid into the rectogenital space (sigmoidocoele) is significantly less common than an enterocoele.

#### 5.3.1.5: Dyssynergic defecation

Various proctographic abnormalities have been described including prominent puborectal impression, a narrow anal canal, and acute anorectal angulation. However these observations may be found in normal controls and are in themselves unreliable distinguishing features.

### 5.4: Contrast Enema

Contrast enema is used to identify colon pathology (benign and malignant lesions, diverticular disease, inflammatory conditions, congenital anomalies, intrinsic and extrinsic abnormalities).

#### 5.4.1: Single-contrast barium enema

Using an appropriate catheter, a barium-water mixture or a water-soluble solution of diatrizoate sodium (Gastrografin) is inserted into the colon with the patient in the prone position until the column of barium reaches the splenic flexure.

#### 5.4.2: Double-contrast or air-contrast barium enema

This procedure has become the routine study for evaluation of the bowel.<sup>108</sup> With the double-contrast examination, the colon is coated with a thin layer of contrast material and the bowel is distended with air so that the entire mucosal circumference is visualized.

### 5.5: Colonic Transit Studies (Radio-Opaque Oral Markers, Pill Transit, Nuclear Medicine Scintigraphy)

Slow transit constipation can be distinguished by colonic transit studies.<sup>109,110</sup>

#### 5.5.1: Radiological transit (shapes) study

Segmental and total colonic transit time is assessed with the use of radio-opaque markers and sequential abdominal X-rays. There are different protocols. Most frequently used, utilizes a capsule containing 24 markers of  $1 \times 4.5$  mm. Patient takes one capsule on day 0 by mouth and X-ray is performed on day 5 (Fig. 11). Patients who expel at least 80% markers on day 5 have normal colonic transit. Patients who retain 6 or more markers may have follow-up abdominal X-rays within several days. If remaining markers are scattered about the colon, the condition is slow transit or colonic inertia. If the remaining markers are accumulated in the rectum or rectosigmoid, this suggests functional outlet obstruction.



Fig. 11. Radiologic transit study. On day 5, the remaining markers are more than 80%, suggesting functional outlet obstruction.

#### 5.5.2: Nuclear transit study

Colon scintigraphy is performed at 6, 24, and 48 hr in ventral and dorsal projection after oral administration of methacrylate-coated capsule of non-resorbable <sup>111</sup>Indium-labeled polystyrene (<sup>111</sup>In-DTPA) micropellets.<sup>109</sup> The geometric center, as the sum of products of colon segment activity and colon segment number (1 = ascending colon, 2 = transverse colon, 3 = descending colon, 4 = rectosigmoid, and 5 = evacuated feces) dividing by the total counts is used to determine the velocity of colonic transit. Meals normally reach the cecum at 6 hr and are evacuated in 30 to 58 hr. Retention of radioactivity in the proximal colon at 48 hr, indicates slow colonic transit while retention in the rectum indicates anorectal dysfunction. Table III shows utility of various imaging modalities for female anorectal dysfunction.

### 6: DIAGNOSIS

#### 6: **DIAGNOSIS** (most common) [defined as prevalence >10%]

Diagnosis is based on symptoms, signs, examination, and any relevant diagnostic investigations

##### 6.1: Local (Fissures, Hemorrhoids)

Fissure: Is a break in the lining of the anal canal

Hemorrhoids: Abnormality of the normal cushion of specialized, highly vascular tissue in the anal canal in the submucosal space.

##### 6.2: Fecal Incontinence

Fecal incontinence: involuntary loss of solid or liquid stool and could be due to:

**6.2.1:** Anal sphincter disruption is due to discontinuity of the external anal sphincter, internal anal sphincter or both.

**6.2.2:** Hypocontractile/acontractile sphincter is due to neuropathy or atrophy.

**6.2.3:** Combined anal sphincter disruption and hypocontractile/acontractile sphincter.

**6.2.4:** Rectal overactivity due to exaggerated smooth muscle contraction of the rectum could also be associated with hypersensitivity.<sup>110,111</sup>

**6.2.5:** Overflow incontinence seepage of stool due to fecal impaction.

##### 6.3 Obstructed Defecation Syndrome

Obstructed defecation: incomplete evacuation of fecal contents from rectum due to physical blockage of the fecal stream during defecation attempts. It includes symptoms such as straining to defecate, sensation of blockage, digitation, and splinting. Constipation due to slow transit, irritable bowel syndrome, Hirschsprung's disease, megarectum, anismus are not within the remit of this standardization document. Associated features of obstructed defecation are:

**6.3.1: Rectocele:** Bulge in posterior vaginal wall associated with herniation of anterior wall of the rectum (See <sup>FN16</sup>).

**6.3.2: Enterocele/sigmoidocele:** Bulge of upper wall of vagina associated with herniation of peritoneal sac and small bowel (enterocele) or sigmoid colon (sigmoidocele).

**6.3.3: Intussusception:** Full thickness invagination of the upper rectum without extrusion through the anus leading to interruption of flow of the fecal stream.

<sup>FN16</sup> A transverse defect rectocele occurs simply by a detachment of the perineal body from the rectovaginal fascia. The hammock of rectovaginal fascia supporting the rectum remains intact but separates from the perineal body. A midline vertical defect is created by a midline separation of the rectovaginal fascia, and a separation of the rectovaginal fascia can occur from its lateral attachments. Rectoceles are more commonly situated in the mid to distal aspect of the posterior vaginal wall.

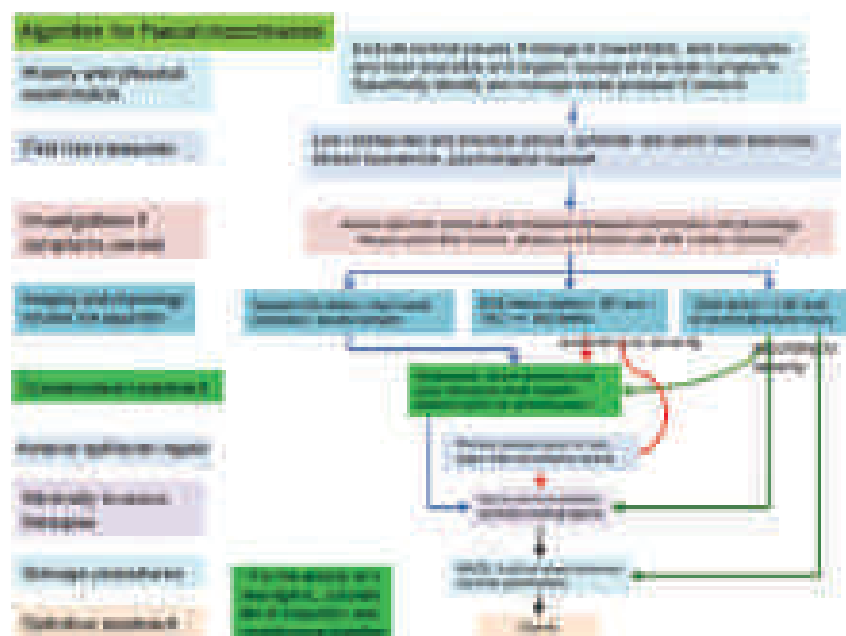


Fig. 12. (adapted from ref. [125]). Algorithm: fecal incontinence. IAS, internal anal sphincter; EAS, external anal sphincter; SNM, sacral neuromodulation; MACE, malone antegrade continence enema.

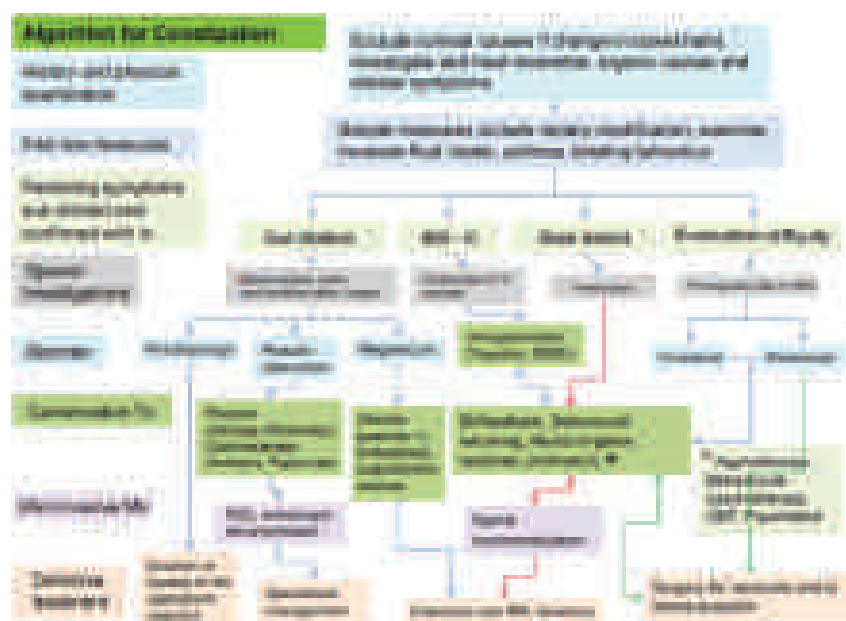


Fig. 13. (adapted from ref. [125]). Algorithm: constipation. IBS-C, irritable bowel constipation predominant; IRA, ileorectal anastomosis; J, hypnotherapy; behavioural psychotherapy; CBT, psychiatrist management; CBT, cognitive behavioural therapy; Ix, investigations; Mx, management; Tx, treatment.

**6.3.4: Internal mucosal prolapse:** Mucosal prolapse of the anterior, posterior, or circumferential mucosal layer.

**6.3.5: External rectal prolapse:** Full thickness rectal prolapse outside the anal canal

#### 6.4: Sepsis

##### 6.4.1: Abscess

Infection in a (non Crohn's) anal gland, located at the base of the dentate line, that initially forms an abscess, which can be located in one of the potential spaces surrounding the anus and rectum.

##### 6.4.2: Ano-rectal/vaginal/perineal fistula

Rectovaginal fistula is a communication from the rectum to the vagina and rarely the perineal area. An anovaginal/perineal fistula is an abnormal communication from the anal canal to the vagina or perineal area.

#### 6.5: Pain Syndromes

##### 6.5.1: Levator ani syndrome

Episodic rectal pain caused by spasm of the levator ani muscle. Proctalgia fugax (fleeting pain in the rectum) and coccydynia (pain in the coccygeal region) are variants of levator ani syndrome (See <sup>FN17</sup>).

##### 6.5.2: Proctalgia fugax

Definition: Proctalgia fugax (or Levator syndrome) is a severe, episodic, rectal and sacrococcygeal pain.<sup>112</sup> It can be caused by cramp of the pubococcygeus or levator ani muscles (See <sup>FN18</sup>).

##### 6.5.3: Pudendal neuralgia

Pudendal Neuralgia (PN) is a painful condition that is caused by inflammation of the pudendal nerve involving its dermatome.<sup>115</sup> It can affect both men and women (See <sup>FN19</sup>).

<sup>FN17</sup> Symptoms of levator ani syndrome are painful rectal spasm, typically unrelated to defecation, usually lasting >20 min. The pain may be brief and intense or a vague ache high in the rectum. It may occur spontaneously or with sitting and can waken the patient from sleep and occurs more often on the left. The pain may feel as if it would be relieved by the passage of gas or a bowel movement. In severe cases, the pain can persist for many hours and recur frequently. During clinical evaluation: a dull ache to the left 5 cm above the anus or higher in the rectum and a feeling of constant rectal pressure or burning. Physical examination can exclude other painful rectal conditions (e.g., thrombosed hemorrhoids, fissures, abscesses, scarring from previous surgery). Physical examination is often normal, although tenderness or tightness of the levator muscle, usually on the left, may be present. Occasionally the cause can be low back disorders. Coccydynia (coccygodynia) is complaint of pain and point tenderness of the coccyx (this is NOT anorectal pain).

<sup>FN18</sup> Proctalgia fugax most often occurs in the middle of the night and lasts for seconds to 20 min. During an episode, which sometimes occurs after orgasm, the patient feels spasm-like, sometimes excruciating pain in the anus, often misinterpreted as a need to defecate. Because of the high incidence of internal anal sphincter thickening with the disorder, it is thought to be a disorder of the internal sphincter or that it is a neuralgia of pudendal nerves. It tends to occur infrequently (once a month or less). Like all ordinary muscle cramps, it is a severe, deep rooted pain. Defecation can worsen the spasm, but may relieve it,<sup>113</sup> or provide a measure of comfort. The pain might subside by itself as the spasm disappears on its own, or may persist or recur during the same night. Patients with proctalgia fugax are usually asymptomatic during the anorectal examination, leaving no signs or findings to support the condition, which is based on symptoms by history taking, diagnostic criteria, described above, and the exclusion of underlying organic disease (anorectal or endopelvic) with proctalgia.<sup>114</sup>

<sup>FN19</sup> The condition is also known as pudendal neuropathy, pudendal nerve entrapment, cyclist's syndrome, pudendal canal syndrome, or Alcock's syndrome. The Nantes criteria<sup>13</sup> includes:

1. Pain in the anatomical region of pudendal nerve innervation.
2. Pain that is worse with sitting.
3. No waking at night with pain.
4. No sensory deficit on examination.
5. Relief of symptoms with a pudendal block.

Primary symptoms of PN include:

- a) Pelvic pain with sitting that may be less intense in the morning and increase throughout the day. Symptoms may decrease when standing or lying down. The pain can be perineal, rectal or in the clitoral/penile area; it can be unilateral or bilateral.
- b) Sexual dysfunction. In women, dysfunction manifests as pain or decreased sensation in the genitals, perineum or rectum. Pain may occur with or without touch. It may be difficult or impossible for the woman to achieve orgasm.
- c) Difficulty with urination/defecation. Patients may experience urinary hesitancy, urgency and/or frequency. Post-void discomfort is not uncommon. Patients may feel that they have to "strain" to have a bowel movement and the movement may be painful and/or result in pelvic pain after. Constipation is also common among patients with PN. In severe cases, complete or partial urinary and/or fecal incontinence may result.
- d) Sensation of a foreign object being within the body. Some patients will feel as though there is a foreign object sitting inside the vagina or the rectum.

It is important to note PN is largely a "rule out" condition. In other words, because its symptoms can be indicative of another problem, extensive testing by physical examination, assessment by touch, pinprick, bimanual pelvic palpation with attention to the pelvic floor muscles, in particular the levator and obturator muscles, tenderness of the bladder and sacrospinous ligaments are required to ensure that symptoms are not related to another condition. Maximum tenderness, or a trigger point can be produced by applying pressure to the ischial spine. Palpation of this area can reproduce pain and symptoms as a positive Tinel's sign.<sup>115</sup>

As PN is a diagnosis of exclusion, other conditions that should be excluded include coccygodynia, piriformis syndrome, interstitial cystitis, vulvodynia, vestibulitis, chronic pelvic pain syndrome, proctalgia, anorectal neuralgia, pelvic contracture syndrome/pelvic congestion, proctalgia fugax, or levator ani syndrome.

In addition to eliminating other diagnoses, it is important to determine if the PN is caused by a true entrapment or other compression/tension dysfunctions. In almost all cases, pelvic floor dysfunction accompanies PN. Electrodiagnostic studies will help the practitioner determine if the symptoms are caused by a true nerve entrapment or by muscular problems and neural irritation.

**First degree:** laceration of the vaginal epithelium or perineal skin only.

**Second degree:** involvement of the perineal muscles but not the anal sphincter.

**Third degree:** disruption of the anal sphincter muscles that should be further subdivided into:

3a: <50% thickness of external sphincter torn.

3b: >50% thickness of external sphincter torn.

3c: internal sphincter also torn.

**Fourth degree:** a third degree tear with disruption of the anal epithelium as well.

**Button hole tear of rectum:** isolated tear of rectum without involvement of the anal sphincter

Fig. 14. Classification of perineal trauma.<sup>119</sup>



Fig. 15. Classification of 3rd and 4th degree tears (with permission from Springer<sup>116</sup>).

#### 6.6: Obstetric Anal Sphincter Injuries (OASIS)

OASIS are reported to occur in 0.5–14% of vaginal deliveries (2.9–19% of primiparous vaginal deliveries).<sup>116</sup> It has previously been shown in a prospective study that about one third of OASIS can be diagnosed 8 weeks after delivery by endoanal ultrasound alone. As these were not identified clinically, the injuries were believed to be “occult.”<sup>2</sup> However, it has subsequently been proven that such injuries are not necessarily occult but in fact undiagnosed due to lack of expertise of midwives and doctors.<sup>3</sup>

Training in diagnosis and management of perineal trauma has been shown to be suboptimal<sup>117</sup> and dedicated hands-on courses have shown significant improvements in diagnosis and classification of OASIS.<sup>118</sup> Sultan therefore proposed a more descriptive classification of OASIS (Figs. 12 and 13)<sup>119</sup> that has now been accepted internationally to support consistency in reporting.<sup>120–122</sup> To avoid underestimation of the injury, if there is uncertainty regarding the full extent of the injury it should be classified as the greater degree, for example, if one is unsure as to whether an injury is a Grade 3a or 3b it should be classified as 3b (Figs. 14 and 15). This classification also has clinical relevance as it ensures increased vigilance for internal sphincter injuries that are best repaired soon after delivery<sup>123</sup> as persistent internal sphincter defects are associated with fecal incontinence.<sup>124</sup> Examination techniques to improve detection of these injuries and avoiding pitfalls in diagnosis have been described in detail.<sup>116</sup>

#### ACKNOWLEDGMENTS

We gratefully acknowledge contributions from Dr Helen Frawley, Beth Shelley following ICS (V29 Jan 2015) IUGA website presentation of Version 30 (Aug15, Dr Alexis Schizas and Kari Bo at ICS Montreal (V33 8Oct15).

#### REFERENCES

1. Snooks SJ, Setchell M, Swash M, et al. Injury to innervation of pelvic floor sphincter musculature in childbirth. *Lancet* 1984;2:546–50.
2. Sultan AH, Kamm MA, Hudson CN, et al. Anal-sphincter disruption during vaginal delivery. *N Engl J Med* 1993;329:1905–11.
3. Andrews V, Sultan AH, Thakar R, et al. Occult anal sphincter injuries—Myth or reality? *BJOG* 2006;113:195–200.
4. Dal Corso HM, D’Elia A, De Nardi P, et al. Anal endosonography: A survey of equipment, technique and diagnostic criteria adopted in nine Italian centers. *Tech Coloproctol* 2007;11:26–33.
5. Kapoor DS, Sultan AH, Thakar R, et al. Management of complex pelvic floor disorders in a multidisciplinary pelvic floor clinic. *Colorectal Dis* 2008;10:118–23.

## Terminology for Female Anorectal Dysfunction 23

6. Milsom I, Altman D, Lapitan MC, et al. Epidemiology of urinary (UI) and faecal (FI) incontinence and pelvic organ prolapse (POP). In: Abrams P, Cardozo L, Khoury S, Wein A, editors. 4th International Consultation on Incontinence. Paris: Health Publication Ltd; 2009. Chapter 1, 35–111.
7. Haylen BT, de Ridder D, Freeman RM, et al. An international urogynecological association (IUGA)/international continence society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J* 2010;21:5–26.
8. Rosier PF, de Ridder D, Meijlink J, et al. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn* 2012;31:621–4.
9. Stedman's medical dictionary 28th Edition Baltimore, Maryland USA: Lippincott and Wilkins 2006. p1884.
10. Abrams P, Blaivas JG, Stanton SL, et al. The standardisation of terminology of lower urinary tract function. The International Continence Society Committee on Standardisation of Terminology. *Scand J Urol Nephrol Suppl* 1988;114:5–19.
11. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: Report from the standardisation sub-committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
12. Miles AJ, Allen-Mersh TG, Wastell C. Effect of anoreceptive intercourse on anorectal function. *J R Soc Med* 1993;86:144–7.
13. Labat JJ, Riant T, Robert R, et al. Diagnostic criteria for pudendal neuralgia by pudendal nerve entrapment (Nantes criteria). *Neurourol Urodyn* 2008;27:306–10.
14. Brody S, Weiss P. Heterosexual anal intercourse: Increasing prevalence, and association with sexual dysfunction, bisexual behavior, and venereal disease history. *J Sex Marital Ther* 2011;37:298–306.
15. Weiss P, Brody S. Female sexual arousal disorder with and without a distress criterion: Prevalence and correlates in a representative Czech sample. *J Sex Med* 2009;6:3385–94.
16. Costa RM, Brody S. Immature defense mechanisms are associated with lesser vaginal orgasm consistency and greater alcohol consumption before sex. *J Sex Med* 2010;7:775–86.
17. Hensel DJ, Fortenberry JD, Orr DP. Factors associated with event level anal sex and condom use during anal sex among adolescent women. *J Adolesc Health* 2010;46:232–7.
18. Costa RM, Brody S. Anxious and avoidant attachment, vibrator use, anal sex, and impaired vaginal orgasm. *J Sex Med* 2011;8:2493–500.
19. Brody S, Costa RM. Satisfaction (sexual, life, relationship, and mental health) is associated directly with penile-vaginal intercourse, but inversely with other sexual behavior frequencies. *J Sex Med* 2009;6:1947–54.
20. Bruck CE, Lubowski DZ, King DW. Do patients with haemorrhoids have pelvic floor denervation? *Int J Colorectal Dis* 1988;3:210–4.
21. Lin YH, Stocker J, Liu KW, et al. The impact of hemorrhoidectomy on sexual function in women: A preliminary study. *Int J Impot Res* 2009;21:343–7.
22. Toozs-Hobson P, Freeman R, Barber M, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol J* 2012;23:527–35.
23. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: Report from the Pelvic Floor Clinical Assessment Group of the International Continence Society. *Neurourol Urodyn* 2005;24:374–80.
24. Laycock J. Clinical evaluation of pelvic floor. In: Schussler B, Laycock J, Norton P, Stanton S, editors. *Pelvic floor re-education*. London: Springer-Verlag; 1994. 42–48.
25. Bo K, Finckenhagen HB. Vaginal palpation of pelvic floor muscle strength: Inter-test reproducibility and comparison between palpation and vaginal squeeze pressure. *Acta Obstet Gynecol Scand* 2001;80:883–7.
26. Morin M, Dumoulin C, Bourbonnais D, et al. Pelvic floor maximal strength using vaginal digital assessment compared to dynamometric measurements. *Neurourol Urodyn* 2004;23:336–41.
27. Isherwood PJ, Kane A. Comparative assessment of pelvic floor strength using a perineometer and digital examination. *BJOG* 2000;107:1007–11.
28. Jayaseelan S, Haslam J, Winstanley J, et al. Digital vaginal assessment: An inter-tester reliability study. *Physiotherapy* 2001;87:243–50.
29. Mumenthaler M, Appenzeller O. Neurologic differential diagnosis. 2nd edition. New York: Thieme; 1992. 122.
30. Montenegro ML, Mateus-Vasconcelos EC, Rosa e Silva JC, et al. Importance of pelvic muscle tenderness evaluation in women with chronic pelvic pain. *Pain Med* 2010;11:224–8.
31. Kotarinos RK. CP/CPPS pelvic floor dysfunction, evaluation and treatment. In: Potts Jeannette M, editor. *Genitourinary pain and inflammation: Diagnosis and management*. Humana Press; 2008. Chapter 20, 303–314.
32. Heaton KW, Radvan J, Cripps H, et al. Defecation frequency and timing, and stool form in the general population: A prospective study. *Gut* 1992;33:818–24.
33. Lewis SJ, Heaton KW. Stool form scale as a useful guide to intestinal transit time. *Scand J Gastroenterol* 1997;32:920–4.
34. Manning AP, Wyman JB, Heaton KW. How trustworthy are bowel histories? Comparison of recalled and recorded information. *Br Med J* 1976;2:213–4.
35. Bharucha AE, Seide BM, Zinsmeister AR, et al. Insights into normal and disordered bowel habits from bowel diaries. *Am J Gastroenterol* 2008;103:692–8.
36. Ashraf W, Park F, Lof J, et al. An examination of the reliability of reported stool frequency in the diagnosis of idiopathic constipation. *Am J Gastroenterol* 1996;91:26–32.
37. Kelleher C, Staskin D, Cherian P, et al. Patient-reported outcome assessment. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *ICUD-EAU 5th International Consultation on Incontinence*. Paris: ICUD-EAU; 2013. Chapter 5B, 389–427.
38. Jorge JM, Wexner SD. Etiology and management of fecal incontinence. *Dis Colon Rectum* 1993;36:77–97.
39. Vaizey CJ, Carapeti E, Cahill JA, et al. Prospective comparison of faecal incontinence grading systems. *Gut* 1999;44:77–80.
40. Maeda Y, Pares D, Norton C, et al. Does the St. Mark's incontinence score reflect patients' perceptions? A review of 390 patients. *Dis Colon Rectum* 2008;51:436–42.
41. Rockwood TH, Church JM, Fleshman JW, et al. Fecal incontinence quality of life scale: Quality of life instrument for patients with fecal incontinence. *Dis Colon Rectum* 2000;43:9–16.
42. Rockwood TH, Church JM, Fleshman JW, et al. Patient and surgeon ranking of the severity of symptoms associated with fecal incontinence: The fecal incontinence severity index. *Dis Colon Rectum* 1999;42:1525–32.
43. Cotterill N, Norton C, Avery KN, et al. Psychometric evaluation of a new patient-completed questionnaire for evaluating anal incontinence symptoms and impact on quality of life: The ICIQ-B. *Dis Colon Rectum* 2011;54:1235–50.
44. Cotterill N, Norton C, Avery KN, et al. A patient-centered approach to developing a comprehensive symptom and quality of life assessment of anal incontinence. *Dis Colon Rectum* 2008;51:82–7.
45. Marquis P, De La Loge C, Dubois D, et al. Development and validation of the patient assessment of constipation quality of life questionnaire. *Scand J Gastroenterol* 2005;40:540–51.
46. Frank L, Kleinman L, Farup C, et al. Psychometric validation of a constipation symptom assessment questionnaire. *Scand J Gastroenterol* 1999;34:870–7.
47. Frank L, Flynn J, Rothman M. Use of a self-report constipation questionnaire with older adults in long-term care. *Gerontol* 2001;41:778–86.
48. Slappendel R, Simpson K, Dubois D, et al. Validation of the PAC-SYM questionnaire for opioid-induced constipation in patients with chronic low back pain. *Eur J Pain* 2006;10:209–17.
49. Agachan F, Chen T, Pfeifer J, et al. A constipation scoring system to simplify evaluation and management of constipated patients. *Dis Colon Rectum* 1996;39:681–5.
50. Altomare DF, Spazzafumo L, Rinaldi M, et al. Set-up and statistical validation of a new scoring system for obstructed defaecation syndrome. *Colorectal Dis* 2008;10:84–8.
51. Diamant NE, Kamm MA, Wald A, et al. AGA technical review on anorectal testing techniques. *Gastroenterology* 1999;116:735–60.
52. Rao SS, Azpiroz F, Diamant N, et al. Minimum standards of anorectal manometry. *Neurogastroenterol Motil* 2002;14:553–9.
53. Gundling F, Seidl H, Scalerico N, et al. Influence of gender and age on anorectal function: Normal values from anorectal manometry in a large caucasian population. *Digestion* 2010;81:207–13.
54. Rao SS, Hatfield R, Soffer E, et al. Manometric tests of anorectal function in healthy adults. *Am J Gastroenterol* 1999;94:773–83.
55. Read NW, Harford WV, Schmulen AC, et al. A clinical study of patients with fecal incontinence and diarrhea. *Gastroenterology* 1979;76:747–56.
56. Caruana BJ, Wald A, Hinds JP, et al. Anorectal sensory and motor function in neurogenic fecal incontinence. Comparison between multiple sclerosis and diabetes mellitus. *Gastroenterology* 1991;100:465–70.
57. Orkin BA, Hanson RB, Kelly KA, et al. Human anal motility while fasting, after feeding, and during sleep. *Gastroenterology* 1991;100:1016–23.
58. McHugh SM, Diamant NE. Effect of age, gender, and parity on anal canal pressures. Contribution of impaired anal sphincter function to fecal incontinence. *Dig Dis Sci* 1987;32:726–36.
59. Rao SS, Singh S. Clinical utility of colonic and anorectal manometry in chronic constipation. *J Clin Gastroenterol* 2010;44:597–609.

*Neurourology and Urodynamics* DOI 10.1002/nau



## 24 Sultan et al.

60. Schizas AM, Emmanuel AV, Williams AB. Vector volume manometry—Methods and normal values. *Neurogastroenterol Motil* 2011;23:886–e393.
61. Schizas AM, Emmanuel AV, Williams AB. Anal canal vector volume manometry. *Diseases of the colon and rectum*. 2011;54:759–68.
62. Jones MP, Post J, Crowell MD. High-resolution manometry in the evaluation of anorectal disorders: A simultaneous comparison with water-perfused manometry. *Am J Gastroenterol* 2007;102:850–5.
63. Kumar D, Waldron D, Williams NS, et al. Prolonged anorectal manometry and external anal sphincter electromyography in ambulant human subjects. *Dig Dis Sci* 1990;35:641–8.
64. Ferrara A, Pemberton JH, Grotz RL, et al. Prolonged ambulatory recording of anorectal motility in patients with slow-transit constipation. *Am J Surg* 1994;167:73–9.
65. Ferrara A, Pemberton JH, Levin KE, et al. Relationship between anal canal tone and rectal motor activity. *Dis Colon Rectum* 1993;36:337–42.
66. Chiarioni G, Scattolini C, Bonfante F, et al. Liquid stool incontinence with severe urgency: Anorectal function and effective biofeedback treatment. *Gut* 1993;34:1576–80.
67. Wald A, Tunuguntla AK. Anorectal sensorimotor dysfunction in fecal incontinence and diabetes mellitus. Modification with biofeedback therapy. *N Eng J Med* 1984;310:1282–7.
68. Merkel IS, Locher J, Burgio K, et al. Physiologic and psychologic characteristics of an elderly population with chronic constipation. *Am J Gastroenterol* 1993;88:1854–9.
69. Kamm MA, Lennard-Jones JE. Rectal mucosal electrosensory testing—Evidence for a rectal sensory neuropathy in idiopathic constipation. *Dis Colon Rectum* 1990;33:419–23.
70. Andersen IS, Michelsen HB, Krogh K, et al. Impedance planimetric description of normal rectoanal motility in humans. *Dis Colon Rectum* 2007;50:1840–8.
71. Wiesner A, Jost WH. EMG of the external anal sphincter: Needle is superior to surface electrode. *Dis Colon Rectum* 2000;43:116–7.
72. Kiff ES, Swash M. Slowed conduction in the pudendal nerves in idiopathic (neurogenic) faecal incontinence. *Br J Surg* 1984;71:614–6.
73. Bliss DZ, Mellgren A, Whitehead WE, et al. Assessment and conservative management of faecal incontinence and quality of life in adults. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *ICUD-EAU 5th International Consultation on Incontinence*. Paris: ICUD-EAU; 2013. Chapter 16, 1443–1486.
74. Stoker J, Bartram CI, Halligan S. Imaging of the posterior pelvic floor. *Eur Radiol* 2002;12:779–88.
75. Tubaro A, Vodusek DB, Amarengo G, et al. Imaging, neurophysiological testing and other tests. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *ICUD-EAU 5th International Consultation on Incontinence*. Paris: ICUD-EAU; 2013. Chapter 7, 507–622.
76. Santoro GA, Wiecek AP, Dietz HP, et al. State of the art: An integrated approach to pelvic floor ultrasonography. *Ultrasound Obstet Gynecol* 2011;37:381–96.
77. Frudinger A, Halligan S, Bartram CI, et al. Female anal sphincter: Age-related differences in asymptomatic volunteers with high-frequency endoanal US. *Radiology* 2002;224:417–23.
78. Sultan AH, Kamm MA, Talbot IC, et al. Anal endosonography for identifying external sphincter defects confirmed histologically. *Br J Surg* 1994;81:463–5.
79. Williams AB, Bartram CI, Halligan S, et al. Anal sphincter damage after vaginal delivery using three-dimensional endosonography. *Obstet Gynecol* 2001;97:770–5.
80. Williams AB, Cheetham MJ, Bartram CI, et al. Gender differences in the longitudinal pressure profile of the anal canal related to anatomical structure as demonstrated on three-dimensional anal endosonography. *Br J Surg* 2000;87:1674–9.
81. Santoro GA, Fortling B. The advantages of volume rendering in three-dimensional endosonography of the anorectum. *Dis Colon Rectum* 2007;50:359–68.
82. Dietz HP. Ultrasound imaging of the pelvic floor. Part I: two-dimensional aspects. *Ultrasound Obstet Gynecol* 2004;23:80–92.
83. Braekken IH, Majida M, Ellstrom-Eng M, et al. Test-retest and intra-observer repeatability of two-, three- and four-dimensional perineal ultrasound of pelvic floor muscle anatomy and function. *Int Urogynecol J Pelvic Floor Dysfunct* 2008;19:227–35.
84. Dietz HP. Ultrasound imaging of the pelvic floor. Part II: Three-dimensional or volume imaging. *Ultrasound Obstet Gynecol* 2004;23:615–25.
85. Santoro GA, Wiecek AP, Stankiewicz A, et al. High-resolution three-dimensional endovaginal ultrasonography in the assessment of pelvic floor anatomy: A preliminary study. *Int Urogynecol J* 2009;20:1213–22.
86. Santoro GA, Wiecek AP, Shobeiri SA, et al. Interobserver and interdisciplinary reproducibility of 3D endovaginal ultrasound assessment of pelvic floor anatomy. *Int Urogynecol J Pelvic Floor Dysfunct* 2011;22:53–9.
87. Wagenlehner FME, Del Amo E, Santoro GA, et al. Live anatomy of the perineal body in patients with 3rd degree rectocele. *Colorectal Dis* 2013;15:1416–22.
88. Dobben AC, Terra MP, Deutekom M, et al. Anal inspection and digital rectal examination compared to anorectal physiology tests and endoanal ultrasonography in evaluating fecal incontinence. *Int J Colorectal Dis* 2007;22:783–90.
89. Tubaro A, Vodusek DB, Amarengo G, et al. Imaging, neurophysiological testing and other tests. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *ICUD-EAU 5th International Consultation on Incontinence*. Paris: ICUD-EAU; 2013. Chapter 7, 507–622.
90. Sultan AH, Kamm MA, Nicholls RJ, et al. Prospective study of the extent of internal anal sphincter division during lateral sphincterotomy. *Dis Colon Rectum* 1994;37:1031–3.
91. Richter HE, Fielding JR, Bradley CS, et al. Endoanal ultrasound findings and fecal incontinence symptoms in women with and without recognized anal sphincter tears. *Obstet Gynecol* 2006;108:1394–401.
92. Starck M, Bohe M, Fortling B, et al. Endosonography of the anal sphincter in women of different ages and parity. *Ultrasound Obstet Gynecol* 2005;25:169–76.
93. Norderval S, Marksrog A, Rossaak K, et al. Correlation between anal sphincter defects and anal incontinence following obstetric sphincter tears: Assessment using scoring systems for sonographic classification of defects. *Ultrasound Obstet Gynecol* 2008;31:78–84.
94. Dietz HP, Moegni F, Shek KL. Diagnosis of levator avulsion injury: A comparison of three methods. *Ultrasound Obstet Gynecol* 2012;40:693–8.
95. Dietz HP, Steensma AB. Posterior compartment prolapse on two-dimensional and three-dimensional pelvic floor ultrasound: The distinction between true rectocele, perineal hypermobility and enterocele. *Ultrasound Obstet Gynecol* 2005;26:73–7.
96. Stoker J. Anorectal and pelvic floor anatomy. *Best Pract Res Clin Gastroenterol* 2009;23:463–75.
97. Tan E, Anstee A, Koh DM, et al. Diagnostic precision of endoanal MRI in the detection of anal sphincter pathology: A meta-analysis. *Int J Colorectal Dis* 2008;23:641–51.
98. Mortele KJ, Fairhurst J. Dynamic MR defecography of the posterior compartment: Indications, techniques and MRI features. *Eur J Radiol* 2007;61:462–72.
99. Lakeman MM, Zijta FM, Peringa J, et al. Dynamic magnetic resonance imaging to quantify pelvic organ prolapse: Reliability of assessment and correlation with clinical findings and pelvic floor symptoms. *Int Urogynecol J* 2012;23:1547–54.
100. Bolog N, Weishaupt D. Dynamic MR imaging of outlet obstruction. *Rom J Gastroenterol* 2005;14:293–302.
101. Dobben AC, Terra MP, Slors JF, et al. External anal sphincter defects in patients with fecal incontinence: Comparison of endoanal MR imaging and endoanal US. *Radiology* 2007;242:463–71.
102. Terra MP, Beets-Tan RG, van Der Hulst VP, et al. Anal sphincter defects in patients with fecal incontinence: Endoanal versus external phased-array MR imaging. *Radiology* 2005;236:886–95.
103. Delancey JO, Sorensen HC, Lewicky-Gaupp C, et al. Comparison of the puborectal muscle on MRI in women with POP and levator ani defects with those with normal support and no defect. *Int Urogynecol J* 2012;23:73–7.
104. Broekhuis SR, Fütterer JJ, Hendriks JC, et al. Symptoms of pelvic floor dysfunction are poorly correlated with findings on clinical examination and dynamic MR imaging of the pelvic floor. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:1169–74.
105. Brennan D, Williams G, Kruskal J. Practical performance of defecography for the evaluation of constipation and incontinence. *Semin Ultrasound CT MR* 2008;29:420–6.
106. Maglinte DD, Hale DS, Sandrasegaran K. Comparison between dynamic cystocolpoproctography and dynamic pelvic floor MRI: Pros and cons: Which is the “functional” examination for anorectal and pelvic floor dysfunction? *Abdom Imaging* 2013;38:952–73.
107. Groenendijk AG, Birnie E, de Blok S, et al. Clinical-decision taking in primary pelvic organ prolapse; the effects of diagnostic tests on treatment selection in comparison with a consensus meeting. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:711–9.
108. Rolland GA, Biscaldi E, DeCicco E. Double contrast barium enema: Technique, indications, results and limitations of a conventional imaging methodology in the MDCT virtual endoscopy era. *Eur J Radiol* 2007;61:382–7.
109. Ghoshal UC, Sengar V, Srivastava D. Colonic transit study technique and interpretation: Can these be uniform globally in different populations with non-uniform colon transit time? *J Neurogastroenterol Motil* 2012;18:227–8.
110. Chan CLH, Lunniss PJ, Wang D, et al. Rectal sensorimotor dysfunction in patients with urge faecal incontinence: Evidence from prolonged manometric studies. *Gut* 2005;54:1263–72.
111. Santoro GA, Eitan BZ, Pryde A, et al. Open study of low-dose amitriptyline in the treatment of patients with idiopathic fecal incontinence. *Dis Colon Rectum* 2000;43:1676–81. discussion 1681–2.

*Neurourology and Urodynamics* DOI 10.1002/nau

112. Whitehead WE, Wald A, Diamant NE, et al. Functional disorders of the anus and rectum. *Gut* 1999;45:II55–9.
113. Hibner M, Desai N, Robertson LJ, et al. Pudendal neuralgia. *J Minim Invasive Gynecol* 2010;17:148–53.
114. Potter MA, Bartolo DC. Proctalgia fugax. *Eur J Gastroenterol Hepatol* 2001;13:1289–90.
115. Robert R, Prat-Pradal D, Labat JJ, et al. Anatomic basis of chronic perineal pain: Role of the pudendal nerve. *Surg Radiol Anat* 1998;20:93–8.
116. Sultan AH, Thakar R, Fenner D. *Perineal and anal sphincter trauma*. London: Springer; 2007.
117. Sultan AH, Kamm MA, Hudson CN. Obstetric perineal tears: An audit of training. *J Obstet Gynaecol* 1995;15:19–23.
118. Andrews V, Thakar R, Sultan AH. Structured hands-on training in repair of obstetric anal sphincter injuries (OASIS): An audit of clinical practice. *Int Urogynecol J Pelvic Floor Dysfunct* 2009;20:193–9.
119. Sultan AH. Editorial: Obstetric perineal injury and anal incontinence. *Clinical Risk* 1999;5:193–6.
120. Norton C, Christiansen J, Butler U, et al. Anal incontinence. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *Incontinence*. 2nd edition: Plymouth: Health Publication Ltd; 2002. 985–1044.
121. Royal College of Obstetricians and Gynaecologists. *The management of third and fourth degree perineal tears*. London: RCOG Press; 2015.
122. Fernando R, Sultan A, Kettle C, et al. Methods of repair for obstetric anal sphincter injury. *Cochrane Syst Rev* 2006;3:CD002866.
123. Sultan AH, Monga AK, Kumar D, et al. Primary repair of obstetric anal sphincter rupture using the overlap technique. *Br J Obstet Gynaecol* 1999;106:318–23.
124. Mahony R, Behan M, Daly L, et al. Internal anal sphincter defect influences continence outcome following obstetric anal sphincter injury. *Am J Obstet Gynecol* 2007;196:217. e1–5.
125. Chatoor D, Soligo M, Emmanuel A. Organising a clinical service for patients with pelvic floor disorders. *Best Pract Res Clin Gastroenterol* 2009;23:611–20.

# International Continence Society Good Urodynamic Practices and Terms 2016: Urodynamics, uroflowmetry, cystometry, and pressure-flow study

Peter F.W.M Rosier<sup>1\*</sup> | Werner Schaefer<sup>2</sup> | Gunnar Lose<sup>3</sup> |  
Howard B. Goldman<sup>4</sup> | Michael Guralnick<sup>5</sup> | Sharon Eustice<sup>6</sup> |  
Tamara Dickinson<sup>7</sup> | Hashim Hashim<sup>8</sup>

<sup>1</sup> Department of Urology, University Medical Center Utrecht, Utrecht, The Netherlands

<sup>2</sup> Department of Medicine (Geriatrics), University of Pittsburgh, Pittsburgh, Pennsylvania

<sup>3</sup> University of Copenhagen Herlev Hospital, Herlev, Denmark

<sup>4</sup> Glickman Urologic and Kidney Institute Cleveland Clinic, Lerner College of Medicine, Cleveland, Ohio

<sup>5</sup> Medical College of Wisconsin, Milwaukee, Wisconsin

<sup>6</sup> Peninsula Community Health, Cornwall, UK

<sup>7</sup> UT Southwestern Medical Center, Dallas, Texas

<sup>8</sup> Bristol Urological Institute, Bristol, UK

## \*Correspondence

Peter F.W.M Rosier, MD, PhD, Department of Urology, University Medical Centre Utrecht, C04.236, Heidelberglaan 100 PoBox 85500, 3508GA Utrecht, The Netherlands  
Email: p.f.w.m.rosier@umcutrecht.nl

**AIMS:** The working group initiated by the ICS Standardisation Steering Committee has updated the International Continence Society Standard “Good Urodynamic Practice” published in 2002.

**METHODS:** On the basis of the manuscript: “ICS standard to develop evidence-based standards,” a new ICS Standard was developed in the period from December 2013 to December 2015. In July, a draft was posted on the ICS website for membership comments and discussed at the ICS 2015 annual meeting. The input of ICS membership was included in the final draft before ICS approval and subsequent peer review (for this journal).

**RESULTS:** This evidence-based ICS-GUP2016 has newly or more precisely defined more than 30 terms and provides standards for the practice, quality control, interpretation, and reporting of urodynamics; cystometry and pressure-flow analysis. Furthermore, the working group has included recommendations for pre-testing information and for patient information and preparation. On the basis of earlier ICS standardisations and updating according to available evidence, the practice of uroflowmetry, cystometry, and pressure-flow studies are further detailed.

**CONCLUSION:** ICS-GUP2016 updates and adds on to ICS-GUP2002 to improve urodynamic testing and reporting both for individual care and scientific purposes.

## KEYWORDS

clinical practice standard and quality, cystometry, incontinence, lower urinary tract dysfunction, pressure-flow study, urodynamic, uroflowmetry

## 1 | INTRODUCTION

The ICS Standardisation Steering Committee has initiated a working group (WG) to update the International Continence Society's Good Urodynamic Practice 2002<sup>1</sup> (GUP2002) with the aim of including new evidence and information on

urodynamic practice and urodynamic quality control and the revised ICS standard on urodynamic equipment.<sup>2</sup> Following the traditional ICS Standardisation style, while including the new method and structure,<sup>3</sup> changes of current standards are recommended and arguments provided for making these changes.

This report provides evidence-based specific recommendations for routine clinical urodynamic testing, and includes expert consensus where evidence is lacking.

Dr. Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper

Conclusions and recommendations are highlighted in the text and can be used for summary and express reading. We define “ICS standard” as: “Best practice, based on evidence, with the use of standard terms and standard techniques, evaluated and reported clinically or scientifically, in a complete and validated manner.” In individual cases and/or in research settings, the decision may be made not to adhere to this standard, but any deviation from the standard should be specified.

The ICS standard is particularly intended for evaluation of the function of the lower urinary tract (LUT) of adult persons without relevant neurological abnormalities and with intact “normal” anatomy of the LUT. Many of the recommendations in this document may, however, also be considered relevant, generalizable, or applicable for patients with neurological abnormalities, for Video-urodynamics or for urodynamics in research settings and/or also for patients with neobladders, augmented bladders, or diversions. The recommendations may also be helpful for performing urodynamics in children.<sup>4</sup>

## 2 | DEFINITIONS OF TERMS FOR URODYNAMIC TESTS

### 2.1 | Introduction and evidence base

Over the years, a variety of terms have been developed for the group of diagnostic tests that evaluate LUT function. The WG has constructed a table with terms and has provided their frequencies of use, both in PubMed (searching in title and abstract) and in Google (Table S1). Uroflowmetry, Post Void Residual (PVR), Cystometry, Pressure-flow study, Electromyography (EMG), Urethral Pressure Profile, and Video urodynamics are the terms most frequently used in the scientific literature. The ICS Standardisation of Terminology of LUT Function (ST2002)<sup>5</sup> (re-) introduced or used many of these terms, and the AUA-SUFU has also provided definitions of some terms.<sup>6</sup>

### 2.2 | Conclusions

Many terms have been introduced in earlier standardizations, without providing a precise definition.

A significant variety of synonyms are used for urodynamic tests and studies in the scientific literature as well as in lay texts and we conclude that the use of currently existing terms is not yet without variation in scientific literature.

### 2.3 | Discussion

Variations in the application of terms may bias communication, in science and also in communication with patients. The following terms are not really new and many were introduced earlier, sometimes long ago.

## 2.4 | Recommendation

For the purpose of uniformity, particularly in research we recommend and define the following as ICS standard terms:

**Urodynamics:** The general term to describe all the measurements that assess the function and dysfunction of the LUT by any appropriate method. Urodynamics allows direct assessment of LUT function by the measurement of relevant physiological parameters. (GUP2002 not changed).

**Invasive urodynamics:** Any test that is invasive, as it involves insertion of one or more catheters or any other transducers into the bladder and/or other body cavities, or insertion of probes or needles, for example for EMG measurement.

**Non-invasive urodynamics:** All urodynamics done without the insertion of catheters: for example, uroflowmetry, PVR, penile compression-release test, penile cuff, urethral connector, condom catheter, or sonography.

**Ambulatory urodynamics:** See the applicable ICS Standard.<sup>7</sup> (Not further discussed in this standard.)

**ICS standard urodynamics protocol (NEW):** a patient undergoing collection of a clinical history (should include (a) valid symptom and bother score(s) and medication list), relevant clinical examination, (3 days) bladder diary, representative uroflowmetry with post-void residual (PVR) and a complete ICS standard urodynamic test (see below), is referred to as having had the “ICS standard urodynamics protocol (ICS-SUP).”

**ICS standard urodynamic test (NEW):** Uroflowmetry and PVR plus transurethral cystometry and pressure-flow study (see below): all tests are performed in the patient's preferred or most usual position: comfortably seated and/or standing, if physically possible. The patient(s) is reported as having had an ICS standard urodynamic test (ICS-SUT).

**ICS supplementary urodynamic tests:** ICS-SUT may be supplemented with EMG, with imaging, with continuous urethral pressure(s) and/or with urethral pressure profile measurement. Cystometry may be done via a suprapubic catheter (specify supplements).

**Recommendation:** The WG suggests all ICS-SUT-data as a minimum, and preferably complete ICS-SUP data should be specifically reported or summarized for the total cohort of patients in all research reports that contain (invasive) urodynamic results.

Furthermore, the WG suggests referring to the current manuscript when research is reported as “... according to ICS Standard Good Urodynamic Practices (ICS-GUP2016),” when complete ICS-SUT or SUP data are reported.

**Uroflowmetry:** A test that produces the [Citation from GUP2002]: “... flow rate of the external urinary stream as

volume per unit time in millilitres per second (mL/s).” ICS uroflowmetry minimally reports the maximum flow rate and the volume voided and PVR. (GUP2002, not changed.) Other characteristics such as flow pattern (specify) and other parameters may be added but should be specified.

**Post-void residual volume (PVR):** (GUP 2002) The remaining intravesical fluid volume determined directly after completion of the voiding. The technique (eg, ultrasound or catheter) used to measure the volume should be specified.

**Voided percentage (Void%):** The numerical description of the voiding efficacy or efficiency which is the proportion of bladder content emptied. Calculation:  $[(\text{volume voided}/\text{volume voided} + \text{PVR}) \times 100]$ . The WG suggests—solely for the purpose of standardization—that the term voided percentage with the abbreviation Void% is preferred. The relevance of the parameter is not discussed here.

**Cystometry:** Continuous fluid filling of the bladder via a transurethral (or other route, eg, suprapubic or mitrofanoff) catheter, at least with intravesical and abdominal pressure measurement and display of detrusor pressure, including cough (stress) testing. Cystometry ends with “permission to void” or with incontinence of the total bladder content. The fluid type and temperature, filling method and rate, catheter sizes, pressure recording technique, and patient position should all be specified.

**Cysto-urethrometry:** A cystometry is done with continuous urethral pressure measurement (specify technique).

**Pressure-flow study:** The intravesical and abdominal pressures are measured, from the moment of “permission to void,” while uroflowmetry is performed with a transurethral (or suprapubic) catheter in place. The position of the patient, the catheter sizes, and the pressure and flow recording technique should be specified.

**Pelvic muscle electromyography (EMG):** Pelvic muscle activity is judged with surface electrodes. ICS Standard: two skin electrodes on the perineal surface with an appropriate reference (=Pelvic muscle EMG). Other type, for example, vaginal probe: “vaginal EMG,” “anal EMG” or “needle EMG,” etc. and/or number and position of electrodes should be specified.

**Urethral pressure profile:** See ICS Standardisation of urethral pressure measurement.<sup>8</sup>

Urodynamics may be combined with imaging (specify). Invasive urodynamics performed with contrast fluid as the filling medium is Video urodynamics: X-ray (image amplifier) pictures or cine-loops are made at relevant moments. The contrast medium and report patient radiation dose should be specified. Video urodynamics is not further discussed in this document.

### 3 | PATIENT INFORMATION AND PREPARATION OF THE PATIENT FOR INVASIVE URODYNAMICS

#### 3.1 | Introduction and evidence base

Although evidence indicates that urodynamics is generally well tolerated, studies have examined pain and embarrassment, using a variety of questionnaire methods. Younger patients have been identified as a group that may experience more pain and apprehension<sup>9</sup> associated with depression, anxiety and/or bladder pain syndrome.<sup>10</sup> Effectiveness of patient information leaflets requires comprehensibility and communicative effectiveness.<sup>11–13</sup> However, reports analysing existing information conclude that this is of poor quality. Studies to develop a detailed explanatory leaflet, which were used in a double-blind randomized controlled trial to conclude that “leaflet” or “no leaflet” intervention had a disappointing satisfaction outcome.<sup>14,15</sup> Poor understanding of the test has been associated with lack of satisfaction with care and with, for example, the perception that the investigation in itself is therapeutic.<sup>16</sup>

#### 3.2 | Conclusions

Some evidence exists that information leaflets about urodynamic investigations are too difficult for patients to understand.

Young adults and patients with a bladder pain syndrome may have a relatively negative experience with urodynamic investigation.

Conflicting evidence exists about which precise information is helpful to give to patients before urodynamic testing to reduce distress.

#### 3.3 | Discussion

Effective communication is an expectation in modern healthcare, so that patients become actively engaged in the test and their care delivery. The WG has discussed that a leaflet with a minimum set of items would facilitate informed decision making. The WG is convinced that good information before and during the test increases a patient's acceptance and confidence, and will reduce confusion.

#### 3.4 | Recommendation

The WG suggests, although in the absence of good evidence, that an explanatory leaflet about urodynamic investigation with sufficient information, which uses clear, unambiguous wording will be appreciated by the majority of patients.

The WG suggests that a leaflet should include the items listed here below. The WG recommends that a leaflet that includes these items in an understandable manner for the

patient is referred to as the (NEW) ICS Standard Information Leaflet for Urodynamics.

Overview of the content of an ICS Standard Information Leaflet for Urodynamics.	
•	What is a urodynamic investigation
•	That the test involves insertion of catheters into the bladder and rectum, and relevant technical issues
•	What is the usefulness of urodynamics, Why is the testing done
•	What are the different steps of urodynamic investigation and how they are performed (e.g. uroflowmetry, cystometry, urethral pressure measurement and pressure-flow)
•	How dignity, communication and comfort during the investigation are maximized (What you do or offer in this regard)
•	The symptoms that may occur following the investigation, what they indicate and how can they be handled or prevented, e.g. the fact that mild discomfort, frequency, dysuria and haematuria may be experienced, and a urinary tract infection may occasionally develop*
•	Additional information including length of the investigation, sterility of relevant parts of equipment, lack of 'injections'
•	That the test is done interactively and that communication with the patient is a necessary part of the test.
•	What the patient should do before the test (e.g. arrive if possible with a full bladder for uroflow, and also with an empty bowel if possible).
•	Whether the patient should continue medication before the test, or whether there are specific medications that the patient should not take in (a defined period) before the test. Note: This should be individualized, e.g. with a tick box or a written instruction of the requester.
•	What the patient should do after the test <ul style="list-style-type: none"> <li>○ e.g.: Immediately drink one portion of ½ - 1L extra fluid to ensure prompt voiding again, in order to relieve urethral irritation rapidly.</li> <li>○ All usual activities are permitted after the test.</li> <li>○ Symptoms and signs of urinary tract infection and what steps to take if these arise.</li> </ul>

\* Consider (also depending on local situation and regulations) to list adverse events (and incidence) that a reasonable patient might be expected to be informed as a standard.

## 4 | URODYNAMIC PRACTICE PROTOCOLS

### 4.1 | Introduction and evidence base

In an area where a minimum standard for urodynamic testing workload exists,<sup>17</sup> it was concluded on the basis of a postal survey that training had insufficient effect, and that practice significantly varied.<sup>18</sup> When 100 consecutive graphs from all men who underwent cystometry in one center were reviewed, “significant defects [in the pressures] were not uncommon”; furthermore,  $\pm 10\%$  of the transurethral catheters was reported to have been “falling out during voiding.”<sup>19</sup> Disappointingly, although willingness to change practice was observed, actual changes did not occur despite the distribution of a standard protocol for some of the elements of urodynamic testing.<sup>20</sup>

### 4.2 | Conclusions

Published evidence to support implementation of practice standards is scarce and the conclusion on the basis of simple implementation strategies toward the achievability of practice improvement is not very encouraging.

### 4.3 | Discussion

Implementation of standardized practice is a complex process that requires changing routine habits and beliefs while keeping an eye on context, for example, acceptability, adoption, appropriateness, feasibility, fidelity, and costs.<sup>21</sup> Furthermore, the quality of the practice guidelines or

standards for implementation is of importance.<sup>22</sup> Simple dissemination is not usually very effective and, as an example, for example, “blended” or “continuous quality improvement,” strategies may be required.<sup>23</sup>

## 4.4 | Recommendations

The WG recommends that departments develop urodynamic practice protocols on the basis of the ICS-GUP standards and facilitate specific training in, and evaluation of, urodynamic practice.

We recommend that centers should—ideally coordinated and together on a nationwide level—decide on individual accreditation and recertification (eg, required minimum number of tests) as well as the level of authority and autonomy to perform urodynamic tests.

## 5 | CLINICAL PRACTICE PRE-TESTING INFORMATION

### 5.1 | Introduction and evidence base

All guidelines on urinary incontinence recommend a clinical history, and validated symptom and/or bother scores are recommended in the majority of these.<sup>24–28</sup> Urinalysis and physical examination as the first step in the evaluation of a patient with urinary incontinence are considered routine. The GUP2002 has in this regard mentioned non-invasive urodynamics, frequency/voiding chart (FVC), or bladder diary (BD) uroflowmetry and PVR) for all patients with LUT symptoms (LUTS). FVC and BD are mentioned in ST2002 and defined after that publication.<sup>29</sup> The test should be requested with the goal of answering a specific question (GUP2002). In order to formulate this question prior to urodynamics, as mentioned here above, a complete history, a list of medications taken must be available as well as the results of the physical exam. Observation of the patient's gait, evaluation of sacral sensation and reflexes and identification of other neuro-urological findings are important. An abdominal exam and evaluation of the extremities for oedema are also helpful. In women, a systematic pelvic exam should include evaluation for prolapse,<sup>29</sup> vaginal wall masses, atrophy, pelvic muscle quality, and the ability to voluntarily contract them (as is standardized<sup>30</sup>), urinary leakage with strain, and any other details. In men, genital exam and a digital rectal prostate examination with an estimation of size is necessary. Prostate pain or abnormalities and degree of anal tone should be noted.

A (3-day) FVC or BD provides information that may obviate cystometry (eg, when excessive fluid intake is recognized) or may help to ensure and evaluate whether the cystometry, especially cystometric capacity, is representative of the patient's typical situation (“typical voided volumes”;



from GUP2002). Non-invasive urodynamic testing, that is, uroflowmetry plus PVR in men and women, should precede invasive urodynamics. This information gathering process serves as the foundation for determining treatment as well as formulating questions that can be answered with (invasive) urodynamics. A urinalysis to screen for infection or haematuria should be available.

When planning urodynamic tests, the physician should specifically instruct the patient whether or not to change any conservative measures or change or take medication before or after the test according to ((local) standards and/or guidelines and) the individual situation of the patient.

## 5.2 | Conclusion

We conclude that clinical practice guidelines and expert “first principles” agree that prior to invasive urodynamics, history, physical examination, and urinalysis should be completed.

The usefulness of a FVC-BD to help anticipate cystometric capacity and appropriate fill rate has never been formally investigated. It is, however, the WG's conclusion that the FVC-BD voided volumes should be considered relevant to evaluate the representativeness of the cystometry, as was recommended in GUP2002.

## 5.3 | Recommendation

The WG advises that apart from the clinical information (history, medication, and clinical examination), the information from the (3-day) FVC or BD, and the uroflowmetry and PVR are utilized while performing invasive urodynamics.

The WG advises specific instructions to the patient with regard to the continuation of usual LUT management (eg, medication) if the patient is on treatment, and—persisting or new onset—symptoms require urodynamic analysis.

# 6 | PRACTICE OF UROFLOWMETRY

## 6.1 | Introduction and evidence base

GUP2002 presents uroflowmetry as a first line screening for most patients with LUTS and has provided practice recommendations. ICI consultations and clinical practice guidelines have reconfirmed uroflowmetry as the first line test.<sup>5,7,28</sup> Data quality control is relevant and important<sup>31</sup> and ICS has updated equipment performance requirements.<sup>2</sup> Apart from technical quality, the clinical situation is relevant. Some papers concerning position during voiding of men<sup>32–39</sup> or women<sup>40–46</sup> have been published since GUP2002, with a

variety of primary outcomes related to different voiding positions (see Table S2). The results do not allow a very strong recommendation to be made, partly because test-retest variation inherently plays a role.<sup>47</sup> On the basis of these results and also on the basis of expert experience and plausibility, the WG concludes as follows.

## 6.2 | Conclusions

The WG concludes that it is useful, considering the representativeness of the test-result, for patients to be allowed to undergo uroflowmetry in their own preferred position.

## 6.3 | Discussion

Uroflowmetry and therefore flow rate, voided volume, and PVR are inherently sensitive to patient cooperation and emotion, and should only be clinically interpreted if the voiding has been representative with regard to both voided volume and the patient's opinion (eg, uroflowmetry may be abnormal if voiding was postponed for too long before the test). Furthermore, the interpretation can only be relevant if the test was done in a technically reliable manner, based on the examiner's opinion.

## 6.4 | Recommendations

The WG recommends permitting patients to undergo uroflowmetry in their preferred position and to strive for minimum physical discomfort and anxiety for the patient, as well as ensuring personal dignity.

The WG recommends checking if the voiding is representative, based on the patient's report and also on the association with the patient's FVC or BD volumes.

The position of the patient during voiding studies should be reported.

The WG recommends considering repetition of the uroflowmetry if the result has not been representative for the patient or if the result indicates abnormality. Particularly, if the voided volume and/or flow rate are unexpectedly low or the PVR is (much) larger than expected or explainable in both women and in men.

# 7 | PRACTICE OF CYSTOMETRY

## 7.1 | Introduction and evidence base

GUP2002 has specified catheters, pressures, pressures reference and quality checks for cystometry (and also for pressure-flow study). The WG has not found evidence that supports changes in these specifications. The WG has however studied and further specified six items in relation to the practice of filling cystometry. For each item we report



conclusions on the basis of the evidence and provide recommendations below.

## 7.2 | What determines filling rate?

The rate at which the bladder is filled during cystometry affects the results of the cystometry.<sup>48,49</sup> ST2002 has defined two different ranges of filling rate: maximum physiological filling rate as estimated by body weight in kilogram divided by four, thus typically in the range of 20–30 mL/min. The commonly applied filling rate in practice is often higher and, and this is (ST2002-) referred to as non-physiological filling rate. Neither ST2002 nor GUP2002 are however specific in the rate to select however GUP2002 has stated that the [citation] “typical voided volumes should be used for the control of subsequent invasive studies.”

The actual volumes in the bladder during cystometry may differ from the recorded filling volumes due to diuresis, which can add significantly volume, for example, up to 25% to the cystometry volume.<sup>50,51</sup> Cystometric capacity is most reliably determined by calculation of voided volume (mL) plus PVR (mL) immediately after pressure-flow study (ST2002). The WG has been unable to find evidence that stopping or slowing down the filling rate, for example, when urgency is perceived and/or when detrusor overactivity (DO) is observed, is of any relevance. GUP2002 has suggested that the investigator should stop filling and observe the pressure, when reduced compliance is thought to be a consequence of filling rate above physiological filling rate.

### 7.2.1 | Conclusions

Current ST2002 cystometry (pump-) non-physiological filling rate is frequently applied, but a recommended more specific value or range is lacking.

Filling rate, especially when very fast or to volumes that are very much larger than the person's usual (maximum) volumes, may influence the results or the representativeness of the cystometry. Evidence that filling rate should be changed during the cystometry is lacking.

Diuresis, occurring during cystometry, adds volume that is not recorded by the urodynamics system with automated filling volume recording, but that is relevant for interpretation of the results.

Correction of filled volume for diuresis in retrospect should be considered with regard to reporting of filling sensation parameters, compliance and cystometric capacity (=pressure-flow voided volume plus PVR; and assuming the diuresis to be constant).

### 7.2.2 | Discussion

A balance between a filling rate that is slow enough to mimic a representative bladder filling and fast enough to complete the cystometry in an efficient fashion is a pragmatic approach to achieving a representative result. The WG considered,

without specific evidence, but similar to practice in children's cystometry, that a filling rate in mL/min of roughly 10% of the largest voided volume (reported on a FVC or –BD; and PVR should be taken into account here) at a constant rate is a practical means to implement the above cited GUP2002 recommendation to use the person's typical voided volumes. This would, in a sensible manner, narrow the currently existing non-physiological fill rate-range and may also prevent too fast filling or filling to very unusual volumes. The WG suggests standardizing the filling in a fixed rate for the purpose of comparability in clinical cohort (management) research protocols where cystometric capacity, sensation, or compliance are outcome parameters.

The end of filling should relate to a “strong but not uncomfortable need to void.” The largest voided volume on the FVC-BD may be an indicator for this volume, however with as yet unknown specificity, and PVR should be taken into account. “Strong desire to void” (SDV) should be indicated on the urodynamic graph. Permission to void is given when the pump is stopped (ST2002) and end of filling should be regarded as the beginning of the voiding phase. A specific marker on the urodynamics graph to indicate permission to void must be used however, if there is a delay between halting the pump and permission to void.

### 7.2.3 | Recommendations

The WG recommends that the person doing the cystometry knows the FVC-BD results as well as the results of uroflowmetry and PVR, prior to performing invasive urodynamics.

The WG suggests that the ICS maximum physiological filling rate is standard and suggests that “non physiological filling rate” is standardized on the basis of the individual patient's typical voided volumes (including estimation of the PVR volume) to prevent too fast filling and/or too large volumes.

The WG recommends use of the maximum physiological rate when comparability is relevant (eg, this may be required in prospective research cohorts, before and after intervention).

Parameters during cystometry depending on bladder volumes should be corrected for diuresis if relevant for clinical management or for scientific purposes.

The WG recommends that “permission to void” should always be marked on the urodynamic graph to indicate the beginning of the pressure-flow study. Stopping the fill pump is a more or less automatic marker, but when there is a delay between stopping the filling and this permission, a specific marker should be used to allow correct interpretation of the graphs after the test.

## 7.3 | How is the patient instructed to report sensations?

Prior to filling cystometry, patients are typically informed (written and verbal) that they will be asked to report the sensations they experience during the test. The ST2002

recommends that three sensation parameters be recorded during cystometry: first sensation of filling (FSF), first desire to void (FDV) and SDV. In addition, the patient may report sensation(s) that are considered to represent “urgency” (ST2002) which can be marked specifically. These sensory parameters have been confirmed as applicable, consistent, and reproducible in healthy persons and in patients with overactive bladder (OAB) syndrome.<sup>52–54,57,58</sup> There is, however, conflicting data regarding the reliability and/or representativeness of bladder sensation reporting during cystometry.<sup>55–57,59,60</sup> The use of a visual analogue scale (VAS) to grade the level of sensation has been shown to correlate well with some of the standard sensation parameters.<sup>61</sup> Similarly, a keypad, allowing patients to indicate differing levels of sensation, had a good and reproducible association with filling volume.<sup>62</sup>

### 7.3.1 | Conclusions

The ST2002 expert-based recommendation for the assessment of sensations during cystometry is reasonable and applicable as is demonstrated in various study reports.

### 7.3.2 | Discussion

The WG has decided not to change the ICS standard in favor of the use of VAS. However, despite introduction of standard terms in 2002, few studies published have reported cystometry filling sensations and the WG feels the need to reintroduce these and to add practice recommendations. It should be noted that the WG has not evaluated the relevance of the filling sensation parameters.

FSF should, at the beginning of the cystometry, be separated from the (urethral) sensations caused by the catheterization. The explanation to the patient may be that FSF is “Tell me the moment when you perceive that your bladder is not empty anymore”; FDV is (if little or no chronic PVR exists) usually roughly associated with FVC-BD “typical voided” volumes and can be asked as “Tell me when you have the sensation that normally tells you to go to the toilet, without any hurry, at the next convenient moment.” SDV is “. . . the moment that you, without any pain or any fear of losing urine, will not postpone the voiding; you will visit the nearest restroom also, for example, while shopping.” SDV may however occur suddenly and include the fear of leaking (or actual urine loss) in specific patients and patients should report this also. Correlating the results of cystometry volume and sensations with FVC-BD may provide background information regarding day-to-day sensory findings and bladder volumes and may also limit the risk of overfilling.

Fear of leakage, pain, or other signs or symptoms during the test should be specifically marked on the urodynamic graph.

### 7.3.3 | Recommendations

The WG recommends marking FSF, FDV, and SDV, during cystometry as recommended by ST2002, on the basis of explicit verbal instructions and communication before and during the test specified in this GUP, and reporting the results.

## 7.4 | Fluid-filled external transducers and catheter system

Current ICS standard cystometry and pressure-flow study requires fluid-filled catheters with external pressure transducers to be leveled at the height of the upper edge of symphysis pubis. (GUP2002, ST2002). The urodynamic pressure is therefore the excess pressure above atmospheric pressure at the hydrostatic level of the upper edge of the symphysis pubis. Some studies that have compared fluid-filled catheters with microtip sensor catheters or air-filled catheters have shown that the results of the cystometry using these alternative systems are not interchangeable with the current ICS standard.<sup>63–65</sup>

### 7.4.1 | Conclusions

ICS standard urodynamic intravesical pressure ( $P_{ves}$ ), abdominal pressure ( $P_{abd}$ ) or other urodynamic pressure is the excess pressure above atmosphere at the hydrostatic level of the upper edge of the symphysis pubis. This is valid for all pressures recorded with fluid-filled lines.

The WG concludes that comparisons of micro-tip catheter systems (multicenter group averages) or air-filled catheters in vitro or in vivo (pairwise averages of two measurements) with ICS standard fluid-filled systems demonstrated that both systems give different results. The reports of these studies have concluded that systems are not interchangeable.

### 7.4.2 | Discussion

Fluid-filled external pressure systems referenced to the symphysis pubis are fundamentally different from the micro-tip or air-filled catheter systems, as the latter record pressure without a clear reference level. The use of ICS standard urodynamic pressures allows pressure related data to be comparable between patients and centers. Systematically obtained clinical evidence for the clinical reliability of micro-tip or air-filled catheter systems is scarce. Every urodynamic laboratory should be familiar with the potential artefacts of the specific system used for pressure measurement, and take the possibility of system- differences of up to 10 cm H<sub>2</sub>O into account.<sup>66</sup> The WG considers that the availability of alternative systems has consequences for multi-center studies. Also the WG has considered generalizability of pressure values published in studies using

other than fluid-filled external pressure systems is undecided.

ICS guidelines on equipment performance provide minimum system requirements for pressure responses and calibration.<sup>2,66</sup> Centers that utilize other pressure systems should provide reference values for their data.

### 7.4.3 | Recommendations

ICS standard cystometry is performed with a fluid-filled system with external transducers at the reference level of the upper edge of the symphysis pubis.

Urodynamic laboratories should ensure that the equipment, including the catheters and transducers, meet the requirements as explained in the ICS guideline on equipment performance.<sup>2,66</sup>

Urodynamic laboratories should check the performance of their system at regular intervals and calibrate according to manufacturer recommendation, and as advised in the ICS guideline on equipment performance.<sup>66</sup>

## 7.5 | Transurethral catheter

ICS standard invasive urodynamics is done with the thinnest possible (6–7F) transurethral double or triple lumen catheter or a suprapubic catheter on the basis of ST2002 and GUP2002.

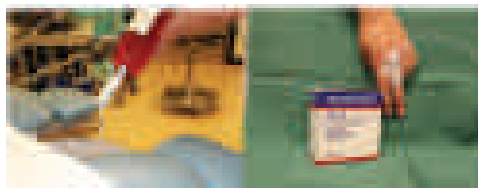
### 7.5.1 | Discussion

The ICS recommendation, reiterated here above, is based on expert opinion and consensus. GUP2002 notes that the use of two separate catheters is “less convenient.” However, many studies since 2002 report the use of separate filling and pressure catheters and the removal of the filling catheter for stress provocation and/or for the pressure-flow study. Reported practice includes the range from 5 to 8F for the pressure recording catheter and usually  $\pm 10F$  for the filling catheter. The WG has no arguments for discarding the use of double catheter systems at present but has again (after GUP2002) discussed the need to re-catheterize if the test needs to be repeated and also the necessity to interfere with the patient at the moment of SDV, just before the voiding. However, the excess cost of the double or triple lumen catheter is a disadvantage. No head to head comparisons have been performed and no new evidence has been published on the spectrum of advantages and disadvantages of two catheter technique versus the recommendations in GUP2002.

Publications applying results of invasive urodynamics sometimes report a high rate of expelled catheters and it is the WG's opinion that advice on catheter fixation, applicable for both intravesical (shown here for double lumen) and rectal catheters, will reduce that problem:

Men (left picture): Catheter is taped in the length of the penis over the catheter, without obstructing the meatus.

Women (right picture): Catheter is taped to the inner side of the labia or (similar in men and women) adjacent to the anus.



### 7.5.2 | Recommendation

ICS standard invasive urodynamics is done with the thinnest possible double lumen catheter. However, on the basis of the lack of evidence for inferiority of two catheter techniques, this alternative is considered acceptable.

The WG recommends finding evidence with specific studies to direct practice standardization and harmonization for the catheters used for invasive urodynamics.

The WG recommends fixation of the catheters as adjacent as possible to the anus and the urethral meatus with tape, without blocking the urinary meatus.

## 7.6 | Abdominal pressure catheter placement: rectal versus vaginal

Flaccid filled balloon which may be punctured or slowly perfused open end catheters in the rectal ampulla are used to measure abdominal (“perivesical”) pressure (GUP2002). The WG has discussed that “slowly perfused open end” should not be used because rectal filling may cause a sensation of need to defecate and may influence the result of urodynamics, though there is no research evidence on this topic.

In a prospective, randomized trial comparing open (without balloon) vaginal versus open rectal abdominal pressure 6F catheters in women undergoing external sensor, fluid fill cystometry, the authors noted no differences in discomfort or patient acceptability, however it was reported that women declined randomization on the basis of a preference for a vaginal catheter. Set-up time, catheter events affecting signal quality (including during provocation), or alteration in patients with vaginal prolapse were also not different. The report states that despite quality control measures (catheter repositioning and flushing of air bubbles, checking signal quality during and at end of study) only 13% of graphs all had optimum quality and a significant number of catheters was lost during the tests.<sup>67</sup>

### 7.6.1 | Conclusions

Although limited evidence suggests that women may prefer vaginal reference catheter placement, the WG concludes that this is insufficient to demonstrate that this is a reliable alternative to rectal catheterization.

### 7.6.2 | Discussion

After bowel resection with anal closure, the stoma may need to be considered as the route to measure abdominal pressure, especially in men. There is no specific evidence, but the position of the catheter-tip is usually above the bladder in a stoma, and bowel activity may much more likely cause artefacts in those cases, hampering measurement of absolute abdominal pressures and detrusor subtraction pressure, and therefore, the interpretation.

The WG considered that full (pre) filling or overfilling of rectal catheters with a balloon, as widely used, is a significant source of abdominal pressure measurement error. The catheter and balloon should be filled with water in a way that all air is replaced and without causing any excess pressure inside the balloon. Rectal balloon catheters should not be re-filled after insertion and therefore should be punctured to prevent over-filling and measurement error.

### 7.6.3 | Recommendations

Rectal placement of a fully fluid-filled open, or punctured balloon catheter, to measure abdominal pressure should be considered the ICS standard.

The WG recommends that vaginal or stoma placement of the abdominal pressure catheter is used alternatively only if rectal catheter placement is impossible.

## 7.7 | Patient positioning for cystometry and pressure-flow

It was noted on the basis of a literature review that DO was detected with a consistently higher rate in the upright position compared to supine position. DO would have been missed in 76% of cases of cystometry was done in the supine position and 60% would have been missed if the study was done supine compared to seated. Having the patient stand after being filled increased the chance of detecting DO by 21%.<sup>68</sup> In a prospective study, urodynamic stress incontinence was detected in 55% if the women were sitting but only 2% if supine, while DO was detected in 55% when seated but only in 9% when supine.<sup>69</sup> Combined diagnosis (DO plus USI) was observed seated in 18%, and zero when supine. Volumes at the time of reporting—ICS-standard—filling sensations and cystometric capacity were lower for seated cystometry.<sup>2</sup> Position during cystometry may also be relevant for the need to change the position for the optimal pressure-flow study (see below).

### 7.7.1 | Conclusions

The detection of DO, the detection of urodynamic stress incontinence, and bladder volumes at reported bladder filling sensation are influenced by the position of the patient. Sitting or standing position appears to have a higher sensitivity for detecting these abnormalities.

### 7.7.2 | Discussion

The sitting or standing position is the most representative for daily life situations and is probably the least uncomfortable and/or embarrassing for the patient. Furthermore, in the sitting position the intra-rectal as well as the intravesical catheter are at similar levels in the pelvic cavity (and similar to the transducer) which makes reliable (better balanced) pressure and subtraction more likely. Seated or standing (men) cystometry also allows a smooth transition from cystometry to pressure-flow study when SDV is reached, causing little movement artefact.

### 7.7.3 | Recommendations

ICS standard cystometry is done in the vertical position (standing or normally seated) whenever physically possible.

A pressure-flow study is done comfortably seated (women, some men) or standing if that is preferred position (men).

## 7.8 | Reliability and need for repeat cystometry for confirmation

In a prospective study of invasive urodynamics in healthy, asymptomatic female volunteers, poor reproducibility of sensory volume markers (FSF and FDV) as well as  $Q_{\max}$  and  $P_{\det Q_{\max}}$  between two cystometries done at the same session was reported.<sup>70</sup> Similarly, poor reproducibility of urodynamic results at short-term follow-up (1–5 months) was noted.<sup>71</sup> In another prospective study of immediate repeat cystometry in patients with neurogenic LUT dysfunction, the authors noted wide 95% limits of agreement for differences in same session test parameters (maximum cystometric capacity, compliance, storage  $P_{\det, \max}$ , DLPP,  $Q_{\max}$ , voiding  $P_{\det, \max}$ ,  $P_{\det Q_{\max}}$ ).<sup>72</sup> However, the study reported excellent reproducibility in the detection of DO. The authors suggested that one single urodynamic study may be inadequate to form the basis for clinical decisions in patients with spinal cord injury.<sup>73</sup>

In a later single-center study in women with symptoms and signs of urinary incontinence (without neurological abnormalities), the reproducibility of immediate repeat cystometry plus pressure-flow analysis was overall good to excellent, with intra-class correlations of around 0.75 and few differences in urodynamic diagnosis between the first and second run. Nevertheless, these authors suggested that repetition of urodynamic tests is justified to ensure diagnosis.

In elderly men, the immediate or longer interval test retest variation is less with regard to pressure-flow analysis. However, it is not reported whether differences in cystometry values have been observed.<sup>74–78</sup>

### 7.8.1 | Conclusions

Predominantly, single-center evidence suggests that immediate or longer term test- retest variation is sometimes large

for specific parameters (like sensation) but less with regard to pressure-flow variables, especially in elderly men.

There is no convincing evidence that the clinical diagnosis on the basis of the first cystometry is often changed on repetition of the test. There is no definite evidence that immediate repetition of an adequately performed urodynamic test “for confirmation” is required.

### 7.8.2 | Discussion

The WG considered that large test-retest variations may also reflect inadequately standardized methods of testing. Test retest data is scarce which was the reason to also include studies with patients with neurological abnormalities in the WG's summary of the evidence. Measurement errors are a significant source of test-retest variation, but are seldom reported. The WG considers it prudent to repeat a technically adequate test when observations are not explainable in relation to the patient's symptoms and signs, and especially when the urodynamic question is insufficiently answered and consequences for management are significant. Furthermore, the WG considers that some observations may be situational (eg, the inability to void during a test) and may not always be soluble.

### 7.8.3 | Recommendations

The WG does not recommend routine immediate repetition of invasive urodynamics “for confirmation” if the test was technically adequate, has been considered representative, and has answered the clinical question.

The WG recommends immediate repetition of the test when doubt exists as to whether the test has answered the clinical question.

The WG recommends repetition of a urodynamic test when technical errors and artefacts have been observed at immediate post-test analysis.

## 8 | PRACTICE OF PRESSURE-FLOW STUDIES AND AN UPDATE OF TERMS

### 8.1 | Introduction

An ICS subcommittee (ST1997) on standardization of terminology for pressure-flow studies revised and expanded diverse sections of the earlier ICS terminology.<sup>79,80</sup> ST1997 identified and defined five relevant parameters with the preferred abbreviations to depict pressure-flow studies.

For urodynamic practice: the “pressure-flow study” (as defined above) begins immediately after permission to void (ST2002) and ends when the detrusor pressure has returned to the baseline value and/or the flow rate to zero and/or the

patient considers the micturition completed. Note that pressure-flow analysis is only validated for voluntarily initiated micturitions and not for incontinence.

The WG considered that the relevance of instruction, position and privacy for the patient while performing pressure-flow study is equal to uroflowmetry and we refer to both the paragraphs here above for the practice of uroflowmetry and/or cystometry for the practice of pressure-flow study.

### 8.2 | Discussion

There is an inevitable delay between the fluid stream leaving the bladder and hitting the flowmeter which should be taken into account when a pressure-flow study is analysed (ST1997; GUP2002).<sup>2</sup> The delay between urethral meatus and flowmeter should be reduced by placing the flowmeter as close to the meatus as possible for every voiding position. Reducing the meatus to flowmeter distance may also result in more relaxed voiding because the patient may experience less concern about spattering.

### 8.3 | Recommendation

The WG recommends, especially for the purpose of pressure-flow analysis, a shortest possible meatus-to-flowmeter distance, adjusted to the voiding position, but recommends correcting for delay between pressure and flow.

### 8.4 | Discussion and suggested terms

Presentation of pressure-flow studies should be with a plot of the flow (-delay corrected) rate (mL/s) on the X-axis and the (delay corrected) synchronous detrusor pressure (cm H<sub>2</sub>O) on the Y-axis in addition to the time-based graphs (ST 1997).

ST1997 introduced “urethral function” and “urethral resistance (relation)” without precisely defining these as (new or standard) terms. The “(passive) urethral resistance relation” as a means of quantifying bladder outflow obstruction (in male patients with prostatic enlargement) was defined before ST1997.<sup>81,82</sup> New ICS terms are desirable to acknowledge the relevance of the anatomical structures adjacent to the anatomically defined urethra per se, to describe outflow conditions during micturition (with or without further specifying anatomy) and the WG suggests introducing a specific (ICS) standard to further detail terms and practice for pressure-flow study analysis.

The terms bladder outlet obstruction and bladder outflow obstruction are already frequently used. The WG introduces (**NEW**) **Bladder Outflow Obstruction (BOO)** (“outflow” to recognize what is measured) with the definition: a (specified) cut-off of bladder outflow resistance based on the pressure flow relation (ratio) that is considered clinically relevant (the WG does not define cut-off values



but advises that the term should be preferred for both genders and all ages).

ST1997 also stated that the urethral function during voiding can be overactive, without further definition or specification. There is a lack of terminology with regard to specific diagnosis of voiding dysfunction, also here the here above mentioned specific new ICS standard is needed.

The WG suggests already now: **(NEW) Normal voiding function:** flow rate (and pressure-rise) are within normal limits, begin more or less directly after permission to void and ends with an empty bladder.

Bladder outflow physical properties may vary during one course of voiding and the WG suggests that new terms are introduced when analysis methods and cut-off values or pattern descriptions are provided to describe (as introduced in ST1997) “overactive urethral function during voiding.” We conclude that no commonly agreed parameter or pattern description exists to clinically quantify or qualify “(over-) active urethral function” (if) outflow properties vary during a voiding.

“Underactive detrusor” and “acontractile detrusor” are defined in ST1997 and ST2002 as different from “normal detrusor” during micturition. GUP 2002 has also introduced that contraction during micturition may vary, or may be variable. Within this context, the WG discussed that voiding may be influenced by mental state and, although evidence is lacking in the neuro-gyneco-urological literature, anxiety in the test situation for the patient may plausibly influence initiation of the voiding reflex<sup>83–85</sup> and consequently affect detrusor function. The WG suggests **(NEW) “Situational inability to void”** and **“Situational inability to void as usual”** when in the opinion of the person performing the test, in communication with the patient, the attempted voiding has been not representative.

The WG here introduces the term **“detrusor voiding contraction”** for any analysis of combined pressure and flow ( $\pm$  other variables) that qualifies or quantifies the actual observed voiding. Following on to this: **“detrusor contractility”** is now suggested for any method that aims to quantify “intrinsic” detrusor muscle properties (eg, potential-maximum-force or velocity) by any method. We refer to, for example, stop-flow or interrupted-voiding tests and mathematical (extrapolation) or graphical analysis methods of pressure, flow and/or other parameters, such as, for example, the bladder working function.

Acknowledging the GUP2002, we suggest that the terms **“unsustained contraction”** (when waxing and waning) or **“fading contraction”** may be used when analysis methods and cut-off values or pattern descriptions are provided. We also acknowledge that no parameters to clinically demarcate normal, stable, or sustained detrusor contraction are available as yet.

## 8.5 | Recommendations

The WG has suggested some terms with the aim of improving communication with regard to pressure-flow analysis. However, the WG strongly recommends an updated ICS standard for pressure-flow analysis to ensure optimal ICS standardization of quantitative analysis (and standardization of diagnosis) of bladder outflow function as well as of detrusor voiding contraction diagnosis and/or detrusor contractility analysis for all patient groups.

## 9 | TECHNICAL AND CLINICAL QUALITY CONTROL DURING INVASIVE URODYNAMICS

### 9.1 | Introduction and evidence base

Quality control and standardization are an important part of urodynamics. Without training and standardization of equipment, and adherence to quality control and standards of urodynamic practice has been shown to be difficult.<sup>17</sup> The consequence is a large inter-site variability.<sup>18</sup> One national board has argued that maintaining expertise requires performing at least 30 urodynamic tests a year per urodynamicist and 200 tests in a department.<sup>19,20</sup>

A number of recommendations for control during urodynamics has been provided in the GUP2002 and a number are renewed or added, in the recently published “ICS guidelines on urodynamic equipment performance.”<sup>2</sup> Furthermore, an overview of common features errors and artefacts has been published.<sup>66,86</sup>

The WG has found no new evidence necessitating re-discussion of equipment requirements, labelling and scaling of traces in the graph and refers to earlier documents in this regard.<sup>1,2,5,79</sup>

Typical signal patterns, such as straining, rectal contractions, coughing and DO are important in quality control and everyone who performs or evaluates urodynamic tests should be able to recognize these during the test.<sup>66,87,96–100</sup> In diverse retrospective single and multicenter evaluations, it was demonstrated that the expert recognition and identification of specific patterns occurring in the urodynamic traces has required adaption or correction of the—initial—diagnoses.<sup>19,87–100</sup>

### 9.2 | Conclusions

Expert evidence confirms that prevention, recognition and management of errors and recognition of artefacts are important elements of urodynamic quality control. Systematic urodynamic quality management, including plausibility analysis, is relevant before, during and after the test as well as while reporting the results of the test.

### 9.3 | Discussion

The WG considers that regular calibration of pressure measurement systems should be documented in each urodynamic laboratory and that, in general, new technologies need to prove their usefulness as well as accuracy compared to existing standards before clinical application.

### 9.4 | Recommendations

The WG recommends that everyone performing or evaluating urodynamics should be able to recognize usual pressure patterns and be able to perform continuous quality control during the test.

The WG recommends that training and a process of continuous knowledge maintenance as the basis for performing urodynamic tests should be established.

#### *Terms related to the cystometry observations and evaluation.*

Adequate set-up of the system and continuous quality monitoring are mandatory and all patterns and features occurring during the test should be recognized. Typical patterns may lead to recognition of pathophysiology or explain the perceived dysfunction. However, when an error or an artefact is observed during the test,<sup>59</sup> the person performing the test should act accordingly and prevent continuation in case of an error. The WG explains here for clarity that artefacts are, like rectal activity, in analogy with, for example, scattering on ultrasound imaging, more or less unavoidable. Errors are usually preventable or correctable.

**Recommended terms to describe most common features, artefacts, and errors during invasive urodynamics:** A fluid-filled pressure measuring system shows patient movement and external manipulation of the catheter. This causes signals or signal patterns that should be recognized during the test and at (re-) evaluation of graphs. Prevention of fluid leaks and air bubbles in the pressure tubing system is needed (GUP2002). This already starts before beginning the test while setting up the equipment. However, the effects of fluid leaks and air in the system on the pressures should be recognized at the beginning of the test and during the test also and should be corrected (GUP2002). Furthermore, they should also be recognized and reported during post-test analysis, if recognition and correction during the procedure has failed, to prevent mis-diagnosis.<sup>66</sup>

Urodynamic laboratories should apply standard practice and therefore be aware of all potential features, errors, and artefacts that may occur when measuring with the fluid-filled system. Whoever is performing tests should be able to recognize artefacts and prevent, recognize, and correct errors.

The WG has listed terms here that are considered to be of use during the test and its evaluation. Many of the terms have been used in earlier ICS standardization documents, but usually not with precise definitions. While many terms refer to preventable or correctable problems, these features including artefacts should nevertheless also be recognized during evaluation after the test. The WG has opted for terms that are as descriptive as possible and is convinced that better definition and description of these errors and artefacts is a tool to improve practice. The features, patterns or events terms mentioned here should also be used in the ICS standard urodynamics report (see below).

**Initial resting pressure (NEW)** is the  $p_{ves}$  and the  $p_{abd}$  pressure at the beginning of the cystometry. To prevent reading measurements from a kinked catheter in an empty bladder with the catheter holes blocked with (insertion) gel and/or pushed against the bladder surface, the WG recommends (GUP2002) gentle flushing of both catheter channels and/or filling 20–30 mL of the bladder, before the initial resting intravesical pressures are considered to be “established.” Initial resting pressures should be within the physiological limits specified in previous manuscripts<sup>96,97</sup> and GUP2002.

**Dead signal (NEW):** A signal that is not showing small pressure fluctuations and is not adequately responding on straining, patient movements, or coughing is reported as a dead signal.

Previously (GUP2002): “In principle, a good  $p_{det}$  signal requires only that  $p_{ves}$  and  $p_{abd}$  show the same fine structure and quality of signals before filling, during filling, and after voiding.”

**Pressure drift (NEW):** Continuous slow fall or rise in pressure, that is physiologically inexplicable.

**Poor pressure transmission (NEW):** Poor pressure transmission has occurred when the cough/effort pressure peak signals on  $p_{ves}$  and  $p_{abd}$  are not nearly equal.

Note: The WG does not define a new limit for not “nearly equal.”

**Expelled catheter (NEW):** When a catheter is expelled, this is observed as a sudden drop in either  $p_{ves}$  or  $p_{abd}$ , usually below zero.

Earlier ICS description: “If a sudden drop or increase occurs in either  $p_{ves}$  or  $p_{abd}$  signal, the usual cause is movement, blockage, or disconnection of a catheter.”

Expelled catheter is usually simply visible during the test and should provoke correction or repetition of the test. However, this term should also be used in post-test evaluation.

**Catheter flush (NEW):** When one of the catheters is flushed during the test a steep pressure rise is observed in that pressure line for one or two seconds followed by an immediate fall to resting pressure.

A catheter flush is not always necessary after a carefully performed set-up but is suggested in GUP2002.



Flushing of the catheter measuring channel may be considered necessary to wash away entrapped air, or the gel used during insertion or urethral mucus, from the measuring hole. The rectal catheter can only be flushed when an open or a punctured balloon catheter is used, and flushing should definitely not be done if a closed balloon is used (which is not ICS standard). A catheter flush should be marked accordingly, but flushes are normally unnecessary after the cystometry has continued after the first milliliter of filling.

**Tube knock (NEW):** Tube knock is observable as high frequency, short duration spikes visible in  $p_{ves}$ ,  $p_{abd}$ , or both, and with spikes also usually visible in  $p_{det}$ .

**Pump vibrations (NEW):** Pump vibrations are visible as stable frequency oscillations of small but constant amplitude if the filling tube touches the pressure connecting tube (when a two catheter system is used) and the pump is switched on (switching of the pump can ascertain the situation).

**Cough pressure peak (NEW):** A cough pressure peak is recognizable during post-test evaluation as a phasic positive pressure change observed in  $p_{ves}$  and in  $p_{abd}$ .

**Urodynamic stress test (NEW):** The term urodynamic stress test is used for any physical effort of the person tested, to elevate abdominal pressure during cystometry, with the aim of examining (urodynamic) stress urinary incontinence.

ICS has defined urodynamic stress incontinence. Evidence is lacking (or conflicting) with regard to the preferred technique of urodynamic stress testing.

Note: The provocation method, the pressure measuring catheter(size) and method, the leak detection method as well as the absolute or relative (percentage of cystometric capacity) intravesical volume(s) while testing should be reported.

**Leak point pressure (NEW):** The leak point pressure (LPP) is the pressure (spontaneous or provoked) that has caused fluid to be expelled from the bladder at the moment that it is visible outside the urethra (may also be used for extra-urethral urine loss or stoma). This may refer to Abdominal, Cough or Valsalva LPP or Detrusor LPP.<sup>5,6,28,29</sup> Provocation and pressure recording site ("type of LPP") should be reported.

Diverse methods of LPP measurement have been published with a variety of combinations of provocation or pressure recording site/type and/or technique. Detrusor LPP and Valsalva LPP were defined in ST2002. However, no ICS (or commonly agreed) standard technique or protocol is available and a variety of terms and techniques are used (counts in PubMed (April 2015): Cough LPP: 21; Valsalva LPP: 226; Detrusor LPP: 64; Abdominal LPP: 98; Overactivity LPP: 0).

**Cough associated detrusor overactivity (NEW):** Cough associated DO is reported when the onset of the DO

(with or without leakage) occurs immediately following the cough pressure peak.

No precise definition of cough associated detrusor activity is available. "Cough induced DO" is sometimes reported, although the precise (patho-)physiology and/or relevance remain speculative.

**Position change (NEW):** A change in patient position, either active or passive (eg, tilting), is visible on the cystometry trace by a lasting change of equal magnitude in both  $p_{ves}$  and  $p_{abd}$ .

Note: A position change should be (is readily) noted during the test. Position change should be followed by readjustment of the external pressure sensors height to the standard so that the  $p_{ves}$  and  $p_{abd}$ -values are similar to the pressure values before the position change. A position change should not affect  $p_{det}$ . The position change pattern should be recognized during post-test evaluation of the cystometry.

**Rectal contractions (NEW):** Rectal contractions are temporary phasic increases in  $p_{abd}$  without synchronous change in  $p_{ves}$  resulting in negative deflections of  $p_{det}$ .

Previously (GUP-2002), "Rectal contractions are usually of low amplitude and may or may not be felt by the patient."

**Dropped  $p_{abd}$  at void (NEW):** A drop in  $p_{abd}$  during voiding is reported during the voiding time,  $p_{abd}$  decreases below the previous resting pressure (as a consequence of pelvic (and abdominal) muscle relaxation).

Note: The WG considers that this phenomenon will affect the pressure-flow analysis result, because it affects  $p_{det}$ . This observation should be differentiated from expelled catheter (that usually results in a much larger pressure drop).

**Straining (NEW):** Straining is observable as a temporary increase in both  $p_{ves}$  and  $p_{abd}$  pressure. Straining may be associated with (patient-active) position change (such as repositioning from leaning backwards to upright).

Note: A short abdominal strain peak may in retrospect be indistinguishable from a position change or a cough.

**After-contraction (NEW):** An after-contraction, is a continued or new detrusor pressure rise immediately after flow ended. It is important to note if this occurs with the complete emptying of the bladder.

Note: Cough checking of (intravesical) catheter position is always required after pressure-flow. To separate the after-contraction pattern from expelled catheter or catheter tip (with measuring hole) bending in the outlet when the bladder empties, this cough check is specifically important when a  $p_{ves}$  increment after voiding is observed.

Previously published description: a pressure increase after flow ceases at the end of micturition.

## 10 | THE URODYNAMIC GRAPHS AND THE URODYNAMICS REPORT

### 10.1 | Introduction and evidence base

A standard urodynamics protocol contains diverse elements. Results of clinical analysis and evaluations are documented when a (ICS Standard) Urodynamic Test is ordered. An ICS-SUT should be followed by a urodynamics report. The WG has not found evidence with regard to the standardization of such a report and no evidence regarding the elements that it should contain.

ICS (ST2002) has acknowledged urodynamic observations, but has not been specific in the definition of the type of observations relevant for diagnosis or for urodynamic conditions or the elements of urodynamic testing to be reported. Furthermore, the ST2002 has only mentioned (or standardized) a few of the possible observations, out of the many that can be the result of a complete ICS-SUT. Contemporary urodynamic equipment is able to provide lists test data and/or graphs, but here too no standard exists for these.

GUP2002 has standardized the layout of the urodynamic graph. The WG presents elements for qualitative reporting of the results of a ICS-SUT to ensure a descriptive and objective urodynamic diagnosis or establishment of a urodynamic condition.

### 10.2 | Discussion

While it will not be possible to cover all possibilities in one standard urodynamics report, the report may be customized, for example, relevant to the final diagnosis the urodynamic evidence has to be reported. However, when a test is done, all results and observations should be systematically reported. It is good clinical practice to integrate the urodynamics report with what is known about the patient from history and other examinations and tests.

On the basis of expert experience and consensus, the WG lists qualitative elements to be included in the urodynamics report of an ICS SUT without standardizing the numerical values.

### 10.3 | Recommendations

The WG recommends that, in addition to the GUP2002 standard urodynamic graph, a [cited form ST1997] “plot of detrusor pressure against flow rate during voiding” should be provided, according to the example in this ICS standard (ST1997).<sup>79</sup> For the “ICS standard urodynamic test,” the WG recommends both (NEW) an “ICS standard urodynamic (time-based) graph” as well as (NEW) an “ICS standard pressure-flow plot” to be required elements in the ICS standard urodynamics report. The WG recommends

development of an ICS standard urodynamics report template.

Furthermore, the WG recommends reporting as follows:

- Overall judgement of the *technical quality* and the *clinical reliability* of the test to represent: the lower urinary tract function ‘as usual’, to be evaluated by the person who performed the tests.
- Uroflowmetry: *Voiding position*, *urge* (before the test) and *representativeness*, as reported by the patient.
- Introduction of catheters: *sensation*; (if occurring: *pain*), *muscular* (pelvic or adductor) *defence* and *perceptibly unusual obstruction(s) during insertion*.
- *Position(s)* during cystometry and pressure flow study.
- *Patient’s ability to report filling sensations and/ or urgency and/ or urine loss*.
- *Method of urodynamic stress test* (if applicable).
- *Pressure-flow: position and representativeness* as reported by the patient.
- *Accessory tests or measurements* (if applicable -no further standard).
- *Representativeness of the tests to reflect the ‘usual LUT behaviour’* as reported by the patient.
- *Filling sensation -diagnosis*.
- *Cystometry (detrusor) pressure pattern -diagnosis*.
- *Pressure-flow -diagnosis* (compared with uroflowmetry) includes:
  - *Bladder outflow function*, or *obstruction* (and the method for assessment)
  - *Detrusor contraction*, (and the method for assessment)

## 11 | CONCLUSION

The ICS Standardisation WG has updated the International Continence Society’s Good Urodynamic Practice standard. This evidence-based ICS GUP2016 has defined terms and standards for the practice of urodynamics labs in general as well as for the (individual) practice of quality control during and after cystometry, and pressure-flow analysis. Furthermore, the WG has included recommendations for pretesting information and for patient information and preparation as well as recommendations for the urodynamics report. On the basis of earlier ICS standardisations and the available evidence, the practice of uroflowmetry, cystometry and pressure-flow study have been further detailed. The WG expresses the hope that implementation of this update of Good Urodynamic Practices will help to increase the quality of both individual clinical and research urodynamics.

## 12 | POTENTIAL CONFLICTS OF INTEREST

Dr. Rosier reports grants from Astellas, grants from Laborie/MMS/Tdoc, grants from ONO-Pharma, outside the submitted work; Dr. Guralnick reports personal fees from Astellas, other from InControl Medical, LLC, outside the submitted work; Dr. Lose reports grants from Coloplast, other from Astellas, other from Contura, outside the submitted work; Dr. Eustice has nothing to disclose; Dr. Hashim has nothing to disclose; Dr. Goldman has nothing to disclose; Ms. Dickinson has nothing to disclose; Dr. Schaefer has nothing to disclose.

## REFERENCES

- Schäfer W, Abrams P, Liao L, et al. International Continence Society. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
- Gammie A, Clarkson B, Constantinou C, et al. International continence society guidelines on urodynamic equipment performance. *Neurourol Urodyn*. 2014;33:370–379.
- Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31:621–624.
- Bauer SB, Nijman RJ, Drzewiecki BA, Sillen U, Hoebeke P. International Children's Continence Society standardization report on urodynamic studies of the lower urinary tract in children. *Neurourol Urodyn*. 2015;34:640–647.
- Abrams P, Cardozo L, Fall M, et al. Standardisation subcommittee of the International Continence Society. The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. *Urology*. 2003;61:37–49.
- Winters JC, Dmochowski RR, Goldman HB, et al. American Urological Association; Society of Urodynamics Female Pelvic Medicine & Urogenital Reconstruction. Urodynamic studies in adults: AUA/SUFU guideline. *J Urol*. 2012;188:2464–2472.
- van Waalwijk van Doorn E, Anders K, Khullar V, et al. Standardisation of ambulatory urodynamic monitoring: report of the standardisation sub-committee of the International Continence Society for Ambulatory Urodynamic Studies. *Neurourol Urodyn*. 2000;19:113–125.
- Lose G, Griffiths D, Hosker G, et al. Standardisation of urethral pressure measurement: report from the standardisation sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:258–260.
- Yiou R, Audureau E, Loche CM, Dussaud M, Lingombet O, Binhas M. Comprehensive evaluation of embarrassment and pain associated with invasive urodynamics. *Neurourol Urodyn*. 2015;34:156–160.
- Yeung JY, Eschenbacher MA, Pauls RN. Pain and embarrassment associated with urodynamic testing in women. *Int Urogynecol J*. 2014;25:645–650.
- Scarpero HM, Padmanabhan P, Xue X, Nitti VW. Patient perception of videourodynamic testing: a questionnaire based study. *J Urol*. 2005;173:555–559.
- Hadjipavlou M, Khan S, Rane A. Readability of patient information leaflets for urological conditions and treatments. *J Clin Urol*. 2013;6:302.
- Garner M, Ning Z, Francis J. A framework for the evaluation of patient information leaflets. *Health Expect*. 2012;15:283–294.
- Bright E, Parsons BA, Swithinkbank L. Increased patient information does not reduce patient anxiety regarding urodynamic studies. *Urol Int*. 2011;87:314–318.
- Hougardy V, Vandeweerd JM, Reda AA, Foidart JM. The impact of detailed explanatory leaflets on patient satisfaction with urodynamic consultation: a double-blind randomized controlled trial. *Neurourol Urodyn*. 2009;28:374–379.
- Smith AL, Nissim HA, Le TX, et al. Misconceptions and miscommunication among aging women with overactive bladder symptoms. *Urology*. 2011;77:55–59.
- Singh G, Lucas M, Dolan L, Knight S, Ramage C, Hobson PT. Minimum standards for urodynamic practice in the UK. United Kingdom Continence Society. 3. *Neurourol Urodyn*. 2010;29:1365–1372.
- Moore KC, Emery SJ, Lucas MG. Quality and quantity: an audit of urodynamics practice in relation to newly published National Standards. *Neurourol Urodyn*. 2011;30:38–42.
- Sullivan J, Lewis P, Howell S, Williams T, Shepherd AM, Abrams P. Quality control in urodynamics: a review of urodynamic traces from one centre. *BJU Int*. 2003;91:201–207.
- Sriram R, (1), Ojha H, Farrar DJ. An audit of urodynamic standardization in the West Midlands, UK. *BJU Int*. 2002;90:537–539. Comment in *BJU Int*. 2003 Mar;91(4):430. An audit of urodynamic standardization in the West Midlands, UK. Sullivan J, Swithinkbank L, Abrams P. 2. *BJU Int*. 2003;91:430.
- Peters DH, Adam T, Alonge O, Agyepong IA, Tran N. Implementation research: what it is and how to do it. *BMJ*. 2013;347:f6753.
- Brouwers MC, Kho ME, Browman GP, et al. AGREE Next Steps Consortium. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 2010;182:E839–E842.
- Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. *Med Care*. 2012;50:217–226.
- Winters JC, Dmochowski RR, Goldman HB, et al. American Urological Association Society of Urodynamics Female Pelvic Medicine Urogenital Reconstruction. Urodynamic studies in adults: AUA/SUFU guideline. *J Urol*. 2012;188:2464–2472.
- McNanley AR, Duecy EE, Buchsbaum GM. Symptom-based, clinical, and urodynamic diagnoses of urinary incontinence: how well do they correlate in postmenopausal women? *Female Pelvic Med Reconstr Surg*. 2010;16:97–101.
- Lenherr SM, Clemens JQ. Urodynamics: with a focus on appropriate indications. *Urol Clin North Am*. 2013;40:545–557.
- Lucas MG, Bosch RJ, Burkhard FC, et al. European Association of Urology. EAU guidelines on assessment and nonsurgical management of urinary incontinence. *Eur Urol*. 2012;62:1130–1142.
- Rosier P.F.W.M., Kuo H-C, De Gennaro M, et al.: Urodynamic testing, Chapter 6. In Incontinence. Ed: Abrams P, Cardozo L, Khoury S, Wein A. 5th Edition. 2013. International Consultation on Urologic Disease. 5th International Consultation on Incontinence; Recommendations of the International Scientific Committee: Evaluation and Treatment of Urinary Incontinence, Pelvic Organ Prolapse and Faecal Incontinence. Abrams et al In Incontinence. Abrams P Cardozo L Khoury S and Wein A, eds. Paris: ICUD-EAU2013 (ISBN 978-9953-493-21-3); 2013:1895–1955.

29. Haylen BT, de Ridder D, Freeman RM, et al. International Urogynecological Association; International Continence Society. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
30. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: report from the pelvic floor clinical assessment group of the International Continence Society. *Neurourol Urodyn*. 2005;24:374–380.
31. Grino PB, Bruskewitz R, Blaivas JG, et al. Maximum urinary flow rate by uroflowmetry: automatic or visual interpretation. *J Urol*. 1993;149:339–341.
32. Choudhury S, Agarwal MM, Mandal AK, et al. Which voiding position is associated with lowest flow rates in healthy adult men? Role of natural voiding position. *Neurourol Urodyn*. 2010;29:413–417.
33. El-Bahnasawy MS, Fadl FA. Uroflowmetric differences between standing and sitting positions for men used to void in the sitting position. *Urology*. 2008;71:465–468.
34. Aghamir SM, Mohseni M, Arasteh S. The effect of voiding position on uroflowmetry findings of healthy men and patients with benign prostatic hyperplasia. *Urol J*. 2005;2:216–221.
35. Amjadi M, Madaen SK, Pour-Moazen H. Uroflowmetry findings in patients with bladder outlet obstruction symptoms in standing and crouching positions. *Urol J*. 2006;3:49–53.
36. Eryildirim B, Tarhan F, Kuyumcuoğlu U, Erbay E, Pembegül N. Position-related changes in uroflowmetric parameters in healthy young men. *Neurourol Urodyn*. 2006;25:249–251.
37. Unsal A, Cimentepe E. Voiding position does not affect uroflowmetric parameters and post-void residual urine volume in healthy volunteers. *Scand J Urol Nephrol*. 2004;38:469–471.
38. Unsal A, Cimentepe E. Effect of voiding position on uroflowmetric parameters and post-void residual urine volume in patients with benign prostatic hyperplasia. *Scand J Urol Nephrol*. 2004;38:240–242.
39. Yamanishi T, Yasuda K, Sakakibara R, et al. Variation in urinary flow according to voiding position in normal males. *Neurourol Urodyn*. 1999;18:553–557.
40. Riehmann M, Bayer WH, Drinka PJ, et al. Position-related changes in voiding dynamics in men. *Urology*. 1998;52:625–630.
41. Moore KH, Richmond DH, Sutherst JR, Imrie AH, Hutton JL. Crouching over the toilet seat: prevalence among British gynaecological outpatients and its effect upon micturition. *Br J Obstet Gynaecol*. 1991;98:569–572.
42. Devreese AM, Nuyens G, Staes F, Vereecken RL, De Weerdt W, Stappaerts K. Do posture and straining influence urinary flow parameters in normal women? *Neurourol Urodyn*. 2000;19:3–8.
43. Gupta NP, Kumar A, Kumar R. Does position affect uroflowmetry parameters in women? *Urol Int*. 2008;80:37–40.
44. Yang KN, Chen SC, Chen SY, Chang CH, Wu HC, Chou EC. Female voiding postures and their effects on micturition. *Int Urogynecol J*. 2010;21:1371–1376.
45. Rane A, Corstiaans A. Does leaning forward improve micturition? *J Obstet Gynaecol*. 2000;20:628–629.
46. Rane A, Corstiaans A. Does micturition improve in the squatting position? *J Obstet Gynaecol*. 2008;28:317–319.
47. Sonke GS, Kiemeny LA, Verbeek AL, Kortmann BB, Debruyne FM, de la Rosette JJ. Low reproducibility of maximum urinary flow rate determined by portable flowmetry. *Neurourol Urodyn*. 1999;18:183–191.
48. Robertson AS, Griffiths CJ, Ramsden PD, Neal DE. Bladder function in healthy volunteers: ambulatory monitoring and conventional urodynamic studies. *Br J Urol*. 1994;73:242–249.
49. Ko HY, Lee JZ, Park HJ, Kim H, Park JH. Comparison between conventional cystometry and stimulated filling cystometry by diuretics in a neurogenic bladder after spinal cord injury. *Am J Phys Med Rehabil*. 2002;81:731–735.
50. Heesakkers JP, Vandoninck V, van Balken MR, Bemelmans BL. Bladder filling by autologous urine production during cystometry: a urodynamic pitfall! *Neurourol Urodyn*. 2003;22:243–245.
51. Lee SW, Kim JH. The significance of natural bladder filling by the production of urine during cystometry. *Neurourol Urodyn*. 2008;27:772–774.
52. Bradley WE, Timm GW, Scott FB. Cystometry. V. Bladder sensation. *Urology*. 1975;6:654–658.
53. Nathan PW. Sensations associated with micturition. *Br J Urol*. 1956;28:126.
54. Erdem E, Akbay E, Doruk E, Cayan S, Acar D, Ulusoy E. How reliable are bladder perceptions during cystometry? *Neurourol Urodyn*. 2004;23:306–309.
55. Erdem E, Tunçkiran A, Acar D, Kanik EA, Akbay E, Ulusoy E. Is catheter cause of subjectivity in sensations perceived during filling cystometry? *Urology*. 2005;66:1000–1003.
56. De Wachter S, Wyndaele JJ. Frequency-volume charts: a tool to evaluate bladder sensation. *Neurourol Urodyn*. 2003;22:638–642.
57. De Wachter S, Van Meel TD, Wyndaele JJ. Can a faked cystometry deceive patients in their perception of filling sensations? A study on the reliability of spontaneously reported cystometric filling sensations in patients with non-neurogenic lower urinary tract dysfunction. *Neurourol Urodyn*. 2008;27:395–398.
58. Naoemova I, Van Meel T, De Wachter S, Wyndaele JJ. Does sensory bladder function during cystometry differ from that in daily life? A study in incontinent women. *Neurourol Urodyn*. 2009;28:309–312.
59. Van Meel TD, Wyndaele JJ. Reproducibility of urodynamic filling sensation at weekly interval in healthy volunteers and in women with detrusor overactivity. *Neurourol Urodyn*. 2011;30:1586–1590.
60. Dmochowski RR, FitzGerald MP, Wyndaele JJ. Measuring urgency in clinical practice. *World J Urol*. 2009;27:739–745.
61. Dompeyre P, Fritel X, Bader G, Delmas V, Fauconnier A. Bladder sensitivity testing using a visual analogue scale: comparative cystometric study on women. *Neurourol Urodyn*. 2007;26:350–355.

62. Oliver S, Fowler C, Mundy A, Craggs M. Measuring the sensations of urge and bladder filling during cystometry in urge incontinence and the effects of neuromodulation. *Neurourol Urodyn*. 2003;22:7–16.
63. Hundley AF, Brown MB, Brubaker L, et al. Multicentered comparison of measurements obtained with microtip and external water pressure transducers. *Int Urogynecol J Pelvic Floor Dysfunct*. 2006;17:400–406.
64. Lotze PM. A comparison of external transducers and micro-transducers in urodynamic studies of female patients. *Curr Urol Rep*. 2005;6:326–334.
65. Digesu GA, Derpapas A, Robshaw P, Vijaya G, Hendricken C, Khullar V. Are the measurements of water-filled and air-charged catheters the same in urodynamics? *Int Urogynecol J*. 2014;25:123–130.
66. Hogan S, Gammie A, Abrams P. Urodynamic features and artefacts. *Neurourol Urodyn*. 2012;31:1101–1117.
67. Dolan LM, Dixon WE, Brown K, Ord T, Hilton P. Randomized comparison of vaginal and rectal measurement of intra-abdominal pressure during subtracted dual-channel cystometry. *Urology*. 2005;65:1059–1063.
68. Al-Hayek S, Belal M, Abrams P. Does the patient's position influence the detection of detrusor overactivity? *Neurourol Urodyn*. 2008;27:279–286.
69. Arunkalaivanan AS, Mahomoud S, Howell M. Does posture affect cystometric parameters and diagnoses? *Int Urogynecol J Pelvic Floor Dysfunct*. 2004;15:422–424.
70. Brostrom S, Jennum P, Lose G. Short-term reproducibility of cystometry and pressure-flow micturition studies in healthy women. *Neurourol Urodyn*. 2002;21:457–460.
71. Gupta A, Defreitas G, Lemack GE. The reproducibility of urodynamic findings in healthy female volunteers: results of repeated studies in the same setting and after short-term follow-up. *Neurourol Urodyn*. 2004;23:311–316.
72. Broekhuis SR, Kluivers KB, Hendriks JC, Massolt ET, Groen J, Vierhout ME. Reproducibility of same session repeated cystometry and pressure-flow studies in women with symptoms of urinary incontinence. *Neurourol Urodyn*. 2010;29:428–431.
73. Bellucci CH, Wöllner J, Gregorini F, et al. Neurogenic lower urinary tract dysfunction-do we need same session repeat urodynamic investigations? *J Urol*. 2012;187:1318–1323.
74. Rosier PF, de la Rosette JJ, Koldewijn EL, Debruyne FM, Wijkstra H. Variability of pressure-flow analysis parameters in repeated cystometry in patients with benign prostatic hyperplasia. *J Urol*. 1995;153:1520–1525.
75. Witjes WP, de Wildt MJ, Rosier PF, Caris CT, Debruyne FM, de la Rosette JJ. Variability of clinical and pressure-flow study variables after 6 months of watchful waiting in patients with lower urinary tract symptoms and benign prostatic enlargement. *J Urol*. 1996;156:1026–1034.
76. Sonke GS, Kortmann BB, Verbeek AL, Kiemeny LA, Debruyne FM, de La Rosette JJ. Variability of pressure-flow studies in men with lower urinary tract symptoms. *Neurourol Urodyn*. 2000;19:637–651.
77. Tammela TL, Schäfer W, Barrett DM, et al. Repeated pressure-flow studies in the evaluation of bladder outlet obstruction due to benign prostatic enlargement. Finasteride Urodynamics Study Group. *Neurourol Urodyn*. 1999;18:17–24.
78. Hashim H, Elhilali M, Bjerkklund Johansen TE, Abrams P. ARIB3004 pressure flow study group. The immediate and 6-mo reproducibility of pressure-flow studies in men with benign prostatic enlargement. *Eur Urol*. 2007;52:1186–1193.
79. Griffiths D, Höfner K, van Mastrigt R, Rollema HJ, Spångberg A, Gleason D. Standardization of terminology of lower urinary tract function: pressure-flow studies of voiding, urethral resistance, and urethral obstruction. International Continence Society subcommittee on standardization of terminology of pressure-flow studies. *Neurourol Urodyn*. 1997;16:1–18.
80. Abrams P, Blaivas JG, Stanton S, Anderson JT. Standardisation of terminology of lower urinary tract function. *Neurourol Urodyn*. 1988;403–427.
81. Schäfer W. Principles and clinical application of advanced urodynamic analysis of voiding function. *Urol Clin North Am*. 1990;17:553–566.
82. Abrams PH, Griffiths DJ. The assessment of prostatic obstruction from urodynamic measurements and from residual urine. *Br J Urol*. 1979;51:129–134.
83. Deacon BJ, Lickel JJ, Abramowitz JS, McGrath PB. Development and validation of the shy bladder scale. *Cogn Behav Ther*. 2012;41:251–260.
84. Soifer S, Nicaise G, Chancellor M, Gordon D. Paruresis or shy bladder syndrome: an unknown urologic malady? *Urol Nurs*. 2009;29:87–93.
85. Hammelstein P, Pietrowsky R, Merbach M, Brähler E. Psychogenic urinary retention ('paruresis'): diagnosis and epidemiology in a representative male sample. *Psychother Psychosom*. 2005;74:308–314.
86. Gammie A, Drake M, Swithinbank L, Abrams P. Absolute versus relative pressure. *Neurourol Urodyn*. 2009;28:468.
87. Hogan S, Jarvis P, Gammie A, Abrams P. Quality control in urodynamics and the role of software support in the QC procedure. *Neurourol Urodyn*. 2011;30:1557–1564.
88. Kraus SR, Dmochowski R, Albo ME, Xu L, Klise SR, Roehrborn CG. Urodynamic standardization in a large-scale, multicenter clinical trial examining the effects of daily tadalafil in men with lower urinary tract symptoms with or without benign prostatic obstruction. *Neurourol Urodyn*. 2010;29:741–747.
89. Schaefer W. Humpty Dumpty – still alive. Quality control in urodynamics: analysis of an International Multi-Center Study. Letter to the Editor. *Neurourol Urodyn*. 2010;29:797–798.
90. Lenherr SM, Clemens JQ. Urodynamics: with a focus on appropriate indications. *Urol Clin North Am*. 2013;40:545–557.
91. Liao L, Schaefer W. Qualitative quality control during urodynamic studies with TSPs for cystometry in men with lower urinary tract symptoms suggestive of benign prostatic hyperplasia. *Int Urol Nephrol*. 2014;46:1073–1079.
92. Liao LM, Schaefer W. Effects of retrospective quality control on pressure-flow data with computer-based urodynamic systems from men with benign prostatic hyperplasia. *Asian J Androl*. 2007;9:771–780.

93. Lorenzo AJ, Wallis MC, Cook A, et al. What is the variability in urodynamic parameters with position change in children? Analysis of a prospectively enrolled cohort. *J Urol.* 2007;178: 2567–2570.
94. Nager CW, Albo ME, Fitzgerald MP, et al. Urinary Incontinence Treatment Network. Reference urodynamic values for stress incontinent women. *Neurourol Urodyn.* 2007;26:333–340.
95. Nager CW, Albo ME, Fitzgerald MP, et al. Urinary Incontinence Treatment Network. Process for development of multicenter urodynamic studies. *Urology.* 2007;69:63–67.
96. Sullivan JG, Swithinkbank L, Abrams P. Defining achievable standards in urodynamics-a prospective study of initial resting pressures. *Neurourol Urodyn.* 2012;31:535–540.
97. Liao L, Schaefer W. Urodynamic quality control, I: establishment of typical value ranges and its role in real-time quantitative control. *Chin J Urol.* 2006;27:296–299.
98. Liao L, Schaefer W. Development of urodynamic standards for quality control. In: Ivanov O, ed. *Applications and Experiences of Quality Control*. Rijeka Croatia: InTech; 2011:75–137. ISBN: 978-953-307-236-4.
99. Liao LM, Schaefer W. Effects of retrospective quality control on pressure-flow data with computer-based urodynamic systems from men with benign prostatic hyperplasia. *Asian J Androl.* 2007;9:771–780.
100. Liao L, Schaefer W. Urodynamic quality control, II: Recognition of typical signal pattern and its role in real-time qualitative quality control. *Chin J Urol.* 2006;27:300–303.
101. Uluocak N, Oktar T, Acar O, Incesu O, Ziyilan O, Erkorkmaz U. Positional changes in voiding dynamics of children with non-neurogenic bladder dysfunction. *Urology.* 2008;72: 530–534.
102. Rane A, Iyer J. Posture and micturition: does it really matter how a woman sits on the toilet? *Int Urogynecol J.* 2014;25:1015–1021.
103. Balakrishnan SS, Kannan K, Corstiaans A, Abdullah AR, Rane A. Comparison of Intra-abdominal and Intravesical Pressures in Sitting and Squatting positions. Townsville Australia: Penang Hospital Malaysia, Mater Misericordiae-Townsville Australia. Presented in IUGA 2010. 2007. Available at: <http://www.ics.org/Abstracts/Publish/105/ScientificProgramme.pdf>
104. Moore KH, Richmond D, Sutherst JR, Imrie AH, Hutton JL. Crouching over the toilet seat: prevalence among British gynaecological outpatients and its effect upon micturition. *Br J Obstet Gynaecol.* 1991;98:569–572.



## Good Urodynamic Practices: Uroflowmetry, Filling Cystometry, and Pressure-Flow Studies

Werner Schäfer,\* Paul Abrams, Limin Liao, Anders Mattiasson, Francesco Pesce, Anders Spangberg, Arthur M. Sterling, Norman R. Zinner, and Philip van Kerrebroeck

*International Continence Society Office, Southme Hospital, Bristol, BS10 5NB, United Kingdom*

This is the first report of the International Continence Society (ICS) on the development of comprehensive guidelines for Good Urodynamic Practice for the measurement, quality control, and documentation of urodynamic investigations in both clinical and research environments. This report focuses on the most common urodynamics examinations; uroflowmetry, pressure recording during filling cystometry, and combined pressure–flow studies. The basic aspects of good urodynamic practice are discussed and a strategy for urodynamic measurement, equipment set-up and configuration, signal testing, plausibility controls, pattern recognition, and artifact correction are proposed. The problems of data analysis are mentioned only when they are relevant in the judgment of data quality. In general, recommendations are made for one specific technique. This does not imply that this technique is the only one possible. Rather, it means that this technique is well-established, and gives good results when used with the suggested standards of good urodynamic practice. *Neurourol. Urodynam.* 21:261–274, 2002. © 2002 Wiley-Liss, Inc.

**Key words:** urodynamics; standardisation; uroflowmetry; cystometry; pressure-flow studies

### INTRODUCTION

A Good Urodynamic Practice comprises three main elements:

- A clear indication for and appropriate selection of, relevant test measurements and procedures
- Precise measurement with data quality control and complete documentation
- Accurate analysis and critical reporting of results

The aim of clinical urodynamics is to reproduce symptoms whilst making precise measurements in order to identify the underlying causes for the symptoms, and to quantify the related pathophysiological processes. By doing so, it should be possible to establish objectively the presence of a dysfunction and understand its clinical implications. Thus, we may either confirm a diagnosis or give a new, specifically urodynamic, diagnosis. The quantitative measurement may be supplemented by imaging (videourodynamics).

Urodynamic measurements cannot yet be completely automated, except for the most simple urodynamic procedure, uroflowmetry. This is not an inherent problem of the measurement itself, but is due to the current limitations of urodynamic equipment and the lack of a consensus on the precise method of measurement, signal processing, quantification, documentation, and interpretation. With the publication of this ICS Standardisation document on good urodynamic practice, it

is expected that the necessary technological developments in automation will follow.

Urodynamics allows direct assessment of lower urinary tract (LUT) function by the measurement of relevant physiological parameters. The first step is to formulate the 'urodynamic question or questions' from a careful history, physical examination, and standard urological investigations. The patient's recordings of micturitions and symptoms on a frequency volume chart, and repeated free uroflowmetry with determination of post-void residual volume provide important

---

Urodynamic techniques were performed according to the 'Good Urodynamic Practice' recommended by the International Continence Society.

This report is from the Standardization Committee of the International Continence Society.

\*Correspondence to: Werner Schäfer, International Continence Society Office, Southme Hospital, Bristol, BS10 5NB, United Kingdom.  
E-mail: Vicky@icsoffice.org

DOI 10.1002/nau.10066

Published online in Wiley InterScience (www.interscience.wiley.com).

© 2002 Wiley-Liss, Inc.



noninvasive, objective information that helps to define the specific 'urodynamic question' or questions, prior to invasive urodynamics such as filling cystometry and pressure-flow studies.

Recommendations for good urodynamic practice are bullet pointed, inset, and printed in bold.

## RECORDING MICTURITIONS AND SYMPTOMS

A *Micturition Time Chart* records the time of each micturition. The usefulness of such a record is significantly enhanced when the voided volumes are recorded in a *Frequency Volume Chart*. The *Bladder Diary* adds to this the relevant symptoms and events such as urgency, pain, incontinence episodes, and pad usage. Recording for a minimum of 2 days is recommended. From the recordings, the average voided volume, voiding frequency, and if the patient's time in bed is recorded, day/night urine production and nocturia can be determined. This information provides objective verification of the patient's symptoms, and furthermore, key values for plausibility control of subsequent urodynamic studies, for example, in order to prevent over-filling of the patient's bladder.

## UROFLOWMETRY

Uroflowmetry is noninvasive and relatively inexpensive. Therefore, it is an indispensable, first-line screening test for most patients with suspected LUT dysfunction. Objective and quantitative information, which helps one to understand both storage and voiding symptoms are provided by this simple urodynamic measurement.

Adequate privacy should be provided and patients should be asked to void when they feel a "normal" desire to void. Patients should be asked if their voiding was representative of their usual voiding and their view should be documented. Automated data analysis must be verified by inspection of the flow curve, artifacts must be excluded, and verification must be documented. The results from uroflowmetry should be compared with the data from the patient's own recording on a frequency/volume chart. Sonographic estimation of post-void residual volume completes the noninvasive assessment of voiding function.

### Normal Uroflow

Normal voiding occurs when the bladder outlet relaxes (is passive) and the detrusor contracts (is active). An easily distensible bladder outlet with a normal detrusor contraction results in a smooth arc-shaped flow rate curve with high amplitude. Any other shapes, such as curves that are flat, asymmetric, or have multiple peaks (fluctuating and/or intermittent), indicate abnormal voiding, but are not specific for its cause.

It is assumed that it is normal for the mechanical properties of a relaxed outlet to be constant, and that the properties can be defined by the dependency of the cross-sectional area of the

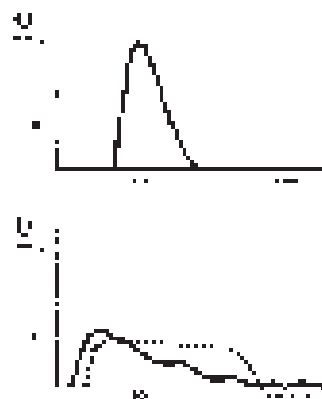


Fig. 1. Typical normal flow (top), constrictive flow (bottom, dotted line), compressive flow curve (bottom).

urethral lumen on the intraurethral pressure at the flow rate controlling zone (FRCZ). Typically, below the minimum urethral opening pressure (pmuo), the urethral lumen is closed. The lumen then opens widely with little additional pressure increase. With normal detrusor contractility and low intraurethral pressure, the normal flow curve is arc-shaped with a high maximum flowrate. (Fig. 1, top).

A normal flow curve is a smooth curve without any rapid changes in amplitude, because the shape of the flow curve is determined by the kinetics of the detrusor contraction, which arising from smooth muscle, does not show rapid variations. A decreased detrusor power and/or a constant increased urethral pressure will both result in a lower flowrate and a smooth flat flow curve. A constrictive obstruction (e.g., urethral stricture), with reduced lumen size results in a plateau-like flow curve. (Fig. 1, broken line).

A compressive obstruction with increased urethral opening pressure (e.g., benign prostatic obstruction) shows a flattened asymmetric flow curve with a slowly declining end part. (Fig. 1, bottom).

The same pattern may also originate from a weak detrusor in aging males and females. Fluctuations in detrusor contractility or abdominal straining, as well as variable outlet conditions, (e.g., intermittent sphincter activity) will lead to complex flow rate patterns.

Rapid changes in flowrate may have physiological or physical causes that owe to either changes in outlet resistance, for example, sphincter/pelvic floor contraction or relaxation, mechanical compression of the urethral lumen, or interference at the meatus, or to changes in driving energy, for example, abdominal straining. These intracorporeal causes lead to true flowrate changes. Rapid changes in flowrate may also be artifacts, when the flowrate signal is extracorporeally modified through interference between the stream and the collecting funnel, the flowmeter, movement of the stream across the

surface of the funnel, or patient movements. (see flow-curves in Figs. 3–8).

### Accuracy of Uroflowmeters

Uroflowmetry measures the flow rate of the external urinary stream as volume per unit time in milliliters per second, (ml/s). The ICS Technical Report [Rowan et al., 1984] made technical recommendations with respect to uroflowmetry, but did not compare different flowmeters by specific testing. There are, however, differences in the accuracy and precision of the flow rate signals that depend on the type of flowmeter, on internal signal processing, and on the proper use and calibration of the flowmeter. The desired and actual accuracy of uroflowmetry should be assessed in relation to the potential information that could be obtained from the urinary stream compared to the information actually abstracted for clinical and research purposes. Some relevant aspects of the physiological and physical information contained in the urinary stream are outlined here.

The desired clinical accuracy may differ from the technical accuracy of a flow meter. The ICS Technical report recommended the following standards: a range of 0–50 ml/s for  $Q_{\max}$ , and 0–1,000 ml for voided volume, maximum time constant of 0.75 s; an accuracy of  $\pm 5\%$  relative to full scale, although a calibration curve representing the percentage error over the entire range of measurement should be made available. However, technical specifications from the manufacturers are rare and often not in accordance with ICS recommendations: this situation should be rectified.

Furthermore, as most flowmeters are mass flow meters (e.g., a weight transducer or rotating disk), variations in the specific gravity of the fluid will have a direct influence on the measured flow rate. For example, urine of high concentration may increase apparent flow rate by 3%. With X-ray medium, the flow rate may be overestimated by as much as 10%. These effects should be corrected by calibration software.

Thus, since the overall accuracy of flow rate signals will not be better than  $\pm 5\%$ , it would not be meaningful to report a maximum flow rate to a resolution better than a full milliliter per second (ml/s). Under carefully controlled research conditions, a better resolution may be possible by flowmeter calibration and instrument selection. However, such improvements in resolution may not be required for routine clinical applications. The dynamic properties of most flowmeters will be good enough for free uroflowmetry. When pressure flow data are analyzed, however, the limitation in signal dynamics should be taken into account because they will be different for pressure than for flow. Flow signals have a much slower response, and are less accurate than pressure signals.

### Problems in Urine Flow Rate Measurement

The problems in measurement, as well as the information that can be abstracted from the flow rate signal are rather dif-

ferent for free uroflowmetry compared to combined pressure/flow recordings.

In free uroflowmetry, the shape of the flow curve may suggest specific types of abnormality, but reliable, specific, and detailed information about the cause for abnormal voiding cannot be derived from a flow curve alone. Only when uroflowmetry is combined with intravesical and abdominal pressure recordings does it become possible, from the pressure–flow relationship, to analyze separately the contributions of detrusor contractility and bladder outlet function to the overall voiding pattern. (Figs. 3–8)

Urine flow rate measurement is affected by a number of important factors.

### Detrusor Contractility

As the voiding function reflects the interaction between the relaxed outlet and the contracting detrusor, variation of both will affect the flow. For steady outflow conditions, all variations in flowrate are related to changes in detrusor activity alone. The detrusor contraction strength varies neurogenically and myogenically, and can cause significant variability in urine flow rate measurements. (Fig. 5).

### Bladder Outflow Resistance

If detrusor, contractility is constant, then changes in outflow resistance will lead to changes in flow rate, for example, in patients with detrusor–sphincter dyssynergia (Figs. 3, 7, 8).

### Bladder Volume

As the bladder volume increases and the detrusor muscle fibers become more stretched, there is an increase in the potential bladder power and work associated with a contraction. This is most pronounced in the range from empty up to 150–250 ml bladder filling volume. It appears that at volumes higher than 400–500 ml, the detrusor may become overstretched and contractility may decrease again. Therefore,  $Q_{\max}$  is physiologically dependent on the bladder volume. This dependency will vary between individuals and with the type and degree of pathology, for example, in constrictive obstruction,  $Q_{\max}$  is almost independent of volume, and in compressive obstruction, the dependency becomes weaker with increasingly obstructed outlet conditions and lower flow rate.

### Technical Considerations

The flow rate signal is influenced by the technique of measurement and by signal processing. The external urinary stream should reach the flowmeter unaltered and with minimal delay. However, any funnel or collecting device, as well as the flowmeter, will inevitably introduce modifications to

the flow rate recording. Physically, the external urinary stream breaks into drops not far from the meatus. This fine structure of the stream has a high frequency, which can be assessed by drop spectrometry, and contains interesting information. For standard uroflowmetry, however, such high frequencies should be eliminated by signal processing.

For free uroflowmetry, all intracorporeal modulations of the flow rate are physiological artifacts and should be minimized, for example by asking the patient to relax and not to strain. Nevertheless, certain dynamic patterns of intracorporeal modulations can provide information about functional obstruction, for example, typical patterns of the detrusor-sphincter dyssynergia, or abnormal straining. This information may be lost by excessive filtering or during analog to digital A/D conversion with a filter speed of less than 10 Hz. The precise interpretation of dynamic variations in the flow rate signal is only possible when the flow rate is viewed together with the simultaneously recorded pressure signals. Thus, only in combined pressure-flow recordings can the details of the flow signal be fully understood.

For the determination of the 'true' maximum flow rate value, particularly during free flow, such high frequency signal variations are more likely to be misleading, and consequently they should be suppressed electronically.

### Recommendations for Uroflowmetry

In order to facilitate the recording of urine flow rate and pattern recognition of flow curves, it is recommended that graphical scaling should be standardized as follows:

- one millimeter should equal 1 s on the x-axis and 1 ml/s and 10 ml voided volume on the y-axis.

With respect to the technical accuracy of uroflowmeters, it is meaningful for routine clinical measurements to read flowrate values only to the nearest full ml/s and volumes to the nearest 10 ml.

In order to make electronically-read  $Q_{\max}$  values more reliable, comparable, and clinically useful, we recommend internal electronic smoothing of the flow rate curve. It is recommended that:

- a sliding average over 2 s should be used to remove positive and negative spike artifacts.

If curves are smoothed by hand, the same concept should be applied. That is, when reading  $Q_{\max}$  graphically, the line should be smoothed by eye into a continuous curve so that in each period of 2 s, there are no rapid changes. Such a smoothed, clinically-meaningful maximum free flow  $Q_{\max}$  will be different (lower) from the peak value in the flow rate recording of electronic instruments currently available. (see Figs. 2, 5, 6, 8).

It is recommended that:

- only flow rate values, which have been 'smoothed', either electronically or manually, should be reported.

If a maximum flow value is determined electronically by simple signal peak detection without the recommended electronic smoothing, it should be labeled differently,  $Q_{\max, \text{raw}}$ . Such raw data has meaning only if a detailed specification of the type of flowmeter used is given.

The interpretation of any dynamic variation (signal patterns) in free flow will rely on personal experience, can be only descriptive, and in general will remain speculative.

For the documentation of the results of uroflowmetry, the following recommendations are made:

- Maximum (smoothed) urine flow rate should be rounded to the nearest whole number (a recording of 10.25 ml/s would be recorded as 10 ml/s);
- Voided volume and post void residual volume should be rounded to the nearest 10 ml (a recording of a voided volume of 342 ml would be recorded as 340 ml);
- The maximum flow rate should always be documented together with voided volume and post void residual volume using a standard format: VOID: Maximum Flow Rate/Volume Voided/Post Void Residual Volume.

For example, the automatically detected flows,  $Q_{\max, \text{raw}}$ , are 16.6 and 21.3 ml/s with voided volumes 86 and 182 ml, respectively. The smoothed  $Q_{\max}$  values are 8 and 17 ml/s and should be reported with voided volumes of 90 and 180, respectively, and the estimated residuals as VOID1 = 8/90/0 and VOID2 = 17/180/20 (see Figs. 2, 5, 6).

The adoption of these standards will aid the interpretation of uroflowmetry results. If data are not available, then a hyphen should be used, for example, if only the voided volume is known, VOID:—/340/— or if the voided volume was missing, VOID: 10/—/90.

- If a flow/volume nomogram is used, this should be stated and referenced.

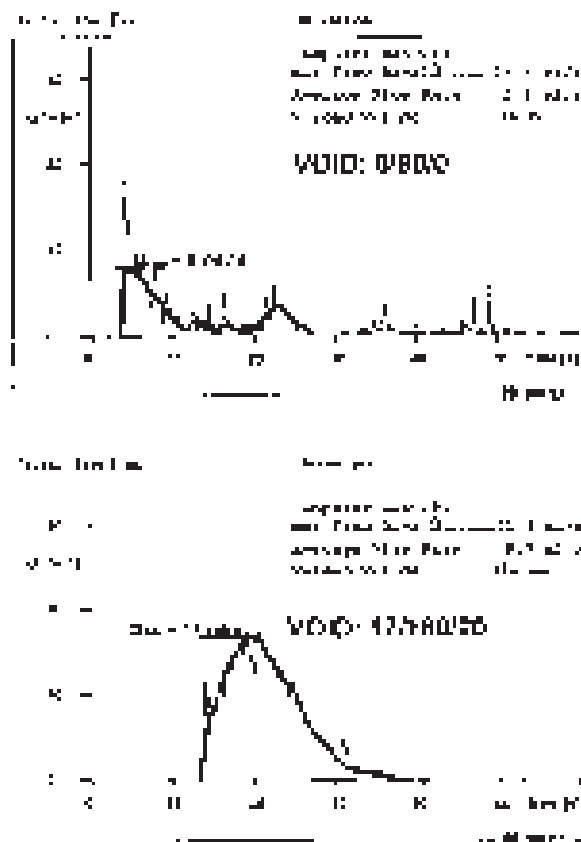
Uroflowmetry data from other than free flow, for example, measured in combination with intravesical pressure should be reported with an additional descriptive index, p, i.e.,  $Q_{\max, \text{p}}$ , for pressure-flow recording.

## INVASIVE URODYNAMICS: FILLING CYSTOMETRY, PRESSURE-FLOW STUDY OF VOIDING

### Introduction

Invasive urodynamic procedures should not be performed without clear indications and the formulation of specific urodynamic question(s). This process will usually be aided by the a priori completion of a frequency volume chart and free uroflowmetry. There are certain key recommendations, which will lead to the performance of a successful urodynamic study.

- A good urodynamic investigation should be performed interactively with the patient. It should be established by



**Fig. 2.** Exclusion of artifactual spikes in the flow curve,  $Q_{\max,raw}$ , and determination of a clinically relevant maximum flow rate,  $Q_{\max}$ , by manual smoothing. The results from uroflowmetry should be reported in the standard format:  $Q_{\max}/V_{void}/V_{res}$ .

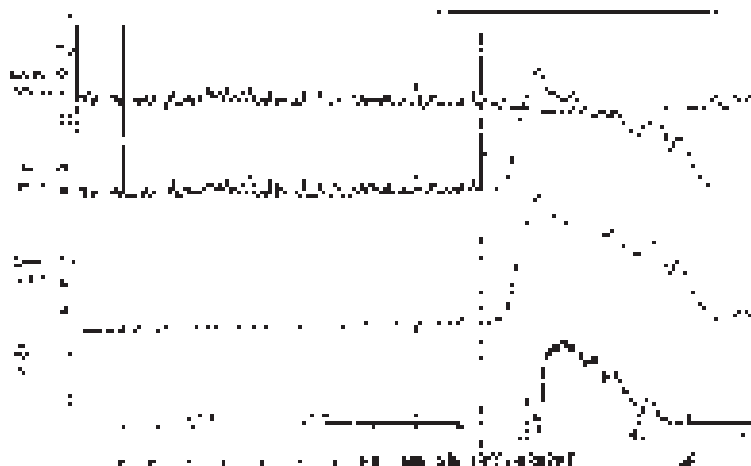
discussion with the patient that the patient's symptoms have been reproduced during the test;

- There should be continuous and careful observation of the signals as they are collected, and the continuous assessment of the qualitative and quantitative plausibility of all signals;
- Artifacts should be avoided, and any artifacts that occur should be corrected immediately. It is always difficult and is often impossible to correct artifacts during a retrospective analysis. Furthermore, it is more time consuming than if the signals are continuously observed and tested at regular intervals and artifacts recognized during the urodynamic study and corrected.

At present, ambulatory urodynamic monitoring has to rely on retrospective quality control and artifact corrections. However, in principle, the same quality criteria apply for ambulatory urodynamic monitoring as for standard urody-

namics [van Waalwijk et al., 2000]. This makes a consensus on quality even more important, because only when such criteria are precisely defined can they be implemented in an "automated intelligent" ambulatory system.

Quality control relies on pattern recognition and a knowledge of normal values as well as prior identification of useful information obtained from noninvasive urodynamics and all other sources relevant for the urodynamic question. Thus, before invasive urodynamics, a frequency volume chart should be completed and multiple free flows should be evaluated. Useful information obtained from noninvasive testing includes typical voided volumes and post-void residual volumes as well as the expected values for  $Q_{\max}$ . This information should be used for the control of subsequent invasive studies. Only by good preparation can it be assured that (a) the proper answers to the urodynamic questions will be obtained before the study is terminated and (b) necessary modifica-

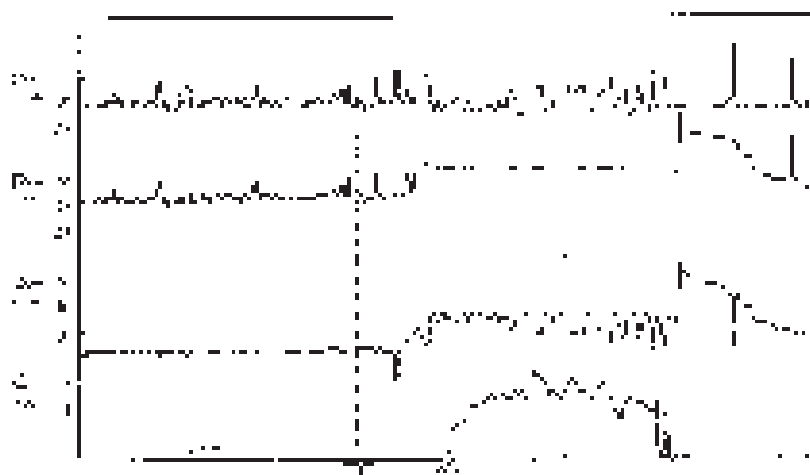


**Fig. 3.** Full recording of filling and voiding. Starting with initial values for  $p_{ves}$ ,  $p_{abd}$  of 32 cmH<sub>2</sub>O in the typical range for a standing patient with zero  $p_{det}$ ; testing signal quality with a vigorous cough at beginning, and regularly repeated (here less strong) coughs. Additionally, the pressure recordings show the typical pattern of a talking patient, while the  $p_{det}$  trace is unaffected; a weak contraction at first desire FD; another vigorous cough before voiding; beginning of flow shows dyssynergic sphincter activity as proven by decrease in flow with increase in  $p_{det}$ .

tions, additions, or repetitions of measurements will have been performed in order to derive the necessary information.

The effective practice of urodynamics requires: (a) a theoretical understanding of the underlying physics of the measurement, (b) practical experience with urodynamic equipment

and procedures, (c) an understanding of how to assure quality control of urodynamic signals, and (d) the ability to analyze critically the results of the measurements. Because urodynamics deals largely with mechanical measurements such as pressure and volume and their related changes in time, and



**Fig. 4.** Good recording quality until cystometric capacity CC is reached; at second cough before voiding the intravesical signal is lost (no response in  $p_{ves}$ , negative spike in  $p_{det}$ ). Dead  $p_{ves}$  — signal during voiding, which is “live” again only at second cough after voiding. Thus, pressure–flow study is lost. Careful observation of signals would have made it possible to interrupt the study immediately when signal failed and correct this problem before voiding starts.

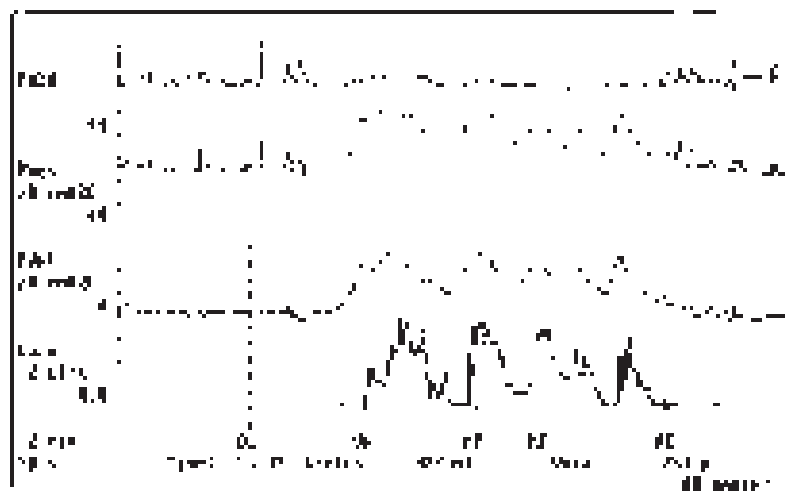


Fig. 5. Variable flowrate due to varying detrusor contraction strength. VOID: 7/250/70.

because many analytical models use mechanical concepts such as resistance to flow or contraction power, it is essential that the nature of these measurements and concepts, in particular for pressure and flowrate, are understood. Therefore, in addition to a comprehensive understanding of anatomy and physiology, some basic knowledge of biomechanics and physics is required.

The quality control of urodynamic measurements must be approached on a holistic basis. Different types and levels of data

quality and plausibility control should be used: (a) on a physical and technical level, (b) on a biomechanical level, and (c) on a pathophysiological clinical level. A common problem in urodynamics is that clinicians often proceed immediately to a clinical interpretation, i.e., to level c without a critical analysis of the potential pathophysiological information content, without considering the plausibility of the signals (level a), without considering the biomechanical context of the measurements (level b), and without taking into account the physical properties of the

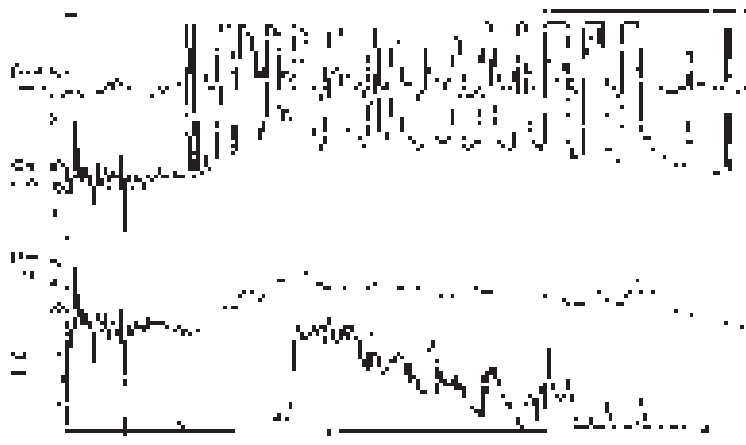
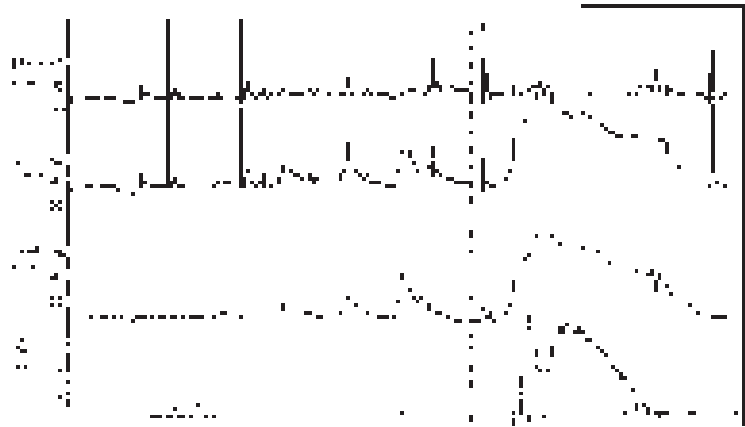


Fig. 6. The first part of the traces shows typical bi-phasic movement artifacts. The two coughs before voiding prove good recording quality. The typical picture of a unobstructed voiding: a weak detrusor contraction with  $P_{det}$  of 40 cmH<sub>2</sub>O and a  $Q_{max}$  of 9 ml/s is supported by vigorous straining, which causes some variability in flow (VOID: 9/380/100).



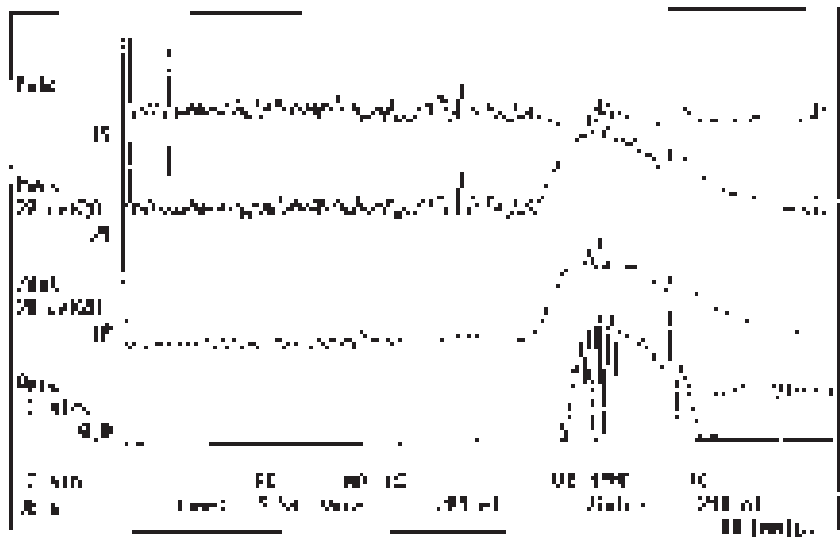
**Fig. 7.** A good recording showing the typical pattern of increasing detrusor overactivity and a dyssynergic event during voiding.

parameters, technical limitations, and accuracy of the signals. Therefore, it is recommended that:

- Invasive urodynamics should not be performed without precise indications and well-defined ‘urodynamic questions’ that are to be answered by the results of the urodynamic study.

**Measurement of Urine Flow Rate During Pressure–Flow Studies**

The usefulness of the concept of a FRCZ for data analysis requires that the recorded pressure and flow rate signal be synchronized with respect to the FRCZ [Griffiths et al. 1997]. Normally, no measurable time delay will exist between



**Fig. 8.** High quality recordings allow detailed interpretation. The typical pattern of rectal activity becomes clearly visible in  $p_{det}$ . The flow artifacts can be identified as dyssynergic events and manually corrected from  $Q_{max,raw} = 11.2 \text{ ml/s}$  to  $Q_{max} = 9 \text{ ml/s}$ .



the intravesical pressure signal and the actual flow at the FRCZ. However, a significant delay is to be expected for the typical urodynamic flow rate recorded extracorporeally. This delay will vary with anatomy, pathology, flow rate, and the set-up for measurement. Our understanding of the actual dynamics of flow rate changes is limited, and the relatively slow response of most flow meters may not be sufficient to match the dynamics of the much-faster pressure signal. The actual time difference may be from 0.5 to 2 s; the time delay between urethral closure and the end of any flow recording may be much longer, particularly in prostatic obstruction and terminal dribbling than between the opening of the urethra and the start of a flow rate signal. Therefore, we recommend the use of more descriptive terminology for synchronizing pressure and flow values, such as  $p_{\text{det},Q_{\text{beg}}}$  for the pressure at which flow begins instead of  $p_{\text{det},\text{open}}$ , and  $p_{\text{det},Q_{\text{end}}}$  when flow ends instead of  $p_{\text{det},\text{close}}$ . The time delay correction needs to be considered when analyzing pressure flow studies [Griffiths et al. 1997].

In average, the maximum flow rate  $Q_{\text{max}}$  recorded during PF studies, ( $Q_{\text{max},p}$ ), is lower than during free flow ( $Q_{\text{max}}$ ). This, however, is not due simply to a mechanical increase of outflow resistance by the intraurethral catheter, because such a difference is also found in suprapubic PF studies. A difference has also been reported between  $Q_{\text{max},p}$  during conventional and ambulatory urodynamics. This indicates more complex causes, possible psychogenic, but also physiologic, for example, that a difference in detrusor contraction strength may be involved, and that the fast filling rate used in clinical studies may lead to reduced contractility. This could also explain the difference in results between conventional and ambulatory studies.

#### Measurement of Intravesical and Abdominal Pressure

- It is recommended that there is strict adherence to the ICS standardization of zero pressure and reference height. Only then can pressure recordings be compared between patients and centers.

Zero pressure and reference height are concepts which are often confused in urodynamics. For example, by use of the misleading term “zero reference height”. As both are independent features of pressure, they must be considered separately, and both must follow recommended ICS methodology.

- Zero pressure is the surrounding atmospheric pressure.

Zero pressure is the value recorded when a transducer is open to the environment when disconnected from any tubes or catheters, or when the open end of a connected, fluid-filled tube is at the same vertical level as the transducer. Only then can a “set zero” or “balance” be performed.

- The reference height is defined as the upper edge of the symphysis pubis.

The reference height is the level at which the transducers must be placed so that all urodynamic pressures have the same hydrostatic component. It is often argued that it does not make a difference for the most relevant parameter,  $p_{\text{det}}$ , if the same error is introduced to  $p_{\text{ves}}$  and  $p_{\text{abd}}$ , as they tend to cancel each other out. This is not an acceptable argument. The hydrostatic pressure is real and important, and inevitably plays a role in any intracorporeal pressure recording. Many important aspects of quality and plausibility control, such as typical resting value ranges at different patient position, are based on the proper recording of pressures, and will not apply if pressures are not recorded according to ICS standards. Also, it is only meaningful to subtract one pressure from the other, for example ( $p_{\text{ves}} - p_{\text{abd}} = p_{\text{det}}$ ), when both are recorded to the same reference level.

#### Pressure Transducers

Urodynamic techniques were developed using external pressure transducers connected to the patient with fluid-filled lines, allowing easier compliance with the standards of correct zero and reference height. Catheter mounted pressure transducers, so-called microtip transducer catheters have become popular due to their apparent higher accuracy, better dynamic resolution, and their apparent independence from hydrostatic pressure. A catheter mounted pressure transducer is an advantage for dynamic recordings of urethral pressures during coughing (stress profiles) as well as for ambulatory urodynamics in mobile patients. Here only the application of catheter mounted pressure transducers for intravesical and abdominal pressure recordings will be discussed as urethral pressures are dealt with in a separate report [Lose et al., 2002].

All aspects of urodynamic pressure recording outlined in the preceding section are valid and independent of transducer type. It is impossible to define the precise position of an intravesical and a rectal catheter mounted pressure transducers at to place them at any common level, and impossible to position them at the standard level of the upper boarder of the symphysis pubis. It has become popular to circumvent this problem by setting the catheter mounted pressure transducers to zero pressure when inside the body at the start of pressure recording. This, however, means that both the standard zero pressure as well the reference level are ignored, so that such recorded pressure cannot be compared between patients or centers. The fact is, the initial intravesical and abdominal resting pressures are real, are different between patients, and depend significantly on patient's position. Thus, there are significant potential errors; by ignoring the correct atmospheric zero pressure, an error of up to 50 cmH<sub>2</sub>O, and as the reference height of the catheter mounted pressure transducers is usually undetermined, another potential error of 10 cmH<sub>2</sub>O is possible for a full bladder can occur. In addition, when a study starts with zero abdominal pressure then the commonly observed abdominal pressure decrease at pelvic floor relaxation during voiding will evidently result in negative abdominal pressure values, and thus in  $p_{\text{det}}$  being higher than  $p_{\text{ves}}$ .

The same problems of apparent independence from the existing hydrostatic pressure also applies to air-filled catheters and/or connection tubings. Due to the absence of a water column between the balloon-covered opening on the catheter and the external transducer, the reference height in an air-filled system will refer to the position of the sensing balloon on the catheter and not to the external transducer.

- It is recommended that for intravesical and abdominal pressure recording external transducers connected to fluid-filled tubings and catheters be used. If microtip or air-filled catheters are used, any deviation from standard zero and reference level should be minimized and taken into account at the time of data analysis.

### Urodynamic Catheters

Comparison between patients and urodynamic studies performed in different centers would be facilitated by the use of standard catheters. It is recommended that:

- For the measurement of intravesical pressure and for bladder filling, the standard catheter for routine urodynamics is a transurethral double-lumen catheter.

Only in small children and patients with severe constrictive obstruction (stricture) does suprapubic pressure recording have clear advantages. Intraurethral catheters should be as thin as possible, limited only by the practicality of insertion and by internal lumen sizes, which should be sufficiently large to avoid excessive damping of pressure transmission and to achieve the desired filling rate with standard pumps. A 6-Fr double lumen catheter is the smallest practical size at present.

The major advantage of a double lumen catheter is that the fill/void sequence can be repeated without the need for re-catheterization. Note that the use of a 6-Fr double lumen catheter can limit the infusion rate during cystometry to 20–30 ml/min, as a typical roller pump may not manage to transport a higher perfusion rate through such a small lumen. This can result in an incorrect filling volume being indicated by the machine, when the filling volume is calculated from the pump setting. For example, with a filling rate set at 60 ml/min and an actually achieved filling rate of 30 ml/min, the machine will show double the filling volume. Thus after voiding, a high calculated residual will occur. With some equipment, higher filling rates are possible; it is essential that any system should be critically tested to (a) measure the maximum filling rate that can be achieved by a particular catheter attached to an individual pump and (b) correct or calibrate the indicated infused volume.

The use of two separate tubes for filling and recording is less convenient. Removing the larger filling tube for voiding may appear to be an advantage because only a single small tube is left in the urethra. However, there are no data to suggest that, for example, in a compressive obstruction such as BPO, a 6-F catheter has detrimental influence on the pressure

or flow data. There are, however, data suggesting that results from a single study may be misleading. A double lumen catheter facilitates a second fill/void study to establish reproducibility. Re-introduction of the separate filling tube for a repeated study is more invasive and complicated.

- The use of a rectal balloon catheter is recommended for the measurement of abdominal pressure,  $p_{abd}$ .

Although there are various methods for the successful recording of abdominal pressures, a flaccid, air-free balloon in the rectal ampulla gives a suitable signal for  $p_{abd}$  to determine a meaningful  $p_{det}$  when  $p_{ves}$  is measured synchronously ( $p_{det} = p_{ves} - p_{abd}$ ). In females, vaginal recording may be more acceptable and provides comparable results. The recording of  $p_{abd}$  allows the measurement of any abdominal (i.e., perivesical) pressure component during changes in intravesical pressure. The role of the balloon is to maintain a small fluid volume at the catheter opening and to avoid fecal blockage, which can prevent or impair pressure transmission to the transducer. Additionally, as the rectal ampulla and the vagina are not homogeneously fluid filled spaces, the balloon prevents pressure artifacts arising from contact between the catheter opening and the wall tissue. The balloon serves this function best when it is filled only to 10–20% of its unstretched capacity. Overfilling and elastic distention of the balloon is the most common mistake in abdominal pressure recording. The resultant high balloon (not abdominal) pressure will produce a misleading pressure reading. Such an artificially-elevated balloon distention pressure can be avoided by making a small hole in the balloon, although this is unnecessary if the balloon is filled properly as described above. It is also possible to record reliable abdominal pressure with a very slowly perfused (<2 ml/min) open ended catheter. However, excessive fluid volume in the rectal ampulla may cause problems.

### Equipment: Minimum Requirements for Filling Cystometry and Pressure–Flow Studies of Voiding

The ICS has not yet specified definite technical standards in respect of minimum requirements for filling cystometry and pressure flow studies beyond the ICS Technical Equipment Report [Rowan et al. 1997] and the appendix to the ICS document on pressure flow [Griffiths et al., 1997], where an data exchange software standard is recommended. Some further aspects will be discussed in more detail here.

#### Equipment Recommendations

The minimum recommended requirements for a urodynamic system are:

- three measurement channels, two for pressure and one for flow;
- a display (on printer and/or monitor) and secure storage of three pressures ( $p_{abd}$ ,  $p_{ves}$ ,  $p_{det}$ ) and flow ( $Q$ ) as tracings against time;

- infused volume and voided volume may be shown graphically or numerically;
- on-line display of pressures and flow, with adequate scale and resolution; scales must be clearly given on all axes; no information should be lost electronically when tracings go off-scale on display;
- possibilities to record standard information about sensation and additional comments (event recording).

Meaningful plausibility assessment and quality control is possible only when the measured and derived signals are displayed continuously as curves over time, without delay (in real time), as the examination proceeds. Each displayed curve and number should be labeled according to ICS standards with clear scaling of amplitudes and the time axis. The following sequential position of tracings is suggested:  $p_{abd}$  at the top, then  $p_{ves}$ ,  $p_{det}$  and  $Q$  (see Figs. 3–8). It is least important when  $p_{abd}$  goes off-scale and is cut off (Fig. 6). Additional parameters such as EMG, bladder filling, and voided volumes can be displayed either as curves or digitally as numbers.

The following minimum technical specifications are recommended:

- Minimum accuracy should be  $\pm 1$  cmH<sub>2</sub>O for pressure and  $\pm 5\%$  full scale for flow and volume;
- Ranges of 0–250 cmH<sub>2</sub>O, 0–25(50) ml/s, and 1,000 ml for pressure, flow, and volume, respectively;
- The software must ensure that no information for pressures up to 250 cmH<sub>2</sub>O and for flow rates up to 50 ml/s is lost internally even when not displayed and that off-scale values are clearly identified;
- An analog/digital (A/D) frequency of 10 Hz per channel as the lower limit for pressure and flow;
- A higher frequency (minimum 20 kHz) is necessary for recording EMG;
- Calibration of all measurements should be possible.

The scalings should be kept unchanged as much as possible, because urodynamic data quality control is based on pattern recognition, and the recognition of patterns depend on scaling. Therefore, it is recommended that:

- During recording and for analysis, minimum scaling for pressure be of 50 cmH<sub>2</sub>O per cm, for flow 10 ml/s per cm, and for the time axis 1 min/cm or 5 s/mm during filling and 2 s/mm during voiding.

To enable a retrospective judgment of the curves, urodynamic measurements should be documented as curves over time with comments and explanations. It is usually insufficient to document urodynamic measurements by a few numerical values alone. The same amplitude of scaling should be used for all documentation, although the time axis may be compressed. Only if there is no relevant information to be lost by reducing resolution, for example, during filling, the time scale can be compressed.

For a print-out, maximum full scale deflections of 200 cmH<sub>2</sub>O, 50 ml/s, and 1,000 ml are sufficient for pressure, flow and volume, respectively. In most cases, half the maximum full scale will be sufficient to show all relevant parts of curves. Line resolution should be better than 0.10 mm.

During interventions, for example, interruption of bladder filling or manipulation of catheters, the continuation of both measurement and recording must always be possible.

On-line recording of comments should be possible, to complete the documentation.

### Calibration of Equipment

The need to calibrate pressure transducers, flowmeters, and pumps cannot be stated; simply “yes” if there is a need or “no” there is not. The specification of the manufacturer should be studied. Two aspects must be considered: the intended accuracy of the system and the investigator’s experience with the system. If a new system is installed or new transducers are being used, it is recommended that regular calibration be carried out. If experience with daily calibration shows that the potential error is small (e.g.,  $< 2$  cmH<sub>2</sub>O), then it will be sufficient to calibrate once a month. However, calibration should not be ignored and good urodynamic equipment makes it technically possible to perform a calibration. Calibration should not be confused with simple ‘zero balancing’, which is only one part of a calibration. In addition to setting the zero, it must be possible to check and adjust the amplitudes of all measurement channels, i.e., to calibrate all signals.

Calibration of a flowmeter can be achieved by pouring a precisely measured volume at a constant flow into the flowmeter, typically 400 ml in 20–30 s (at 15–20 ml/s) and checking the recorded volume. Special constant-flowrate bottles are available for flow calibration. Similarly, one can test a pump by measuring the time to deliver a known volume, for example, 100 ml into a measuring cylinder. It is recommended that pump calibration be performed with the filling catheter connected. Such a pump calibration can only be as good as the cylinder used, which needs to have good resolution and be accurate. Some measuring beakers that are usually available in clinics are not accurate.

### Pressure Signal Quality Control: Qualitative and Quantitative Plausibility

It is very important to observe and to test signals carefully and to correct any problems before starting the urodynamic study. If the signals are perfect at the beginning of the study, they usually remain so without the need for major intervention. If the signals are not perfect, remedial action must be taken. If a quality problem does not disappear at once, when filling commences, it will usually deteriorate further during the study.

Conscientious observation of the patient and of the signals, in particular  $p_{det}$ , during all parts of the study, together with

continuous signal testing, are the keys to high quality urodynamics. The first aim is to avoid artifacts and the second to correct the source of all artifacts immediately when they occur.

The following three criteria form the minimum recommendations for ensuring quality control of pressure recordings:

- Resting values for abdominal, intravesical, and detrusor pressure are in a typical range (see below);
- The abdominal and intravesical pressure signals are 'live', with minor variations caused by breathing or talking being similar for both signals; these variations should not appear in  $p_{det}$ ;
- Coughs are used (every 1 min. or, for example, 50 ml filled volume) to ensure that the abdominal and intravesical pressure signals respond equally. Coughs immediately before voiding and immediately after voiding should be included.

When standards are followed, i.e., with the transducer zeros set to atmospheric pressure, and the transducers placed at the level of the upper edge of the symphysis, a typical range for initial resting pressures values for  $p_{ves}$  and  $p_{abd}$  is (Schäfer, unpublished communications):

- supine 5–20 cmH<sub>2</sub>O.
- sitting 15–40 cmH<sub>2</sub>O.
- standing 30–50 cmH<sub>2</sub>O.

Usually both recorded pressures are almost identical, so that the initial  $p_{det}$  is zero, or close to zero, 0–6 cmH<sub>2</sub>O in 80% of cases and in rare cases up to 10 cmH<sub>2</sub>O [Liao et al., 1999].

All initial pressure values should be verified and patients' position should be documented on the urodynamics trace.

All negative pressure values, except when caused by rectal activity, should be corrected immediately. It should always be kept in mind that  $p_{abd}$  is recorded not to know the actual rectal pressure, but to eliminate the impact of (abdominal) pressure changes on  $p_{ves}$ . The principal aim is to determine the detrusor pressure,  $p_{det}$ , which is the pressure in the bladder without the influence of abdominal pressure. Therefore,  $p_{det}$  cannot be negative.

By talking to the patient during the study, the proper dynamic response in the pressure signals can be observed and is "automatically" documented (see Figs. 3, 4, 8).

### Problem Solving

If either detrusor or rectal contractions occur, the recorded pressures in  $p_{ves}$  and in  $p_{abd}$  will be different. Such changes can be identified and interpreted with sufficient accuracy and reliability only when the patient is observed and the relation between signal changes and patient sensation/activity are checked for plausibility and documented. Any pressure change caused by smooth muscle contractions will show a "smooth" pattern, (Figs. 5, 7, 8) i.e., there should be no rapid ("stepwise") changes (Fig. 4). If pressures increase or decrease step-wise, or with a constant slope over a long period of time,

a nonphysiological cause, such as catheter movement, should be considered.

If a sudden drop or increase occurs in either the  $p_{ves}$  or  $p_{abd}$  signal, the usual cause is the movement, blockage (Fig. 4), or disconnection of a catheter. When the patient changes position, sudden changes in resting values occur and are seen equally in both pressure signals. If  $p_{ves}$  (without change in  $p_{abd}$ ) increases slowly—as typical for a low compliance bladder—it is important to test for any other possible cause for a slow pressure increase. One cause could be a problem with the intravesical catheter measurement, for example, the hole for the pressure conducting lumen is slowly moving into the bladder neck region. This should be assessed by asking the patient to cough, if there is no other apparent artifact. Furthermore, it is recommended that bladder filling is stopped, if the filling rate was above a physiological limit of 10 ml/min. If the value of  $p_{ves}$  drops after filling is stopped, it is likely that 'low compliance' was, at least in part, related to fast filling.

There are several common problems that must be solved before the study is started or when observed during a study:

*Problem: Initial resting  $p_{det}$  is negative, for example, –5 cmH<sub>2</sub>O Possible explanations:*

- because  $p_{abd}$  is too high

*Solution: If  $p_{ves}$  is in the typical range, and both pressures are 'live', open the valve in the abdominal line and drain 1 or 2 drops from the rectal balloon filling volume. This will usually cause  $p_{abd}$  to fall to a proper value. If not, gently re-position the rectal balloon and/or make a small hole in the balloon.*

- because  $p_{ves}$  is too low

*Solution: This may be due to air bubbles trapped in the catheter, the catheter not being in the bladder, or the catheter being blocked/kinked. Gently flush through the  $p_{ves}$  line (max. 10 ml). It is very important to flush slowly while observing the pressure signal because pressures above 300 cmH<sub>2</sub>O may damage the transducer. If this does not solve the problem, add some more volume to the bladder via the filling lumen. If resistance to filling is high and it does not drain easily when opened, it will be necessary to check catheter position, and to re-position the catheter, if necessary.*

*Problem: Initial  $p_{det}$  too high, for example, 15 cmH<sub>2</sub>O*

*Possible explanations:*

*The key problem here is indicated by the measurement of 15 cmH<sub>2</sub>O. The situation is different from the clear statement that ' $p_{det}$  cannot be negative', as we do not have a definite upper limit for the normal maximum 'resting' value for  $p_{det}$ . Thus, we can only follow the present guidelines that in most tests, in an empty bladder  $p_{det}$  is between 0–5 cmH<sub>2</sub>O, and in some 90% it is between 0–10 cmH<sub>2</sub>O. For any higher value, stringent plausibility checking must be applied. If the patient has no detrusor overactivity, a  $p_{det}$  of 15 cmH<sub>2</sub>O is unlikely to be valid and there may be a signal problem. First*

check, if  $p_{abd}$  and  $p_{ves}$  are in the expected ranges. For example, if in a standing patient, initial  $p_{ves}$  is 30 cmH<sub>2</sub>O and  $p_{abd}$  is 15 cmH<sub>2</sub>O, then by experience the value of  $p_{abd}$  is too low (because  $p_{abd}$  is too low). If in a supine patient  $p_{abd}$  is 10 cmH<sub>2</sub>O and  $p_{ves}$  is 25 cmH<sub>2</sub>O, then the value of  $p_{ves}$  is too high (because  $p_{ves}$  is too high). Check the zero balance and proper signal response to coughing for both signals.

- because  $p_{abd}$  is too low

*Solution to  $p_{abd}$  being too low: Very slowly flush the rectal balloon with 1 or 2 ml.*

- because  $p_{ves}$  is too high.

*Solution to  $p_{ves}$  being too high: This problem can be related to a misplaced catheter, a kink in the catheter, or contact with the bladder wall in an empty bladder, which occludes the eyehole(s) of the catheter. Proceed according to the solution for  $p_{ves}$  being too high, in the first example above.*

*If no signal problem can be identified, the clinical study may be started, but the  $p_{det}$  signal deserves particular attention. If compliance is normal and the bladder normal at filling, then it is very important to record and check, for some period after the micturition, the post-voiding resting value of  $p_{det}$ . Only if an elevated  $p_{det}$  is perfectly reproducible for repeated filling and voiding studies can it be accepted. However, it is most likely that a high resting  $p_{det}$  will not be reproducible and will be corrected by the measures described above.*

*In summary, if any resting value or cough response does not fit the usual values or patterns, it should be corrected before bladder filling is started. If this is not possible, the signals must be observed even more carefully and every effort made to reveal the potential source of error or artifact during the study.*

### Retrospective Artifact Correction

In principle, a good  $p_{det}$  signal requires only that  $p_{ves}$  and  $p_{abd}$  show the same fine structure and quality of signals before filling, during filling, and after a voiding. (Figs. 3, 4, 7, 8) Both  $p_{ves}$  and  $p_{abd}$  must have the same zero and reference level. The most common mistake is to set (*balance*) the initial pressure values of  $p_{ves}$  and  $p_{abd}$  to zero with the catheters connected to the patient instead of setting zero to atmospheric pressure. This results in incorrect  $p_{ves}$  and  $p_{abd}$ . If this is done, urodynamic studies cannot be compared between centers and between patients. Although it may seem convenient and easy to start with a value of  $p_{det}$  as zero, this practice will lead to problems later in the test. As soon as pelvic floor relaxation occurs, which is particularly common during voiding, the value of  $p_{abd}$ , if starting at zero, becomes negative. With a negative  $p_{abd}$ ,  $p_{det}$  will be higher than  $p_{ves}$ , a conceptually meaningless result. Furthermore, it will then be impossible to correct a negative  $p_{abd}$ . Cough tests at regular intervals, particularly before voiding and after voiding, document the dynamic response of the pressure channels and are fundamentally important.

A typical physiological artifact that can be easily recognized is a rectal contraction. Rectal contractions are usually of low amplitude and may or may not be felt by the patient (Fig. 8). The value of  $p_{abd}$  shows a phasic rise with no change in the  $p_{det}$  signal—a potentially confusing fall in  $p_{det}$  results from the electronic subtraction, but this is, of course, an artefact. Usually rectal contractions are relevant only because they may be misinterpreted as detrusor overactivity (Fig. 8): they have no relevance to voiding.

Biphasic spikes as a response to cough tests are another example of artifacts that are easy to correct. However, any other artifacts such as a signal which is nonresponding (dead), has stepwise changes in pressure, or has negative pressures, often cannot be corrected or can be corrected only with a lot of speculation about the underlying causes of the problem. Studies with such artefacts, should be repeated see the next section).

Retrospective corrections require the same strategies for plausibility control as during recording, but then they are much more difficult and less successful to perform.

A few common artifacts (e.g., rectal activity, biphasic spikes at cough tests, or insufficient  $p_{abd}$  response during straining) can be accepted during the study as they can be corrected retrospectively. Usually, this is easier to do manually than through a computerized system.

### Urodynamic Computer Software

Computer applications should allow the easy use of even the most complicated analytical algorithms. However, most of the software offered by the urodynamic equipment industry is neither original nor validated. The software may, in fact, not do what the original developer(s) of the algorithm intended. Therefore, it is recommended that:

- When analytical urodynamic software is used to perform data analysis according to any published concept, the source of the software should be specified. It should also be clearly stated if the software has been validated, i.e., proven to provide results consistent with the algorithms to which the analyses are attributed.

### STRATEGY FOR REPETITION OF URODYNAMIC TESTS

- It is recommended that a urodynamic test should be repeated if the initial test suggests an abnormality, leaves the cause of troublesome lower urinary tract symptoms unresolved, or if there are technical problems preventing proper analysis.

It may not be necessary, however, to repeat a study, which beyond any doubt, confirms the expected pathology, for example, detrusor overactivity which correlates with the patient's symptoms. However, if the study is inconclusive, then the



274 Schäfer et al.

consequences of not finding a clear answer to the urodynamic question(s) should be considered. If an invasive therapy is planned, the urodynamics should be repeated. Therefore, it is necessary to analyze the signals during the study and document the study immediately upon its conclusion. Only then is it possible to be sure that the urodynamic study is of a quality that answers the urodynamic question and provides an understanding about the patient's clinical problem. Therefore, it is recommended that:

- The urodynamic findings and the interpretation of the results should be documented immediately after the study is finished, i.e., before the patient has left the urodynamic laboratory. Doing so allows for a second test if required.

The analysis of a good study is easy and straight-forward. Indeed, an easy analysis actually is the key criterion for good urodynamics. A good study is one that is easy to read and one from which a any experienced urodynamicist will abstract the same results and come to the same conclusions. For computerized analyses, high data quality is even more important than for manual graphical data analysis. Efforts to achieve urodynamic data of high quality during the study will produce great benefits at the time of data analysis. The future development of urodynamic equipment and software should force investigators to conduct proper on-line data quality control. Analysis of ambulatory studies will remain problematic, as it is less easy to conduct on-line assessment of quality, and analysis is time consuming. Hence, it will be necessary to ask the patient to return, on another occasion, should the investigation require repeating, for whatever reason.

## CONCLUSIONS

This is the first report of the ICS Standardization committee of Good Urodynamic Practice. The authors are well aware that this is just a first step and many more will have to follow. Only the essential aspects are considered, but if these basic standards are followed, the quality of urodynamic studies will be significantly improved.

## ACKNOWLEDGMENTS

The Standardisation Committee is grateful for the extensive editing performed by Vicky Rees, ICS Administrator. The committee is also grateful for the detailed comments received from Linda Cardozo, Paul Dudgeon, Guus Kramer, Joseph Macaluso, Gerry Timm, and Alan Wein.

## REFERENCES

- Griffiths DJ, Höfner K, van Mastrigt R, Rollema HJ, Spangberg A, Gleason DM. 1997. Standardization of terminology of lower urinary tract function: pressure-flow studies of voiding, urethral resistance, and urethral obstruction. *Neurourol Urodyn* 16:1–18.
- Liao L, Kirshner-Hermanns R, Schäfer W. 1999. Urodynamic quality control: quantitative plausibility control with typical value ranges. *Neurourol Urodyn* 18(abstract 99a):365–366.
- Lose G, Griffiths DJ, Hosker G, Kulseng-Hansen S, Perucchini D, Schäfer W, Thind P, Versi E. 2002. Standardisation of urethral pressure measurement: Report of the sub-committee of the International Continence Society. *Neurourol Urodyn* 21:258–60.
- Rowan D, James DE, Kramer AEJL, Sterling AM, Suhel PF. 1987. Urodynamic equipment: technical aspects. *J Med Eng Tech* 11:57–64.
- van Waalwijk E, Anders K, Khullar V, Kulseng-Hanssen S, Pesce F, Robertson A, Rosario D, Schäfer W. 2000. Standardisation of ambulatory urodynamic monitoring: Report of the standardisation sub-committee of the International Continence Society. *Neurourol Urodyn* 19:113–125.



## International Continence Society Guidelines on Urodynamic Equipment Performance

Andrew Gammie,<sup>1\*</sup> Becky Clarkson,<sup>2</sup> Chris Constantinou,<sup>3</sup> Margot Damaser,<sup>4</sup> Michael Drinnan,<sup>5</sup> Geert Geleijnse,<sup>6</sup> Derek Griffiths,<sup>2</sup> Peter Rosier,<sup>7</sup> Werner Schäfer,<sup>2</sup> Ron Van Mastrigt,<sup>6</sup> (The International Continence Society Urodynamic Equipment Working Group)

<sup>1</sup>Bristol Urological Institute, Southmead Hospital, Bristol, United Kingdom

<sup>2</sup>Division of Geriatric Medicine, University of Pittsburgh, Pittsburgh, USA

<sup>3</sup>Department of Urology, Stanford University School of Medicine, Stanford, USA

<sup>4</sup>Department of Biomedical Engineering, Cleveland Clinic, Cleveland, USA

<sup>5</sup>Department of Medical Physics, Freeman Hospital, Newcastle upon Tyne, United Kingdom

<sup>6</sup>Department of Urology, Erasmus Medical Centre, Rotterdam, The Netherlands

<sup>7</sup>Department of Urology, University Medical Centre, Utrecht, The Netherlands

These guidelines provide benchmarks for the performance of urodynamic equipment, and have been developed by the International Continence Society to assist purchasing decisions, design requirements, and performance checks. The guidelines suggest ranges of specification for uroflowmetry, volume, pressure, and EMG measurement, along with recommendations for user interfaces and performance tests. Factors affecting measurement relating to the different technologies used are also described. Summary tables of essential and desirable features are included for ease of reference. It is emphasized that these guidelines can only contribute to good urodynamics if equipment is used properly, in accordance with good practice. *Neurourol. Urodynam.* © 2014 Wiley Periodicals, Inc.

**Key words:** urodynamics; specification; standardization

### INTRODUCTION

The International Continence Society (ICS) published a report on urodynamic equipment in 1987.<sup>1</sup> Since then, technology has changed dramatically, particularly in the application of computers to urodynamics. There is now the possibility that measurement accuracy may exceed clinical need, while new technologies being introduced to the market need benchmarks for assessment of their utility.

This article, developed under the auspices of the ICS Standardization Steering Committee, aims to:

- Summarize clinical performance requirements for urodynamic equipment.
- Relate these to specification and feature requirements.
- Develop technical specification ranges or limits from these requirements.
- Comment on different measurement technologies with respect to limitations and artefacts.
- Propose a set of tests/requirements for assessment of systems.

The readership is intended to be purchasers (to check features are actually necessary), designers (to state what is clinically required) and users (to check that equipment is actually performing). Included, therefore, are technical details, summary lists and some basic descriptions.

This document was developed according to the published methodology of the International Continence Society Standardization Steering Committee.<sup>2</sup> The group commissioned for this report developed an outline of proposed content and revised this in the light of a workshop held at the ICS Annual Scientific Meeting in Glasgow, UK in August 2011. The subsequent text was reviewed by manufacturers of urodynamic equipment before a final draft was discussed at a

workshop during the ICS meeting in Barcelona, Spain in August 2013.

The guideline contains the following sections, which include clinical requirements, measurement technologies and calibration techniques for each parameter. There are also tables for system requirements (features necessary for valid urodynamic measurements) and recommendations (features supportive of good practice).

- Uroflowmetry and voided volume.
- Infused volume.
- Pressure measurement (with special considerations of each parameter measured).
- EMG.
- User interface (recording, display and analysis).
- Standardized performance tests.

The ICS emphasizes that these guidelines can only contribute to good urodynamics if equipment is used properly. For that reason, they should not be assumed to be sufficient in isolation,

Conflict of interest: Mr Gammie – trial sponsor: T-Doc; research grant: MMS, Laborie, Mediwatch, Albyn, Andromeda, Digitimer. Dr Clarkson – none. Prof Constantinou – none. Dr Damaser – consultant and research grants: T-Doc. Dr Drinnan – royalties: Mediplus. Dr Geleijnse – none. Dr Griffiths – consultant: Laborie, Ethicon. director: Griffiths Consulting. Dr Rosier – consultant: MMS, Andromeda, T-Doc, Wellspect. Prof Schäfer – none. Prof van Mastrigt – none. Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

\*Correspondence to: International Continence Society, 19 Portland Square, Bristol BS2 8SJ, United Kingdom.

Received 27 November 2013; Accepted 28 November 2013

Published online in Wiley Online Library

(wileyonlinelibrary.com).

DOI: 10.1002/nau.22546



but only alongside training and practice carried out according to the ICS Good Urodynamic Practices document.<sup>3</sup>

The basic requirement of a standard urodynamic system is that it is able to measure at least two simultaneous pressures and, in real time, calculate detrusor pressure, defined as the simultaneous difference between intravesical and abdominal pressures. Furthermore a standard urodynamic system is usually capable of measuring the flow rate of the voided volume and regulating the rate of fluid infusion. In practice there are a number of other measurements, depending on the clinical demands and the urodynamic investigation being carried out, including urethral pressure or electromyography (EMG). Simultaneous recording of pressure measurements with imaging can be required. Other measurements, such as bladder wall thickness, detrusor perfusion, and sound recording are also being researched. This document, however, is limited to equipment performance for the measurement and recording of flow, volume, pressure and EMG only.

When new urodynamic equipment appears on the market, it is recommended that its function is tested with specific equipment in specialized centers. Such tests are described in the section Recommendations for Standardized Performance Tests. All urodynamic equipment should be calibrated and its performance should be tested with procedures that can be carried out by simple means that are readily available. These tests are described in the relevant sections below. When in use, correct calibration of the equipment should be verified regularly.

UROFLOWMETRY AND VOIDED VOLUME (see Tables I and II)

Clinical Requirements

**Accuracy.** The accuracy of flow measurement must be sufficient to capture physiological variation. We suggest equipment should be twice as accurate as test-retest variation in individual subjects as a minimum. Studies which have measured test-retest variation have found differences of 1.4–3.3 ml/sec.<sup>6,7</sup> Accuracy should therefore be approximately  $\pm 1$  ml/sec for flow measurement over the clinically important range. In voided volume there should be a resolution of 2 ml or less in order to register leakage, while  $\pm 3\%$  error from true value is acceptable (range taken from market survey carried out by authors). This accuracy value must incorporate all variations due to hysteresis, linearity and temperature between 10 and 40°C.

**Range.** The range of flow measurement necessary is 0–50 ml/sec, with a volume range of 0–1,000 ml.<sup>3</sup> Accuracy should be maintained over this range. The expected clinical range for voiding time is between 14 and 54 sec,<sup>8</sup> while gaps between flows in the same void can occur. Equipment documentation should thus state after what time interval it automatically stops recording and should allow for flows at least 120 sec long.

TABLE I. Essential Requirements for Uroflowmetry

Parameter	Guideline value
Accuracy for flow rate	$\pm 1$ ml/sec
Accuracy for voided volume	The greater of $\pm 3\%$ of true value or $\pm 2$ ml
Range for flow rate	0–50 ml/sec
Range for voided volume	0–1,000 ml
Maximum duration of flow recordable	$\geq 120$ sec
Minimum flow recordable	$\leq 1$ ml/sec
Bandwidth of flow measurement	0 to between 1 and 5 Hz

Neurourology and Urodynamics DOI 10.1002/nau

TABLE II. Desirable Features of Uroflowmetry Equipment

Documentation should state the minimum recordable volume change or flow rate
Equipment should allow the user to set the expected density of voided fluid
Equipment with load cells should not be damaged by loads less than 5 kg
Equipment should allow the user to reset the volume recorded to zero between voids during a test
Documentation should clearly state what filtering or integration is used in signal processing
Equipment should display the delay value used when synchronizing urine flow with pressure signals, preferably allowing modification of the value
An adjustable height urine collection funnel is recommended
In order to reduce flow artefacts, good delivery of the urine stream to the meter is recommended

TABLE III. Essential Requirements for Filling Volume Measurement

Parameter	Guideline value
Accuracy	The greater of 1–5% of true value or $\pm 1$ ml/min
Range	0–1,000 ml
Range of rate of infusion	0–100 ml/min, adjustable during filling
Sample rate of volume measurement	$\geq 2$ Hz

**Registering minimum flow.** It is important that a flowmeter registers clinically relevant low flow rates, for instance in the case of severe bladder outlet obstruction or terminal dribble. Not registering low flow rates may fail to trigger the autostart or terminate the reading prematurely resulting in inaccurate volume measurement and an incomplete clinical picture (especially in the case of uroflowmetry carried out alone). Flowmeters would be expected to measure at least down to the lowest level of accuracy, that is, a flow of 1 ml/sec. It is not essential that flowmeters should measure slower urine loss than this, for example as may occur during leakage, but the minimum recordable volume change or flow rate should be documented.

**Frequency response.** Flow is the result of relatively slow detrusor muscle contractions. The risetime constant of isometric contractions of strips of bladder muscle is in the order of 2 sec<sup>9</sup> and that of isovolumetric bladder contractions in patients is comparable.<sup>10</sup> Therefore the upper limit of the bandwidth of a flow measurement system (to  $-3$  dB) need not be higher than 0.1 Hz and a sampling rate of 0.2 Hz should be adequate to record urine flow rate. However, a higher sampling rate would be desirable to allow the more common artefacts to be represented and recognized<sup>3</sup> and a measurement bandwidth from zero to between 1 and 5 Hz is recommended.

Measurement Technologies

Flow and voided volume information are interdependent, as one is normally calculated from the other. Currently, load cell

TABLE IV. Desirable Features of Filling Volume Measurement

Equipment should allow the user to calibrate infusion rate and/or filled volume
Equipment should alert the user to infusion tube or pump blockage
Systems measuring filled volume using a load cell should allow the user to set fluid density and to set filled volume when changing containers

(gravimetric) or rotating disc technologies are commonly used. The dipstick method of measuring flow uses a capacitive technique to measure urine depth in the collecting vessel.<sup>1</sup> However, although technically validated, no reports about its use and reliability in clinical practice have been published. Drop spectrometry,<sup>11</sup> which determines flow by counting the rate of drops of urine leaving the meatus, was technically too demanding and clinically unreliable.<sup>5</sup> We therefore describe only the load cell and the spinning disc methods.

**The load cell flowmeter.** Load cell (or gravimetric) flow meter technology is used by the majority of commercial flow meters,<sup>1,2</sup> and measures the weight of the fluid during voiding. Knowing the density of the fluid enables volume to be calculated, while flow is rate of change of volume. The weighing scale should be in a horizontal position for reliable measurement, which is a potential problem when the equipment is fixed to a urodynamic chair or videourodynamic unit. In practice, a load cell is more vulnerable to errors in its zero point than its sensitivity, and damage normally manifests as a fixed offset in voided volume. For this reason, and because it is not always convenient to empty the flowmeter between voids, a "Set zero volume" function should be available. Equipment should use load cells that will not be damaged by loads less than 5 kg.

**The spinning disk flowmeter.** In a spinning disk or momentum-flux flowmeter, the urine stream falls on a rapidly spinning disk and the flow rate is measured by the power needed to keep the rotation speed constant. The spinning disk flowmeter thus measures mass flow; as with the load cell, the density of the fluid is required in order to calculate volume flow. Volume voided is calculated by integration of the flow rate. The design of these flowmeters must allow effective cleaning.

#### Flow Signal Conditioning and Processing

Urine flow is not continuous; by the time the stream reaches the meter, it has broken into a series of droplets. Therefore a stage of low-pass filtering typically with a cut-off frequency of 1 Hz is added (market survey carried out by authors). Equipment documentation should therefore clearly state what filtering or integration is used, and guide the user as to the effects of this filtering on the display of flow parameters.

#### Calibration of Flowmeters

**Calibration.** Empty the flowmeter. Set volume to zero and fluid density to one on the recording device. Pour a known volume of water, of the order of 300 ml, into the flowmeter at an approximately constant flow rate of 15 ml/sec. For a spinning disk flowmeter, pour it at the funnel wall, not directly on the disk. Set the recording device to register the known volume. On a load cell flowmeter the process can equally well be carried out using a known weight instead of a known volume of water.

**Verifying calibration.** The calibration of the flow measurement system should be verified regularly, for example, once every 10 urodynamic measurements. This may be done by applying the appropriate calibration procedure as described above, but rather than setting the recording device to the known volume, the volume reading is verified. If the reading is more than 20 ml different from the poured volume, recalibration of the system is recommended.

An alternative, easy method to verify calibration is to pour the urine that is collected in the flowmeter into a measuring beaker and check the volume. Another method uses an easily

constructed constant flow bottle to verify the flow rate reading.<sup>13</sup>

If frequent recalibration is necessary, the flow transducer might need to be replaced. The effort and time involved for regular verification should be balanced with the risk that all the flow rate values measured since the previous verification test are incorrect. Verifying calibration may also be necessary after calibration, since in some equipment the process of calibration can alter the zero reading. In these cases it may be necessary to repeat the calibration cycle several times in a series of successive and increasingly accurate approximations.

#### Uroflow and Voided Volume Artefacts

**Liquid density error (load cell and spinning disk).** The volume flow rate is calculated by assuming the density of urine is approximately 1 g/ml. If using a denser contrast medium or if the patient is particularly dehydrated, the indicated flow rate will be proportionally high. A prompt or display of liquid density setting, and the capacity for the user to change this, is recommended.

**Momentum artefact (load cell).** The stream of urine has momentum that is registered as a force by a load cell. This is indicated as an abrupt change in volume and a brief surge at the start of flow. The size of the effect will depend on the amount and velocity of urine hitting the load cell, the resultant movement of liquid in the jug, and the filtering in the electronics. Momentum artefact can be reduced, for example by fitting a baffle and by a funnel spout that reaches into the jug. These slow the urine flow at the impact with the load cell, but cause a time delay in the flowmeter.

**Low flow (spinning disk).** In spinning disk flowmeters, flow is measured and integrated to give volume. Integration is sensitive to small input offsets that are equivalent to a low but constant flow into the device. These small input offsets must be identified and rejected. The corollary is that the signal produced by very low urine flow rates can be missed, and this can be a clinically important effect, masking a long, dribbling flow. See the section Registering minimum flow for recommendations.

**Time delay (all designs).** There is inevitably a delay between a change in bladder pressure and the corresponding change in flow rate being detected. This is caused by mechanical delays due to urethral compliance and due to the urine flowing down into the flow sensor, particularly when the collection funnel is dry. The low-pass filter in the flow meter electronics will introduce a further delay. A total delay of 0.4–0.6 sec has been shown to be normal.<sup>14</sup> This delay is of no importance for plain uroflowmetry, but is relevant when synchronous pressure measurements are made during voiding cystometry. Systems should display the delay value to the user, and possibly allow modification.

#### FILLED (INFUSED) VOLUME (see Tables III and IV)

This section clearly does not apply to ambulatory urodynamic equipment, where natural filling occurs during the test.

#### Clinical Requirements

**Accuracy.** Measurement of infused volume should be accurate to within  $\pm 5\%$ .<sup>3</sup> Accuracy of greater than 1% is unlikely to be clinically useful. However, for very low filling rates, for instance in children or in urethral pressure profiles, accuracy to only 1 ml/min will be required. These accuracy values must

incorporate all variations due to hysteresis, linearity and temperature between 10 and 40°C.

**Range.** Typically, even for repeated cystometry, the filled volume is unlikely to be more than 1,000 ml, so the measurable volume should be between 0 and 1,000 ml. The equipment should enable the disregarding of the weight of the bag or bottle used for fluid. For filling rate, the ICS defines the maximum physiological filling rate as body weight in kilogram divided by four, expressed as ml/min. This is routinely exceeded in clinical practice, and much lower rates are used in children. Nevertheless it is rare that more than 100 ml/min be infused, and faster rates will in any case be limited by catheter diameter. The filling rate is often reduced during the test if the patient shows signs of detrusor overactivity, so the rate must be adjustable during filling. The required range is therefore 0–100 ml/min.

**Frequency response.** If 100 ml/min is the maximum required filling rate, then for 5% volume accuracy a sample should be recorded faster than every 3 sec. Considering other factors affecting accuracy, a frequency response of up to 1 Hz will therefore be acceptable.

Measurement Technologies

Infused fluid is normally saline or contrast medium and the volume is either estimated by counting pump head revolutions or deduced from the decrease in bag weight. The section User Interface, Analysis and Post-Processing discusses how software might correct for residual volume and diuresis to estimate actual bladder volume.

**Infusion pump.** The infusion pump is normally of the peristaltic type where a series of rollers compress a flexible tube to drive the saline. This is susceptible to errors due in particular to variations in tube cross-section and downstream resistance. Equipment should therefore allow checking and calibration of infusion rate, often simply done by running the pumped fluid into a flowmeter. Many peristaltic pumps will turn even when the downstream tube is completely blocked, so equipment should register this error and alert the user. Because of this potential for error, load cell measurement of infused volume is advised.

**Load cell.** A load-cell arrangement measures actual infused volume by weighing the infusion bag. As with the flowmeter, contrast medium is denser than saline and will lead to over-indication of the filled volume if its density is not taken into account. Fluid density settings must therefore apply to both voided and filled volumes alike. In the case of voided volume, the effect of mixing contrast with saline or urine should be considered. Calibration is achieved by measuring known weights or volumes of fluid.

Where a load cell is used, there is a very obvious artefact generated when an empty fluid container is swapped for a full one. In terms of the unprocessed signal, the filled volume will increase by a few tens of ml as the container is removed, then return to approximately zero when the new bag is fitted.

Urodynamics systems should therefore have some means to correct this artefact.

It is known that filling with cooled fluid can promote detrusor contraction.<sup>17</sup> Equipment may therefore allow warming of the infused fluid to body temperature, though there is no conclusive evidence that this significantly affects the results of the cystometry. Historically, CO<sub>2</sub> gas has been used in place of saline to fill the bladder. Simultaneous pressure measurements are possible but it is not possible to measure flow rate or voided volume when using CO<sub>2</sub> gas infusion.

MEASUREMENT OF PRESSURE (see Tables V and VI)

Pressure in urodynamic studies is conventionally measured in centimeters of water (cmH<sub>2</sub>O), a unit based on the pressure exerted by a column of water of measured height. A unit of cmH<sub>2</sub>O is equivalent to 98.07 Pascals (Pa), the standard unit of pressure.

Since pressure signals are sensed, transmitted, and recorded in different forms, when quoting specifications for pressure measurement, values should be quoted for the entire system, that is, transducers, catheters and processing together. The type of catheter should be specified, for example, “measured using 7Fr water-filled double lumen catheter” and ideally also the internal diameter of the pressure measurement lumen.

Clinical Requirements

**Accuracy.** The accuracy of pressure measurement must be sufficient to capture physiological variation. We suggest equipment should be twice as accurate as test–retest variation in individual subjects. Studies which have measured this have found mean differences of 2.8 cmH<sub>2</sub>O<sup>7</sup> and 10 cmH<sub>2</sub>O<sup>6</sup>. This suggests systems should be accurate to between 1.5 and 5 cmH<sub>2</sub>O for p<sub>detv</sub>, and thus between 1 and 2.5 cmH<sub>2</sub>O for p<sub>ves</sub> and p<sub>abd</sub> (rounding to the nearest 0.5 cmH<sub>2</sub>O). These accuracy values must incorporate all variations due to hysteresis, linearity, and temperature between 10 and 40°C, even in catheter-mounted transducers that are calibrated at room temperature then used at body temperature.

**Range.** An acceptable range for pressure measurement would be 0–250 cmH<sub>2</sub>O.<sup>3</sup> In addition it is useful for water-filled catheters to allow a certain amount, say 30 cmH<sub>2</sub>O, of negative pressure to be registered while the patient is temporarily lower than the level of the transducers. Certain events, such as flushing catheters, may apply a pressure significantly higher than the working range (called an overload pressure) to the transducer. Larger diameter syringes are safer in this regard, as they are less likely to generate high overload pressures. It is suggested that the application of pressures up to 5,000 cmH<sub>2</sub>O must not damage the transducer or alter the calibration in the working range by more than 1%.

**Frequency response.** Most clinically relevant pressure signal changes in urodynamics occur below 3 Hz frequency, including the majority of the power spectrum of a cough.<sup>18</sup> Even though a

TABLE V. Essential Requirements for Pressure Measurement

Parameter	Guideline value
Accuracy	The greater of ±3 % of true value or ±1 cmH <sub>2</sub> O
Range	–30–250 cmH <sub>2</sub> O (water-filled systems) 0–250 cmH <sub>2</sub> O (other systems)
Bandwidth of pressure measurement (whole system)	0 to ≥3 Hz, equal on both channels
Required feature when water filled catheters are used and patient positions are changed during the test	Equipment must allow reference levels to be reset

TABLE VI. Desirable Features of Pressure Measurement Equipment

---

Equipment should allow users to compare easily current pressure values with starting (baseline) pressures
The point in time at which baseline pressures are recorded should be able to be set by the user
Equipment should allow the user to see abdominal, intravesical and detrusor pressures concurrently
Equipment should record when calibration has been carried out to enable later checks on performance and use

---

cough has frequency components up to 14 Hz,<sup>19</sup> registering the equal transmission of this signal by both pressure lines is clinically more important than measuring its precise maximum pressure value. To adequately register the presence of a cough signal, therefore, the bandwidth of the whole system (including catheters) should be at least 3 Hz. A higher bandwidth, however, may allow the more common artefacts to be represented and recognized.

#### Pressure Measurement Technologies

In urodynamics, the pressures to be measured are in internal cavities with limited access: the bladder, vagina, rectum or stoma, or urethra. Therefore the transducer will be associated with a catheter and tubing to gain access to the measurement site. Three different transducer arrangements are in common use, all of which require the setting of zero pressure (by convention to atmospheric pressure) and calibration. Only with external transducers and water-filled catheters, however, can the reference height be consistently known, and thus  $p_{ves}$  and  $p_{abd}$  repeatably and comparably measured.

**Water-filled catheter and external transducer.** This is recommended by the ICS.<sup>3</sup> A water-filled catheter or balloon is passed to the measurement site, with pressure transmitted along that catheter and connecting tubing to a transducer that is external to the patient. Even when set up correctly, a water-filled system is sensitive to being tapped or jostled, but responds reasonably well to fast changes in pressure.<sup>20</sup>

With a continuous column of liquid along the catheter, the pressure at the transducer is the same as that in the body *at the vertical level of the transducer*, regardless of where the catheter tip is. By convention the transducer is leveled to the pubic symphysis, an anatomical landmark for the bladder, and the zero point set to atmospheric pressure. The patient can move between supine, standing and sitting during the course of a test. Urodynamics equipment using water-filled measurement should therefore have the facility to move the transducers vertically in order to bring the transducers level with the symphysis pubis, if the patient is required to change position during the test. Alternatively, some other method of resetting the reference level is required.

**Catheter-tip transducers.** With catheter-tip transducers, the transducer is mounted in the tip of the catheter which is passed to the site of measurement. The pressure signal is converted to a voltage which is then amplified. A high measurement bandwidth (fast response) can be achieved with little or no movement artefact using catheter-tip transducers. However the transducer needs to be small, which makes it relatively difficult and expensive to manufacture.

The position of the catheter tip will affect the measurement. At the top of the bladder or rectum, the measured pressure will be typically 10 cmH<sub>2</sub>O lower than at the bottom; there is no easy way to correct for this positioning error. Systems should

therefore display clearly the pressure values at the start of the test so this artefact can be taken into account.

**Air-filled catheter and external transducer.** This arrangement is similar to the water-filled system with an external transducer, except that the catheter is filled with air, and a small balloon covers the opening at the end. The low density of air can be neglected, and the pressure is transmitted directly from the balloon at the catheter tip to the transducer. Therefore functionally, it is more similar to the catheter-tip transducer, suffering from the same uncertainty in positioning the catheter tip in the bladder or rectum. Again, therefore, it is important that the equipment allows the user to register the pressure readings at the start of the test.

There is little or no artefact due to knocking the line, but at the expense of a slowed frequency response. Air-filled catheters behave like an overdamped system, which can result in a delayed and diminished pressure response to rapidly changing pressures.<sup>20</sup>

#### Pressure Signal Conditioning and Processing

Signal conditioning would normally consist of two phases: low-pass filtering to remove high frequency artefacts, then subtraction of  $p_{abd}$  from  $p_{ves}$  to give  $p_{det}$ . The two processes are linear and can be applied in either order. However, the separate  $p_{abd}$  and  $p_{ves}$  traces are of interest, and therefore it is beneficial to filter them separately, that is, filtering before subtraction, which requires that the filters in the two channels be similar in frequency response.

Abdominal pressure signals such as a cough contain components at frequencies in excess of 10 Hz, and indeed there are some investigations, such as a cough urethral pressure profile, in which a faster frequency response is required. In this case, a higher sampling rate of approximately 100 Hz would be required if clinical precision demands this. Note that the entire system must also support the higher measurement bandwidth when required, which may exclude some arrangements.

#### Calibration of Pressure Transducers

During calibration two different pressures are set by exposing the catheter tip or sensor to two different well defined pressures. The calibration becomes more accurate when the pressure difference between the two pressures is larger (a pressure difference of at least 50 cmH<sub>2</sub>O is recommended). It may be necessary to go into some manufacturer-designed calibration routines or use one of the calibration devices available from some manufacturers. It is hoped that publication of this document will induce manufacturers to implement adequate means for calibration and include means for recording when calibration has been carried out. Calibration routines should be available for all measurement channels.

**Verifying calibration.** The calibration of pressure measurement systems should be verified regularly, for example, once every 10 urodynamic measurements for non-disposable transducers. This may be done by applying the appropriate calibration procedure as described in this section, but rather than setting zero level and the pressure reading at a defined height/depth, the pressure readings with the catheter at these levels are verified. If the pressure readings are more than 2 cmH<sub>2</sub>O different from the applied pressures, recalibration of the system is necessary. If frequent recalibration is necessary the transducer or catheter might need to be replaced. The effort and time involved for regular verification should be balanced with the risk that all the pressure values measured since the

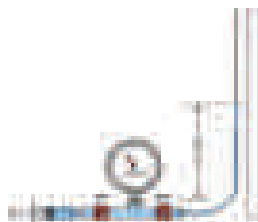


Fig. 1. Calibration of water-filled catheter by filling the line.

previous verification test are incorrect. Verifying calibration may also be necessary after calibration since in some equipment the process of calibration can alter the zero reading. In these cases it may be necessary to repeat the calibration cycle several times in a series of successive approximations.

**Calibration of water-filled catheters with external transducers.** The external transducer is connected to the recording device. Open both three-way valves to the outside air to make sure that the transducer with air-filled dome cover is exposed to atmospheric pressure, and set the zero level at the recording device. Open the valves to the syringe and the line, and completely fill the system with bubble-free water until the water level in the line is a defined level above the transducer, at least 50 cm (Fig. 1). Set that level at the recording device.

Alternatively, a water-filled pressure measuring system may be calibrated by keeping the amount of water in the line constant and moving the line up and down (Fig. 2). With the water level at the level of the transducer, set the recording device to zero. Raise the line so that the water level is at a defined level, at least 50 cm above the transducer, and set that level at the recording device.

The transducer may also be calibrated by putting the line in a water-filled container, noting that the pressure measured reflects the height difference between the water level in the container and the transducer (not the end of the catheter).

**Calibration of catheter-tip transducers.** Mount the catheter on a tripod (Fig. 3). Set zero on the recording device, while holding the catheter tip in the air. Place the catheter tip in a container, and fill to at least 50 cm above the catheter tip. Note the height of the water level above the sensor and set that level at the recording device. (Note that lowering the holder and catheter into a prefilled container will raise the water level, so measure the height with the holder and catheter submerged).

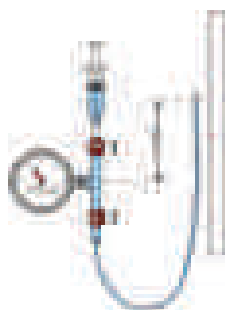


Fig. 2. Calibration of water-filled line by moving the line.

Neurourology and Urodynamics DOI 10.1002/nau

**Calibration of air-filled catheters.** Mount the catheter on a tripod (Fig. 3). Place the catheter balloon in a container and fill to at least 50 cm above the catheter balloon. Set zero on the recording device. Fill the balloon with air (repeatedly charging and discharging the balloon without properly emptying will result in a pressure rise inside the balloon and compromise the pressure measurement). Note the height of the water level above the balloon and set that level at the recording device. (Note that lowering the holder and catheter into a prefilled container will raise the water level, so measure the height with the holder and catheter submerged).

#### Pressure Artefacts

Since there is redundancy in having two pressure channels, most artefacts in urodynamic pressure measurements can be recognized and dealt with through proper quality control.

**Reference level errors.** Catheter-tip transducers and air-filled transducers will have an error due to their unknown and changing height within the bladder, which is difficult to correct. The same errors can occur in abdominal pressure measurements, resulting in potentially greater error when subtracting to obtain detrusor pressure. The trace display should therefore allow easy comparison of current pressure values with starting (referred to as “baseline”) values, in order to allow the operator to compensate for initial pressure offset. It is not recommended that this offset be set to zero in software at the start of the test, as this process changes one pressure reading from its real value.

**Air bubbles.** Air bubbles introduce two issues with water-filled catheters. First, the non-uniform density of fluids in the catheter will introduce an offset to pressure measurements. The size of the offset depends on the difference in height between the two ends of the bubble, which changes as the catheter is moved and as the measured pressure changes. Second, water is incompressible and pressure changes are transmitted without flow of water. Air bubbles are compressible; a change in pressure requires flow to compress or expand the air bubble. The bubble becomes a low pass filter that dampens the frequency response of the catheter. Note that this problem does not affect air-filled catheters to the same degree, because the opposition to flow offered by air is very low. Equipment should allow the operator to compare easily the size of pressure changes on all traces, in order for instance to test for the presence of air bubbles using a cough.

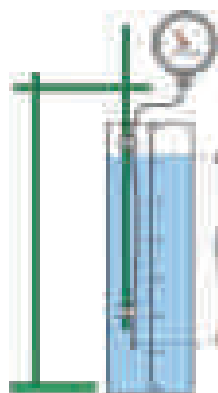


Fig. 3. Calibration of catheter-tip and air-filled transducers.



**Dislodged catheter.** A dislodged catheter that has moved from the measured body cavity can be identified by good quality control, since the measurement in the affected catheter will stop responding to coughs. If the catheter has moved significantly, the measurement may also show a dramatic offset from its baseline value. Again therefore, the trace display should allow comparison with baseline values during the test.

**Incomplete pressure transmission.** At the start of filling, it is sometimes the case that intravesical pressure is not recorded correctly, possibly due to the sensor touching the wall of an empty bladder. Equipment should therefore allow users to fill the bladder a small amount before baseline values for pressure are recorded, rather than automatically assigning baseline values at the start of filling.

**Incomplete cough cancellation.** With water-filled catheters, it is usual that the bladder line is of smaller diameter than the abdominal line. In these circumstances the characteristics of the two lines will be different, with the abdominal line usually having the faster frequency response. Therefore the complete cancellation of a cough in the detrusor trace may be difficult and any automatic processing should treat a symmetric biphasic wave on the detrusor trace as being of acceptable quality.

**Artefacts with separate lines.** With separate filling and measurement catheters, there will be a positive pressure offset in  $p_{ves}$  if the measuring catheter is not disengaged from its insertion position in the filling catheter hole ("piggy-back") before filling commences, or if filling flow faces directly onto the measurement point. This artefact disappears if the infusion pump is stopped.

**Single Lumen Artefact.** If both filling and pressure measurement are done through the same lumen of a catheter, the positive pressure from the filling pump will add an offset to the value measured, and if a roller pump is used this offset is variable and confusing. Pressure measurements should therefore be made only when the pump is not running. Alternatively, if continuous measurements are required, calibration may be done when the pump is running, or users compensate by subtracting the offset, but only when the pump is running. This artefact disappears if the infusion pump is stopped.

**Dual-lumen artefact (pump).** Dual-lumen water-filled catheters are susceptible to a filling artefact in which the pressure generated by the infusion pump affects the pressure in the parallel measuring lumen, particularly at high filling rates. The effect is due to peristalsis from the pump interacting with the compliance of the thin catheter wall, and is manifested as a rhythmic signal from the pump rollers superimposed on the  $p_{ves}$  signal. This artefact too disappears if the infusion pump is stopped.

#### Abdominal Pressure Special Considerations

Catheters in the rectum, vagina, or an abdominal stoma give an approximation to the pressure surrounding the bladder. In particular, the use of rectal transducers in urodynamics makes the assumption that they give a good measure of resting abdominal pressure.<sup>22</sup> However, the rectal transducer will often measure rectal contractions. These will be manifested as positive waves on abdominal pressure and thus negative-going waves on resting detrusor pressure that may sometimes appear to be substantially below zero. Equipment should therefore allow the user to see all pressure traces concurrently and negative  $p_{det}$  readings should be displayed and not clipped to zero.

#### Urethral Pressure—Special Considerations

In some circumstances, it may be requested to quantify the pressure along the length of a dry urethra. Some authors report

making measurements using a solid-state catheter-tip transducer coated in an aqueous lubricating gel.<sup>23</sup> In the Brown and Wickham method,<sup>24</sup> a water-filled catheter is passed *per urethram* then withdrawn using a catheter puller, typically at 2–5 mm/sec. Meanwhile, continuous pressure measurements are made. Since the distal urethra is dry, the line must be perfused with saline, typically at 2–5 ml/min. Equipment that supports urethral pressure measurement should enable perfusion and withdrawal rates within these ranges. As systems perform differently at different rates and with different catheters, centers should maintain a consistent and clearly defined protocol when making urethral pressure measurements.

#### EMG (see Table VII)

Electromyography (EMG) measurements can contribute to the interpretation of urodynamics studies in that they document the relationship between pressure and/or flow as well as the activity of the pelvic floor and striated sphincter. Consequently EMG measurements, particularly when associated with the investigation of neuropathic disorders of the lower urinary tract, can be of critical importance. In the past, needle electrodes have been used to investigate individual muscle action potentials, usually inserted in the anal sphincter providing a record of motor unit activity of the group of muscles. While not exactly reflective of pelvic floor muscle activity, needle or wire electrodes remain the current gold standard of documenting skeletal muscle activity. However needle electrodes are invasive, technically difficult to insert and are not pleasant for the patient. Therefore in centers that use it, EMG measurement is limited to surface electrodes measuring the activation of the pelvic floor muscles.

All skeletal EMG signals have a relatively high bandwidth, typically from 10 Hz up to 1 kHz. The EMG amplitude from surface electrodes is comparatively low, nominally from 10 to 100  $\mu$ V, and depends greatly on skin cleaning, electrode placement and patient morphology in terms of the amount of fat between electrode and muscle to be monitored. Given the small signal amplitude, the amplifier properties are important. In particular, it should have a high input impedance in excess of 100 MOhms, and common-mode rejection ratio (CMRR) in excess of 80 dB.<sup>1</sup> A notch filter at mains frequency is recommended.

In most cases, the high bandwidth of the EMG is addressed by using a rectify-integrate (iEMG) or a root-mean-square circuit that gives a low-bandwidth estimate of the EMG amplitude or envelope. When displayed graphically this gives a line trace where in some cases, subtle or slow changes can be missed and filtering can lose the phase relationship with the pressure or flow signals. In fact, the original EMG can be deliberately under-sampled at typically 100 Hz, which loses some information content, but nevertheless gives a distinctive EMG appearance when displayed at the timescale of urodynamic traces.

TABLE VII. Essential Requirements of EMG Measurement Equipment (Where Fitted)

Parameter	Guideline value
Minimum impedance	100 MOhms
Minimum CMRR	80 dB
Required feature	EMG processing and display variable to suit clinical need

USER INTERFACE (see Table VIII)

Operation

Equipment should be designed such that operation is ergonomic and safe. Surfaces likely to come into contact with clinical materials should be easy to clean, while the physical layout should be stable and allow easy access. The equipment design should be such that technicians at the user's institution can carry out electrical safety checks without causing damage to the equipment.

Recording

Data should be recorded and stored in such a way that the study can be displayed in the same way at a later date, preferably on other equipment as well. Electronic marking of events is important for analysis of studies at a later date, as artefacts and real events can easily get confused if they are not permanently annotated on the original soft copy. The position of event markers should be adjustable after the test has finished, and the meaning of any abbreviations used for their labels should be clear. The ability to enter further diagnostic information such as post void residual volume and the results of related diagnostic tests may be useful in order to display all related information to clinicians. The ability to export in plain data format (.txt or .csv) should be available. Also required is the ability to integrate with popular electronic medical software and to export in the ICS standard format (.ics).<sup>25</sup> For data protection purposes, the system should store data securely, or allow the user's institution network to do so. Backing up of data onto remote systems or media and connection to the hospital data network should be facilitated. Data recovery in the event of power failure would be an advantage.

Display

The ICS suggests that urodynamic tests should be displayed on a 1 mm = 5 sec scale for filling and 1 mm = 2 sec for voiding.<sup>3</sup> This allows resolution of short scale events, easy visual comparison of multiple studies and prevents misinterpretation of traces due to scaling issues. Line thicknesses on screens and on printouts should allow the clear visualization of clinically important details, and these thicknesses should not represent values greater than the accuracies recommended above. A variable on-screen scale allows both visual summary of the whole test, as well as close inspection of detailed features, but default scales and layout should conform to ICS recommendations.<sup>3</sup> The system must allow for simultaneous display of all pressure traces. For those integrating fluoroscopy, temporal synchronization or embedding of the image are necessary features. For ambulatory equipment, the option of a real time display of pressure is helpful, in order to check the setting up of transducers.

Analysis and Post-Processing

Automated analysis is an optional extra which, if included, should not be affected by artefacts (e.g.,  $Q_{max}$  caused by knocking the flow meter,  $p_{max}$  from cough). If summary statistics and automated analysis are provided, the user should have the ability to check the values for feasibility and change the relevant ones if necessary. This implies that software should not filter or remove artefacts, but should be able to ignore them for analysis. Results of validation of any automated analyses should be available.<sup>26</sup> Established nomograms and calculated parameters may also be provided. A facility to estimate bladder volume using post-void residual, infused and voided volumes may be a useful tool, though inaccuracies in these measurements, along with any urethral infusion, diuresis, and leakage will confound calculation.<sup>27</sup>

RECOMMENDATIONS FOR STANDARDIZED PERFORMANCE TESTS

Testing of new technologies for pressure and flow rate measurement should be done by a specialized center prior to introduction to the market to ensure that they have sufficient accuracy, linearity, minimal hysteresis and temperature dependence, and an appropriate frequency response, as well as consistent performance throughout the lifetime of the system. These tests should be performed using all components of the system as they will be utilized clinically since, for example catheter size and length can affect the frequency response of a pressure measurement system. Potential users should utilize the results of these tests to determine if a new technology would provide sufficiently accurate measurements for their needs prior to purchase.

A single study can be utilized to test linearity and hysteresis by production of a linear increase in pressure or flow rate followed by a linear decrease in pressure or flow rate. For pressure, this can be accomplished using a fluid-filled pressure chamber in which the pressure can be tightly controlled. For flow rate, this can be accomplished using a controllable flow pump.

Frequency response can be determined by changing pressure or flow rate in a controllable manner such that different frequencies are tested. Two such standard tests for measuring the frequency response of a pressure measuring system are the pop test and the frequency ramp test.<sup>20</sup> For the pop test, a piece of latex, similar to a balloon, is tightly stretched over the top of an air-filled chamber in which pressure sensing catheters are placed. The chamber is then pressurized to a standard pressure and the latex bulges out in response. The latex is then popped with a pin or needle, dropping the pressure in the chamber to zero (equal to barometric pressure in the room) nearly instantaneously. This test is therefore sometimes called a step test because of the sudden drop to zero pressure. This test enables measurement of the response of a pressure sensing

TABLE VIII. Essential Requirements of User Interfaces

Parameter	Guideline
Access and cleaning	Equipment laid out ergonomically
Display	Should allow for later review with line thicknesses representing smaller values than recommended measurement accuracy
Data export	Text/spreadsheet format, ICS format and electronic patient record interface
Data storage	Backup facility and option for network connection required Secure data storage should be made possible
Image capture and display	Simultaneous recording and playback with pressure traces required, if images are used
Display scales	Clearly displayed and adjustable
Event marking	Required
Automated analyses	Relevant parameters should be controlled by user, not fixed



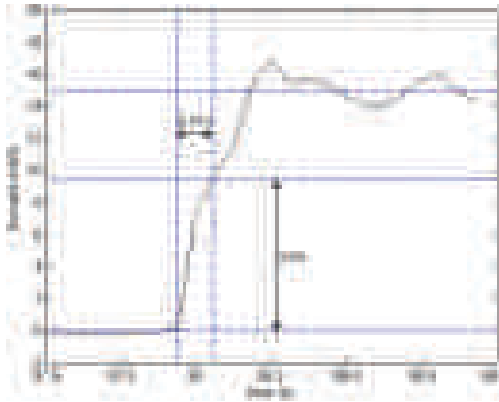


Fig. 4. Simple test for flow meter signal response. The rise time to 63% of final value should be less than 0.16 sec.

system to a sudden change in pressure. For the frequency ramp test the pressure in the pressure chamber is rapidly changed and a range of relevant sinusoidal frequencies are examined. Zero to 20 Hz is sufficient to assess urodynamic pressure measurement systems. Sophisticated software is required to characterize the pressure measurement system from the resultant data, but if done well, an accurate determination can be made and the system can be characterized by its resonant frequency and/or the  $-3$  dB frequency as illustrated with regard to a flowmeter step test (Fig. 4).<sup>28</sup> The resultant data from these tests can also be used to determine if the pressure sensing system constitutes an under- or over-damped recording system.<sup>20</sup> If the system is underdamped, the resonant frequency ought to be outside the working range of the system (greater than 20 Hz in this case). If the system is overdamped, it ought to have adequate slew rate to respond in a timely fashion to pressure changes within the working range of frequencies.

To test simply flowmeter frequency response, put the flowmeter under a running tap, and adjust the tap until the flowmeter indicates approximately 15 ml/sec. Intercept the stream for approx. 4 sec with a plastic cup. Then quickly remove the cup again, and record the flow signal for 4 sec more. Figure 4 shows a detailed recording of the time interval when the cup was removed, using a spinning disk flowmeter. Since we require a cutoff frequency of at least 1 Hz (see Table I), the time taken to rise from zero to 63% of the final value should be at most 0.16 sec.

A frequency ramp test can test new flow rate technologies by creating sinusoidal changes in flow rate whose frequencies change through the working range of flow rate frequencies, that is, 0–5 Hz as stated earlier.

Temperature dependence can be tested by performing the linearity and hysteresis test and the frequency response test at different temperatures within the working range of the system.

Disposable systems do not need to demonstrate lifetime consistency since they are marketed for single use only. Durable systems ought to be tested to ensure they have a consistent response throughout their recommended lifetime, which can be defined either according to time by utilizing an expiration date, or according to number of uses. Repetition of a simulated urodynamics test interleaved with periodic repetition of the

above benchmarking tests could determine the appropriate lifetime of a new technology, regardless of how lifetime is ultimately defined. Change of less than 1% throughout the lifetime of a system would be expected, after periodic recalibration has been undertaken.

### SUMMARY

The review contained in this article allows clinical requirements for a standard urodynamics system to lead to technical recommendations. Equipment can be over-specified (e.g., more accuracy than is required) or under-specified (unable to achieve necessary performance). It is hoped that this document will be helpful to purchasers, users and manufacturers in avoiding these errors. Purchasers can use the lists of required features to check the suitability of equipment for urodynamics. Users can perform the tests described to check ongoing performance and calibration. Manufacturers can be guided by this technical summary of clinical need when introducing new designs or techniques. The document may also encourage the establishment of standard tests for urodynamic equipment, leading to both procurer and operator assurance, and also patient benefit.

### ACKNOWLEDGMENT

The Standardization Steering Committee member responsible for overseeing adherence to the required development protocol was Marcus Drake.


### REFERENCES

- Rowan D, James ED, Kramer AE, et al. Urodynamic equipment: Technical aspects. produced by the international continence society working party on urodynamic equipment. *J Med Eng Technol* 1987;11:57–64.
- Rosier PF, de Ridder D, Meijlink J, et al. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn* 2012;31:621–4.
- Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
- Parsons BA, Bright E, Shaban AM, et al. The role of invasive and non-invasive urodynamics in male voiding lower urinary tract symptoms. *World J Urol* 2011;29:191–7.
- Griffiths CJ, Pickard RS. Review of invasive urodynamics and progress towards non-invasive measurements in the assessment of bladder outlet obstruction. *Indian J Urol* 2009;25:83–91.
- Rosier PF, de la Rosette JJ, Koldewijn EL, et al. Variability of pressure-flow analysis parameters in repeated cystometry in patients with benign prostatic hyperplasia. *J Urol* 1995;153:1520–5.
- Hansen F, Olsen L, Atan A, et al. Pressure-flow studies: An evaluation of within-testing reproducibility–validity of the measured parameters. *Neurourol Urodyn* 1997;16:521–32.
- Boci R, Fall M, Walden M, et al. Home uroflowmetry: Improved accuracy in outflow assessment. *Neurourol Urodyn* 1999;18:25–32.
- van Mastrigt R, Koopal JW, Hak J, et al. Modeling the contractility of urinary bladder smooth muscle using isometric contractions. *Am J Physiol* 1986;251:R978–83.
- van Mastrigt R, Griffiths DJ. An evaluation of contractility parameters determined from isometric contractions and micturition studies. *Urol Res* 1986;14:45–52.
- Zinner NR, Ritter RC, Sterling AM, et al. Drop spectrometer: A non-obstructive, non-interfering instrument for analyzing hydrodynamic properties of human urination. *J Urol* 1969;101:914–8.
- Evaluation Report: Urodynamics Systems CEP09038. Centre for Evidence-based Purchasing. London: NHS Purchasing and Supply Agency; 2009.
- Griffiths CJ, Murray A, Ramsden PD. A simple uroflowmeter tester. *Br J Urol* 1983;55:21–4.
- Kranse R, van Mastrigt R, Bosch R. Estimation of the lag time between detrusor pressure- and flow rate-signals. *Neurourol Urodyn* 1995;14:217–29.
- Abrams P, Cardozo L, Fall M, et al. The Standardisation of terminology of lower urinary tract function: Report from the standardisation sub-committee of the international continence society. *Neurourol Urodyn* 2002;21:167–78.
- Klevmark B. Natural pressure-volume curves and conventional cystometry. *Scand J Urol Nephrol Suppl* 1999;201:1–4.

## 10 Gammie et al.

17. Hellstrom PA, Tammela TL, Kontturi MJ, et al. The bladder cooling test for urodynamic assessment: Analysis of 400 examinations. *Br J Urol* 1991;67: 275–9.
18. Thind P, Bagi P, Lose G, et al. Characterization of pressure changes in the lower urinary tract during coughing with special reference to the demands on the pressure recording equipment. *Neurourol Urodyn* 1994;13:219–25.
19. Kim K, Jurnalov CD, Ham S, et al. Mechanisms of female urinary continence under stress: Frequency spectrum analysis. *J Biomech* 2001;34:687–91.
20. Cooper MA, Fletter PC, Zaszczurynski PJ, et al. Comparison of air-charged and water-filled urodynamic pressure measurement catheters. *Neurourol Urodyn* 2011;30:329–34.
21. Gammie A, Drake M, Swithinkbank L, et al. Absolute versus relative pressure. *Neurourol Urodyn* 2009;28:468.
22. Enhorning GE. A concept of urinary continence. *Urol Int* 1976;31:3–5.
23. Lose G, Griffiths D, Hosker G, et al. Standardisation of urethral pressure measurement: Report from the standardisation sub-committee of the international continence society. *Neurourol Urodyn* 2002;21:258–60.
24. Brown M, Wickham JE. The urethral pressure profile. *Br J Urol* 1969;41:211–7.
25. van Mastrigt R, Griffiths DJ. ICS standard for digital exchange of urodynamic study data. *Neurourol Urodyn* 2004;23:280–1.
26. Hogan S, Jarvis P, Gammie A, et al. Quality control in urodynamics and the role of software support in the QC procedure. *Neurourol Urodyn* 2011;30: 1557–64.
27. Wyndaele JJ, Gammie A, Bruschini H, et al. Bladder compliance what does it represent: Can we measure it, and is it clinically relevant? *Neurourol Urodyn* 2011;30:714–22.
28. Hok B. Dynamic calibration of manometer systems. *Med Biol Eng* 1976; 14:193–8.

# An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the assessment of sexual health of women with pelvic floor dysfunction

Rebecca G. Rogers MD<sup>1</sup>  | Rachel N. Pauls MD<sup>2</sup> | Ranee Thakar MD<sup>3</sup> |  
Melanie Morin PhD<sup>4</sup> | Annette Kuhn MD<sup>5</sup> | Eckhard Petri Dd, PhD<sup>6</sup> |  
Brigitte Fatton MD<sup>7</sup> | Kristene Whitmore MD<sup>8</sup> | Sheryl Kinsberg PhD<sup>9</sup> |  
Joseph Lee MBChB, FRANZCOG<sup>10</sup>

<sup>1</sup> Dell Medical School, University of Texas, Austin, Texas

<sup>2</sup> TriHealth Good Samaritan Hospital, Cincinnati, Ohio

<sup>3</sup> Croydon University Hospital Croydon, London, United Kingdom

<sup>4</sup> Université de Sherbrooke, Montreal, Quebec, Canada

<sup>5</sup> University Teaching Hospital Berne (Inselspital), Bern, Switzerland

<sup>6</sup> University of Greifswald, Schwerin, Germany

<sup>7</sup> University Hospital Nîmes, Nîmes, Languedoc-Roussillon, France

<sup>8</sup> Drexel University College of Medicine, Philadelphia, Pennsylvania

<sup>9</sup> Case Western Reserve University, Cleveland, Ohio

<sup>10</sup> University of New South Wales, St Vincents Hospital, Sydney, New South Wales, Australia

## Correspondence

Rebecca G. Rogers, Department of Women's Health, 1301 W 38th Street, Suit705, Dell Medical School, University of Texas, Austin, TX 78705.  
Email: rebecca.rogers@austin.utexas.edu

**Aims:** The terminology in current use for sexual function and dysfunction in women with pelvic floor disorders lacks uniformity, which leads to uncertainty, confusion, and unintended ambiguity. The terminology for the sexual health of women with pelvic floor dysfunction needs to be collated in a clinically-based consensus report. **Methods:** This report combines the input of members of the Standardization and Terminology Committees of two International Organizations, the International Urogynecological Association (IUGA), and the International Continence Society (ICS), assisted at intervals by many external referees. Internal and external review was developed to exhaustively examine each definition, with decision-making by collective opinion (consensus). Importantly, this report is not meant to replace, but rather complement current terminology used in other fields for female sexual health and to clarify terms specific to women with pelvic floor dysfunction.

Eckhard Petri and Joseph Lee belongs to Standardization and Terminology Committees IUGA.

Kristene Whitmore belongs to Standardization and Terminology Committees ICS.

Rebecca G. Rogers, Rachel N. Pauls, RaneeThakar, Melanie Morin, Annette Kuhn, Eckhard Petri, Brigitte Fatton, Kristene Whitmore, Sheryl Kinsberg, and Joseph Lee belongs to Joint IUGA/ICS Working Group on Female Anorectal Terminology.

Dr. Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

**Results:** A clinically based terminology report for sexual health in women with pelvic floor dysfunction encompassing over 100 separate definitions, has been developed. Key aims have been to make the terminology interpretable by practitioners, trainees, and researchers in female pelvic floor dysfunction. Interval review (5-10 years) is anticipated to keep the document updated and as widely acceptable as possible.

**Conclusion:** A consensus-based terminology report for female sexual health in women with pelvic floor dysfunction has been produced aimed at being a significant aid to clinical practice and a stimulus for research.

#### KEYWORDS

female pelvic floor dysfunction, female sexual health, terminology

## 1 | INTRODUCTION

The terminology in current use for sexual function and dysfunction in women with pelvic floor disorders lacks uniformity, which leads to uncertainty, confusion, and unintended ambiguity. Comprehensive and precise description will aid this situation, leading to more accurate reporting. For example, many definitions are used to describe dyspareunia; few are specific as to the location or etiology of the pain. Women may be treated for sexual complaints from a large array of providers including physicians, psychologists, psychiatrists, or sex therapists. While other fields have standardized terminology regarding diagnoses of sexual dysfunction in women without pelvic floor dysfunction, these diagnoses and descriptions do not include descriptions of conditions commonly encountered by the urogynecologist or others who treat women with pelvic floor disorders, such as coital incontinence. More standardized terminology would aid inter-disciplinary communication and understanding, as well as educate our providers on standardized terminology used in other fields.

Existing published reports document the importance of including the assessment of sexual function. For example, while Haylen et al<sup>1</sup> offers definitions of symptoms, that document does not comment on how to further evaluate sexual function or incorporate it into the assessment of women with pelvic floor dysfunction. Assessment of how pelvic floor dysfunction treatment affects sexual health and how to measure changes in sexual health are important to the practice of urogynecology. Ideally, terminology should be consistent between practitioners who treat women with sexual dysfunction and those who treat pelvic floor disorders. Terminology presented in this document will align with current terminology documents and a literature terms analysis will be included in the process.

This report contains;

1. Definitions of sexual function relevant to the treatment of pelvic floor dysfunction and terminology developed to designate the anatomic location of the symptom.
2. Terminology currently accepted as standard outside the field of urogynecology will be referenced, as these terms will allow urogynecologists to communicate effectively with other practitioners providing care to women with sexual dysfunction and pelvic floor disorders.
3. Assessment of sexual dysfunction of women with pelvic floor disorders including the history and physical exam necessary to assess women reporting sexual difficulties which may or may not be related to their pelvic floor dysfunction including physical exam, imaging, nerve testing, as well as descriptions of how sexual dysfunction is related to other pelvic floor disorders, such as urinary and anal incontinence and pelvic organ prolapse.
4. Management of sexual dysfunction in women with pelvic floor disorders is described including conservative, surgical, and pharmacological management. Management of sexual dysfunction may be provided by different disciplines working in this field. Terminology related to the different types of therapy will be specified and distinguished. In addition, surgical and non-surgical management strategies are defined and described.
5. The working group consisted of stakeholders in sexual function including urogynecologists, sex therapists and physiotherapists and the document was vetted through the wider membership of IUGA and ICS. The working group includes optimal methods of reporting sexual function research in women with pelvic floor dysfunction. Currently no single document collates all elements required for diagnoses in the area of female sexual function in women with pelvic floor dysfunction in a comprehensive way. This report includes a full outline of the terminology for all

symptoms, signs, ordered clinical assessments, the imaging associated with those investigations, the most common diagnoses, and terminology for different conservative and surgical treatment modalities.

Like all the other joint IUGA-ICS female-specific terminology reports, every effort has been made to ensure this Report is:

1. User-friendly: Able to be understood by all clinical and research users.
2. Clinically-based: Symptoms, signs, and validated assessments/investigations are presented for use in forming workable diagnoses for sexual health and associated dysfunctions.
3. Origin: Where a term's existing definition (from one of multiple sources used) is deemed appropriate, that definition is included and duly referenced.
4. Able to provide explanations: Where a specific explanation is deemed appropriate to explain a change from earlier definitions or to qualify the current definition, this will be included as an addendum to this paper (*Footnote a,b,c . . .*). Wherever possible, evidence-based medical principles have been followed. This Terminology Report is inherently and appropriately a definitional document, collating definitions of terms. Emphasis has been on comprehensively including those terms in current use in the relevant peer-reviewed literature. Our aim is to assist clinical practice, medical education, and research. Some new and revised terms have been included. Explanatory notes on definitions have been referred, where possible, to the "Footnotes" section.

Acknowledgement of these standards in written publications related to female pelvic floor dysfunction, should be indicated by a footnote to the section "Methods and Materials" or its equivalent, to read as follows: "Methods, definitions and units conform to the standards jointly recommended by the International Continence Society and the International Urogynecological Association, except where specifically noted."

## 2 | OVERVIEW OF SEXUAL FUNCTION AND DYSFUNCTION

Over 40% of women will experience a sexual problem over the course of their lifetime. A sexual complaint meets the criteria for a diagnosis when it results in personal distress or interpersonal difficulties. With regard to sexual complaints that reach the level of a diagnosable sexual disorder, recent epidemiologic surveys place the prevalence of diagnosable sexual disorders at approximately 8-12%.<sup>2</sup>

### 2.1 | Normal sexual function and models of sexual response

"Normal" sexual function can be determined using a variety of standards and is therefore difficult to define. Multiple models have been developed to describe normal or healthy sexual function. In 1966, Masters and Johnson proposed a linear model of sexual response based on their observations of the physiologic changes that occurred in men and women in a laboratory setting. Their model consisted of four stages: excitement, plateau, orgasm, and resolution. Subsequently, Kaplan and Lief independently modified this model to include the concept of desire as an essential component of the sexual response. Basson introduced an intimacy-based circular model to help explain the multifactorial nature of women's sexual response and that desire is responsive as well as spontaneous. This model further allows for the overlap between desire and arousal and is ultimately the basis for the DSM 5 combined disorder, Female Sexual Interest, and Arousal Disorder (FSIAD).

#### 2.1.1 | Screening and diagnosis

Sexual concerns should be addressed routinely. Many women are hesitant to initiate discussions but still want their provider to open the dialogue about sexual problems. When a provider opens this dialogue, he/she acknowledges and prioritizes the role that sexual health plays in overall wellbeing. A variety of questionnaires can be used to help identify women who suffer from sexual problems. These questionnaires are a useful adjunct to the patient history and physical examination in the diagnosis of sexual disorders.

Once a sexual problem has been brought up and/or identified, it is important that it is adequately assessed. Though time is limited in the clinical setting, it is important to ask questions that help determine the true nature of problem. When the patient presents with low desire, a detailed description of her problem, including the onset, duration, and severity of her symptoms, should be obtained. Her level of distress should be determined. Open-ended questions allow the patient to provide information essential for accurate diagnosis and the development of an appropriate treatment plan. If there is not enough time to have a complete discussion, a return visit should be scheduled to specifically focus on her sexual concerns.

#### 2.1.2 | History and physical exam

A comprehensive medical and psychosocial history, preferably of both partners, is essential.<sup>3</sup>

A completed medical history can identify conditions that contribute to her symptoms. The gynecologic history is also a vital component in the diagnosis. Components of the sexual

history should include direct questions about sexual behavior, safe sex practices, and whether or not there is a history of sexual abuse. Sexual history taking should always be conducted in a culturally sensitive manner, taking account of the individual's background and lifestyle, and status of the partner relationship. A history of current medications should be taken. It should be noted in what way the additional pelvic floor symptoms interfere with sexual function. Medications as antihypertensive agents (alpha blockers, beta blockers, calcium channel blockers, antidiuretics) chemotherapeutics, drugs that act on the central nerve system and anti-androgens may interfere with sexual function.<sup>4</sup> A history and physical examination with special attention to atrophy, infections, scar tissue, and neoplasms should be performed. Motor and sensory neurological function should be assessed. Clinical signs of urinary and fecal incontinence should be noted and provocation tests such as a cough stress test performed. For women with pelvic neurological disease a detailed neurological genital exam is necessary, clarify light touch, pressure, pain, temperature sensation, anal and vaginal tone, voluntary contraction of vagina and anus as well as anal and bulbocavernosus reflexes.<sup>5</sup> Basic laboratory testing should be performed such as serum chemistry, complete blood count, and lipid profiles to identify vascular risk factor as hypercholesterolemia, diabetes, and renal failure.<sup>4</sup>

## 2.2 | Pelvic floor disorders and sexual dysfunction

The effects of pelvic floor disorders (PFDs) including urinary (UI) and anal incontinence (AI) and pelvic organ prolapse (POP) on sexual function remain debatable with some studies showing no and others a negative impact.<sup>6–8</sup> This variability can be attributed partly to the fact that the populations studied, as well as the methodology and the type of questionnaires used, are different between the studies. These discordant findings can also be attributed to the complexity of human sexual function which is subject to a host of influences. Despite conflicting published data, in general most PFDs are thought to negatively affect sexual health. Pelvic floor symptoms have been shown to be associated with low sexual arousal, and infrequent orgasm and dyspareunia.<sup>7</sup> Up to 45% of the women with UI and/or lower urinary tract symptoms (LUTS) complain of sexual dysfunction with 34% reporting hypoactive sexual desire, 23% sexual arousal disorder, 11% orgasmic deficiency, and 44% sexual pain disorders (dyspareunia or non coital genital pain).<sup>9</sup> Sexual function is related to women's self-perceived body image and degree of bother from pelvic organ prolapse (POP).<sup>10</sup> Genital body image and sexual health are related in women with stage 2 or greater POP<sup>11–13</sup> particularly in the domains of sexual desire and satisfaction. Women with anal incontinence (AI) have similar rates of sexual activity but poorer sexual function than

women without.<sup>12,14</sup> An estimated 16% to 25% of women with chronic pelvic pain experience dyspareunia often leading to sexual avoidance.<sup>15</sup> High pelvic floor muscle tone and sexual dysfunction are related.<sup>16</sup> In women with PFDs there is a positive association between pelvic floor strength and sexual activity and function.<sup>17</sup>

Resolution of symptoms after successful treatment of PFDs often improves sexual function and/or women's wellbeing as measured on pelvic floor condition specific measures. After surgery for stress urinary incontinence (SUI) sexual function was unchanged in 55.5% of women, improved in 31.9% and deteriorated in 13.1%.<sup>18</sup> The resolution of coital incontinence is closely correlated to patient's degree of sexual satisfaction and preoperative coital incontinence has been suggested as a prognostic factor for improvement of sexual function after surgery.<sup>19</sup> Most women who undergo surgery for POP report unchanged sexual function.<sup>20</sup>

## 3 | SYMPTOMS OF SEXUAL FUNCTION SPECIFIC TO PELVIC FLOOR DYSFUNCTION

### 3.1 | Symptom

Any morbid phenomenon or departure from the normal in structure, function, or sensation, experienced by the woman and indicative of disease or a health problem. Symptoms are either volunteered by, or elicited from the individual, or may be described by the individual's caregiver.<sup>1</sup> Sexual symptoms may occur in combination with other pelvic floor symptoms such as urinary, fecal, or combined incontinence or pelvic organ prolapse (POP) or pelvic pain.

### 3.2 | Vaginal symptoms

1. Obstructed intercourse: Vaginal intercourse that is difficult or not possible due to obstruction by genital prolapse or shortened vagina or pathological conditions such as lichen planus or lichen sclerosis.
2. Vaginal laxity: Feeling of vaginal looseness.<sup>1</sup>
3. Anorgasmia: Complaint of lack of orgasm; the persistent or recurrent difficulty, delay in or absence of attaining orgasm following sufficient sexual stimulation and arousal, which causes personal distress.<sup>3</sup>
4. Vaginal dryness (NEW): Complaint of reduced vaginal lubrication or lack of adequate moisture in the vagina.

### 3.3 | Lower urinary tract sexual dysfunction symptoms

1. Coital urinary incontinence: urinary incontinence occurring during or after vaginal intercourse<sup>a</sup>

2. Orgasmic urinary incontinence (NEW): urinary incontinence at orgasm
3. Penetration urinary incontinence (NEW): urinary incontinence at penetration (penile, manual, or sexual device)
4. Coital urinary urgency (NEW): Feeling of urgency to void during vaginal intercourse.
5. Post coital LUT symptoms (NEW): Such as worsened urinary frequency or urgency, dysuria, suprapubic tenderness.
6. Receptive urethral intercourse (NEW): Having a penis penetrating one's urethra (urethral coitus).<sup>b</sup>

### 3.4 | Anorectal sexual dysfunction symptoms<sup>28</sup>

1. Coital fecal (flatal) incontinence: Fecal (flatal) incontinence occurring with vaginal intercourse (see related definition "Coital fecal urgency").
2. Coital Fecal Urgency: Feeling of impending bowel action during vaginal intercourse.
3. Anodyspareunia: Complaint of pain or discomfort associated with attempted or complete anal penetration.<sup>28</sup>
4. Anal laxity: Complaint of the feeling of a reduction in anal tone.

### 3.5 | Prolapse specific symptoms

1. Abstinence due to pelvic organ prolapse: Non engagement in sexual activity due to prolapse or associated symptoms.<sup>c</sup>
2. Vaginal wind (Flatus): Passage of air from vagina (usually accompanied by sound).
3. Vaginal laxity: Feeling of vaginal looseness.<sup>d</sup>
4. Obstructed intercourse: vaginal intercourse is difficult or not possible due to obstruction by genital prolapse or shortened vagina or pathological conditions such as lichen planus or lichen sclerosis.

### 3.6 | Pain symptoms

1. Dyspareunia: Complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration.<sup>1,e</sup>
2. Superficial (Introital) dyspareunia: Complaint of pain or discomfort on vaginal entry or at the vaginal introitus.
3. Deep dyspareunia: complaint of pain or discomfort on deeper penetration (mid or upper vagina)
4. Vaginismus (NEW): recurrent or persistent spasm of vaginal musculature that interferes with vaginal penetration.<sup>f</sup>
5. Dyspareunia with penile vaginal movement: pain that is caused by and is dependent on penile movement.

6. Vaginal dryness: Complaint of reduced vaginal lubrication or lack of adequate moisture in the vagina.<sup>g</sup>
7. Hypertonic pelvic floor muscle: A general increase in muscle tone that can be associated with either elevated contractile activity and/or passive stiffness in the muscle.<sup>4,35,h</sup>
8. Non coital sexual pain (NEW): pain induced by non coital stimulation.<sup>i</sup>
9. Post coital pain (NEW): pain after intercourse such as vaginal burning sensation or pelvic pain.
10. Vulvodynia: vulvar pain of at least 3 months' duration, without clear identifiable cause, which may have potential associated factors.<sup>37</sup>

### 3.7 | Specific postoperative sexual dysfunction symptoms

- 1 De novo sexual dysfunction symptoms (NEW): new onset sexual dysfunction symptoms (not previously reported before surgery)
- 2 De novo dyspareunia (NEW): dyspareunia first reported after surgery or other interventions
- 3 Shortened vagina (NEW): perception of a short vagina expressed by the woman or her partner
- 4 Tight vagina (NEW):
  - Introital narrowing: vagina entry is difficult or impossible (penis or sexual device)
  - Vaginal narrowing: decreased vaginal calibre.
- 5 Scarred vagina (NEW): perception by the partner of a "stiff" vagina or a foreign body (stitches, mesh exposure, mesh shrinkage) in the vagina
- 6 Hispareunia: male partner pain with intercourse after female reconstructive surgery.<sup>j</sup>

### 3.8 | Other symptoms

1. Decreased libido or sexual desire (NEW): Absent or diminished feelings of sexual interest or desire, absent sexual thoughts or fantasies, and a lack of responsive desire.<sup>1,3</sup> Motivations (here defined as reasons/incentives) for attempting to become sexually aroused are scarce or absent. The lack of interest is considered to be beyond the normative lessening with lifecycle and relationship duration.
2. Decreased arousal (NEW): Persistent or recurrent inability to achieve or maintain sexual excitement. This may be expressed as lack of excitement, lack of lubrication, lack of vaginal and clitoral engorgement, or lack of expression of other somatic responses.<sup>1,3,k</sup>
3. Anorgasmia or difficulty in achieving orgasm (NEW): Lack of orgasm, markedly diminished intensity of



orgasmic sensations or marked delay of orgasm from any kind of stimulation.<sup>1,3</sup>

## 4 | SIGNS

### 4.1 | Sign

Any abnormality indicative of disease or health problem, discoverable on examination of the patient: an objective indication of disease or health problem.<sup>1</sup> Not all observed changes are associated with pathology from the point of view of the patient, and not all require intervention. The genital examination is often informative and in women with sexual dysfunction can often be therapeutic. A focused genital examination is highly recommended in presence of dyspareunia, vaginismus, neurological disease, genital arousal disorders, history of pelvic trauma, acquired or lifelong orgasmic disorder.<sup>4,1</sup> The internal examinations are generally best performed with the woman's bladder empty.<sup>1</sup> Examination should be performed and described including vaginal length, calibre and mobility, presence of scarring and/or pain and estrogenization, and whether or not there is vaginal or labial agglutination. The location of any vaginal pain should be noted. Pelvic organ prolapse should be evaluated at it may influence sexual function by both affecting body image and vaginal symptoms during sexual activity.<sup>39</sup> If the patient has had an operation in which a synthetic mesh is utilized then mesh may be felt in the vagina which may or may not be associated with symptoms.<sup>40</sup> Bimanual examination should be performed to make observations for any pelvic mass or unusual tenderness by vaginal examination together with suprapubic palpation. Examination of the pelvic floor muscles may elicit signs pertaining to female sexual dysfunction. If dyspareunia, vaginismus, or history of pelvic trauma are present, completing internal exams is difficult and may be impossible. Assessing for presence of vulvar pain via a gentle, introital palpation, or performing a "Q-tip touch test" of the introitus is recommended prior to any internal examination.

### 4.2 | Perineal/vulval/urethral inspection and/or examination

1. Vulval gaping: non-coaptation of vulva at rest, commonly associated with increased size of genital hiatus.
2. Deficient perineum/cloacal-like defect: A spectrum of tissue loss from the perineal body and rectovaginal septum with variable appearance. There can be a common cavity made up of the anterior vagina and posterior rectal walls or just an extremely thin septum between the anorectum and vagina.<sup>28</sup>

3. Urethral: Prolapse, caruncle, diverticulum.

4. Vulval agglutination: Labial lips fused.<sup>m</sup>

### 4.3 | Vaginal examination

1. Vaginal agglutination: defined as condition where the walls of the vagina are fused together above the hymen.
2. Vulvo-vaginal hypoesthesia: Reduced vulvo-vaginal sensitivity to touch, pressure, vibration, or temperature.<sup>4,34,35,n</sup>
3. Vulvo-vaginal hyperaesthesia: Increased vulvo-vaginal sensitivity to touch, pressure, vibration, or temperature
4. Pudendal neuralgia: elicited or described by the patient as burning vaginal and vulva pain (anywhere between the anus and the clitoris) with tenderness over the course of the pudendal nerve.<sup>1,o</sup>

### 4.4 | Examination of pelvic floor muscles<sup>1,p</sup>

1. Muscle tone: In normally innervated skeletal muscle, tone is created by "active" (contractile) and "passive" (viscoelastic) components clinically determined by resistance of the tissue against stretching or passive movement.<sup>47,48</sup>
2. Normal pelvic floor muscles: Pelvic floor muscles which can voluntarily and involuntarily contract and relax.
3. Overactive pelvic floor muscles: Pelvic floor muscles which do not relax, or may even contract when relaxation is functionally needed, for example, during micturition or defecation.
4. Underactive pelvic floor muscles: Pelvic floor muscles which cannot voluntarily contract when this is appropriate.
5. Non-functioning pelvic floor muscles: Pelvic floor muscles where there is no voluntary action palpable.
6. Pelvic floor muscle spasm or pelvic floor myalgia: defined as the presence of contracted, painful muscles on palpation and elevated resting pressures by vaginal manometry.<sup>49</sup> This persistent contraction of striated muscle cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp. Pelvic floor myalgia (a symptom) may be present with or without a change in PFM tone (a sign).
7. Pelvic floor muscle tenderness: occurrence of the sensation of pain or painful discomfort of the pelvic floor muscles elicited through palpation.
8. Hypertonicity: A general increase in muscle tone that can be associated with either elevated contractile activity and/or passive stiffness in the muscle.<sup>47,48,50</sup> As the cause is often unknown the terms neurogenic hypertonicity and non-neurogenic hypertonicity are recommended.
9. Hypotonicity: A general decrease in muscle tone that can be associated with either reduced contractile activity and/

or passive stiffness in the muscle. As the cause is often unknown the terms neurogenic hypotonicity and non-neurogenic hypotonicity are recommended.<sup>48</sup>

10. Muscle strength: Force-generating capacity of a muscle.<sup>48,51</sup> It is generally expressed as maximal voluntary contraction measurements and as the one-repetition maximum (1RM) for dynamic measurements.<sup>52,53</sup>
11. Muscle endurance: The ability to sustain near maximal or maximal force, assessed by the time one is able to maintain a maximal static or isometric contraction, or ability to repeatedly develop near maximal or maximal force determined by assessing the maximum number of repetitions one can perform at a given percentage of 1 RM.<sup>48,54</sup>

#### 4.5 | Urogenital aging (NEW): genitourinary syndrome of menopause—(GSM)<sup>4,5</sup>

1. Pallor/erythema: Pale or erythematous genital mucosa
2. Loss of vaginal rugae: Vaginal rugae flush with the skin
3. Tissue fragility/fissures: Genital mucosa that is easily broken or damaged
4. Vaginal petechiae: A petechia, plural petechiae, is a small (1-2 mm) red or purple spot on the skin, caused by a minor bleed (from broken capillary blood vessels)
5. Urethral mucosal prolapse: Urethral epithelium turned outside the lumen
6. Loss of hymenal remnants: Absence of hymenal remnants
7. Prominence of urethral meatus vaginal canal shortening and narrowing: Introital retraction
8. Vaginal dryness: Complaint of reduced vaginal lubrication or lack of adequate moisture in the vagina.

#### 4.6 | General examination

Identify chronic systemic diseases and their treatments (eg, Diabetes, Multiple Sclerosis, Depression, Hypertension, lichen sclerosis) which can be associated with sexual dysfunction.

#### 4.7 | Neurological examination

For women with neurological disease affecting the pelvic nerves clarify light touch, pressure, pain, temperature sensation, and vaginal tone, voluntary tightening of the anus and vagina, anal and bulbocavernosus reflexes.<sup>55</sup>

### 5 | INVESTIGATIONS QOL; MEASUREMENT OF SEXUAL FUNCTION/HEALTH

While some physiologic measures of sexual activity and function exist, most are not readily available in the clinical or

research setting, and many do not accurately reflect patient rating of improvement. Therefore, measurement of sexual activity and function is largely limited to self-report and the use of sexual diaries or event logs, clinician-administered interviews, or questionnaires. The US Food and Drug Administration drafted guidelines in 2016 which support the use of event logs and diaries as the primary measures for the evaluation of the efficacy of interventions. Further, they specified that diaries and event log should record “Sexually Satisfying Events (SSE)” and that the number of SSE's may be used as a primary endpoint in efficacy trials. Unfortunately, these measures do not correlate well with patient report of improvement using other validated sexual function and quality of life measures.<sup>56</sup> Personal interviews are time consuming and have wide variation in application making the reliability of findings suspect.

The FDA also recommended the use of patient reported outcomes for evaluation of sexual function. Most clinicians and researchers feel that questionnaires are the most accurate in measuring sexual function. Sexual function questionnaires include measures which were developed to include concepts important to women with pelvic floor dysfunction and those that were developed to address sexual health in women without pelvic floor dysfunction. In general, pelvic floor condition specific measures are more likely to be responsive to change than measures that are not condition specific, although both have been used in the evaluation of women with pelvic floor dysfunction. In addition, some questionnaires contain individual items or domains relevant to sexual function, such as the King's Health Questionnaire, which has a domain specific to sexual function.

Increasingly, other measures, including those that evaluate body image, also impact sexual function and are associated with pelvic floor dysfunction. Measurement of these confounders may be important in order to assess the impact of pelvic floor dysfunction on sexual health.

#### 5.1 | Sexual diaries

A daily log of sexual thoughts, activities; supported by the US FDA as a primary outcome measure for the efficacy of interventions to evaluate sexual function.

#### 5.2 | Event logs

Record individual sexual events or activities. Each event is classified as a “sexually satisfying event (SSE)” or not. Event logs record individual events rather than activities on a daily basis.

#### 5.3 | Sexually satisfying event

This term is coined by the US FDA, and is defined by the individual completing the questionnaire. The FDA stated that

**TABLE 1** Sexual function questionnaires

Instrument	Description	Number of items	ICI* Grade	Condition-specific
ICIQ-FLUTSsex (BFLUTS) (International Consultation on Continence Questionnaire- Female Lower Urinary Tract Symptoms Sex) <sup>57</sup>	Female sexual matters associated with urinary symptoms and related bother	4	A	Yes
GRISS (The Golombok-Rust Inventory of Sexual Satisfaction) <sup>58</sup>	Anorgasmia, vaginismus, impotence, and premature ejaculation, avoidance, dissatisfaction and non-sensuality, infrequency and no communication about sex	28	A	No
ICIQ-VS (International Consultation of Incontinence Questionnaire -Vaginal Symptoms) <sup>59</sup>	Assess effects of vaginal symptoms of sexual quality of life	14	B	Yes
PISQ (Pelvic Organ Prolapse Urinary Incontinence Sexual Questionnaire) <sup>60</sup>	Evaluates sexual function in women with incontinence and prolapse	31	B	Yes
PISQ-12 (short form version of the PISQ-31) <sup>61</sup>	Evaluates sexual function in women with incontinence and prolapse	12	Not rated	Yes
PISQ IR (IUGA- revised version of the PISQ) <sup>8</sup>	Evaluates sexual function in women with incontinence and prolapse includes evaluation of women with anal incontinence as well as women who do not report sexual activity	33	Not rated	Yes
FSFI (Female Sexual Function Index) <sup>62</sup>	Assesses multiple dimensions of sexual function	19	A	No
SFQ (Sexual Function Questionnaire) <sup>63</sup>	Assess the impact of OAB on sexual health function in the male and female population	31	C	Yes
SQOL-F (Sexual Quality Of Life-Female) <sup>64</sup>	Assess the impact of female sexual dysfunction of quality of life	18	B	Yes

\*International Consultation on Incontinence.

the term “satisfying” and what activities will be classified as a sexual encounter should be defined but did not supply a definition.

5.4 | Questionnaires

Psychometric properties of some tools are reported in Table 1.<sup>64</sup>

- 1. Pelvic Floor Condition specific sexual function measures: A validated sexual function measure which is developed to include concepts relevant women with pelvic floor dysfunction.
- 2. Generic sexual function measures: A validated measure that was developed to evaluate sexual function but does not contain items relevant to pelvic floor dysfunction such as coital incontinence or vaginal looseness.

6 | INVESTIGATIONS;  
MEASUREMENT OF PHYSIOLOGIC  
CHANGES

Physical investigations aim to evaluate different causes of sexual dysfunction and include investigations that focus on

the vascular, neurologic, musculoskeletal, and hormonal systems. The clinical utility of these investigations in the routine assessment of female sexual health needs further validation. In many instances, these investigations are utilized in the research setting. Supplemental Table S1 reviews the validity and reliability testing of physiologic investigations.

6.1 | Vascular assessment

Sexual arousal results in increased blood flow allowing genital engorgement, protrusion of the clitoris and augmented vaginal lubrication through secretion from the uterus and Bartholin's glands and transudation of plasma from engorged vessels in the vaginal walls. Several instruments are available to measure blood flow during sexual stimulation.<sup>65,66</sup> Inadequate vasculogenic response may be related to psychological factors as well as vascular compromise due to atherosclerosis, hormonal influence, trauma, or surgery.

- 1. Vaginal photoplethysmography: A tampon shape intra-vaginal probe equipped with an incandescent light that projects toward the vaginal walls is inserted; the amount of light that reflects back to the photosensitive cell provides a measure of vaginal engorgement which can be expressed as

vaginal blood volume or vaginal pulse amplitude depending on the mode of recording.<sup>67,68</sup> Likewise, labial and clitoral photoplethysmography can also be evaluated.<sup>69,70</sup>

2. Vaginal and clitoral duplex Doppler ultrasound: The anatomical integrity of clitoral structures and the changes in clitoral and labial diameter associated with sexual stimulation can be evaluated in B mode.<sup>71</sup> Movement of the blood relative to the transducer can be expressed as measurement of velocity, resistance, and pulsatility.<sup>72</sup> Blood flow in arteries irrigating the clitoris and the vagina are more commonly assessed during sexual stimulation.<sup>71,73,74</sup>
3. Laser Doppler imaging of genital blood flow: An imager positioned close to the vulva allows the assessment of skin/mucosae microcirculation at a depth of up to 2-3 mm.<sup>75</sup> This method has been used to assess response to sexual stimulation and correlated with subjective arousal.<sup>75</sup> It has also led to a better understanding of microvascular differences in women with provoked vestibulodynia compared to asymptomatic controls.<sup>76</sup>
4. Magnetic resonance of imaging of the genito-pelvic area: Evaluation of the increase in clitoral structure volume related to tissue engorgement occurring during arousal.<sup>76</sup>
5. Measurements of labial and vaginal oxygenation: A heated electrode and oxygen monitor are used to evaluate the arterial partial pressure of oxygen (PO<sub>2</sub>) transcutaneously.<sup>78,79</sup> The temperature of the electrode is kept at a constant elevated temperature by an electric current. Increase in blood flow under the electrode results in more effective temperature dissipation (heat loss) with the result that more current is needed to maintain the electrode at its prefixed temperature. The changes in current provide an indirect measurement of blood flow during sexual stimuli.<sup>79,80</sup> The electrode also monitors oxygen diffusion across the skin.<sup>78,79</sup>
6. Labial thermistor: Temperature measurement evaluated with a small metal clip attached to the labia minora and equipped with a sensitive thermistor.<sup>80,81</sup>
7. Thermography or thermal imaging of the genital area: Evaluation of genital temperature using a camera detecting infrared radiation from the skin during sexual stimulation.<sup>82</sup> This method has been correlated with subjective arousal.<sup>83</sup>

## 6.2 | Neurologic assessment

Related to intact sensation, neurological innervation is important for arousal and orgasm. Peripheral neuropathy or central nervous system disorders (eg, diabetic neuropathy, spinal cord injury) may lead to anorgasmia and decreased

arousal.<sup>84–86</sup> Different approaches can be used to evaluate motor and sensory neurological function.

1. Functional magnetic resonance imaging: Investigation of neural activation in anatomically localized cerebral regions evaluated through monitoring subtle changes in regional cerebral blood flow that occur with activation of the neurons. These patterns of activation and deactivation are used to examine the cerebral and cognitive response to sexual stimulation.<sup>77</sup>
2. Quantitative sensory testing: Assessment of the sensitivity by applying different stimuli (light touch, pressure, temperature, or vibration) using an ascending or descending method in order to evaluate the detection threshold. These methods can be used to evaluate different vulvo-vaginal sites including the clitoris, labia minora, and majora as well as vaginal and anal margins.<sup>84,87,88</sup>
3. Reflex examination: Evaluating sacral arc integrity, the bulbocavernosus reflex can be elicited by squeezing the clitoris and assessing the contraction of the anal sphincter.<sup>89</sup> The external anal reflex is tested by repetitive pricking delivered to perianal skin and observing anal sphincter contraction.<sup>89</sup> Latencies can also be evaluated by stimulating the nerve and evaluating muscle response through a needle electrode.<sup>90</sup>

## 6.3 | Pelvic floor muscle assessment

Assessment of pelvic floor muscle (PFM) function involves evaluating the tone, strength, endurance, coordination, reflex activation during rises in intra-abdominal pressure as well as the capacity to properly relax this musculature. These muscles are involved in sexual function as PFM contraction occurs during arousal and intensifies with orgasm and PFM tone is related to vaginal sensation.<sup>91–93</sup> Superficial PFMs such as the bulbospongiosus and ischiocavernosus are also involved in erection of the clitoris by blocking the venous escape of blood from the dorsal vein.<sup>94</sup> Thus, reduction in PFM strength and endurance has been related to lower sexual function.<sup>95,96</sup> Likewise, PFM hypotonicity may be related to vaginal hypoesthesia, anorgasmia, and urinary incontinence during intercourse<sup>9</sup> while hypertonicity may lead to dyspareunia.<sup>97,98</sup>

1. Pelvic floor manometry: measurement of resting pressure or pressure rise generated during contraction of the PFMs using a manometer connected to a sensor which is inserted into the urethra, vagina, or rectum. Pelvic floor manometric tools measuring pressure in either mmHg, hPa, or cmH<sub>2</sub>O can be used to assess resting pressure, maximal squeeze pressure (strength), and endurance.<sup>99</sup> Details about recommendations to ensure validity of pressure measurements are provided elsewhere.<sup>99</sup>

2. Pelvic floor dynamometry: measurement of PFM resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina.<sup>100–102</sup> Dynamometry measures force in Newton (N). Several parameters such as tone, strength, endurance, speed of contraction, and coordination can be evaluated.<sup>100–102</sup>
3. Pelvic floor electromyography (EMG): the recording of electrical potentials generated by the depolarization of PFM fibers. Intra-muscular EMG consists in the insertion of a wire or needle electrode into the muscle to record motor unit action potentials while surface EMG requires electrodes placed on the skin of the perineum or inside the urethra, vaginal, or rectum. EMG amplitude at rest and contraction can be recorded.
4. Pelvic floor ultrasound imaging: evaluation of PFM morphology at rest, during maximal contraction and Valsalva. Several parameters pertaining to assess the bladder neck and anorectal positioning and hiatus dimensions can be measured.<sup>103–105</sup>

## 6.4 | Hormonal assessment

Hormones such as estrogen, progesterin, and androgen influence sexual function and imbalance may lead to various symptoms including decreased libido, lack of arousal, vaginal dryness, and dyspareunia.<sup>106, 107, 107</sup> Depending on the underlying suspected conditions associated with sexual dysfunction, hormonal investigations such as estradiol (or FSH if symptoms of deficiency), serum testosterone, dehydroepiandrosterone acetate sulphate (DHEAS), free testosterone, dihydrotestosterone, prolactin, and thyroid function testing may be considered.<sup>108</sup> Moreover, the evaluation of vaginal pH and vaginal maturation index (ie, percentage of parabasal cells, intermediate cells, and superficial cells) can be helpful in women with vulvovaginal atrophy as it has been shown to be correlated with patient's symptomatology.<sup>109</sup>

## 7 | COMMON DIAGNOSES

The Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5), the International Classification of

**TABLE 2** Sexual dysfunction diagnoses

Diagnosis	Description
DSM—5 Diagnoses (American Psychiatric Association)	
Female Sexual Interest/Arousal disorder	Lack of, or significantly reduced, sexual interest/arousal as manifested by 3 of the following: <ol style="list-style-type: none"> <li>1. Absent/reduced interest in sexual activity</li> <li>2. Absent/reduced sexual/erotic thoughts or fantasies</li> <li>3. No/reduced initiation of sexual activity and unresponsive to partner's attempts to initiate</li> <li>4. Absent/reduced sexual excitement/pleasure during sexual activity in almost all or all (75–100%) sexual encounters</li> <li>5. Absent/reduced sexual interest/arousal in response to any internal or external sexual/erotic cues (written, verbal, visual)</li> <li>6. Absent/reduced genital or non-genital sensations during sexual activity in almost all or all (75–100%) sexual encounters</li> </ol>
Genito-Pelvic Pain/Penetration disorder	Persistent or recurrent difficulties with 1 or more of the following: <ol style="list-style-type: none"> <li>1. Vaginal penetration during intercourse</li> <li>2. Marked vulvovaginal or pelvic pain during intercourse or penetration attempts</li> <li>3. Marked fear or anxiety about vulvovaginal or pelvic pain in anticipation of, during, or as a result of vaginal penetration</li> <li>4. Marked tensing or tightening of the pelvic floor muscles during attempted vaginal penetration.</li> </ol>
Female orgasmic disorder	Presence of either of the following on all or almost all (75–100%) occasions of sexual activity: <ol style="list-style-type: none"> <li>1. Marked delay in, marked infrequency of, or absence of orgasm.</li> <li>2. Markedly reduced intensity of orgasmic sensations</li> </ol>
Joint terminology from the International Society for the Study of Women's Sexual Health and the North American Menopause Society	
Genitourinary Syndrome of Menopause	The genitourinary signs and symptoms of menopause that arise from decreasing level of estrogens and other steroids. This includes burning and irritation of reproductive organs and structures, dryness, pain with intercourse and urinary urgency, dysuria and recurrent infections.

Diseases 10th edition (ICD-10), and the Joint Terminology from the fourth International Consultation of Sexual Medicine (ICSM) all have proposed diagnoses for sexual disorders in women. Many of the diagnoses from the various societies overlap; we have chosen the diagnoses from the DSM 5, as well as the diagnosis of genitourinary syndrome of menopause as these diagnoses seem most relevant to the population of women with pelvic floor dysfunction, as shown in Table 2.

The DSM 5 has combined disorders that overlap in presentation and reduced the number of disorders from six to three. Hypoactive sexual desire disorder (HSDD) and female sexual arousal disorders (FSAD) have been combined into one disorder, now called Female Sexual Interest/Arousal Disorder (FSIAD), based on data suggesting that sexual response is not always a linear, uniform process, and that the distinction between certain phases, particularly desire and arousal, may be artificial. Although this revised classification has not been validated clinically and is controversial, it is the new adopted standardization. One reason offered for the new diagnostic name and criteria were clinical and experimental observations that sexual arousal and desire disorders typically co-occur in women and that women may therefore experience difficulties in both.<sup>110,111</sup>

The DSM-IV categories of vaginismus and dyspareunia have been combined to create “genito-pelvic pain/penetration disorder” (GPPPD). Female Orgasmic Disorder remains its own diagnosis. The DSM 5 has also changed the relevant specifiers of these disorders with the goal of increasing objectivity and precision and to avoid over-diagnosis of transient sexual difficulties. In particular, all diagnoses now require a minimum duration of approximately 6 months and are further specified by severity.

Genitourinary syndrome of menopause (GSM) is a new term introduced by the International Society of Sexual Medicine to describe a variety of symptoms which may be associated with sexual health. Although not validated, this diagnosis was introduced in an effort to improve communication between providers and patients regarding symptoms which may be difficult to discuss. While not a sexual dysfunction diagnosis, given the age of women who typically develop pelvic floor dysfunction, symptoms associated with GSM may be relevant to the assessment of the sexual health of women with pelvic floor dysfunction.

For each of the DSM-5 diagnoses, providers should indicate whether or not the condition is lifelong or acquired, generalized or situational, and rate the severity as mild, moderate or severe in terms of the distress it causes. All of the diagnoses, except for the pain diagnoses, need to meet the criterion that it has been present for 6 months, causes significant distress, and are not a consequence of non-sexual mental disorder, severe relationship distress and are not solely or primarily attributable to a medication or underlying illness.<sup>112</sup> For genitourinary syndrome of menopause, not all

signs and symptoms need be present, but the symptoms must be bothersome and not better accounted for by another diagnosis.<sup>113</sup>

## 8 | TERMS FOR CONSERVATIVE TREATMENTS

### 8.1 | Lifestyle modification

Alterations of certain behaviors may improve sexual function. These include weight loss, appropriate sleep, adequate physical fitness, and management of mood disorders.<sup>114–118</sup> Vulvovaginal pain may be treated by dietary changes and perineal hygiene (avoiding irritant soaps, detergents, and douches), although data are conflicting.<sup>119</sup> Dietary modifications may be disorder specific including low oxalate diet as reduction in dietary levels of oxalate may improve symptoms of vulvodynia,<sup>120</sup> or a bladder friendly diet with reductions in acidic foods and bladder irritants may treat bladder pain and associated sexual pain.<sup>121,122</sup>

### 8.2 | Bibliotherapy

Use of selected books and videos to aid in treatment and reduce stress. Shown to improve sexual desire.<sup>123,124</sup>

### 8.3 | Topical therapies

Lubricants and moisturizers—Application of vaginal lubricant during sexual activity or vaginal moisturizers as maintenance may assist with atrophic symptoms and dyspareunia.<sup>125–127</sup> Examples of some lubricants are described below, although no one lubricant or moisturizer has been adequately studied to recommend it over others. Additionally, not all products are available in all countries.

- Essential arousal oil: Feminine massage oil applied to vulva prior to activity. Some evidence to support efficacy in treatment of sexual dysfunction, including arousal and orgasm, compared with placebo.<sup>128,129</sup>
- Vulvar soothing cream: Non-hormonal cream containing cutaneous lysate, to be applied twice daily. Study shows improvement in vulvar pain with use compared to placebo.<sup>130,131</sup>
- Prostaglandin E1 analogue, may help increase genital vasodilation. Ongoing trials to determine efficacy in arousal or orgasmic dysfunction.<sup>131–133</sup>

### 8.4 | Psychological intervention

Counseling and therapy are widely practiced treatments for female sexual dysfunction.<sup>114,134</sup> Even when a sexual



problem's etiology and treatment is primarily urogenital, once a problem has developed there are typically psychological, sexual, relationship, and body image consequences and it may be tremendously validating and helpful for these women to be referred to counselors or therapists with expertise in sexual problems. Psychological interventions include cognitive behavioral therapy (CBT), sex therapy, and mindfulness training. While there is insufficient evidence with regard to controlled trials studying the efficacy of psychological treatment in women with sexual dysfunction, the available evidence suggests significant improvements in sexual function after intervention with traditional sex therapy and/or cognitive behavioral therapy.

Specific techniques include:

- Sex therapy: Traditional treatment approach with aim to improve individual or couple's sexual experiences and reduce anxiety related to sexual activity.<sup>114</sup>
- Cognitive-behavioral therapy: Incorporates sex therapy components but with larger emphasis on modification of thought patterns that may interfere with sexual pleasure.<sup>114</sup>
- Mindfulness: An ancient eastern practice with Buddhist roots. The practice of "relaxed wakefulness," and "being in the moment," has been found to be an effective component of psychological treatments for sexual dysfunction.<sup>135–137</sup>

## 8.5 | Non-pharmacologic treatments

- Clitoral suction device: Non-pharmacological treatment, this is a battery-operated hand held device, designed to be placed over the clitoris. It provides a gentle adjustable vacuum suction with low-level vibratory sensation. Intended to be used three or more times a week for approximately 5 min at a time, this therapy has been shown to increase blood flow to the clitoral area as well as to the vagina and pelvis.<sup>117</sup> Small non-blinded studies have shown it may significantly improve arousal, orgasm, and overall satisfaction in patients with sexual arousal disorder.<sup>137,138</sup>
- Vaginal dilators: Vaginal forms or inserts, dilators are medical devices of progressively increasing lengths or girths designed to reduce vaginal adhesions after pelvic malignancy treatments or in treatment of vulvar/vaginal pain.<sup>139,140</sup> Can be useful for perineal pain or introital narrowing following pelvic reconstructive repairs, however, routine use after surgery not supported.<sup>141</sup> Dilators can also be used for pelvic floor muscle stretching (ie, Thiele massage) and was found helpful in women with interstitial cystitis and high-tone pelvic floor dysfunctions.<sup>142</sup>

- Vaginal vibrators, external and internal: May be associated with improved sexual function, data controversial.<sup>143,144</sup> Possibility that use of vibrators for self-stimulation may negatively impact sexual function with partner related activity.<sup>145</sup>
- Vaginal exercising devices: Pelvic muscle strengthening tools in form of balls, inserts or biofeedback monitors. May improve pelvic floor muscle tone and coordination by improving ability to contract and relax. Studies are lacking assessing their use without concurrent physical therapy.
- Fractional CO2 laser treatment: Use of thermoablative laser to vaginal mucosa may improve microscopic structure of epithelium.<sup>146–148</sup> This results in increased thickness, vascularity, and connective tissue remodeling, which can improve climacteric symptoms. Although long term data are lacking, some studies have shown significant improvements in subject symptoms of vaginal dryness, burning, itching, and dyspareunia as well as quality of life.<sup>147,149,150</sup>

## 8.5.1 | Alternative treatments

- Acupuncture: Ancient Chinese practice that involves insertion of small needles into various points in the body in an effort to heal pain or treat disease. It may help with stress reduction, pelvic pain, and sexual dysfunction.<sup>122,151,152</sup>

## 8.5.2 | Physical therapy

Manual therapy: Techniques that include stretching, myofascial release, pressure, proprioceptive neuromuscular facilitation, and massage applied externally on the perineum and internally to increase flexibility, release muscle tensions and trigger points in the pelvic floor muscles. It was found to be effective to improve sexual function in women with pelvic floor disorders in recent meta-analysis and systematic review.<sup>17,153,154</sup> These therapies have also been found helpful in women with genito-pelvic pain.<sup>155</sup>

- Pelvic muscle exercises with or without biofeedback: May improve sexual function in women with pelvic floor disorders<sup>154</sup> or pain.<sup>122</sup>
- Dry needling: Placement of needles without injection in myofascial trigger points.<sup>156</sup>
- Trigger point injections
  - i. Anesthetic: Injection of local anesthetics, often Lidocaine, directed by trigger point palpation, can be external or transvaginal.<sup>156–158</sup>
  - ii. Botox: Injection of Botulinum toxin type A, a potent muscle relaxant, into refractory myofascial trigger points to reduce pelvic pain.<sup>122,156,157</sup>



## 8.6 | Prescription treatments

### 8.6.1 | Hormonal

- Estrogen: Available via prescription for both systemic use (oral or transdermal preparations); or locally use (creams, rings, or tablets). May assist with overall well-being, sexual desire, arousal, and dyspareunia.<sup>117,127,159</sup> Role for topical use in treatment of post-surgical atrophy or mesh extrusion.<sup>160</sup>
- Ospemifene: Selective estrogen receptor modulator for treatment of moderate to severe dyspareunia related to vulvar and vaginal atrophy, in postmenopausal women.<sup>161–163</sup> Acts as an estrogen agonist/antagonist with tissue selective effects in the endometrium
- Testosterone: Not approved for use in women in the USA or UK, may be available in other countries. Variety of preparations including transdermal, oral, or pellet administration. Long term safety unknown, studies suggest improvements in satisfying sexual events, sexual desire, pleasure, arousal, orgasm, and decreased distress.<sup>114,127,133</sup>
- Tibolone: Synthetic steroid with estrogenic, progestogenic, and androgenic properties. It is not currently available in the USA. Studies have suggested a positive effect on sexual function with use.<sup>159</sup>
- Prasterone: dehydroepiandrosterone suppository available as a vaginal insert. It has been shown to be efficacious when compared to placebo in decreasing vulvovaginal atrophy.<sup>164</sup>

### 8.6.2 | Non hormonal

- Bremelanotide; formerly PT-141- Melanocortin agonist, initially developed as a sunless tanning agent, utilizes a subcutaneous drug delivery system. Treatment significantly increased sexual arousal, sexual desire, and number of sexually satisfying events with associated decreased distress in premenopausal women with FSD.<sup>165</sup>
- Serotonin receptor agonist/antagonist; Flibanserin-5-hydroxytryptamine (HT)1A receptor agonist and 5-HT2A receptor antagonist, initially developed as antidepressant. Challenges in FDA applications, due to possible long term risks. Studies show improved sexual desire, satisfying sexual events, and reduced distress.<sup>166,167</sup>
- Dual control model in differential drug treatments for hypoactive sexual desire disorder and female sexual arousal disorder:
  - i. Testosterone in conjunction with phosphodiesterase type 5 inhibitor (PDE-5)
  - ii. Testosterone in conjunction with a 5-HT1A agonist

May be able to target physiologic and subjective measures of sexual functioning in a more specific manner. Premise of

two types of HASDD subjects: low sensitivity to sexual cues, or prone to sexual inhibition. Tailoring on demand therapeutics to different underlying etiologies may be useful to treat common symptoms in women with lack of sexual interest and provide the appropriate therapy. Testosterone is supplied as a short acting agent 4 h prior to sexual event to lessen the side effect/risk profile.<sup>168–171</sup>

- Apomorphine: Nonselective dopamine agonist that may enhance response to stimuli.<sup>133,172</sup>
- Antidepressants and Neuropathics: Include tricyclic antidepressants, and anticonvulsants, may be useful in treating sexual pain, and vulvar pain.<sup>120,122</sup>
- Bupropion: Mild dopamine and norepinephrine reuptake inhibitor and acetylcholine receptor antagonist, it may improve desire and decrease distress or modulate Selective Serotonin Reuptake Inhibitor (SSRI) induced FSD.<sup>173</sup>

Supplemental Table S2 presents studies evaluating the effect of various treatments on sexual dysfunction.

## 9 | SURGERY

### 9.1 | The effect of pelvic reconstructive surgery for prolapse and incontinence on sexual health

Women with pelvic floor dysfunction commonly report impaired sexual function, which may be associated with the underlying pelvic floor disorder. Treatment of the underlying disorders may or may not impact sexual function.<sup>13</sup> While both urinary incontinence and pelvic organ prolapse affect sexual function, prolapse is more likely than urinary incontinence to result in sexual inactivity. Prolapse is also more likely to be perceived by women as affecting sexual relations and overall sexual satisfaction. This perception is independent of diagnosis or therapy for urinary incontinence or prolapse.<sup>29,174,175</sup> Very little is known about the impact of fecal incontinence on sexual function.<sup>14</sup> The effect of pelvic reconstructive surgery on sexual function has increased but there is need for more focused research.<sup>30,176</sup> Overall, randomized trials are lacking, varied outcome measures are used among studies.<sup>18</sup> There is a lack of reporting per DSM-IV/DSM 5 categories and a lack of long-term follow-up. Level of Evidence (LOE) is poor in many studies, and sexual dysfunction is usually reported as a secondary outcome measure. While any surgery can impact sexual function postoperatively, most commonly performed pelvic floor surgeries were not designed with the intent to improve sexual function. In general, successful surgical treatment of incontinence or prolapse may improve sexual symptoms associated with the underlying disorder. For example,

coital incontinence improves after sling surgery, but whether it impacts other aspects of sexual function such as orgasm, desire, or arousal is unclear.<sup>18</sup> Surgery for prolapse may improve underlying symptoms of laxity or embarrassment from bulge, which in turn may improve sexual function, but does not seem to have a direct impact on other aspects of sexual function. A small but significant number of patients will develop pain or other sexual disorders following surgery. These pain disorders spring from a variety of causes including those caused by the use of grafts. Prediction of who will develop these pain disorders is challenging. A recent paper which evaluated the effect of vaginal surgery on sexual function reported that women overall reported improved function, decrease in dyspareunia rates, and that de novo dyspareunia rates were low at 5% at 12 months and 10% at 24 months.<sup>177</sup> Nonetheless, assessment of sexual activity and partner status and function prior to and following surgical treatment is essential in the evaluation of surgical outcomes. Because of the negative impact of pain on sexual function, assessment of sexual pain prior to and following procedures should also be undertaken.

## 9.2 | Female genital cosmetic surgery

A number of surgeries have been developed that aim to improve sexual function by altering the appearance and/or the function of female genital tract. Evidence supporting the efficacy and safety of these procedures is lacking. In addition, standardized definitions of these procedures may help foster high quality research, standardization of technique, and outcome measurement in this field, but is currently lacking, and beyond the scope of this document. These procedures include, but are not limited to, labioplasty, vaginoplasty, laser vaginoplasty, perineoplasty, laser rejuvenation, clitoral de-hooding, labia majora augmentation, G spot amplification, laser treatment of vulvovaginal atrophy, and platelet risk plasma treatments.

## 10 | CONSIDERATIONS FOR REPORTING IN RESEARCH

Sexual health should be included as an outcome for reporting research related to pelvic floor dysfunction; this is particularly important in the case of surgical interventions as adverse or advantageous sexual function outcomes would likely impact patient's choice and satisfaction with interventions. The IUGA ICS Joint Report on terminology<sup>39</sup> for reporting outcomes of surgical procedures for POP described in detail items to be considered when reporting outcomes for prolapse surgical intervention.<sup>18</sup> De novo painful intercourse following prolapse surgery should be classified as described in these documents. While pain and its impact on sexual function is

important, assessments limited to descriptions of sexual pain are not an adequate assessment of sexual health, and absence of pain should not be inferred to indicate that sexual function is intact or changed.

At a minimum, sexual activity status should be assessed. Assessment of sexual activity status should be self-defined and not limited to women who engage in sexual intercourse. In addition, it is important to not assume the gender of the woman's partner. When reporting level of sexual activity, authors should report numbers of all patients who are sexually active (or inactive), with and without pain, pre- and post intervention.

In addition to sexual activity status, its associated level of bother should be documented. Use of validated patient reported outcome questionnaires to further assess the quality of sexual function should also be considered. These and other self-reported outcomes including sexually satisfying events and sexual diaries are described in Section 4, in this document. Assessment of the impact of pelvic floor disorder treatment on women's sexual partners should also be considered. Conditions, among others, that commonly impact sexual function include hormonal status, body image, underlying medical conditions, and history of sexual abuse. Researchers may want to consider inclusion of these outcomes.

## 11 | LIMITATIONS

This document includes a broad overview of terms important in the diagnosis and treatment of women with pelvic floor disorders. We have not included an in-depth description of all sexual disorders as this is beyond the scope of this document. Some disorders such as the persistent vulvar pain and vulvodynia are described elsewhere and we have tried to reference these documents as appropriate.<sup>37</sup> Not all management strategies presented are supported by robust evidence as to their efficacy; we have tried to include the data that supports interventions as it is available. In addition, there are ongoing debates regarding terms and diagnoses. For example, subsequent to the publication of the DSM-5, the International Consultation on Sexual Medicine (ICSM) in 2015,<sup>180</sup> and the International Society for Study of Women's Sexual Health (ISSWSH)<sup>181</sup> published consensus papers on the nomenclature for female sexual dysfunctions. Based on the available evidence regarding clinical presentation, risk factors, and treatment response, both organizations recommended maintaining desire and arousal as distinct and separate clinical entities.

## ACKNOWLEDGMENTS

This document has involved 14 rounds of full review, by co-authors, of an initial draft, with the collation of comments.

The co-authors acknowledge the input to an earlier version of this document by Dr. E Lukacz, Dr. V Handa, Dr S Jha, and Professor Bernard Haylen. The authors further acknowledge the contributions of members of ICS SSC (2017). The authors would also like to acknowledge the helpful comments provided by Elisabetta Constantini, Beth Shelley, Helena Frawley, together with the substantial review by ISSWSH.

## COMPLIANCE WITH ETHICAL STANDARDS

Disclaimer: Any products/companies referred to in this document are not necessarily recommended or endorsed by the ICS or IUGA.

## CONFLICTS OF INTEREST

RG Rogers, Royalties from UPTODATE; R Pauls, no disclosures; R Thakar, Vice President of the International Urogynecological Association, Honorariums from Astellas and Pfizer for lectures; M Morin, no disclosures; A Kuhn, no disclosures; E Petri, no disclosures; B Faton, consultant for Astellas, Allergan, Boston Scientific; K Whitmore: Clinical Research, Coloplast, Allergan; S Kingsberg, Paid consultant to: Apricus, Emotional Brain, Sprout, Teva, SST, Pfizer, Shionogi, Novo Nordisk, Viveve, Palatin, Metagenenics; Stock options, Viveve; J Lee, Research Grant from AMS/BSCI for investigator led clinical trials.

## AUTHORS' CONTRIBUTIONS

RR, JL, RNP, RT, MM, AK, EP, BF, KW, SK contributed in conception and writing of manuscript.

## ENDNOTES

<sup>a</sup> Coital incontinence is defined as a complaint of involuntary leakage of urine during or after coitus. Coital incontinence seems to be an aggravating factor that women generally describe as humiliating.<sup>1</sup> The prevalence of urinary incontinence during intercourse has been evaluated to range from 2% to 56%, depending on the study population (for eg, the general population or a cohort of women with incontinence), the definition used (any leakage, weekly, on penetration, during orgasm, only severe leakage) and the evaluation method used (questionnaire, interviews). In a literature review reported in 2002 that covered English-language papers from 1980 to 2001, Shaw<sup>21</sup> reported a 2-10% prevalence of coital incontinence in randomly selected community samples. The physio pathological mechanisms involved have been widely debated,<sup>22</sup> with bladder overactivity conventionally being implicated in orgasmic incontinence and SUI in penetration incontinence. In the past 5 years, studies however, have underlined the role of the urethral sphincter in coital incontinence, which is thought to be crucial even in women with detrusor overactivity and orgasmic incontinence.<sup>23</sup> The penetration form of coital incontinence is largely associated with urodynamics findings of

SUI, whereas orgasmic incontinence might be associated with both detrusor overactivity and SUI.<sup>23,24</sup> Nevertheless, among women with OAB, orgasmic incontinence is more common than penetration incontinence. Coital incontinence on penetration can be cured by surgery in 80% of women with urodynamically proven SUI. Similarly, orgasmic incontinence can respond to treatment with anticholinergics in 59% of women with detrusor overactivity.<sup>25,26</sup>

<sup>b</sup> Rare condition mostly described in women who have genital abnormalities such as micro perforate hymen.<sup>27</sup>

<sup>c</sup> A third of sexually active women with POP complain that their prolapse interferes with sexual function.<sup>29,30</sup> However, it has been shown that women with POP have comparable rate of sexual activity to similarly aged individuals without POP.<sup>31,32</sup>

<sup>d</sup> A recent survey of IUGA members noted that 57% of responders considered vaginal laxity a bothersome condition that impacts relationship happiness and patient's sexual functioning. The most frequently cited (52.6%) location responsible from laxity was the introitus and the majority of respondents (87%) thought both muscle and tissue changes were responsible.<sup>33</sup>

<sup>e</sup> Dyspareunia rates reported in the literature range from 14 % to 18%.<sup>34</sup>

<sup>f</sup> There is often (phobic) avoidance and anticipation/fear/experience of pain, along with variable involuntary pelvic muscle contraction. Patients with vaginismus could present with severe fear avoidance without vulvar pain or fear avoidance with vulvar pain. Structural or other physical abnormalities must be ruled out/addressed.<sup>35</sup> There is controversy of whether or not this term should be retained; the Diagnostic and statistical manual of mental disorders 2013 proposed to replace dyspareunia and vaginismus with the term "Genito-Pelvic Pain/ Penetration Disorder (GPPPD)."<sup>36</sup>

<sup>g</sup> Decreased vaginal lubrication is often involved in pain with sexual activity among postmenopausal women, women with hypo-estrogenic states for other reasons or after pelvic surgery and may result in persistent or recurrent vaginal burning sensation with intercourse (penile or any device).<sup>4</sup>

<sup>h</sup> A non-relaxing pelvic floor that is mainly associated with dyspareunia. See 4.4.<sup>8</sup>

<sup>i</sup> In certain disorders such as genital herpes, vestibulitis, endometriosis, or bladder pain syndrome, pain may also occur after non coital stimulation.<sup>4</sup>

<sup>j</sup> The term "Hispareunia" has been first suggested by Brubaker in one editorial to describe partner dyspareunia after sling insertion.<sup>38</sup>

<sup>k</sup> It has been suggested that a distinction could be made between women with sexual arousal concerns that are psychological or subjective in nature (ie, absence of or markedly diminished feelings of sexual arousal while vaginal lubrication or other signs of physical response still occur), those that are genital (impaired genital sexual arousal—reduction of the physical response), and those that include complaints of both decreased subjective and genital arousal.<sup>1,4</sup>

<sup>l</sup> A normal examination is highly informative to the women and can be of reassurance value.<sup>4</sup>

<sup>m</sup> Other conditions that may influence sexual function are fissures, vulval excoriation, skin rashes, cysts, and other tumors, atrophic changes or lichen sclerosis, scars, sinuses, deformities, condylomata, papillomata, hematoma.

<sup>n</sup> Increased blood flow in the vaginal walls associated with arousal increases the force in the vaginal walls, which drives transudation of

NaCl+-rich plasma through the vaginal epithelium, coalescing into the slippery film of vaginal lubrication and neutralizing the vagina's usually acidic state.<sup>33</sup> Reduced vulvo-vaginal sensitivity has been associated with sexual dysfunction and neurologic impairment.<sup>34</sup>

<sup>o</sup> Sitting often exacerbates the pain, which may be relieved in the supine position. Presentation may be unilateral or bilateral in presentation.

<sup>p</sup> Intra-vaginal or intra-rectal assessment palpation is useful to provide a subjective appreciation of the PFM. PFM tone can be evaluated and defined as hypotonic, normal, and hypertonic,<sup>41</sup> or assessed using Reissing's 7 point scale from -3 to +3.<sup>42</sup> Squeeze pressure or strength during voluntary and reflex contraction can also be graded as strong, normal, weak, absent, or alternatively by using a validated grading system such as Brink's scale or the PERFECT scheme.<sup>42-44</sup> These scales also include quotations of muscular endurance (ability to sustain maximal or near maximal force), repeatability (the number of times a contraction to maximal or near maximal force can be performed), duration, co-ordination, and displacement. Each side of the pelvic floor can also be assessed separately to allow for any unilateral defects and asymmetry.<sup>42</sup> Voluntary muscle relaxation can be graded as absent, partial, complete, delayed.<sup>42</sup> The presence of major morphological abnormalities of the puborectalis muscle may be assessed for by palpating its insertion on the inferior aspect of the os pubis. If the muscle is absent 2-3 cm lateral to the urethra, that is, if the bony surface of the os pubis can be palpated as devoid of muscle, an "avulsion injury" of the puborectalis muscle is likely.<sup>45</sup> Tenderness can be scored during a digital rectal (or vaginal) examination of levator ani, piriformis and internal obturator muscles bilaterally, according to each subject's reactions: 0, no pain; 1, painful discomfort; 2, intense pain; with a maximum total score of 12.<sup>46</sup>

<sup>q</sup> GSM is a syndrome associated with aging that results in alkalization of vaginal pH, changes in the vaginal flora, increased parabasal cell on maturation index and decreased superficial cells on wet mount or maturation index. In addition, there is a loss of collagen, adipose, and water-retention of the vulva which results in loss of elasticity, generalized reduction in blood perfusion of the genitalia. The vaginal epithelium may become friable with petechiae, ulcerations, and bleeding after minimal trauma.<sup>48</sup>

<sup>r</sup> Two classification systems for complications following prolapse surgery, includes the more generic Modified Clavien Dindo<sup>178</sup> and the more specific IUGA ICS classification of complications related to insertion of grafts/prosthesis<sup>40</sup> or use of native tissue.<sup>179</sup> These classification systems did include pain related to prolapse surgery complications which was sub-classified depending on whether pain was at rest, provoked during examination, during sexual activities, physical activities, or spontaneous.

## ORCID

Rebecca G. Rogers  <http://orcid.org/0000-0002-3991-7348>

## REFERENCES

- Haylen BT, de Ridder D, Freeman RM, et al. An international urogynecological association (IUGA)/International continence society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J*. 2010;21:5-26.
- Shifren JL, Monz BU, Russo PA, Segretti A, Johannes CB. Sexual problems and distress in United States women: prevalence and correlates. *Obstet Gynecol*. 2008;112:970-997.
- Basson R, Berman J, Burnett A, et al. Report of the international consensus development conference on female sexual dysfunction: definitions and classifications. *J Urol*. 2000;163:888-893.
- Rupesh R, Pahlajani G, Khan S, Gupta S, Agarwal A, Zippe CD. Female sexual dysfunction: classification, pathophysiology and management. *Fertil Steril*. 2007;88:1273-1284.
- Basson R, Althof S, Davis S, et al. Summary of the recommendations on sexual dysfunctions in women. *J Sex Med*. 2004;1:24-34.
- Fashokun TB, Harvie HS, Schimpf MO, et al. Sexual activity and function in women with and without pelvic floor disorders. *Int Urogynecol J*. 2013;24:91-97.
- Handa VL, Cundiff G, Chang HH, Helzlsouer KJ. Female sexual function and pelvic floor disorders. *Obstet Gynecol*. 2008;111:1045-1052.
- Rogers RG. Sexual function in women with pelvic floor disorders. *Can Urol Assoc J*. 2013;7:S199-S201.
- Salonia A, Zanni G, Nappi RE, et al. Sexual dysfunction is common in women with lower urinary tract symptoms and urinary incontinence: results of a cross-sectional study. *Eur Urol*. 2004;45:642-648.
- Lowenstein L, Gamble T, Sanses TV, et al. Sexual function is related to body image perception in women with pelvic organ prolapse. *J Sex Med*. 2009;6:2286-2291.
- Jelovsek JE, Barber MD. Women seeking treatment for advanced pelvic organ prolapse have decreased body image and quality of life. *Am J Obstet Gynecol*. 2006;194:1455-1461.
- Zielinski R, Miller J, Low LK, Sampselle C, DeLancey JO. The relationship between pelvic organ prolapse, genital body image, and sexual health. *Neurourol Urodyn*. 2012;31:1145-1148.
- Lowenstein L, Pierce K, Pauls R. Urogynecology and sexual function research. How are we doing? *J Sex Med*. 2009;6:199-204.
- Cichowski SB, Komesu YM, Dunivan GC, Rogers RG. The association between fecal incontinence and sexual activity and function in women attending a tertiary referral center. *Int Urogynecol J*. 2013;24:1489-1494.
- Kingsberg SA, Knudson G. Female sexual disorders: assessment, diagnosis, and treatment. *CNS Spectr*. 2011;16:49-62.
- Bortolami A, Vanti C, Banchelli F, Gruccione AA, Pillastrini P. Relationship between female pelvic floor dysfunction and sexual dysfunction: an observational study. *J Sex Med*. 2015;12:1233-1241.
- Kanter G, Rogers RG, Pauls RN, Kammerer-Doak D, Thakar R. A strong pelvic floor is associated with higher rates of sexual activity in women with pelvic floor disorders. *Int Urogynecol J*. 2015;26:991-996.
- Jha S, Ammenbal M, Metwally M. Impact of incontinence surgery on sexual function: a systematic review and meta-analysis. *J Sex Med*. 2012;9:34-43.
- Lonnee-Hoffmann RA, Salvesen O, Morkved S, Schei B. What predicts improvement of sexual function after pelvic floor surgery? A follow-up study. *Acta Obstet Gynecol Scand*. 2013;92:1304-1312.
- Jha S, Gray T. A systematic review and meta-analysis of the impact of native tissue repair for pelvic organ prolapse on sexual function. *Int Urogynecol J*. 2015;26:321-327.

21. Shaw C. A systematic review of the literature on the prevalence of sexual impairment in women with urinary incontinence and the prevalence of urinary leakage during sexual activity. *Eur Urol.* 2002;42:432–440.
22. Serati M, Salvatore S, Cattoni E, et al. Female urinary incontinence at orgasm: a possible marker of a more severe form of detrusor overactivity. Can ultrasound measurement of bladder wall thickness explain it? *J Sex Med.* 2011;8:1710–1716.
23. El-Azab AS, Yousef HA, Seifeldein GS. Coital incontinence: relation to detrusor overactivity and stress incontinence. *Neurourol Urodyn.* 2011;30:520–524.
24. Pastor Z. Female ejaculation orgasm vs. coital incontinence: a systematic review. *J Sex Med.* 2013;10:1682–1691.
25. Serati M, Cattoni E, Braga A, Siesto G, Salvatore S. Coital incontinence: relation to detrusor overactivity and stress incontinence. A controversial topic. *Neurourol Urodyn.* 2011;30:1415.
26. Serati M, Salvatore S, Uccella S, et al. Urinary incontinence at orgasm: relation to detrusor overactivity and treatment efficacy. *Eur Urol.* 2008;54:911–915.
27. Di Denato V, Mancini N, Palaia I, et al. Urethral coitus in a patient with a microperforate hymen. *JMIG.* 2008;15:642–643.
28. Sultan AH, Monga A, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female anorectal dysfunction. *Int Urogynecol J.* 2015;28:5–31.
29. Barber MD, Visco AG, Wyman JF, Fantl JA, Bump RC. Sexual function in women with urinary incontinence and pelvic organ prolapse. *Obstet Gynecol.* 2002;99:281–289.
30. Weber AM, Walters MD, Piedmonte MR. Sexual function and vaginal anatomy in women before and after surgery for pelvic organ prolapse and urinary incontinence. *Am J Obstet Gynecol.* 2000;182:1610–1615.
31. Jelovsek JE, Maher C, Barber MD. Pelvic organ prolapse. *Lancet.* 2007;369:1027–1038.
32. Weber AM, Walters MD, Schover LR, Mitchinson A. Sexual Function in women with uterovaginal prolapse and urinary incontinence. *Obstet Gynecol.* 1995;85:483–487.
33. Pauls RN, Fellner AN, Davila GW. Vaginal laxity: a poorly understood quality of life problem; a survey of physician members of the International Urogynecological Association (IUGA). *Int Urogynecol J.* 2012;23:1435–1448.
34. Spector IP, Carey MP. Incidence and prevalence of the sexual dysfunctions: a critical review of the empirical literature. *Arch Sex Behav.* 1990;19:389–408.
35. Basson R, Leiblum S, Brotto L, et al. Revised definitions of women's sexual dysfunction. *J Sex Med.* 2004;1:40–48.
36. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders.* 5th ed. Arlington, VA: Author; 2013.
37. Bornstein J, Goldstein AT, Stockdale CK, et al. 2015 ISSVD, ISSWSH, and IPPS consensus terminology and classification of persistent vulvar pain and vulvodynia. *J Sex Med.* 2016;13:607–612.
38. Brubaker L. Editorial: partner dyspareunia (Hispareunia). *Int Urogynecol J Pelvic Floor Dysfunct.* 2006;17:311.
39. Toozs-Hobson P, Freeman R, Barber M, et al. International Urogynecological Association, International Continence Society. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol J.* 2012;23:527–535.
40. Haylen BT, Freeman RM, Swift SE, et al. An international urogynecological association (IUGA)/international continence society (ICS) joint terminology and classification of the complications related directly to the insertion of prostheses (meshes, implants, tapes) and grafts in female pelvic floor surgery. *Int Urogynecol J.* 2011;22:3–15.
41. Devreese A, Staes F, De Weerd W, et al. Clinical evaluation of pelvic floor muscle function in continent and incontinent women. *Neurourol Urodyn.* 2004;23:190–197.
42. Reissing ED, Brown C, Lord MJ, Binik YM, Khalifé S. Pelvic floor muscle functioning in women with vulvar vestibulitis syndrome. *J Psychosom Obstet Gynaecol.* 2005;26:107–113.
43. Messelink B, Benson T, Berghmans B, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: report from the Pelvic Floor Clinical Assessment Group of the International Continence Society. *Neurourol Urodyn.* 2005;24:374–380.
44. Laycock J, Jerwood D. Pelvic floor muscle assessment: the PERFECT scheme. *Physiotherapy.* 2001;87:631–642.
45. Brink CA, Wells TJ, Sampsel CM, Taillie ER, Mayer R. A digital test for pelvic muscle strength in women with urinary incontinence. *Nurs Res.* 1994;43:352–356.
46. Dietz HP, Moegni F, Shek KL. Diagnosis of levator avulsion injury: a comparison of three methods. *Ultrasound Obstet Gynecol.* 2012;40:693–698.
47. Simons DG, Mense S. Understanding and measurement of muscle tone as related to clinical muscle pain. *Pain.* 1998;75:1–17.
48. Bo K, Frawley H, Haylen B, et al. International (IUGA)/International continence society (ICS) joint report on the terminology for the conservative and non-Pharmacological management of female pelvic floor dysfunction. *Int Urogynecol J.* 2017;28:191–213.
49. Montenegro ML, Mateus-Vasconcelos EC, Rosa e Silva JC, Nogueira AA, Dos Reis FJ, Poli Neto OB. Importance of pelvic muscle tenderness evaluation in women with chronic pelvic pain. *Pain Med.* 2010;11:224–228.
50. Masi AT, Hannon JC. Human resting muscle tone (HRMT): narrative introduction and modern concepts. *J Body Mov Ther.* 2008;12:320–332.
51. Bottomley J. *Quick reference dictionary for physical therapy.* 3rd ed. New Jersey: SLACK Incorporated; 2013.
52. Howley ET. Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Med Sci Sports Exerc.* 2001;33:S364–S369.
53. Komi PV. Strength and power in sport. In: *Encyclopaedia of sports medicine.* 2nd edn. Oxford: Blackwell Science Ltd; 2003.
54. Wilmore JH, Costill DL. *Neuromuscular adaptations to resistance training. Physiology of sport and exercise.* 2nd Ed. Chapter 3, USA: Human Kinetics; 1999. 82–111.
55. Basson R, Leiblum S, Brotto L, et al. Definitions of women's sexual dysfunction reconsidered: advocating expansion and revision. *J Psychosom Obstet Gynaecol.* 2003;24:221–229.
56. Kingsberg SA, Althof SE. Satisfying sexual events as outcome measures in clinical trial of female sexual dysfunction. *Behav Res Ther.* 2011;49:352–360.
57. Brookes ST, Donovan JL, Wright M, Jackson S, Abrams P. A scored form of the Bristol Female Lower Urinary Tract



- Symptoms Questionnaire: data from a randomized controlled trial of surgery for women with stress incontinence. *Am J Obstet Gynecol*. 2004;191:73–82.
58. Rust J, Golombok S. The colombok-Rust inventory of sexual satisfaction (GRISS). *Br J Clin Psychol*. 1985;24:63–64.
  59. Price N, Jackson SR, Avery K, Brookes ST, Abrams P. Development and psychometric evaluation of the ICIQ vaginal symptoms questionnaire: the ICIQ-VS. *BJOG*. 2006;113:700–712.
  60. Rogers RG, Kammerer-Doak D, Villarreal A, Coates K, Qualls C. A new instrument to measure sexual function in women with urinary incontinence or pelvic organ prolapse. *Am J Obstet Gynecol*. 2001;184:552–558.
  61. Rogers RG, Coates KW, Kammerer-Doak D, Khalsa S, Qualls C. A short form of the pelvic organ prolapse/urinary incontinence sexual questionnaire (PISG-12). *Int Urogynecol J Pelvic Floor Dysfunct*. 2003;14:164–168.
  62. Rosen RC, Brown C, Heman J, et al. The female sexual function index (FSFI): a multi-centered self-report instrument for the assessment of female sexual function. *J Sex Marital Ther*. 2000;26:191–208.
  63. Quirk FH, Heiman JR, Rosen RC, et al. Development of a sexual function questionnaire for clinical trials of female sexual dysfunction. *J Womens Health Gend Based Med*. 2002;11:277–289.
  64. Berman JR. Physiology of female sexual function and dysfunction. *Int J Impot Res*. 2005;17:S44–S51.
  65. Park K, Goldstein I, Andry C, Siroky MB, Krane RJ, Azadzi KM. Vasculogenic female sexual dysfunction: the hemodynamic basis for vaginal engorgement insufficiency and clitoral erectile insufficiency. *Int J Impot Res*. 1997;9:27–37.
  66. Ottesen B, Pedersen B, Nielsen J, Dalgaard D, Wagner G, Fahrenkrug J. Vasoactive intestinal polypeptide (VIP) provokes vaginal lubrication in normal women. *Peptides*. 1987;8:797–800.
  67. Laan E, Everaerd W, Evers A. Assessment of female sexual arousal: response specificity and construct validity. *Psychophysiology*. 1995;32:476–485.
  68. Rosen RC. Assessment of female sexual dysfunction: review of validated methods. *Fertil Steril*. 2002;77:S89–S93.
  69. Prause N, Cerny J, Janssen E. The labial photoplethysmograph: a new instrument for assessing genital hemodynamic changes in women. *J Sex Med*. 2005;2:58–65.
  70. Gerritsen J, van der Made F, Bloemers J, et al. The clitoral photoplethysmograph: a new way of assessing genital arousal in women. *J Sex Med*. 2009;6:1678–1687.
  71. Garcia S, Talakoub L, Maitland S, Dennis A, Goldstein I, Munarriz R. Genital duplex doppler ultrasonography before and after sexual stimulation in women with sexual dysfunction: gray scale, volumetric, and hemodynamic findings. *Fertil Steril*. 2005;83:995–999.
  72. Khalife S, Binik YM, Cohen DR, Amsel R. Evaluation of clitoral blood flow by color Doppler ultrasonography. *J Sex Marital Ther*. 2000;26:187–189.
  73. Kukkonen TM, Paterson L, Binik YM, Amsel R, Bouvier F, Khalife S. Convergent and discriminant validity of clitoral color Doppler ultrasonography as a measure of female sexual arousal. *J Sex Marital Ther*. 2006;32:281–287.
  74. Berman JR, Berman LA, Lin H, et al. Effect of sildenafil on subjective and physiologic parameters of the female sexual response in women with sexual arousal disorder. *J Sex Marital Ther*. 2001;27:411–420.
  75. Waxman SE, Pukall CF. Laser Doppler imaging of genital blood flow: a direct measure of female sexual arousal. *J Sex Med*. 2009;6:2278–2285.
  76. Bohm-Starke N, Hilliges M, Blomgren B, Flaconer C, Rylander E. Increased blood flow and erythema in the posterior vestibular mucosa in vulvar vestibulitis (1). *Obstet Gynecol*. 2001;98:1067–1074.
  77. Maravilla KR, Yang CC. Magnetic resonance imaging and the female sexual response: overview of techniques, results, and future directions. *J Sex Med*. 2008;5:1559–1571.
  78. Sommer F, Caspers HP, Esders K, Klotz T, Engelmann U. Measurement of vaginal and minor labial oxygen tension for the evaluation of female sexual function. *J Urol*. 2001;165:1181–1184.
  79. Levin RJ, Wagner G. Haemodynamic changes of the human vagina during sexual arousal assessed by a heated oxygen electrode [proceedings]. *J Physiol*. 1978;275:23P–24P.
  80. Prause N, Heiman JR. Assessing female sexual arousal with the labial thermistor: response specificity and construct validity. *Int J Psychophysiol*. 2009;72:115–122.
  81. Payne KA, Binik YM. Reviving the labial thermistor clip. *Arch Sex Behav*. 2006;35:111–113.
  82. Kukkonen TM, Binik YM, Amsel R, Carrier S. Thermography as a physiological measure of sexual arousal in both men and women. *J Sex Med*. 2007;4:93–105.
  83. Kukkonen TM, Binik YM, Amsel R, Carrier S. An evaluation of the validity of thermography as a physiological measure of sexual arousal in a non-university adult sample. *Arch Sex Behav*. 2010;39:861–873.
  84. Romanzi LJ, Groutz A, Feroz F, Blaivas JG. Evaluation of female external genitalia sensitivity to pressure/touch: a preliminary prospective study using Semmes-Weinstein monofilaments. *Urology*. 2001;57:1145–1150.
  85. Leedom L, Feldman M, Procci W, Zeidler A. Symptoms of sexual dysfunction and depression in diabetic women. *J Diabet Complications*. 1991;5:38–41.
  86. Sipski ML, Alexander CJ. Sexual activities, response and satisfaction in women pre- and post-spinal cord injury. *Arch Phys Med Rehabil*. 1993;74:1025–1029.
  87. Vardi Y, Gruenwald I, Sprecher E, Gertman I, Yartnitsky D. Normative values for female genital sensation. *Urology*. 2000;56:1035–1040.
  88. Cordeau D, Belanger M, Beaulieu-Prevost D, Courtois F. The assessment of sensory detection thresholds on the perineum and Breast compared with control body sites. *J Sex Med*. 2014;11:1741–1748.
  89. Lundberg PO, Ertekin C, Ghezzi A, Swash M, Vodusek D. Neurosexology: guidelines for neurologists. *European Journal of Neurology*. 2001;8:2–24.
  90. Tas I, On Yagiz, Altay B, Ozdedeli K. Electrophysiological assessment of sexual dysfunction in spinal cord injured patients. *Spinal Cord*. 2007;45:298–303.
  91. Messe MR, Geer JH. Voluntary vaginal musculature contractions as an enhancer of sexual arousal. *Arch Sex Behav*. 1985;14:13–28.
  92. Graber B, Kline-Graber G. Female orgasm: role of pubococcygeus muscle. *J Clin Psychiatry*. 1979;40:348–351.
  93. Shafik A. The role of the levator ani muscle in evacuation, sexual performance and pelvic floor disorders. *Int Urogynecol J Pelvic Floor Dysfunct*. 2000;11:361–376.

94. Puppo V. Embryology and anatomy of the vulva: the female orgasm and women's sexual health. *Eur J Obstet Gynecol Reprod Biol.* 2011;154:3–8.
95. Martinez CS, Ferreira FV, Castro AA, Gomide LB. Women with greater pelvic floor muscle strength have better sexual function. *Acta Obstet Gynecol Scand.* 2014;93:497–502.
96. Lowenstein L, Gruenwald I, Gartman I, Vardi Y. Can stronger pelvic muscle floor improve sexual function? *Int Urogynecol J.* 2010;21:553–556.
97. Rosenbaum TY, Owens A. The role of pelvic floor physical therapy in the treatment of pelvic and genital pain-related sexual dysfunction (CME). *J Sex Med.* 2008;5:513–523. quiz 524–5.
98. Morin M, Bergeron S, Khalife S, Mayrand MH, Binik YM. Morphometry of the pelvic floor muscles in women with and without provoked vestibulodynia using 4D ultrasound. *J Sex Med.* 2014;11:776–785.
99. Bo K, Sherburn M. Evaluation of female pelvic-floor muscle function and strength. *Phys Ther.* 2005;85:269–282.
100. Dumoulin C, Bourbonnais D, Lemieux MC. Development of a dynamometer for measuring the isometric force of the pelvic floor musculature. *NeuroUrol Urodyn.* 2003;22:648–653.
101. Morin M, Gravel D, Bourbonnais D, Dumoulin C, Ouellet S, Pilon JF. Application of a new method in the study of pelvic floor muscle passive properties in continent women. *J Electromyogr Kinesiol.* 2010;20:795–803.
102. Morin M, Gravel D, Bourbonnais D, Dumoulin C, Ouellet S. Reliability of dynamometric passive properties of the pelvic floor muscles in postmenopausal women with stress urinary incontinence. *NeuroUrol Urodyn.* 2008;27:819–825.
103. Dietz HP, Haylen BT, Broome J. *Ultrasound Obstet Gynecol.* 2001;18:511–514.
104. Beer-Gabel M, Teshler M, Barzilai N, et al. Dynamic transperineal ultrasound in the diagnosis of pelvic floor disorders: a pilot study. *Dis Colon Rectum.* 2002;45:239–245. Discussion 245–8.
105. Majida M, Braekken IH, Umek W, Bo K, Saltyte Benth J, Ellstrom Engh M. Interobserver repeatability of three- and four-dimensional transperineal ultrasound assessment of pelvic floor muscle anatomy and function. *Ultrasound Obstet Gynecol.* 2009;33:567–573.
106. Sandhu KS, Melman A, Mikhail MS. Impact of hormones on female sexual function and dysfunction. *Female Pelvic Med Reconstr Surg.* 2011;17:8–16.
107. Stuckey BG. Female sexual function and dysfunction in the reproductive years: the influence of endogenous and exogenous sex hormones. *J Sex Med.* 2008;5:2282–2290.
108. Jha S, Thaker R. Female sexual dysfunction. *Eur J Obstetrics, Gynecol Reprod Biol.* 2010;153:117–123.
109. Tuntiviriyapun P, Panyakhamlerd K, Triatamachat S, et al. Newly developed vaginal atrophy symptoms II and vaginal pH: a better correlation in vaginal atrophy? *Climacteric.* 2015;18:246–251.
110. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders 5th edn. American Psychiatric Publishing, Danvers; 2013.
111. Sarin S, Amsel RM, Binik YM. Disentangling desire and arousal: a classificatory conundrum. *Arch Sex Behav.* 2013;42:1079–1100.
112. McCabe MP, Sharlip ID, Atalla E, et al. Definition of sexual dysfunction in women and men: a consensus statement from the fourth international consultation of sexual medicine. *J Sex Med.* 2015;13:135–143.
113. Portman DJ, Gass ML. Vulvovaginal atrophy terminology consensus conference panel. Genitourinary syndrome of menopause: new terminology for vulvovaginal atrophy from the international society for the study of women's sexual health and the north american menopause society. *Menopause.* 2014;21:1063–1068.
114. Kingsberg SA, Woodward T. Female sexual dysfunction: focus on low desire. *Obstet Gynecol.* 2015;125:477–486.
115. Halis F, Yildirim P, Kocaaslan R, Cecen K, Gokce A. Pilates for better sex: changes in sexual functioning in healthy turkish women after pilates exercise. *J Sex Marital Ther.* 2015;31:1–7.
116. Aversa A, Bruzziches R, Francomano D, et al. Weight loss by multidisciplinary intervention improves endothelial and sexual function in obese fertile women. *J Sex Med.* 2013;10:1024–1033.
117. Pauls RN, Kleeman SD, Karram MM. Female sexual dysfunction: principles of diagnosis and therapy. *Obstet Gynecol Surv.* 2005;60:196–205.
118. Kalmbach DA, Arnedt JT, Pillai V, Ciesla JA. The impact of sleep on female sexual response and behavior: a pilot study. *J Sex Med.* 2015;12:1221–1232.
119. Farrell J, Cacchioni T. The medicalization of women's sexual pain. *J Sex Res.* 2012;49:328–336.
120. De Andres J, Sanchis-Lopez N, Asensio-Samper JM, et al. Vulvodynia-an evidence-based literature review and proposed treatment algorithm. *Pain Pract.* 2016;16:204–236.
121. O'Hare PG, 3rd, Hoffmann AR, Allen P, Gordon B, Salin L, Whitmore K. Interstitial cystitis patients' use and rating of complementary and alternative medicine therapies. *Int Urogynecol J.* 2013;24:977–982.
122. Wehbe SA, Fariello JY, Whitmore K. Minimally invasive therapies for chronic pelvic pain syndrome. *Curr Urol Rep.* 2010;11:276–185.
123. Balzer AM, Mintz LB. Comparing two books and establishing probably efficacious treatment for low sexual desire. *J Couns Psychol.* 2015;62:321–328.
124. Mintz LB, Balzer AM, Zhao X, Bush HE. Bibliotherapy for low sexual desire: evidence for effectiveness. *J Couns Psychol.* 2012;59:471–478.
125. Herbenick D, Reece M, Schick V, Sanders SA, Fortenberry JD. Women's use and perceptions of commercial lubricants: prevalence and characteristics on a nationally representative sample of American adults. *J Sex Med.* 2014;11:642–652.
126. Sutton KS, Boyer SC, Goldfinger C, Ezer P, Pukall CF. To lube or not to lube: experiences and perceptions of lubricant use in women with and without dyspareunia. *J Sex Med.* 2012;9:240–250.
127. Goldstein I. Current management strategies of the postmenopausal patient with sexual health problems. *J Sex Med.* 2007;4:235–253.
128. Ferguson DM, Hosmane B, Heiman JR. Randomized, placebo-controlled, double-blind, parallel design trial of the efficacy and safety of zestra in women with mixed Desire/Interest/Arousal/Orgasm disorders. *J Sex Marital Ther.* 2010;36:66–86.
129. Ferguson DM, Steidle CP, Singh GS, Alexander JS, Weihmiller MK, Crosby MG. Randomized, placebo-controlled, double blind, crossover design trial of the efficacy and safety of zestra for women in women with and without female sexual arousal disorder. *J Sex Marital Ther.* 2003;29:33–44.
130. Donders GG, Bellen G. Cream with cutaneous fibroblast lysate for the treatment of provoked vestibulodynia: a double-blind



- randomized placebo-controlled crossover study. *J Low Genit Tract Dis*. 2012;16:427–436.
131. Islam A, Mitchel J, Rosen R, et al. Topical alprostadil in the treatment of female sexual arousal disorder: a pilot study. *J Sex Marital Ther*. 2001;27:531–540.
  132. Kielbasa LA, Daniel KL. Topical alprostadil treatment of female sexual arousal disorder. *Ann Pharmacother*. 2006;40:1369–1376.
  133. Belkin ZR, Krapf JM, Goldstein AT. Drugs in early clinical development for the treatment of female sexual dysfunction. *Expert Opin Investig Drugs*. 2015;24:159–167.
  134. Kao A, Binik YM, Amsel R, Funaro D, Leroux N, Khalife S. Biopsychosocial predictors of postmenopausal dyspareunia: the role of steroid hormones, vulvovaginal atrophy, cognitive emotional factors, and dyadic adjustment. *J Sex Med*. 2012;9:2066–2076.
  135. Brotto LA, Basson R, Luria M. A mindfulness-based group psychoeducational intervention targeting sexual arousal disorder in women. *J Sex Med*. 2008;5:1646–1659.
  136. Brotto LA, Erskine Y, Carey M, et al. A brief mindfulness-based cognitive behavioral intervention improves sexual functioning versus wait-list control in women treated for gynecologic cancer. *Gynecol Oncol*. 2012;125:320–325.
  137. Billups KL. The role of mechanical devices in treating female sexual dysfunction and enhancing the female sexual response. *World J Urol*. 2002;20:137–141.
  138. Billups KL, Berman L, Berman J, Metz ME, Glennon ME, Goldstein I. A new non-pharmacological vacuum therapy for female sexual dysfunction. *J Sex Marital Ther*. 2001;27:435–441.
  139. Bakker RM, Ter Kuile MM, Vermeer WM, et al. Sexual rehabilitation after pelvic radiotherapy and vaginal dilator use: consensus using the delphi method. *Int J Gynecol Cancer*. 2014;24:1499–1506.
  140. Miles T, Johnson N. Vaginal dilator therapy for women receiving pelvic radiotherapy. *Cochrane Database Syst Rev*. 2014;9:CD007291.
  141. Antosh DD, Gutman RE, Park AJ, et al. Vaginal dilators for prevention of dyspareunia after prolapse surgery: a randomized controlled trial. *Obstet Gynecol*. 2013;121:1273–1280.
  142. Idama TO, Pring DW. Vaginal dilator therapy- an outpatient gynaecological option in the management of dyspareunia. *J Obstet Gynaecol*. 2000;20:303–305.
  143. Herbenick D, Reece M, Sanders S, Dodge B, Ghassemi A, Fortenberry JD. Prevalence and characteristics of vibrator use by women in the United States: results from a nationally representative study. *J Sex Med*. 2009;6:1857–1866.
  144. Herbenick D, Reece M, Schick V, et al. Beliefs about women's vibrator use: results from a nationally representative probability survey in the United States. *J Sex Marital Ther*. 2011;37:329–345.
  145. Klapilova K, Brody S, Krejcova L, Husarova B, Binter J. Sexual satisfaction, sexual compatibility, and relationship adjustment in couples: the role of sexual behaviors, orgasm, and men's discernment of women's intercourse orgasm. *J Sex Med*. 2015;12:667–675.
  146. Zerbinati N, Serati M, Origoni M, et al. Microscopic and ultrastructural modifications of postmenopausal atrophic vaginal mucosa after fractional carbon dioxide laser treatment. *Lasers Med Sci*. 2015;30:429–436.
  147. Salvatore S, Nappi RE, Parma M, et al. Sexual function after fractional microablative CO2 Laser in women with vulvovaginal atrophy. *Climacteric*. 2015;18:219–225.
  148. Hutchinson-Colas J, Segal S. Genitourinary syndrome of menopause and the use of laser therapy. *Maturitas*. 2015;82:342–345.
  149. Perino A, Calligaro A, Forlani F, et al. Vulvo-vaginal atrophy: a new treatment modality using thermo-ablative fractional CO2 laser. *Maturitas*. 2015;80:296–301.
  150. Salvatore S, Nappi RE, Zerbinati N, et al. A 12-week treatment with fractional CO2 laser for vulvovaginal atrophy: a pilot study. *Climacteric*. 2014;17:363–369.
  151. Schlaeger JM, Xu N, Mejta CL, Park CG, Wilkie DJ. Acupuncture for the treatment of vulvodynia: a randomized wait-list controlled pilot study. *J Sex Med*. 2015;12:1019–1027.
  152. Oakley S, Walther-Liu J, Crisp CC, Pauls RN. Acupuncture in premenopausal women with hypoactive sexual desire disorder: a prospective cohort study. *J Minimal Invasive Gynecol*. 2015;22:S37–S38.
  153. Dumoulin C, Hay-Smith EJ, Mac Habee-Sequin G. Pelvic floor muscle training versus treatment, or inactive control treatments, for urinary incontinence in women. *Cochrane Database Syst Rev*. 2014;5:CD005654.
  154. Sacomori C, Cardoso FL. Predictors of improvement in sexual function of women with urinary incontinence after treatment with pelvic floor exercises: a secondary analysis. *J Sex Med*. 2015;12:746–755.
  155. Gentilcore-Saulnier E, McLean L, Goldfinger C, Pukall CF, Chamberlain S. Pelvic floor muscle assessment outcomes in women with and without provoked vestibulodynia and the impact of a physical therapy program. *J Sex Med*. 2010;7:1003–1022.
  156. Kamanli A, Kaya A, Ardicoglu O, et al. Comparison of lidocaine injection, botulinum toxin injection, and dry needling to trigger points in myofascial pain syndrome. *Rheumatol Int*. 2005;25:604–611.
  157. Zoorob D, South M, Karram M, et al. A pilot randomized trial of levator injections versus physical therapy for treatment of pelvic floor myalgia and sexual pain. *Int Urogynecol J*. 2015;26:845–852.
  158. Morrissey D, El-khawand D, Ginzburg N, Wehbe S, O'Hare P, 3rd, Whitmore K. Botulinum toxin A injections into pelvic floor muscles under electromyographic guidance for women with refractory high-tone pelvic floor dysfunction: a 6 month prospective pilot study. *Female Pelvic Med Reconstr Surg*. 2015;21:277–282.
  159. Modelska K, Cummings S. Female sexual dysfunction in postmenopausal women: systematic review of placebo-controlled trials. *Am J Obstet Gynecol*. 2003;188:286–293.
  160. Hammett J, Peters A, Trowbridge E, Hullfish K. Short-term surgical outcomes and characteristics of patients with mesh complications from pelvic organ prolapse and stress urinary incontinence surgery. *Int Urogynecol J*. 2014;25:465–470.
  161. Wurz GT, Kao CJ, DeGregorio MW. Safety and efficacy of ospemifene for the treatment of dyspareunia associated with vulvar and vaginal atrophy due to menopause. *Clin Interv Aging*. 2014;9:1939–1950.
  162. Constantine GD, Goldstein SR, Archer DF. Endometrial safety of ospemifene: results of the phase 2/3 clinical development program. *Menopause*. 2015;22:36–43.
  163. Constantine G, Graham S, Portman DJ, Rosen RC, Kingsberg SA. Female sexual function improved with ospemifene in postmenopausal women with vulvar and vaginal atrophy: results of a

- randomized, placebo-controlled trial. *Climacteric*. 2015;18:226–232.
164. Labrie F, Archer DF, Martel C, Vaillancourt M, Montesino M. Combined data of intravaginal prasterone against vulvovaginal atrophy of menopause. *Menopause*. 2017;24:1246–1256.
  165. Safarinejad MR. Evaluation of the safety and efficacy of bremelanotide, a melanocortin receptor agonist, in female subjects with arousal disorder: a double-blind placebo-controlled, fixed dose, randomized study. *J Sex Med*. 2008;5:887–897.
  166. Simon JA, Kingsberg SA, Shumel B, Hanes V, Garcia M, Jr, Sand M. Efficacy and safety of flibanserin in postmenopausal women with hypoactive sexual desire disorder: results of the SNOW-DROP trial. *Menopause*. 2014;21:633–640.
  167. Katz M, DeRogatis LR, Ackerman R, et al. Efficacy of flibanserin in women with hypoactive sexual desire disorder: results from the BEGONIA trial. *J Sex Med*. 2013;10:1807–1815.
  168. Poels S, Bloemers J, van Rooij K, et al. Toward personalized sexual medicine (part 2): testosterone combined with a PDE5 inhibitor increases sexual satisfaction in women with HSDD and FSAD, and a low sensitive system for sexual cues. *J Sex Med*. 2013;10:810–823.
  169. Perelman MA. The sexual tipping point: a mind/body model for sexual medicine. *J Sex Med*. 2009;6:629–632.
  170. Van Rooij K, Poels S, Bloemers J, et al. Toward personalized sexual medicine (part 3): testosterone combined with a Serotonin1A receptor agonist increases sexual satisfaction in women with HSDD and FSAD, and dysfunctional activation of sexual inhibitory mechanisms. *J Sex Med*. 2013;10:824–837.
  171. Bloemers J, van Rooij K, Poels S, et al. Toward personalized sexual medicine (Part 1): integrating the “Dual control model” into differential drug treatments for hypoactive sexual desire disorder and female sexual arousal disorder. *J Sex Med*. 2013;10:791–809.
  172. Bechara A, Bertolino MV, Casabe A, Fredotovich N. A double-blind randomized placebo control study comparing the objective and subjective changes in female sexual response using sublingual apomorphine. *J Sex Med*. 2004;1:209–214.
  173. Segraves RT, Croft H, Kavoussi R, et al. Bupropion sustained release (SR) for the treatment of hypoactive sexual desire disorder (HSDD) in nondepressed women. *J Sex Marital Ther*. 2001;27:303–316.
  174. Pauls RN, Marinkovic SP, Silva WA, Rooney CM, Kleeman SD, Karram MM. Effects of sacral neuromodulation on female sexual function. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007;18:391–395.
  175. Urwitz-Lane T, Ozel B. Sexual function in women with urodynamic stress incontinence, detrusor overactivity, and mixed urinary incontinence. *Am J Obstet Gynecol*. 2006;195:1758–1761.
  176. Rogers RG, Kammerer-Doak D, Darrow A, et al. Does sexual function change after surgery for stress urinary incontinence and/or pelvic organ prolapse? A multicenter prospective study. *Am J Obstet Gynecol*. 2006;195:e1–e4.
  177. Lukacz ES, Warren LK, Richter HE, et al. Quality of life and sexual function 2 years after vaginal surgery for prolapse. *Obstet Gynecol*. 2016;127:1071–1079.
  178. Clavien PA, Barkun J, de Oliveira ML. The clavien-dindo classification of surgical complications: 5 years’ experience. *Ann Surg*. 2009;250:187–196.
  179. Haylen BT, Freeman RM, Lee J, et al. An international urogynecological association (IUGA)/International continence society (ICS) joint terminology and classification of the complications related to native tissue female pelvic floor surgery. *Int Urogynecol J*. 2012;23:515–526.
  180. McCabe MP, Sharlip ID, Atalla E, et al. Definitions of sexual dysfunctions in women and men: a consensus statement from the fourth international consultation on sexual medicine 2015. *J Sex Med*. 2016;13:135–143.
  181. Parish SJ, Goldstein AT, Goldstein SW, et al. Toward a more evidence-Based nosology and nomenclature for female sexual dysfunctions-Part II. *J Sex Med*. 2016;13:1888–1906.

## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

**How to cite this article:** Rogers RG, Pauls RN, Thakar R, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the assessment of sexual health of women with pelvic floor dysfunction. *Neurourology and Urodynamics*. 2018;1–21. <https://doi.org/10.1002/nau.23508>

# An International Urogynecological Association (IUGA)/ International Continence Society (ICS) joint report on the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction

Kari Bo<sup>1</sup> | Helena C. Frawley<sup>2</sup> | Bernard T. Haylen<sup>3</sup> | Yoram Abramov<sup>4</sup> |  
Fernando G. Almeida<sup>5</sup> | Bary Berghmans<sup>6</sup> | Maria Bortolini<sup>5</sup> |  
Chantale Dumoulin<sup>7</sup> | Mario Gomes<sup>8</sup> | Doreen McClurg<sup>9</sup> | Jane Meijlink<sup>10</sup> |  
Elizabeth Shelly<sup>11</sup> | Emanuel Trabuco<sup>12</sup> | Carolina Walker<sup>13</sup> | Amanda Wells<sup>14</sup>

<sup>1</sup> Department of Sports Medicine, Norwegian School of Sport Sciences, PO Box 4014, Ullevål Stadion, 0806, Oslo, Norway

<sup>2</sup> Cabrini Health, La Trobe University, Melbourne, Australia

<sup>3</sup> University of New South Wales, Sydney, NSW, Australia

<sup>4</sup> Technion University, Haifa, Israel

<sup>5</sup> Federal University, São Paulo, Brazil

<sup>6</sup> Maastricht University Medical Centre, Maastricht, Netherlands

<sup>7</sup> University of Montreal, Montreal, QC, Canada

<sup>8</sup> Centro Hospitalar Porto, Oporto, Portugal

<sup>9</sup> Glasgow Caledonian University, Glasgow, UK

<sup>10</sup> Naarden, Netherlands

<sup>11</sup> Moline, IL, USA

<sup>12</sup> Mayo Clinic, Minnesota, USA

<sup>13</sup> Hospital Universitario Quirón, Madrid, Spain

<sup>14</sup> University of Exeter, Exeter, UK

## Correspondence

Kari Bo, Department of Sports Medicine, Norwegian School of Sport Sciences, PO Box 4014, Ullevål Stadion, 0806, Oslo, Norway  
Email: Kari.bo@nih.no

**Introduction and hypothesis** There has been an increasing need for the terminology on the conservative management of female pelvic floor dysfunction to be collated in a clinically based consensus report.

**Methods** This Report combines the input of members and elected nominees of the Standardization and Terminology Committees of two International Organizations, the International Urogynecological Association (IUGA) and the International Continence Society (ICS), assisted at intervals by many external referees. An extensive process of nine rounds of internal and external review was developed to exhaustively examine each definition, with decision-making by collective opinion (consensus). Before opening up for comments on the webpages of ICS and IUGA, five experts from physiotherapy, neurology, urology, urogynecology, and nursing were invited to comment on the paper.

**Results** A Terminology Report on the conservative management of female pelvic floor dysfunction, encompassing over 200 separate definitions, has been developed. It is clinically based, with the most common symptoms, signs, assessments, diagnoses, and treatments defined. Clarity and ease of use have been key aims to make it interpretable by practitioners and trainees in all the different specialty groups involved in female pelvic floor dysfunction. Ongoing review is not only anticipated, but will be required to keep the document updated and as widely acceptable as possible.

**Conclusion** A consensus-based terminology report for the conservative management of female pelvic floor dysfunction has been produced, aimed at being a significant aid to clinical practice and a stimulus for research.

## KEYWORDS

consensus, conservative management, female, pelvic floor dysfunction, terminology

This document is being published simultaneously in *Neurourology and Urodynamics* (NAU) and the *International Urogynecology Journal* (IJU), the respective journals of the sponsoring organizations, the International Continence Society (ICS) and the International Urogynecological Association (IUGA). IJU DOI: 10.1007/s00192-016-3123-4

Standardization and Terminology Committees of the IUGA\* and ICS#: Bernard T. Haylen\*, Jane Meijlink#, Elizabeth Shelly#

Joint IUGA/ICS Working Group on the Conservative Management of Pelvic Floor Dysfunction: Kari Bo, Helena Frawley, Bernard Haylen, Yoram Abramov, Fernando Almeida, Bary Berghmans, Maria Bortolini, Chantale Dumoulin, Mario Gomes, Doreen McClurg, Jane Meijlink, Elizabeth Shelly, Emanuel Trabuco, Carolina Walker, and Amanda Wells

## INTRODUCTION

There is currently no single document addressing the conservative management of female pelvic floor dysfunction in a comprehensive way. The report is based on, and follows on from, the terminology proposed by the International Continence Society (ICS) Standardization of Terminology of Lower Urinary Tract Function,<sup>1</sup> the Standardization of Terminology of Pelvic Floor Muscle Function and Dysfunction: Report from the Pelvic Floor Clinical Assessment group of the International Continence Society,<sup>2</sup> and the International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction.<sup>3</sup>

The terminology in current use related to conservative management generally lacks uniformity, often because different disciplines use their own terminology. The range of terms in use can lead to uncertainty, confusion, and unintended ambiguity. It hampers the ability to build a body of literature concerning conservative interventions, e.g., the terms “behavioral therapy,” “lifestyle intervention,” “conservative treatment,” “nonsurgical treatment,” “physiotherapy,” “biofeedback,” and “pelvic floor muscle exercise” are often used interchangeably and, at times, incorrectly, to describe both the same and different interventions. A more standardized terminology would aid interdisciplinary communication and understanding.

Existing published reports address some of the aspects of this topic, but there are some areas of terminology currently lacking standardization, e.g., Messelink et al.<sup>2</sup> and Haylen et al.<sup>3</sup> refer to evaluation and diagnostic terminology, but not to treatment terminology.

There is a need for a more extensive description of the management of the pelvic floor and pelvic floor muscle (PFM) dysfunction than is currently provided in existing terminology reports. With the development of the evidence base for conservative therapies in the management of pelvic floor dysfunction (PFD), especially treatment of conditions such as incontinence and pelvic organ prolapse (POP), terminology linked with these managements has evolved, but with regional and discipline variations. A consensus on currently accepted terminology is required. Elements in the title of the document need to be defined:

Conservative: restricted to nonsurgical and nonpharmacological approaches.

Management: includes the following aspects:

- a) Assessment: including history and physical examination and investigations
- b) Diagnosis
- c) Prevention
- d) Treatment of pelvic floor dysfunction

Pelvic floor: structures located within the bony pelvis, i.e., urogenital and anorectal viscera, PFM and their connective tissues, and nerves and blood vessels.

Pelvic floor dysfunction: following on from Messelink et al.'s report from the Pelvic Floor Clinical Assessment Group of the ICS,<sup>2</sup> this report will focus on the terminology of the management of pelvic floor function and dysfunction, including bladder and bowel dysfunction, pelvic organ prolapse (POP), sexual dysfunction, and pelvic pain.<sup>4</sup> Terminology regarding pelvic pain and anorectal dysfunction related to PFM dysfunction aligns with the current working groups on chronic pelvic pain and anorectal dysfunction. Terminology includes symptoms, signs, and investigations (expanding on Messelink et al.'s paper<sup>2</sup>; diagnoses of PFM-related conditions (avoiding duplication with Haylen et al.<sup>3</sup>); prevention and treatment (including new therapies, e.g., exercise and adjunctive therapies, including equipment, and lifestyle modifications not covered by Messelink et al.<sup>2</sup> or Haylen et al.<sup>3</sup>

Additional descriptions related to the terms used in this manuscript are:

Clinicians/practitioners: conservative management of PFD may be provided by clinicians or practitioners of different disciplines, commonly physiotherapists/physical therapists, nurses, midwives, and medical doctors. However, other professions, e.g., fitness instructors and personal trainers, may also play a role in education, health promotion, and prevention of PFD. Terminology related to the accepted names of professions and the different types of therapies must be specified and distinguished (e.g., “physiotherapy” as a management provided by a registered physiotherapist, as distinct from “conservative therapy” and “exercises”/“biofeedback,” which may be provided by any clinician). The emphasis in this document will be on management commonly undertaken by clinicians practicing conservative management.

Multidisciplinary approach: relating to, or involving, two or more disciplines that are usually considered distinct,<sup>5</sup> e.g., physical therapy, urology, gynecology

Gender: with the increasing specificity and complexity of female diagnosis and management it can be argued that a gender-specific report is needed. However, many of the terms defined in this report are not gender-specific and are the same for males, e.g., PFM training and electrical stimulation. This report does not preclude an additional future report on male pelvic floor dysfunction

## METHODOLOGY

All working group members were asked to provide terms that they knew existed in the area. After the first “brainstorming activity,” all terms were listed and grouped according to introduction, symptoms, signs, examination methods, investigations, diagnosis, prevention, and treatment. All members were given the text to which to add

more terms. Additional searching for omitted terms in existing terminology papers of the ICS and IUGA, Cochrane reviews, and the 2013 ICI document<sup>6</sup> was undertaken. Existing definitions of established terms from general medicine,<sup>7,8</sup> physiotherapy,<sup>5</sup> and exercise science were used where available. Only in situations where there was no existing terminology were new definitions introduced. We have not referred to or described the responsiveness, reliability, and validity of the measurement methods of symptoms, signs, and evaluations, nor have we acknowledged the evidence for the treatment efficacy of any of the therapies defined.

Agreement on the definitions was reached by consensus. Wherever possible, evidence-based principles were followed. However, this was a challenge in conservative management, as there are many suggested therapies that do not have proven effectiveness.<sup>9,10</sup> Discussion meetings with representatives of the IUGA and ICS were held at the following annual meetings: IUGA Brisbane 2012, ICS Beijing 2012, IUGA Dublin 2013, ICS Barcelona 2013, IUGA-AUGS Washington DC 2014, and IUGA Nice 2015.

It is recommended that acknowledgment of these standards in written publications related to the conservative management of female pelvic floor dysfunction is stated as follows: "Methods, definitions, and units conform to the standards jointly recommended by the IUGA/ICS Joint Report on the Terminology for the Conservative and Nonpharmacological Management of Female Pelvic Floor Dysfunction, except where specifically noted."

## ASSESSMENT

### Symptoms

Symptom: any morbid phenomenon or departure from the normal in structure, function or sensation, experienced by the woman and indicative of disease or a health problem. Symptoms are either volunteered by, or elicited from the individual, or may be described by the individual's caregiver.<sup>3</sup>

#### *Existing (defined) symptoms*

1. Urinary incontinence (UI) symptoms<sup>3</sup>
2. Bladder storage symptoms<sup>3</sup>
3. Sensory symptoms<sup>3</sup>
4. Voiding and postmicturition symptoms<sup>3</sup>
5. POP symptoms<sup>3</sup>
6. Symptoms of sexual dysfunction<sup>3</sup>
7. Symptoms of anorectal dysfunction<sup>3, endnote 1</sup>
8. Lower urinary tract infection UTI<sup>3</sup>

#### *Lower urinary tract pain and/or other pelvic pain*<sup>endnote 2</sup>

1. Pain (in general): "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage".<sup>11</sup>
2. Tenderness: sensation of discomfort with or without pain; discomfort elicited through palpation, indicates unusual sensitivity to pressure or touch.<sup>12</sup>
3. Acute pain: pain related to acute trauma, infection or other well-defined disease processes or conditions.
4. Chronic pain: persistent or continuous/recurrent pain for at least 6 months. If non-acute and central sensitization pain mechanisms are well documented, then the pain may be regarded as chronic, irrespective of the time period.<sup>13,14</sup>
5. Myalgia: muscle pain. Pelvic floor myalgia (a symptom) may be present with or without a change in PFM tone (a sign).<sup>endnote 3</sup>
6. Myofascial pain: pain caused by the presence of trigger points within muscles or their fascia.<sup>15, endnote 4</sup>

### Signs

Sign: any abnormality indicative of disease or a health problem, discoverable on examination of the patient; an objective indication of disease or a health problem.<sup>1</sup>

#### *Existing (defined) signs*

1. Urinary incontinence signs:<sup>3</sup>
  - a) UI<sup>3</sup>
  - b) Stress (urinary) incontinence<sup>3</sup>
  - c) Urgency (urinary) incontinence<sup>3</sup>
  - d) Extraurethral incontinence<sup>3</sup>
  - e) Stress incontinence on prolapse reduction (occult or latent stress incontinence)<sup>3</sup>
2. Pelvic organ prolapse signs:<sup>3</sup>
  - a) Uterine/cervical prolapse<sup>3</sup>
  - b) Vaginal vault (cuff scar) prolapse<sup>3</sup>
  - c) Anterior vaginal wall prolapse<sup>3</sup>
  - d) Posterior vaginal wall prolapse<sup>3</sup>
3. Other pelvic examinations/signs:<sup>3</sup>
  - a) Vulval abnormalities<sup>3</sup>
  - b) Urethral mucosal prolapse<sup>3</sup>
  - c) Urethral caruncle<sup>3</sup>
  - d) Urethral diverticulum<sup>3</sup>
  - e) Total vaginal length (TVL): the distance from the posterior fornix to the hymen.<sup>16</sup>
  - f) Valsalva maneuver: the action of attempting to exhale with the nostrils and mouth, or glottis closed.<sup>7</sup> Valsalva

is usually performed with digital closure of the nose, as when trying to equalize pressure in an airplane. Straining/bearing down may have a similar meaning to Valsalva; however, in practice, straining/bearing down may be interpreted as meaning pushing downward and trying to relax the pelvic floor, as when defecating.

- g) Bimanual pelvic examination<sup>3</sup>
  - h) Perineal elevation: inward (ventrocephalad) movement of the vulva, perineum, and anus during, for example, PFM contraction.
  - i) Perineal descent: excessive dorsocaudal movement of the vulva, perineum, and anus, for example, during coughing, Valsalva or straining.<sup>3,17</sup>
  - j) Trophic: promoting cellular growth, differentiation, and survival.<sup>8</sup> This is the normal status of an organ, tissue or cell with regard to nutrition, size, number, form, and function. A trophic urogenital tract is usually well-estrogenized.
  - k) Atrophic: decrease from previous normal size of the body or a part, cell, organ, or tissue. An organ or body part's cells may be reduced in number, size or both. Atrophy of some cells and organs is normal at certain points in the life cycle. Other causes include malnutrition, disease, disuse, injury, and hormone over- or underproduction.<sup>8, endnote 5</sup>
4. Anal signs<sup>18</sup>
5. Abdominal signs
- a) Bladder fullness/retention: abdominal palpation or suprapubic percussion may indicate a full bladder; however, in overweight patients this may not be easily detected.
  - b) Pelvic bone irregularities: indication of a previous fracture or sacral agenesis.
6. Neurological signs: abnormalities of the nervous system detected by physical examination that reflect an underlying neurological disease or injury. Examples of abnormal signs may include altered sensation, muscle tone or reflexes. If present, the patient should be referred for a full neurological examination.

#### *Pelvic floor muscle function signs*

- 1. Normal PFM: have a level of constant resting tone (except just before and during voiding and defecation), symmetry, and the ability to voluntarily and involuntarily contract and relax.
- 2. Normal PFM contractile function: a constriction and inward (ventrocephalad) movement of the pelvic openings. Normal, well-functioning pelvic floor muscles may demonstrate some (controlled or limited) downward

dorsal perineal movement in response to increased intra-abdominal pressure in the absence of incontinence or POP.

- 3. Muscle tone: state of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement.<sup>19–21</sup> Muscle tone has two components: the contractile component, created by the low-frequency activation of a small number of motor units, and the viscoelastic component, which is independent of neural activity and reflects the passive physical properties of the elastic tension of the muscle fiber elements and the osmotic pressure of the cells.<sup>19, endnote 6</sup>
  - a) Hypertonicity: an increase in muscle tone related to the contractile or viscoelastic components that can be associated with either elevated contractile activity and/or passive stiffness in the muscle.<sup>20,22</sup> The terms neurogenic hypertonicity and non-neurogenic hypertonicity are recommended to describe the diagnosis and inform management.
  - b) Hypotonicity: a decrease in muscle tone related to the contractile or viscoelastic components that can be associated with either reduced contractile activity and/or passive stiffness in the muscle. The terms neurogenic hypotonicity and non-neurogenic hypotonicity are recommended to describe the diagnosis and inform management.<sup>endnote 7</sup>
- 4. Stiffness: resistance to deformation.<sup>23</sup> Passive elastic stiffness is defined as the ratio of the change in the passive resistance or passive force ( $\Delta F$ ) to the change in the length displacement ( $\Delta L$ ) or  $\Delta F/\Delta L$ .<sup>24</sup> The term should only be used if stiffness is measured quantitatively, such as with the use of instruments such as dynamometry or myotonometry.
- 5. Tension: may have a similar meaning to tone and stiffness. Muscle tension can be increased or decreased because of exogenous factors such as the amount of pressure applied and endogenous factors such as thickness/cross-sectional area of the muscle itself, fluid present within the muscle (swelling, inflammation), position (e.g., standing versus sitting) or increased neural activity.
- 6. Spasm: persistent contraction of striated muscle that cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp. Spasms occur at irregular intervals with variable frequency and extent,<sup>25</sup> and over days or weeks may lead to a contracture.
- 7. Contracture: an involuntary shortening of a muscle. Clinically, a muscle cramp and contracture may appear similar; however, contractures are electrically silent.<sup>26</sup>
- 8. Cramp: a painful involuntary muscle contraction that occurs suddenly and can be temporarily debilitating. Pain is intense and localized. It tends to occur when the muscle



is in the shortened position and contracting, is generated by motor units, and displays a high firing rate (20–150 Hz).<sup>26, endnote 8</sup>

9. Fasciculation: a single, spontaneous, involuntary discharge of an individual motor unit. The source generator is the motor unit or its axon, before its terminal branches. Fasciculations display an irregular firing pattern of low frequency (0.1–10 Hz).<sup>5,26</sup> Clinically, fasciculations are recognized as individual brief twitches. They may occur at rest or after muscle contraction and may last several minutes.
10. Tender point: tenderness to palpation at soft-tissue body sites.<sup>19</sup>
11. Trigger point (TrP): a tender, taut band of muscle that can be painful spontaneously or when stimulated.<sup>27</sup> The taut band is electrically silent.<sup>endnote 9</sup>
12. Pelvic floor muscle dyssynergia<sup>2</sup>: incoordination of the PFM and another muscle group during a functional activity, for example, the pelvic floor muscles may not relax appropriately during micturition or defecation.
13. Nonfunctioning PFM (modified from Messelink et al.)<sup>2</sup>: a situation in which there is no PFM action measurable either on instruction to contract (inability) or as the absence of an automatic response to an increase in intra-abdominal pressure. This condition can be based on any pelvic floor symptom and on the sign of a noncontracting or nonrelaxing pelvic floor.
14. Pelvic floor muscle injury (PFMI): on clinical palpation, PFMI is diagnosed when one or more of the following is present:
  - a) A discontinuity of the puborectalis muscle at its attachment to the inferior pubic ramus<sup>28</sup>
  - b) A distance of >3.5 finger widths between the two sides of puborectalis muscle insertion<sup>29,30</sup>
  - c) A gap in the continuity of the pubovisceral muscle between the pubic rami and the anorectum<sup>31</sup>
15. Muscle action characteristics:
  - a) Maximal voluntary contraction (MVC): the attempt to recruit as many fibers in a muscle as possible for the purpose of developing force.<sup>32</sup> MVC of the pelvic floor can be assessed by vaginal palpation, manometers, and dynamometers.<sup>endnote 10</sup>
  - b) Muscle strength: force-generating capacity of a muscle.<sup>5</sup> It is generally expressed as maximal voluntary contraction measurements and as the one-repetition maximum (1RM) for dynamic measurements.<sup>32–34</sup>
  - c) Local muscle endurance: the ability to sustain near maximal or maximal force, assessed by the time a patient is able to maintain a maximal static or isometric contraction, or the ability to repeatedly

develop near maximal or maximal force determined by assessing the maximum number of repetitions the patient can perform at a given percentage of 1RM.<sup>35</sup>

- d) Muscle power: the explosive aspect of strength; the product of strength and speed of movement (force × distance/time).<sup>35</sup>
  - e) Co-ordination: property of movement characterized by the smooth and harmonious action of groups of muscles working together to produce a desired motion.<sup>5</sup>
  - f) Motor control: the ability of the nervous system to control or direct the muscles in purposeful movements and postural adjustment by selective allocation of muscle tension across appropriate joint segments.<sup>5,36</sup>
  - g) Submaximal contraction: all contractions without maximal effort, expressed as a percentage of 1RM.
  - h) Synergistic contraction: the combination of several muscle actions that serve to optimally achieve a motor task.<sup>37</sup>
  - i) Co-contraction: contraction of two or more muscles at the same time. Co-contraction of muscles can be synergistic (e.g., resulting in an augmentation of motor activity) or it could be counterproductive to normal function (e.g., contraction of antagonistic muscles resulting in abnormal movement or training other muscles instead of the targeted ones, e.g., training of gluteal muscles instead of the PFM).
  - j) Antagonistic contraction: contraction of muscle/muscle groups with the opposite action to the desired action (activity that hinders the targeted muscle/muscle group from contracting).
16. Other:
- a) Hypertrophy: the increase in size (volume) of the muscle fibers.<sup>37</sup>
  - b) Atrophy: the decrease in size of muscle fibers as a result of inactivity, illness or aging.<sup>38</sup>
  - c) Bulk: the absolute volume of a muscle measured using imaging techniques such as anatomical magnetic resonance imaging and ultrasound.<sup>39</sup>
  - d) Anatomic cross-sectional area: for an individual muscle, the largest cross-sectional area along the length of that muscle and 90° on the muscle length.<sup>7</sup>
  - e) Physiological cross-sectional area: the total area of cross-section perpendicular to the muscle fibers.<sup>7</sup>
  - f) Flexibility: the ability of a muscle to lengthen and allow one joint (or more than one joint in a series) to move through a range of motion. Loss of flexibility is defined as a decrease in the ability of a muscle to deform.<sup>40</sup>
  - g) Proprioception: sensory information from receptors of muscles, joints, capsules, and ligaments that provides information related to posture and movement.<sup>41</sup>



- h) Exteroception: sensory information from receptors in the skin registering touch, vibration, heat, and cold.<sup>41</sup>

## INVESTIGATIONS AND IMAGING

All methods and devices used for assessments (e.g., palpation, manometers, dynamometers, EMG, urodynamics, ultrasound, and magnetic resonance imaging [MRI]) must be described in detail, and their responsiveness (ability to detect small changes), reliability and validity should be reported.<sup>42</sup>

### Existing (defined) investigations

#### *Urodynamics*

Urodynamics is the functional study of the lower urinary tract<sup>3</sup>:

1. Uroflowmetry<sup>3</sup>
2. Post-void residual (PVR) urine volume<sup>3</sup>
3. Cystometry<sup>3</sup>
4. Pressure flow study<sup>3</sup>
5. Assessment of urethral function<sup>3</sup>
  - a) Urethral pressure measurement<sup>3</sup>
  - b) Abdominal leak point pressure (ALPP)<sup>3</sup>

#### *Frequency–volume chart*

The frequency–volume chart (FVC) records the time of each micturition and the volume voided for at least 24 h, although 2 or 3 days of recording (not necessarily consecutive) generally provide more useful clinical data.<sup>3</sup>

1. Bladder diary: in addition to the FVC, a bladder diary includes fluid intake, pad usage, number incontinence episodes, and the degree of incontinence.<sup>3</sup>

#### *Pad testing*

Quantification of the amount of urine lost over the duration of testing, by measuring the increase in weight of the perineal pads used (weighed pre- and post-testing).<sup>3</sup>

#### *Ultrasound imaging*

1. PFMI: PFMI is diagnosed on ultrasound when at least one of the following is present:
  - a) Undetected puborectalis-to-ipsilateral sidewall attachment on any of the three central slices (full avulsion)

- b) Undetected puborectalis-to-ipsilateral sidewall attachment on at least one slice (partial avulsion)<sup>43</sup>

- c) A levator–urethra gap (LUG) of greater than 2.5 cm<sup>44</sup>

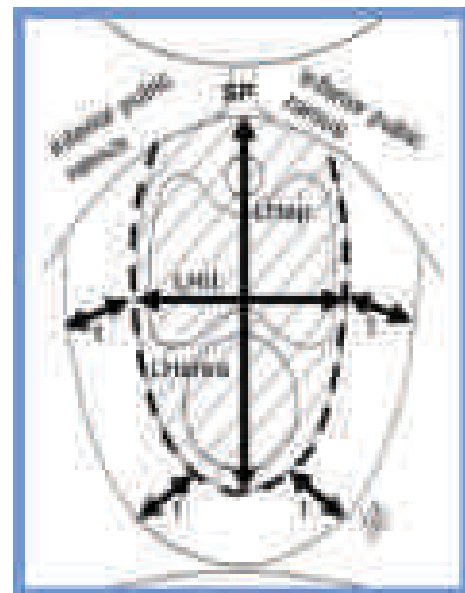
2. PFM position in the pelvis: can be measured in the sagittal plane in relation to defined landmarks, and may be related to PFM dysfunction (elevated or descended pelvic floor).
3. Hiatal dimension: is the cross-sectional area of the pelvic floor/levator hiatus, including anteroposterior and transverse distances (Fig. 1).

#### *Radiological imaging*

Videocystourethrography (VCU); intravenous urography (IVCU); micturating cystography (MCU); defecography; colpocystodefecography.

#### *Magnetic resonance imaging*

1. PFM injury: can represent a full spectrum, from disruption of a single fascicle, to complete disruption of the muscle origin. At present, there is no universally accepted system for the diagnosis and evaluation of the extent of the injury. Essentially, abnormalities are judged to have occurred



**FIG. 1** Levator hiatal dimensions measured using transperineal ultrasound (reproduced with permission from Ingeborg Hoff Braekken). *LHap* levator hiatus antero-posterior, *LHrl* levator hiatus right-left, *LHarea* levator hiatus area, *SP* symphysis pubis, *t* pubovisceral muscle thickness

when the morphology of the pubococcygeal portion of the levator ani muscle deviates from what is seen in normal nulliparous women.<sup>45</sup> Several groups have studied and defined levator damage on MRI when one or more of the following is present: absence of pubococcygeal muscle fibers in at least one 4-mm section, or two or more adjacent 2-mm sections in both the axial and the coronal planes.<sup>46</sup> The degree of injury can be assessed based on the amount of muscle involved in the injury, with reasonable repeatability among different examiners in a single group.<sup>47</sup> More than half the expected muscle bulk is associated with the presence of POP.<sup>48</sup>

2. PFM position in the pelvis: location of the PFM in the sagittal plane in relation to defined landmarks. They may be elevated or descended.

### Palpation

The process of using fingers/hands as part of assessment, to gather information about the tissues. Digital palpation of the PFM is described by Messelink et al. (Fig. 2)<sup>2</sup>.



**FIG. 2** Digital palpation of the pelvic floor muscles (reproduced with permission from subjects in the photo and photographer Andreas Birger Johansen)

### Manometer

A manometer is a device for measuring pressure.

#### *Pelvic floor manometry*

Measurement of resting pressure or pressure rise generated during contraction of the PFM using a manometer connected to a sensor, which is inserted into the urethra, vagina or rectum. Pelvic floor manometric tools measure pressure in mmHg, hPa or cmH<sub>2</sub>O.<sup>42, endnote 11</sup> Conversion of data to the international standard unit of measurement (hPa) is recommended (Figs. 3, 4).

1. Perineometer: the first PFM vaginal pressure device connected to a manometer developed by Kegel.<sup>49, endnote 12</sup>

### Dynamometer

A dynamometer is an instrument that measures power or force.<sup>8</sup>

#### *Pelvic floor dynamometry*

Measurement of PFM resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina.<sup>50</sup> Dynamometry measures force in Newton units ( $N = 1 \text{ kg} \times \text{m/s}^2$ ) (Figs. 5, 6).<sup>endnote 13</sup>

### Electromyography

Electromyography (EMG) is the recording of electrical potentials generated by the depolarization of muscle fibers.

#### *Electromyographic diagnosis*

Electromyographic diagnosis is made by evaluating the state of the muscle (muscle pathology) by recording and analyzing the electrical activity generated by the muscle.<sup>36, endnote 14</sup>



**FIG. 3** Peritron manometer (reproduced with permission from Laborie)



**FIG. 4** Graphical illustration of pelvic floor muscle manometry readings (reproduced with permission from illustrator Ingeborg Hoff Braekken). MVC maximum voluntary contraction, 1/2/3 repetition 1/2/3

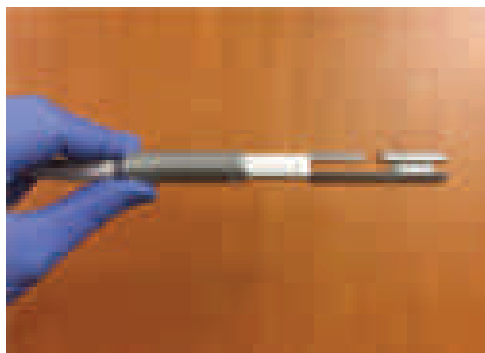
1. Intramuscular EMG: insertion of a wire or needle electrode into the muscle to record motor unit action potentials.<sup>endnote 15</sup>
2. Surface electromyography: electrodes placed on the skin of the perineum or inside the urethra, vaginal or rectum (Fig. 7).<sup>endnote 16</sup>

## Pain assessment

### Pain evaluation

Pain evaluation consists of baseline and ongoing regular evaluation of severity, quality of life, thoughts, emotions, and behavior associated with the pain (via direct consultation or questionnaires) and investigations to identify well-defined/confusable/non-pain syndromes.

1. Pain measurement: pain can only be measured subjectively. Patient-reported outcome measures include:
  - a) Numerical rating scale (NRS), from 0 (no pain) to 10 (extreme pain), with half-points marked.<sup>51,52</sup>



**FIG. 5** Ann Arbor, USA, dynamometer speculum. Note that the bills of the speculum are covered by a condom when in use (reproduced with permission from J.A. Ashton-Miller, R. Zielinski, J.O. DeLancey, J.M. Miller)



**FIG. 6** Montreal, Canada, pelvic floor dynamometer (reproduced with permission from Chantale Dumoulin)

- b) Visual analog scale (VAS), a 10-cm line with the same labels at the ends
- c) A simple verbal rating scale can be used, e.g., “none,” “mild,” “moderate,” “severe.”<sup>endnote 17</sup>
2. Pain mapping: identifying pain generators through diagnostic procedures such as questionnaires, digital palpation, EMG, quantitative sensory threshold measurement, trigger point injections, nerve blocks, and imaging.
  - a) Questionnaires: several pain questionnaires can be used in the evaluation of musculoskeletal pain in the pelvis; the choice will be determined by which is most appropriate to the presenting pelvic floor dysfunction: McGill Pain Questionnaire,<sup>53</sup> Pelvic Floor Distress Inventory (PFDI),<sup>54</sup> Female Sexual Function Index,<sup>55</sup> Female Sexual Distress Scale,<sup>56</sup> Pelvic Pain and Urgency/Frequency Questionnaire.<sup>57</sup>
  - b) Pain chart/body map: a simple line drawing of an outline of the front and back (or relevant body part) of the human body, onto which the patient sketches or ticks or marks areas of bodily pain to demonstrate the site and extent of perceived pain.<sup>58</sup>
  - c) Pain checklist: a list of anatomical locations from which the patient selects sites that are relevant to his/her complaint.



**FIG. 7** Verity Medical NeuroTrac Myoplus Pro surface electromyography biofeedback apparatus (also incorporating electrical stimulation (reproduced with permission from Quintet, Norway)

- d) Measurement of muscle tone: there is no single tool that is able to measure all components of muscle tone. Some tools may be able to measure aspects of tone such as contractility, stiffness or elasticity. Instrumented methods may play a role in the valid and reliable evaluation of muscle tone, e.g., surface electromyography (sEMG), wire and concentric electromyography, dynamometry, real-time ultrasound, elastometry, myotonometry.
- e) TrP injection or needling: a diagnostic test to confirm if the identified TrP is a pain generator. The technique is the same as that used in TrP treatment.
- f) Imaging: tissue-specific evaluation to identify if morphological trauma or deficit is present, which may relate to the presenting pain. Types of imaging may include X-ray, ultrasound, and MRI.

## DIAGNOSES

Diagnosis: the act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, review of laboratory data, and the opinion derived from such an evaluation.<sup>59</sup>

A diagnosis of female PFD is based on the information obtained from the patient's symptoms, signs, and any relevant diagnostic investigations. For the terminology of the six most common PFD diagnoses—urodynamic stress urinary incontinence, detrusor overactivity (DO), POP, voiding dysfunction, bladder oversensitivity, and recurrent UTI—the reader is directed to Haylen et al.<sup>3</sup>

### Additional anorectal diagnosis

1. Local (fissures, hemorrhoids)<sup>18</sup>
2. Fecal incontinence<sup>18</sup>
3. Obstructed defecation syndrome<sup>18</sup>
4. Rectocele<sup>18</sup>
5. Enterocoele/sigmoidocoele<sup>18</sup>
6. Intussusception<sup>18</sup>
7. Internal mucosal prolapse<sup>18</sup>
8. Abscess/fistula<sup>18</sup>

### Pain syndromes

1. Chronic pelvic pain syndrome (CPPS): persistent pain perceived in structures related to the pelvis, in the absence of proven infection or other obvious local pathology that may account for the pain. It is often associated with negative cognitive, behavioral, sexual or emotional consequences,

and with symptoms suggestive of lower urinary tract, sexual, bowel or gynecological dysfunction.<sup>14</sup>

2. Chronic PFM pain syndrome: the occurrence of persistent or recurrent, episodic, pain in the PFM, in the absence of a proven or well-defined local pathological condition. It is often associated with negative cognitive, behavioral, sexual or emotional consequences, and with symptoms suggestive of lower urinary tract, sexual, bowel or gynecological dysfunction.<sup>14, endnote 18</sup>

## Female sexual dysfunction

Any departure from normal sensation and/or function expressed by a woman during sexual activity.<sup>3</sup>

1. Dyspareunia<sup>3</sup>
2. Obstructed intercourse<sup>3</sup>
3. Vaginal laxity<sup>3</sup>

## TREATMENTS

### General terms

#### *Behavioral*

The way someone behaves, especially toward other people, and behavioral science is the study of human behavior.<sup>60</sup>

1. Behavior therapy: a type of psychotherapy that attempts to modify observable maladjusted patterns of behavior by substituting a new response or set of responses to a given stimulus. The treatment techniques involve the methods, concepts, and procedures derived from experimental psychology; they include assertiveness training, aversion therapy, contingency management, flooding, modeling, operant conditioning, and systematic desensitization. It is also called behavior modification.<sup>12, endnote 19</sup>
2. Cognitive therapy: any of the various methods of treating mental and emotional disorders that help a person to change their attitudes, perceptions, and patterns of thinking, from rational to realistic thoughts about the self and situations. The technique is often used in association with behavior therapy principles.<sup>12</sup>
3. Cognitive behavior therapy (CBT): Cognitive techniques are often used in association with behavior therapy principles; this is called cognitive behavior therapy (CBT).

#### *Physiotherapy*

Physiotherapy involves “using knowledge and skills unique to physiotherapists” and “is the service only provided

by, or under the direction and supervision of, a physiotherapist”<sup>61, endnote 20</sup>

### *Adherence*

Adherence is the extent to which a client/patient's behavior corresponds to the agreed treatment protocol and/or regime as recommended by their healthcare provider.<sup>62</sup> It does not refer to the intervention itself; rather, the patient's commitment to undertaking the behavioral change to adhere to the intervention.<sup>endnote 21</sup>

### *Compliance*

Compliance is the extent to which a client/patient's behavior matches, or complies with, their healthcare provider's recommended treatment protocol and/or regime.<sup>63, endnote 22</sup>

### **Combination therapy (also known as polytherapy, multimodal therapy or combined modality therapy)**

Combination therapy is the use of more than one intervention concurrently to treat a single condition with one or multiple symptoms, for example, a combination of medication with PFM training (PFMT).

1. Adjunctive therapies: any treatment or modality used to augment or assist the main treatment. In conservative treatments, adjunctive therapies often refer to equipment or a secondary therapy used to supplement the effect of the primary therapy, e.g., biofeedback-assisted PFMT or neuromuscular electrical stimulation to augment PFMT.

### *Prevention*

Prevention is the act of preventing or decreasing the risk of disease or disability. Activities that are directed toward slowing or stopping the occurrence of both mental and physical illness and disease, minimizing the effects of a disease or impairment on disability, or reducing the severity or duration of an illness.<sup>5</sup>

1. Primary prevention: prevention of the development of disease in a susceptible or potentially susceptible population through such specific measures as general health promotion efforts.<sup>5</sup>
2. Secondary prevention: efforts to decrease the duration of illness, reduce the severity of diseases, and limit the sequelae through early diagnosis and prompt intervention.<sup>5</sup>
3. Tertiary prevention: efforts to limit the degree of disability and promote rehabilitation and restoration of

function in patients/clients with chronic and irreversible diseases).<sup>5</sup>

## **Lifestyle**

### *Lifestyle modification*

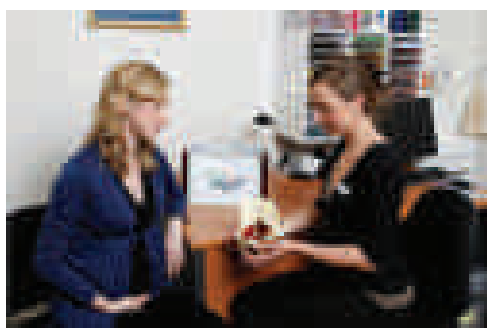
Lifestyle modification is the application of interventions in the management of lifestyle-related health problems, e.g., change to a healthy diet and regular participation in physical activity and smoking cessation. The following lifestyle modifications may be applied to treat pelvic floor dysfunctions, either in combination with other therapies or as “stand-alone” treatments.

1. Fluid consumption/restriction: fluid consumption is the intake of fluid over 24 h. Fluid restriction is the limitation of fluid to a prescribed amount over a period of 24 h. These measures are often undertaken as part of a bladder training process.
2. Dietary modification: an alteration or adjustment of food to treat bowel disorders (e.g., constipation and fecal incontinence) or urinary disorders (e.g., incontinence or urgency), for example, increasing fiber to treat constipation. The specifics of the dietary changes should be described.
3. Elimination diet: a form of dietary modification. A diet designed to detect what ingredient in the food causes symptoms in the patient, food items to which the patient may be sensitive are withdrawn separately and successfully from the diet until the item that causes the symptoms is discovered. This is used frequently in patients with fecal incontinence, urinary urgency and urinary urgency incontinence (bladder diet).<sup>64,65</sup>
4. Physical activity: any body movement produced by the skeletal muscles that results in a substantial increase above resting energy expenditure. Physical activity can be done at work, as transportation, as household and other chores, and as leisure time/sport and fitness activities.<sup>66, endnote 23</sup>

### *Counseling*

Counseling is the provision of professional assistance and guidance in resolving personal or psychological problems,<sup>7</sup> and may be part of any clinician's management.

1. Patient education: providing patients with knowledge and understanding of their condition, thereby empowering them to play an active role in its management (Fig. 8).<sup>67</sup>
2. Motivational interviewing: a directive, client-centered counseling style for eliciting behavior change by helping clients to explore and resolve ambivalence. Compared with nondirective counseling, it is more focused and



**FIG. 8** Patient education of pelvic floor muscle function (reproduced with permission from *Women's and Men's Health Physiotherapy*)

goal-directed. The examination and resolution of ambivalence is its central purpose, and the counselor/clinician is intentionally directive in pursuing this goal.<sup>68</sup>

3. Coping strategies: intervention aimed at helping patients to live with the condition in the best way possible under the circumstances, to regain a feeling of being in control, to adjust their lifestyle where necessary, and to take a positive rather than a negative approach.<sup>67</sup>
4. Self-care: the set of activities that comprise daily living, such as bed mobility, transfers, ambulation, dressing, grooming, bathing, eating, and toileting.<sup>5</sup>
5. Self-help: various methods by which individuals attempt to remedy their difficulties without making use of formal care providers.<sup>5</sup>
6. Self-efficacy: an individual's belief that he or she is capable of successfully performing a certain set of behaviors.<sup>69</sup>

### Scheduled voiding regimes

Toileting on a fixed schedule around the patient's normal voiding pattern, which includes a progressive voiding schedule using relaxation and distraction techniques for urgency suppression.<sup>70</sup> Scheduled voiding regimes have been categorized as: bladder training, timed voiding, habit training, and prompted voiding.<sup>71</sup>

#### Bladder training

In the past, bladder training has also been referred to as bladder drill, bladder discipline, bladder re-education, and bladder retraining. It consists of a program of patient education, along with a scheduled voiding regimen with gradually adjusted voiding intervals. Specific goals are to correct faulty habit patterns of frequent urination, improve control over bladder urgency, prolong voiding intervals, increase bladder capacity, reduce incontinent episodes, and

restore patient confidence in controlling bladder function (modified from Moore et al.<sup>71</sup>).<sup>endnote 24</sup>

#### Timed voiding

Timed voiding is a passive toileting assistance program, initiated and maintained by caregivers for patients who cannot participate in independent toileting. It is a fixed voiding schedule.<sup>71</sup>

#### Habit training

Habit training consists of a toileting schedule matched to the individual's voiding patterns based on their voiding diary. The toileting schedule is assigned to fit a time interval that is shorter than the person's normal voiding pattern and precedes the time period when incontinent episodes are expected.<sup>71</sup>

#### Prompted voiding

Prompted voiding is used to teach people to initiate their own toileting through requests for help and positive reinforcement from caregivers, often done in combination with a scheduled voiding regimen, typically every 2 h.<sup>71</sup>

### Other techniques for bladder and bowel control

Other techniques consist of doing something that takes the patient's mind off the condition. Distraction techniques utilized in urgency may include (but are not limited to) counting backward from 100 in 7 s, reciting a poem, doing breathing exercises, reading or working.

#### Urgency suppression techniques

Urgency suppression techniques are methods/maneuvers that are used to decrease the feeling of urgency, which may include, but are not limited to: distraction, PFM contraction, perineal pressure such as sitting on a hard chair, relaxation and breathing, toe curling or plantar flexion of the ankle.

#### Double voiding

In double voiding, the patient is taught to urinate, relax, and attempt to urinate again.<sup>59</sup>

#### Defecatory dynamics

Defecatory dynamics is a postural and respiratory technique to aid defecation. The mechanics involves co-ordination of the diaphragm, abdominal and PFM, with the intent to maintain rectal support whilst releasing the anal outlet with sufficient expulsion to be effective.<sup>72,73</sup>

### *Bowel habit training*

Bowel habit training is aimed at establishing a regular, predictable pattern of bowel evacuation by patient teaching and adherence to a routine to achieve a controlled response to bowel urgency (modified from NICE guideline).<sup>74, endnote 25</sup>

### **Exercise/exercise training**

Exercise is a form of leisure time activity that is usually performed on a repeated basis over an extended period of time (exercise training) with specific external objectives, such as improvement of fitness, physical performance, or health.<sup>66</sup> Exercise training includes: endurance training, strength training, flexibility training, and motor control (including balance), all of which may apply to the PFM.

### *Therapeutic exercise/exercise therapy*

Therapeutic exercise consists of interventions directed toward maximizing functional capabilities. It includes a broad range of activities intended to improve strength, range of motion (including muscle length), cardiovascular fitness, flexibility, or to otherwise increase a person's functional capacity.<sup>5</sup>

1. Rehabilitation/re-education: help individuals to regain skills and abilities that have been lost as a result of illness, injury or disease, or incarceration, restoring a disabled individual to maximum independence commensurate with his or her limitations.

### *Mode of exercise training*

The mode of exercise training is not only the type of activity to be performed (for instance, fast walking, jogging, or swimming, strength training), but also the temporal pattern of activity that is recommended (that is, continuous or intermittent activity), with a detailed specification of the duration of exercise and rest periods in the case of intermittent activity bouts.<sup>66</sup> Authors are encouraged to specifically describe all components of the mode of exercise and the dose provided.

1. Muscle training: exercise to increase muscle strength, endurance, power, flexibility or relaxation.
  - a) Strength training: training with high resistance (close to maximal contractions) and few repetitions with the aim of increasing muscle volume and neural adaptations.
  - b) Resistance: the amount of force opposing a movement.<sup>39</sup>
  - c) Resistance devices: any object used to increase resistance to contraction, e.g., hand weights.
  - d) Vaginal resistance device: objects inserted into the vagina or rectum that are inflated or spring-loaded devices to increase resistance to contraction.

- e) Local muscle endurance training: training with a low load and a high number of repetitions or holding the contraction over time.
- f) Muscle power training: all training with the aim of generating power; can be close to maximal contraction training and/or rapid contractions.<sup>endnote 26</sup>
- g) Overload: a situation in which the body is required to perform exercise beyond that to which the neuromuscular system is accustomed during routine activities. Training adaptation occurs in response to a progressive "overload".<sup>75</sup>
- h) Progressive overload: the gradual increase in stress placed upon the body during exercise training.<sup>76</sup>
- i) Detraining: cessation of training, but also planned or unplanned reduced volume or intensity of training.<sup>77</sup>
- j) Maintenance training: a program designed to prevent loss of the previous level of functioning.
- k) Isometric/static contraction: a muscular action during which no change in the length of the total muscle or joint angle takes place.<sup>77</sup>
- l) Isotonic contraction: a muscular action during which the tension developed by the muscle remains almost constant while the muscle shortens.<sup>78</sup>
- m) Eccentric contraction: a muscular action in which the muscle lengthens in a controlled manner.<sup>77, endnote 27</sup>
- n) Repetition: the completion of a whole cycle from the starting position, through the end of the movement, and back to the start,<sup>75</sup> e.g., one PFM contraction with relaxation.
- o) Set: the number of times the desired number of repetitions is performed,<sup>33</sup> e.g., three sets of 12 PFM contractions.
- p) PFMT: exercise to improve PFM strength, endurance, power, relaxation or a combination of these parameters.
- q) Kegels: a PFM contraction or PFM exercise. This term is named after Arnold Kegel, an American gynecologist who first described the clinical effect of PFMT in the late 1940s.<sup>49</sup> We recommend the use of the term PFMT (not the word Kegels) to refer to exercises that specifically target the PFM.
- r) Individualized PFMT: an individual PFM program aimed at improving the specific deficiencies in PFM structure or function based on assessment of the woman's ability to contract the PFM.
- s) Supervised PFMT: a PFMT program taught and monitored by a health professional/clinician/instructor.
- t) Group PFMT: PFMT conducted in an exercise class.<sup>79</sup> Class participation may occur with or without previous individualized PFM instruction.<sup>endnote 28</sup>



- u) Home training/home PFM exercise program: an unsupervised PFMT program, which the individual performs at home.
  - v) Weighted vaginal cones: objects of different shapes, sizes, and weights, which are inserted into the vagina above the level of the PFM with the aim of providing sensory biofeedback and load on the PFM to increase muscle recruitment and strength.<sup>80, endnote 29</sup>
3. Facilitation technique: any method of increasing recruitment/response of a nonresponding muscle. In the case of noncontractile or very weak PFMs, this may include a quick stretch of the PFM, with tapping or stretching the PFM digitally. An overflow effect from a strong contraction of a nearby synergistic muscle (e.g., external rotators) may also assist facilitation or recruitment of PFMs.

#### *Dose–response issues related to exercise training*

1. Dose–response: amount/volume of training and its effect on the speed and degree of the effect of the training program.
2. Frequency of exercise: the number of activity sessions per day, week, or month.<sup>33</sup>
3. Duration of exercise: the unit of time (number of seconds/minutes) of activity in each repetition or session, e.g., a 10-s PFM contraction.<sup>33</sup> It also refers to the length of the whole training period (intervention), e.g., 3/6 months.
4. Intensity: the amount of resistance used or the effort associated with the physical activity.<sup>33</sup> For strength training, it is often expressed as a percentage of one repetition maximum: 1RM (the maximum load a person can lift once), e.g., 70 % of maximum.<sup>75</sup>
5. Session/bout: the block of time devoted to the training, e.g., a 1-h session.<sup>75</sup>

#### *Relaxation training*

1. Relaxation: the ability to control muscle activity such that muscles not specifically required for a task are quiet, and those that are required are fired at the minimal level needed to achieve the desired results.<sup>81</sup> Relaxation “can be considered a motor skill in itself because the ability to reduce muscle firing is as important to control as the generation of firing”.<sup>40</sup>
  - a) General relaxation technique: a technique that involves the whole body, with the aim of effecting a global relaxation, including a decrease in the skeletal and smooth muscles, a decrease in the heart rate and respiration rate, and an increase in parasympathetic activity. General relaxation techniques can also be used aimed at relaxing local muscles.

- b) Progressive muscular relaxation (also known as Jacobsen's technique): monitoring tension in each specific muscle group, by contracting, then relaxing the tension, with attention paid to the contrast between tension and relaxation.<sup>82</sup> This type of relaxation is also termed “contract–relax.”
- c) Meditation: a practice of concentrated focus upon a sound, object, visualization, the breath, movement, or attention itself to increase awareness of the present moment, reduce stress, promote relaxation, and enhance personal and spiritual growth.<sup>83</sup>
- d) Mindfulness: intentionally bringing one's attention to the internal and external experiences occurring in the present moment. Mindfulness is often taught through a variety of meditation exercises.<sup>84</sup>
- e) EMG relaxation techniques: techniques to decrease EMG muscle activity or activation through a variety of methods, including a conscious effort to relax.

#### *Stretching*

1. Stretching (also referred to as flexibility training when the method is used on skeletal muscles where increased range of motion over the joints is the aim): the application of an external force to muscle and connective tissue to elongate it in the direction opposite to its shortened position. This can be done parallel or perpendicular to the muscle fiber direction. For the PFM this can be applied as a widening of the levator hiatus in the axial plane (laterolaterally) via a digit or use of a dilator, or a caudal movement (via a straining/bearing down maneuver) in the sagittal plane.
  - a) Dilator therapy: a conical or cylindrically shaped device (made of an inert material) inserted intra-vaginally or intra-anally, with the aim of increasing the flexibility or elasticity of the soft tissues via application of a prolonged elongation or stretch. Dilators may also be used as a desensitizer device, to reduce fear, anxiety or pain associated with vaginal touch and in conjunction with vaginismus or sexual pain. When combined with EMG, dilators can be used to train PFM relaxation during penetration. Dilators may also be used to increase the tolerance of skin to sliding when the dilator is moved in and out.

#### *Functional training*

Functional training consists of training for tasks of daily living and self-care activities, e.g., squatting to train quadriceps and gluteal muscles.

1. Functional PFM training: training and exercises that incorporate a correct PFM contraction into activities of

daily living such as lifting, transferring out of bed, or sneezing. A PFM contraction before a rise in intra-abdominal pressure, e.g., a cough (“the Knack”) is part of functional PFM training.

2. Coordination training: the ability to use different parts of the body together smoothly and efficiently.<sup>7</sup> Related to PFM training, coordination training means PFM contraction with other muscles or other muscle groups, e.g., respiratory muscles.
3. Functional mobility training: an intervention directed at improving the physical ability to perform a daily task. For voiding/defecation, this may include: gait training, transfer training, stair training, and other mobility training to improve speed and safety in reaching the toilet.

## Biofeedback training

### Feedback

Feedback is sensory information that is available as the result of an activity that a person has performed. It can be provided by an intrinsic source (from within the individual), or an extrinsic source (from the clinician), and can occur concurrently with the activity or post-activity, e.g., verbal information from the clinician to the patient during or following PFM assessment.<sup>85, endnote 30</sup>

### Biofeedback

Biofeedback is the use of an external sensor to give an indication with regard to bodily processes, usually with the purpose of changing the measured quality.<sup>86</sup> It is an adjunctive therapy.<sup>endnote 31</sup>

## EMG biofeedback unit instrumentation

1. EMG signal amplitude: number of microvolts ( $\mu\text{V}$ ) a muscle is generating.<sup>87</sup> EMG biofeedback units can deliver either the actual amount of EMG activity in  $\mu\text{V}$  or an average  $\mu\text{V}$  value.<sup>endnote 32</sup>
2. Artifact: extraneous information nonrecognizable in the EMG signal from sources other than the target muscle such as the environment or other body functions.<sup>87, endnote 33</sup>
3. Cross talk: muscle activity from nearby muscles that can artificially increase EMG amplitude; a type of artifact.<sup>87, endnote 34</sup>
4. Dual-channel EMG: use of two channels to monitor two separate muscles or muscle groups at the same time, such as the PFM and abdominal muscles, with the goal of either promoting synergist activity or reducing EMG activity of one muscle while increasing the other.
5. Band pass: limits muscle fiber frequencies that are monitored and displayed in the EMG tracing.<sup>87, endnote 35</sup>

## EMG assessment of PFM

Electromyography assessment of PFM consists of the use and interpretation of the surface EMG recording of a muscle for rehabilitation purposes should be done cautiously, recognizing that the main goal is the qualitative description of the muscle activation pattern, and not a qualitative diagnosis.

1. Baseline muscle activity: amount of microvolts generated by the target muscle during rest.<sup>endnote 36</sup>
2. Peak microvolts: the highest EMG amplitude achieved.
3. Slow recruitment: slow initiation of muscle activation contraction.<sup>endnote 37</sup>
4. Slow de-recruitment or slow latency to return to baseline: slow relaxation of the muscle contraction.<sup>88, endnote 38</sup>
5. Inconsistent resting baseline: variation of baseline between contractions, between sets, or between days may be related to a change in patient symptoms, e.g., hypertonic PFM.
6. Excessive accessory muscle contraction: increased amplitude in accessory muscles often resulting in cross talk and is indicative of poor isolation of target muscle contraction.

## EMG training of PFM

1. Up-training: EMG biofeedback training to increase the EMG activity of a hypotonic muscle with low EMG activity.<sup>87, endnote 39</sup>
2. Down-training: EMG biofeedback training to decrease EMG activity and relax muscles.<sup>87, endnote 40</sup>

## Manual therapy

Manual therapy is a clinical approach utilizing skilled, specific hands-on techniques, including but not limited to, massage, manipulation or mobilization.<sup>endnote 41</sup>

### Joint therapies

1. Mobilization: skilled passive movement of a skeletal joint including graded passive oscillations at the joint to improve joint mobility, e.g., movement of the coccyx.
2. Manipulation: a passive (for the patient) therapeutic movement, usually of small amplitude and high velocity, at the end of the available joint range.<sup>5</sup> Manipulation is a sudden small thrust that is controlled by the clinician.<sup>endnote 42</sup>

### Soft-tissue therapies

1. Touch desensitization: use of finger/hand, vibration or device to reduce hypersensitivity of soft tissues to touch/contact.

2. Massage: the manipulation of the soft tissues of the body for the purpose of affecting the nervous, muscular, respiratory, and circulatory systems.<sup>5</sup>
3. Abdominal massage: therapist or self-directed massage of the abdominal wall with the aim of stimulating peristalsis and relieving the symptoms of constipation. Generally, the technique follows the ascending, transverse, and descending colon to aid emptying. The effect may be mechanical or sensory.<sup>89</sup>
4. Myofascial release techniques: the use of deep friction and stroking of the fascia of the body to improve the ability of the fascia to deform and move within the body.<sup>5</sup>
5. Skin rolling: a manual technique in which skin is pulled away from the underlying structures and elongated in various directions.
6. Scar massage: a specific application of soft-tissue mobilization to an adherent scar.
7. Perineal massage: intravaginal massage by the woman, her partner or the clinician. Technique includes alternating downward and sideward pressure, using thumb and forefinger and a natural oil, with the aim of stretching and elongating the tissue in preparation for vaginal childbirth, or for treatment of adherent scarring in the perineum.<sup>90</sup>
8. Transverse friction: the operator's fingertip is placed on the exact site of the lesion and rubbed firmly across the direction of the fibers of the affected tissue.<sup>91</sup>
9. Thiele's massage: per rectal digital massage of the levator ani, sweeping lengthwise along the muscle fibers. Massage is begun lightly, and pressure is increased as tenderness decreases.<sup>92</sup>
10. TrP treatment: (sometimes called myofascial trigger point treatment): soft-tissue mobilization specifically targeting trigger points and may include ischemic pressure, massage, myofascial release, electrotherapy, ultrasound, laser, spray-and-stretch, injection (a variety of chemicals including local anesthetic, botox or steroids), dry needling (insertion of a solid needle into the TrP), and stretching.<sup>endnote 43</sup>

## Thermal modalities

### *Cold treatment/cryotherapy*

Cold treatment is the application of ice for therapeutic purposes. It is used in the initial management of acute musculoskeletal injuries, to decrease edema through vasoconstriction and to reduce secondary hypoxic injury by lowering the metabolic demand of injured tissues.<sup>93</sup>

### *Heat treatment (moist or dry)*

Heat treatment consists of the application of heat to a body part, with the aim of relieving pain and/or stiffness. It is usually applied when an injury is older than 48 h.

## Electrical therapy

Electrical therapy is the use of electric potential or currents to elicit therapeutic responses. Current may be directed at motor or sensory functions. It is not within the scope of this document to define all electrical stimulation terms. Readers are referred to more complete text books.<sup>94</sup>

*Electrical muscle stimulation (also known as neuromuscular electrical stimulation or electromyostimulation)*

Electrical muscle stimulation (EMS) is the application of electric impulses directly to striated PFM (end-plate) to facilitate contraction. EMS is often referred to as “pelvic floor muscle electrical stimulation” (PFES) or “functional electrical stimulation.” PFES is the application of electrical current to the PFM.<sup>95</sup> All of these stimulations may (indirectly) cause inhibition of the detrusor contraction (Fig. 9).

### *Mode of application*

1. Surface electrodes: non-invasive placement of electrodes, including intravaginal and intra-anal electrodes, in contrast to electrodes that pierce the skin, i.e., needle stimulation.
  - a) Non-invasive electrical nerve stimulation<sup>96,97</sup> or transcutaneous electrical nerve stimulation (TENS): the application of electrical energy to stimulate cutaneous nerve and peripheral motor nerves, via suprapubic, perineal or sacral placement of electrodes, or other external sites, or intravaginal or intra-anal plug electrodes. Tibial nerve stimulation (TNS) is a form of peripheral neuromodulation targeting symptom relief of overactive bladder (OAB) and urinary urge incontinence. Indirect access to the sacral plexus is achieved by



**FIG. 9** Enraf-Nonius Myomed pelvic floor machine, including electrical stimulation (reproduced with permission from Enraf-Nonius)

intermittent, electrical stimulation of the tibial nerve, which lies behind the medial malleolus, using skin surface electrodes applied to the medial malleolar area (transcutaneous TNS).<sup>98</sup> There are two main types of electrical stimulation with surface electrodes:

- i) Long-term or chronic electrical stimulation: is delivered below the sensory threshold. It is aimed at inhibiting detrusor activity by afferent pudendal nerve stimulation. The device is used 6–12 h per day for several months.<sup>99</sup>
  - ii) Maximal neuromuscular electrical stimulation: applies a high-intensity stimulus, set just below the pain threshold. It is aimed at improving urethral closure, via striated muscle recruitment. Detrusor inhibition by afferent pudendal nerve stimulation has also been suggested as a mechanism of effect.<sup>96</sup> Maximal electrical stimulation (35–70 Hz) is applied over short period (15 to 30 min), is used several times per week (and up to 1–2 times daily), and may be provided via in-clinic application or via portable devices at home).<sup>100–102</sup>
2. Percutaneous electrical nerve stimulation: a therapeutic modality that stimulates peripheral sensory nerves performed with a (few) needle electrode(s) that are placed in close proximity to the area to stimulate. Percutaneous neuromuscular electrical stimulation (e.g., posterior TNS) is a peripheral neuromodulation technique, in which the posterior tibial nerve is electrically stimulated three fingerbreadths above the medial malleolus, via insertion of a percutaneous needle electrode. This is coupled with an adhesive reference surface electrode placed near to the needle. This intervention is offered to patients with OAB.<sup>103–105</sup>

#### *Electrophysiological parameters*

1. Electrical current: the flow (current) of electrons (electricity) from an electron source (stimulator) the wires and electrodes used to deliver such an electrical current to soft tissues.<sup>106</sup>

There are three types of current: direct, alternating, and pulsed. –

- a) Direct: the continuous, unidirectional flow of charged particles for 1 s or longer, the direction of which is determined by the polarity selected. Polarity refers to two oppositely charged poles, one positive and one negative. Polarity determines the direction in which current flows.<sup>106</sup>
- b) Alternating: the continuous, bidirectional flow of charged particles, for 1 s or longer, relative to the isoelectric baseline.<sup>106</sup>
- c) Pulsed: the noncontinuous, interrupted, and periodic flow of direct (DC) or alternating (AC) currents.<sup>106</sup>

Currents used in therapy:

- a) Faradic current: an alternating and interrupted low-frequency current capable of stimulating (depolarizing) nerve fibers through the skin using surface-stimulating electrodes. It is used to stimulate innervated muscles, causing them to contract.<sup>107</sup>
- b) TENS: an alternating and interrupted low-frequency current capable of stimulating (depolarizing) nerve fibers through the skin using surface-stimulating electrodes for pain modulation or pain relief.<sup>106</sup>
- c) Interferential current: a medium frequency, amplitude-modulated electrical current that results from the interference (hence the word interferential) caused by crossing two or more medium-frequency alternating sine wave currents with different carrier frequencies. The carrier frequency of these medium, alternating sine wave currents ranges between 2,000 and 5,000 cycles per second.<sup>106</sup>

#### *Neuromuscular electrical stimulation parameters*<sup>endnote 44</sup>

1. Pulse frequency (or rate): the number of pulse cycles that are generated per unit of time (seconds). This is reported in hertz (Hz).<sup>106</sup>
2. Pulse width: the determined period of time elapsing from the beginning to the end of one pulse cycle, usually expressed in microseconds or milliseconds.<sup>106</sup>
3. Current amplitude: the magnitude of current relative to the isoelectric baseline, expressed in amperes (A). The current amplitude of therapeutic electrical stimulators ranges from micro- to milliamps.<sup>106</sup>
4. Train: the continuous series of pulse cycles over time, usually lasting seconds. For example, a train of impulses may be the results of successive pulse cycles delivered at 50 Hz for a duration of 5 s.<sup>106</sup>
5. Train ramp-up time and ramp-down time: ramp-up time is the time elapsed from the onset (or baseline) to the plateau current amplitude (or maximum) of the train, whereas ramp-down time is the time elapsed from the plateau current amplitude to zero baseline.<sup>106, endnote 45</sup>
6. Duty cycle (D): the ratio of ON time to the summation of ON time + OFF time, expressed as a percentage (duty cycle = (ON)/(ON + OFF time) x 100, e.g., a duty cycle of 20 % is calculated when the ON and OFF times equal 10 and 40 s respectively.<sup>106</sup>
7. Impedance (electric resistance): the opposition of our biological tissues to the flow of an electrical current. Measured in ohms and designated as Z.<sup>106</sup>
8. Evoked potentials: electrical potentials recorded from the nervous system following a delivered stimulus.

## Magnetic stimulation

Magnetic stimulation (or extracorporeal magnetic innervation: a pulsed magnetic technology developed for the transmission of nerve impulses that is aimed at causing PFM contraction. Patients receive therapy by sitting in a chair, which contains the device that produces the pulsing magnetic fields.

## Mechanical devices

### *Intravaginal devices*

Intravaginal devices are intended to provide some support to the bladder neck and possibly some compression to the urethra, to correct urinary stress incontinence. These can be traditional tampons, pessaries, and contraceptive diaphragms and devices designed specifically to support the bladder neck (removable, reusable intravaginal ring or single-use disposable devices).<sup>108</sup>

### *Anal plugs*

Anal plugs are containment devices aimed at blocking the loss of stool to control fecal incontinence. Plugs come in different designs, sizes, and compositions, such as polyurethane and polyvinyl-alcohol.<sup>109, endnote 46</sup>

### *Rectal irrigation*

Rectal irrigation is the use of liquid solutions given by enema to remove material from the rectum.<sup>110</sup>

### *Urethral plugs*

Urethral plugs are containment products aimed at blocking urine leakage.<sup>111</sup>

### *Pessaries*

Pessaries are intravaginal devices used to try to restore the prolapsed organs to their normal position and hence to relieve symptoms. Vaginal pessaries can be broadly divided into two types: support pessaries (ring, ring with support, Gehrung, Hodge, shelf) and space-filling pessaries (donut, Gellhorn, cube, inflatable).<sup>111–113</sup>

## Hygiene

### *Bladder hygiene*

Bladder hygiene prevents UTI by using techniques such as wiping the urethral meatus with clean wipes in an anterior-to-posterior direction after voiding, wearing clean

underwear, keeping the genital area clean, and emptying the bladder before and after sexual intercourse.<sup>114,115</sup>

### *Vulval hygiene*

Vulval hygiene involves maintaining a clean perineum by means of washing the area on a regular basis, and wearing cotton underwear. To avoid vulval irritation, shampoo, perfumed creams or soap should be avoided.<sup>116</sup>

### *Anal hygiene*

Anal hygiene involves keeping the perianal region clean, which is especially important when fecal seepage is present. Advice includes using soft toilet paper or moist wipes (avoiding any with an alcohol base), always wiping from front to back, washing after a bowel movement, then gently patting dry.<sup>89</sup> To avoid irritation from products, the vulval hygiene advice above should be followed.

### *Vaginal lubricants*

Vaginal lubricants are pharmacological preparations aimed at reducing friction during coital or any other sexual activity and thereby alleviating dyspareunia,<sup>117</sup> or at reducing discomfort associated with a clinical (per vaginum or per rectum) examination. Pharmacological preparations and natural plant-based oils may be used.

## Aids and appliances

### *Absorbent products*

Absorbent products are those that have been specifically developed to help manage leakage or soiling, such as absorbent pads and pants, absorbent bed sheets and chair covers.<sup>108,118</sup>

### *Catheters*

Urinary catheters are small tubes inserted via the urethra or into the bladder suprapubically, to allow the drainage of urine. Catheters are made of plastic, latex, teflon or silicone, and may be impregnated with antiseptic or antibiotic solution.<sup>119</sup>

1. Self-catheterization: a procedure performed intermittently to empty the bladder by inserting a catheter into the urethra when normal voiding is not possible or if the bladder cannot be emptied completely. If a caregiver undertakes this procedure it is usually a sterile procedure; if a patient undertakes it, it is termed

“self-catheterization” and is generally a clean rather than a sterile procedure.<sup>120–122</sup>

## CONCLUSION

We trust that this consensus-based terminology report for the conservative management of female pelvic floor dysfunction will be a significant aid to clinical practice and a stimulus for research. Future updates will be required to reflect evolving knowledge and applications in this field.

## ACKNOWLEDGEMENTS

We thank Professors Jacques Corcos (Urologist McGill University, Montreal Canada, Mandy Fader (Nurse, University of Southampton, UK), Ingrid Nygaard (Urogynecologist, University of Utah, Salt Lake City, USA), Marijke van Kampen (Physiotherapist, University Hospital Gasthuisberg, K.U. Leuven, Belgium) and David Vodusek (Neurophysiologist, University of Ljubljana, Slovenia) for expert advice on the draft manuscript.

## COMPLIANCE WITH ETHICAL STANDARDS

**Disclaimer** Any products/companies referred to in this document are not necessarily recommended or endorsed by the ICS.

## CONFLICTS OF INTEREST

Elizabeth Shelly is a consultant to Analytica and Amanda Wells is a consultant to ARC Health Services. None of the other authors have any conflicts of interest.

## ENDNOTES

endnote 1 Terminology for Female Anorectal Dysfunction.<sup>18</sup>

endnote 2 A comprehensive definition of these terms is covered by Doggweiler et al.<sup>123</sup>

endnote 3 Symptoms of pelvic floor myalgia should be described in terms of location, quality, intensity, pattern, duration, frequency, moderating factors, and associated symptoms. Pain details may include: (a) Whether pain is present at rest or mechanical in nature (related to muscle contraction or relaxation or body posture) and/or altered with a change of posture (lying to sitting, sitting to standing) or movement (bending, walking, sexual activity) (b) Whether uni- or bilateral in nature (c) Whether accompanied by bladder or bowel dysfunction, vulvodynia or dyspareunia (superficial/deep)

endnote 4 The evidence for the existence of trigger points is debated.<sup>124</sup>

endnote 5 Atrophy of the urogenital tract is normal at certain points in the life cycle, mainly caused by aging and hypoerogenism.<sup>8,125</sup>

endnote 6 Muscle tone is evaluated clinically as the resistance provided by a muscle when a pressure/deformation or a stretch is applied to it.<sup>19–21</sup> Muscle tone may be altered in the presence or absence of pain. There is no single accepted or standardized way of measuring muscle tone, and there are no normative values.

endnote 7 The terms hyper- and hypotonicity are commonly used in neurology and muscle physiology. Messelink et al.<sup>2</sup> introduced the terms overactivity and underactivity related to PFM. These terms are not defined with cut-off points, nor are they based on comparison with normal populations. As activity can only relate to the active (i.e., contractile) portion of muscle tone, activity cannot be used interchangeably with muscle tone, unless it can be shown that the active component of the muscle is altered. If increased (over-) or decreased (under-) activity in the PFM can be demonstrated using electromyography (EMG) or another measure, then these terms may be used appropriately.

endnote 8 Muscle cramp either during or immediately after exercise is commonly referred to as “exercise-associated muscle cramping”<sup>93</sup>; however, cramps are not specific to exercise.

endnote 9 Local or referred pain may be reproduced. An active TrP is said to have a characteristic “twitch” response when stimulated; however, the twitch response to palpation has been shown to be unreliable.<sup>126</sup> The most reliable sign of a TrP is sensitivity to applied pressure. Trigger points are implicated in myofascial pain; however, the validity of this theory is controversial and has recently been refuted.<sup>124</sup>

endnote 10 Palpation is less reliable and responsive than manometers and dynamometers.<sup>42</sup>

endnote 11 The pressure measured does not confirm its origin, and pressure measurement is only valid when used in combination with other methods, e.g., simultaneous observation of the inward movement of the perineum or device during PFM contraction.

endnote 12 The term perineometer is somewhat misleading as the pressure-sensitive region of the manometer probe is not placed at the perineum, but inside the vagina at the level of the levator ani. Vaginal pressure devices should be referred to as PFM manometers.<sup>42,49</sup>

endnote 13 Today's dynamometers for the pelvic floor also detect resting and contractile contributions from muscles other than the PFM, contributing to the force recordings. As dynamometers can be opened at different muscle lengths to measure PFM force, the process of measurement should respect the maximum achievable vaginal aperture without inducing discomfort, so as not to influence the validity of the measurement.

endnote 14 EMG in this case usually means “concentric needle EMG,” but other EMG methods exist. EMG is typically distinguished as either intramuscular or surface. EMG diagnosis is often used as a synonym for “neurophysiological diagnosis of the peripheral neuromuscular system,” and that would also include the measurement of motor and sensory conduction, the recording of reflex responses, etc.<sup>36</sup> EMG does not directly measure muscle strength. The type of electrode being used should be specified.

endnote 15 This is not typically used in clinical assessment, but may be included in research or advanced examinations, for example, to diagnose striated muscle denervation/re-innervation.<sup>36</sup>

endnote 16 Surface EMG is considered to be less specific than intramuscular EMG. The large surface area of the electrodes



may result in cross-talk from adjacent muscles and other artifacts; therefore, technical expertise is required. EMG can reveal the pattern of activity of a particular muscle, as in the diagnosis of detrusor sphincter dyssynergia during urodynamics.<sup>2,36</sup>

endnote 17 Because pain is multidimensional, a single rating scale combines these dimensions in unknown quantities. One may separately assess pain intensity, pain distress, and interference of pain with activities of daily life.

endnote 18 Other urological, gynecological, gastrointestinal and colorectal pain conditions without related PFM dysfunction, are well described in standard texts. Many pelvic floor pain-related conditions or syndromes (e.g., vulvodynia, interstitial cystitis/bladder pain syndrome, irritable bowel syndrome) are described in the Standard for Terminology in Chronic Pelvic Pain Syndromes (CPPS): A Report from the Ad Hoc Working Group of the International Continence Society Standardization Steering Committee (ICS-SSC) on Chronic Pelvic Pain, ICS Standardization of Terminology document on Chronic Pelvic Pain.<sup>123</sup> Several other systemic disorders (e.g., chronic fatigue syndrome, diabetes) may have an impact on the pelvic floor; however, PFD is not part of their recognized etiology.

endnote 19 We recommend that “behavioral” be limited to studies that evaluate how people do or do not behave as desired, e.g., commencement or cessation of PFM training or change of a diet.

endnote 20 We recommend that the specific treatment is described, e.g., PFM training, electrical stimulation, rather than the unspecific term physiotherapy, the latter also referring to a specific profession. Publications should report the actual professional who provided the intervention (e.g., physiotherapist, general practitioner, urogynecologist, urologist, midwife, nurse, fitness instructor), rather than using the vague term, “therapist”/“clinician”/“researcher.”

endnote 21 Adherence is usually reported as the number or percentage of clinical visits attended and home exercises or regimen components followed or completed by the client/patient.

endnote 22 The term “adherence” is generally preferred within health-care, as it acknowledges client/patient autonomy and implies a willingness on their part to participate and cooperate rather than the traditional view, inherent in “compliance,” of an expert clinician dictating to a naive patient.<sup>62,63</sup> Simply, adherence is agreeing what to do; compliance is being told what to do.

endnote 23 An increase in the physical activity level may affect UI positively via weight reduction in obese persons. Conversely, several studies have shown that there is a high prevalence of UI in physically active women during exercise (especially during high impact activity, defined as running and jumping). Strenuous exercise/work has been suggested to be a risk factor for the development of PFD.<sup>71</sup> A well-functioning pelvic floor responds before and during an increase in intra-abdominal pressure.

endnote 24 Ideally, the voiding intervals should be increased by 15–30 min each week, according to the patient's tolerance to the schedule, until a voiding interval of 3–4 h is achieved. Use of a bladder diary is recommended for self-monitoring of progress.<sup>70</sup>

endnote 25 A bowel habit intervention may: encourage bowel emptying at a specific time of day, mainly after a meal (to utilize the gastrocolic response), encourage patients to adopt a sitting or squatting position where possible while emptying the bowel, teach patients techniques to facilitate bowel evacuation and stress the importance of avoiding straining.<sup>74,127,128</sup>

endnote 26 Speed changes little with training. Thus, power is increased almost exclusively by gaining strength.<sup>35</sup>

endnote 27 PFM training can be isometric, concentric or eccentric or a combination of any of these.

endnote 28 Whether PFMT is performed with or without previous assessment of the ability to contract should be reported.

endnote 29 The original shape was conical; however, different shapes are currently available. Maintenance of the weight in position can be challenged via different body positions and activities.

endnote 30 PFM feedback can be provided by the therapist or patient during manual palpation internally or externally, or with a mirror. The purpose of feedback is to increase accuracy of contraction for maximum benefit.

endnote 31 Biofeedback can be visual, auditory or both. Biofeedback is not a treatment on its own. It is an adjunct to training and can be used to help the patient be more aware of muscle function, and to enhance and motivate patient effort during training.<sup>129</sup> The correct terminology should be PFM strength training with biofeedback or relaxation training with biofeedback. Types of PFM biofeedback include: perianal, vaginal, and anal surface EMG, urethral, vaginal or anal manometry, vaginal dynamometry, real-time ultrasound.<sup>129</sup>

endnote 32 Clinicians are to be cautious with regard to the interpretation of the information, as many factors influence amplitude, including muscle activity, skin conductance, and artifact. “EMG amplitude does not equal force”.<sup>87</sup> More microvolt activity means more muscle activity, but does not always mean more strength.

endnote 33 Artifact examples include movement or contact quality artifact, cross talk, heart rate, skin electrode shear, and electrode bridging.

endnote 34 Minimizing cross talk is essential in research into quality EMG tracings.

endnote 35 Recording with surface electrodes is prone to artifact and cross talk. The user should be trained appropriately and understand the limits of the EMG instrument and of the methodology. It is not within the scope of this document to define all EMG terms. Readers are referred to other texts for further terminology.<sup>87,88</sup>

endnote 36 Baseline EMG reading can be influenced by many factors and therapists must take into account the patient's symptoms, digital palpation results, overall tension of the patient, the possibility of artifacts, and other factors in determining the meaning of the baseline muscle activity.

endnote 37 Slow recruitment can be symptomatic of leakage during coughing and sneezing when a quick muscle contraction is needed to counteract increased intra-abdominal pressure.

endnote 38 Slow de-recruitment can be indicative of a hypertonic PFM.

endnote 39 The general principles of strength training are the same with and without biofeedback. (See the sections “Mode of exercise training” and “Dose–response issues related to exercise training”)



- endnote 40 The general principles of relaxation training are the same with and without biofeedback.
- endnote 41 Manual therapy is used to treat soft tissues and joint structures for the purpose of modulating pain; increasing the range of motion; reducing soft tissue edema; inducing relaxation; improving contractile and noncontractile tissue extensibility, and/or stability; facilitating movement; and improving function. This broad group of skilled hands-on treatments can be divided into two groups: joint therapies and soft-tissue therapies.
- endnote 42 Neither mobilization nor manipulation should be used when referring to muscle.
- endnote 43 The notion of trigger points causing myofascial pain is controversial.<sup>124</sup>
- endnote 44 Depending on the particular device being used, the type of electrical current, the specific health problem and condition being treated, and the individual's needs and circumstances, many electrical stimulation parameters may be adjusted by the therapist administering the treatment.
- endnote 45 The slower the current intensity rises to the preset amplitude or threshold level, the more comfortable the stimulation may feel. Conversely, the faster the ramp, or the more vertical the ramping up signal, the more discomfort may be felt.
- endnote 46 Terminology for female anorectal dysfunction.<sup>18</sup>

## REFERENCES

- Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Am J Obstet Gynecol*. 2002; 187:116–26.
- Messelink B, Benson T, Berghmans B, Bo K, Corcos J, Fowler C, et al. Standardization of terminology of pelvic floor muscle function and dysfunction: report from the pelvic floor clinical assessment group of the International Continence Society. *Neurourol Urodyn*. 2005;24:374–80. doi:10.1002/nau.20144.
- Haylen BT, de Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20. doi:10.1002/nau.20798.
- Bump RC, Norton PA. Epidemiology and natural history of pelvic floor dysfunction. *Obstet Gynecol Clin North Am*. 1998;25: 723–46.
- Bottomley JM. *Quick reference dictionary for physical therapy*. 3rd ed. Thorofare, NJ: Slack; 2013.
- Abrams P, Cardozo L, Wein A. Fourth international consultation on incontinence-research society 2013. *Neurourol Urodyn*. 2014; 33:571–2. doi:10.1002/nau.22617.
- Oxford Dictionary. <http://oxforddictionaries.com/>. Accessed 20 October 2015.
- Merriam-Webster Online Dictionary <http://www.merriam-webster.com/dictionary/>. Accessed 20 October 2015.
- Bo K, Herbert RD. There is not yet strong evidence that exercise regimens other than pelvic floor muscle training can reduce stress urinary incontinence in women: a systematic review. *J Physiother*. 2013;59:159–68. doi:10.1016/s1836-9553(13)70180-2.
- Bo K, Herbert RD. When and how should new therapies become routine clinical practice? *Physiotherapy*. 2009;95:51–7. doi:10.1016/j.physio.2008.12.001.
- IASP Taxonomy. International Association for the Study of Pain (IASP). 2012. <http://www.iasp-pain.org/Taxonomy-Pain>. Accessed 5 November 2015.
- Harris P, Nagy S, Vardaxis N. *Mosby's dictionary of medicine, nursing and health professions*. 2nd ed. Chatswood, NSW: Elsevier Australia; 2010.
- Baranowski A, Abrams P, Berger R, Buffington T, Collett B, Emmanuel A, et al. Classification of chronic pain: descriptions of chronic pain syndromes and definitions of pain terms. International Association for the Study of Pain (IASP). <http://www.iasp-pain.org/PublicationsNews/Content.aspx?ItemNumber=1673&navItemNumber=677>. International Association for the Study of Pain (IASP); 2012.
- Engeler D, Baranowski AP, Borovicka J, Cottrell A, Dinis-Oliveira P, Elneil S, et al. EAU guidelines on chronic pelvic pain. 2012. <http://www.uroweb.org/guidelines/online-guidelines>. Accessed 20 October 2015.
- Giamberardino MA, Affaitati G, Fabrizio A, Costantini R. Myofascial pain syndromes and their evaluation. *Best Pract Res Clin Rheumatol*. 2011;25:185–98. doi:10.1016/j.berh.2011.01.002.
- Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol*. 1996;175:10–7.
- Henry MM, Parks AG, Swash M. The pelvic floor musculature in the descending perineum syndrome. *Br J Surg*. 1982;69: 470–2.
- Sultan A, Monga A, Lee J, Emmanuel A, Norton C, Santoro G et al. An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Report on the Terminology for Anorectal Dysfunction in Women. *Int Urogynecol J*. 2016. doi:10.1007/s00192-016-3123-4 and *Neurourol Urodyn*. 2016. doi:10.1002/nau.23055.
- Mense S, Simons DG, Russell IJ. *Muscle pain: understanding its nature, diagnosis, and treatment*. Philadelphia: Lippincott Williams & Wilkins; 2001.
- Simons DG, Mense S. Understanding and measurement of muscle tone as related to clinical muscle pain. *Pain*. 1998;75:1–17.
- Enoka RM. Acute adjustments. In: Enoka RM, editor. *Neuro-mechanics of human movement*. 4th ed. Champaign: Human Kinetics; 2008. p. 305–47.
- Masi AT, Hannon JC. Human resting muscle tone (HRMT): narrative introduction and modern concepts. *J Bodyw Mov Ther*. 2008;12:320–32. doi: 10.1016/j.jbmt.2008.05.007.
- Nordin M, Frankel VH. Biomechanics of Bone. In: Nordin M, Frankel VH, editors. *Basic biomechanics of the musculoskeletal system*. 4th ed. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins Health; 2012. p. 24–56.
- Gajdosik RL. Passive extensibility of skeletal muscle: review of the literature with clinical implications. *Clin Biomech (Bristol, Avon)*. 2001;16:87–101.

25. Mumenthaler M. Neurologic differential diagnosis. 2nd ed. *Neurologische Differentialdiagnostik*. Stuttgart: Thieme; 1992.
26. Preston DC, Shapiro BE. *Electromyography and neuromuscular disorders: clinical-electrophysiologic correlations*. Boston: Butterworth-Heinemann; 1998.
27. Gerwin R. Myofascial pain syndrome: here we are, where must we go? *J Musculoskelet Pain*. 2010;18:329–47. doi:10.3109/10582452.2010.502636.
28. Dietz HP, Shek C. Validity and reproducibility of the digital detection of levator trauma. *Int Urogynecol J Pelvic Floor Dysfunct*. 2008;19:1097–101. doi:10.1007/s00192-008-0575-1.
29. Kruger JA, Dietz HP, Budgett SC, Dumoulin CL. Comparison between transperineal ultrasound and digital detection of levator ani trauma. *Can we improve the odds? NeuroUrol Urodyn*. 2014;33:307–11. doi: 10.1002/nau.22386.
30. Kruger J, Dietz P, Botelho C, Dumoulin C. Can we feel with our fingers as well as we see with ultrasound? *NeuroUrol Urodyn*. 2010;29:1176–7.
31. Dietz HP, Hyland G, Hay-Smith J. The assessment of levator trauma: a comparison between palpation and 4D pelvic floor ultrasound. *NeuroUrol Urodyn*. 2006;25:424–7. doi:10.1002/nau.20250.
32. Knuttgen HG, Kraemer WJ. Terminology and measurement in exercise performance. *J Strength Cond Res*. 1987;1:1–10. doi:10.1519/00124278-198702000-00001.
33. Howley ET. Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Med Sci Sports Exerc*. 2001;33(6 Suppl):S364–9, discussion S419–20.
34. Komi V. *Strength and power in sport*. 2nd ed. Osney Mead: Blackwell Science; 2003.
35. Wilmore JH, Costill DL. *Physiology of sport and exercise*. 2nd ed. Leeds Human Kinetics; 1999.
36. Vodusek DB. Electromyography. In: Bo K, Berghmans B, Morkved S, Van Kampen M, editors. *Evidence-based physical therapy for the pelvic floor: bridging science and clinical practice*. Edinburgh: Churchill Livingstone; 2015.
37. Knudson D. *Fundamentals of biomechanics*. 2nd ed. Boston: Springer Science + Business Media; 2007.
38. Sherwood L. *Human physiology: from cells to systems*. 8th ed. Belmont: Brooks/Cole; 2013.
39. Kent M. The Oxford dictionary of sports science and medicine. 2nd ed. *Oxford Medical Publications*. Oxford: Oxford University Press; 1998.
40. Alter MJ. *Science of flexibility*. 3rd ed. Champaign: Human Kinetics; 2004.
41. Møller AR. *Intraoperative neurophysiological monitoring*. 3rd ed. New York: Springer; 2011.
42. Bo K, Sherburn M. Evaluation of female pelvic-floor muscle function and strength. *Phys Ther*. 2005;85:269–82.
43. Dietz HP, Bernardo MJ, Kirby A, Shek KL. Minimal criteria for the diagnosis of avulsion of the puborectalis muscle by tomographic ultrasound. *Int Urogynecol J*. 2011;22:699–704. doi:10.1007/s00192-010-1329-4.
44. Dietz HP, Abbu A, Shek KL. The levator-urethra gap measurement: a more objective means of determining levator avulsion? *Ultrasound Obstet Gynecol*. 2008;32:941–5. doi:10.1002/uog.6268.
45. DeLancey JO, Kearney R, Chou Q, Speights S, Binno S. The appearance of levator ani muscle abnormalities in magnetic resonance images after vaginal delivery. *Obstet Gynecol*. 2003;101:46–53.
46. Miller JM, Brandon C, Jacobson JA, Low LK, Zielinski R, Ashton-Miller J, et al. MRI findings in patients considered high risk for pelvic floor injury studied serially after vaginal childbirth. *AJR Am J Roentgenol*. 2010;195:786–91. doi:10.2214/ajr.09.3508.
47. Morgan DM, Umek W, Stein T, Hsu Y, Guire K, DeLancey JO. Interrater reliability of assessing levator ani muscle defects with magnetic resonance images. *Int Urogynecol J Pelvic Floor Dysfunct*. 2007;18:773–8. doi:10.1007/s00192-006-0224-5.
48. Berger MB, Morgan DM, DeLancey JO. Levator ani defect scores and pelvic organ prolapse: is there a threshold effect? *Int Urogynecol J*. 2014;25:1375–9. doi:10.1007/s00192-014-2388-8.
49. Kegel AH. Progressive resistance exercise in the functional restoration of the perineal muscles. *Am J Obstet Gynecol*. 1948;56:238–48.
50. Dumoulin C, Bourbonnais D, Lemieux MC. Development of a dynamometer for measuring the isometric force of the pelvic floor musculature. *NeuroUrol Urodyn*. 2003;22:648–53. doi:10.1002/nau.10156.
51. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res*. 2011;63 (Suppl 11): S240–52. doi:10.1002/acr.20543.
52. Dworkin RH, Turk DC, Wyrwich KW, Beaton D, Cleeland CS, Farrar JT, et al. Interpreting the clinical importance of treatment outcomes in chronic pain clinical trials: IMMPACT recommendations. *J Pain*. 2008;9:105–21. doi:10.1016/j.jpain.2007.09.005.
53. Droz J, Howard FM. Use of the Short-Form McGill Pain Questionnaire as a diagnostic tool in women with chronic pelvic pain. *J Minim Invasive Gynecol*. 2011;18:211–7. doi:10.1016/j.jmig.2010.12.009.
54. Barber MD, Chen Z, Lukacz E, Markland A, Wai C, Brubaker L, et al. Further validation of the short form versions of the Pelvic Floor Distress Inventory (PFDI) and Pelvic Floor Impact Questionnaire (PFIQ). *NeuroUrol Urodyn*. 2011;30:541–6. doi:10.1002/nau.20934.
55. Gerstenberger EP, Rosen RC, Brewer JV, Meston CM, Brotto LA, Wiegand M, et al. Sexual desire and the Female Sexual Function Index (FSFI): a sexual desire cutpoint for clinical interpretation of the FSFI in women with and without hypoactive sexual desire disorder. *J Sex Med*. 2010;7:3096–103. doi:10.1111/j.1743-6109.2010.01871.x.
56. Derogatis LR, Rosen R, Leiblum S, Burnett A, Heiman J. The Female Sexual Distress Scale (FSDS): initial validation of a standardized scale for assessment of sexually related personal distress in women. *J Sex Marital Ther*. 2002;28:317–30.
57. Quaghebeur J, Wyndaele JJ. Comparison of questionnaires used for the evaluation of patients with chronic pelvic pain. *NeuroUrol Urodyn*. 2013;32:1074–9. doi:10.1002/nau.22364.

58. Body Mapping. Public and Commercial Services Union. [http://www.pcs.org.uk/en/resources/health\\_and\\_safety/health\\_and\\_safety\\_reps\\_toolkit/body-mapping.cfm](http://www.pcs.org.uk/en/resources/health_and_safety/health_and_safety_reps_toolkit/body-mapping.cfm). Accessed 20 October 2015.
59. The Free Dictionary <http://medical-dictionary.thefreedictionary.com>. Accessed 20 October 2015.
60. Oxford Learner's Dictionary. <http://www.oxfordlearnersdictionaries.com>. Accessed 14 November 2015.
61. Policy statement: Description of physical therapy. World Confederation for Physical Therapy (WCPT). <http://www.wcpt.org/policy/ps-descriptionPT>. Accessed 29 November 2015.
62. World Health Organization. *Adherence to long-term therapies: evidence for action*. Geneva: World Health Organization; 2003.
63. Nunes V, Neilson J, O'Flynn N, Calvert N, Kuntze S, Smithson H, et al. *Clinical guidelines and evidence review for medicines adherence: involving patients in decisions about prescribed medicines and supporting adherence*. London: National Collaborating Centre for Primary Care and Royal College of General Practitioners; 2009.
64. Friedlander JJ, Shorter B, Moldwin RM. Diet and its role in interstitial cystitis/bladder pain syndrome (IC/BPS) and comorbid conditions. *BJU Int*. 2012;109:1584–91. doi:10.1111/j.1464-410X.2011.10860.x.
65. Shorter B, Lesser M, Moldwin RM, Kushner L. Effect of comestibles on symptoms of interstitial cystitis. *J Urol*. 2007;178:145–52. doi:10.1016/j.juro.2007.03.020.
66. Bouchard C, Shephard RJ, Stephens T. *Physical activity, fitness, and health: consensus statement*. Champaign: Human Kinetics 1993.
67. Meijlink JM. A patient perspective. In: Nordling J, Wyndaele JJ, Van de Merwe JP, Bouchelouché P, Cervigni M, Fall M, editors. *Bladder pain syndrome: a guide for clinicians*. New York: Springer Science + Business Media; 2013.
68. Rollnick S, Miller WR. What is motivational interviewing? *Behav Cogn Psychother*. 1995;23:325–34. doi:10.1017/S135246580001643X.
69. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84:191–215.
70. Wyman JF, Burgio KL, Newman DK. Practical aspects of lifestyle modifications and behavioural interventions in the treatment of overactive bladder and urgency urinary incontinence. *Int J Clin Pract*. 2009;63:1177–91. doi:10.1111/j.1742-1241.2009.02078.x.
71. Moore K, Dumoulin C, Bradley C, Burgio K, Chambers T, Hagen S, et al. Adult conservative management. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *Incontinence, 5th International Consultation on Incontinence, Paris, February, 2012*. Paris: ICUD-EAU; 2013. p. 1101–228.
72. Chiarelli P, Markwell S. *Let's get things moving*. Sydney: Gore and Osment; 1992.
73. Markwell S, Sapsford R. Physiotherapy management of pelvic floor dysfunction. In: Sapsford R, Markwell S, Bullock-Saxton J, editors. *Women's health: a textbook for physiotherapists*. London: Saunders; 1998. p. 383–407.
74. NICE. Faecal incontinence: The management of faecal incontinence in adults. NICE clinical guideline 49 June 2007: 6. <http://www.nice.org.uk/guidance/cg49/evidence/full-guideline-195116653>.
75. Kraemer WJ, Häkkinen K. *Strength training for sport. Handbook of Sports Medicine and Science*. Oxford: Blackwell Science; 2002.
76. American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc*. 2009;41:687–708. doi:10.1249/MSS.0b013e3181915670.
77. Fleck SJ, Kraemer WJ. *Designing resistance training programs*. 3rd ed. Champaign: Human Kinetics; 2004.
78. Tortora GJ, Derrickson B. *Principles of anatomy and physiology*. 12th ed. New York: Wiley; 2009.
79. Bo K, Hagen RH, Kvarstein B, Jørgensen J, Larsen S, Burgio KL. Pelvic floor muscle exercise for the treatment of female stress urinary incontinence. III. Effects of two different degrees of pelvic floor muscle exercises. *Neurourol Urodyn*. 1990;9:489–502. doi:10.1002/nau.1930090505.
80. Plevnik S. A new method for testing and strengthening pelvic floor muscle. In: Proceedings of the International Continence Society. 1985. p. 267–8.
81. Coville CA. Relaxation in physical education curricula. *Phys Educ*. 1979;36:176–81.
82. Jacobson E. *Progressive relaxation*. Chicago: University of Chicago Press 1938.
83. Astin JA. Meditation. In: Novey D, editor. *Clinician's complete reference to complementary and alternative medicine*. St. Louis: Mosby; 2000.
84. Baer RA. Mindfulness training as a clinical intervention: a conceptual and empirical review. *Clin Psychol Sci Pract*. 2003;10:125–43. doi:10.1093/clipsy.bpg015.
85. Shumway-Cook A, Woollacott MH. *Motor control: theory and practical applications*. Baltimore: Williams & Wilkins; 1995.
86. Schwartz GE, Beatty J. *Biofeedback, theory and research*. New York: Academic; 1977.
87. Cram JR, Kasman GS, Holtz J. *Introduction to surface electromyography*. Gaithersburg: Aspen; 1998.
88. Schwartz MS, Andrasik F. *Biofeedback: a practitioner's guide*. 3rd ed. New York: Guilford Press; 2003.
89. Haslam J, Mantle J. Bowel and anorectal function and dysfunction. In: Mantle J, Haslam J, Barton S, editors. *Physiotherapy in obstetrics and gynaecology*. 2nd ed. London: Butterworth-Heinemann; 2004. p. 417–20.
90. Beckmann MM, Stock OM. Antenatal perineal massage for reducing perineal trauma. *Cochrane Database Syst Rev*. 2013;4, CD005123. doi:10.1002/14651858.CD005123.pub3.
91. Cyriax JH, Cyriax PJ. *Cyriax's illustrated manual of orthopedic medicine*. 2nd ed. Oxford: Butterworth Heinemann; 1998.
92. Thiele GH. Tonic spasm of the levator ani, coccygeus and piriformis muscles. *Trans Am Proct Soc*. 1936;37:145–55.
93. Brukner P, Khan K. *Brukner & Khan's clinical sports medicine*. 4th ed. Sydney: McGraw-Hill; 2012.
94. Robinson AJ, Snyder-Mackler L. *Clinical electrophysiology: electrotherapy and electrophysiologic testing*. 3rd ed. Baltimore: Lippincott Williams & Wilkins; 2007.
95. Schreiner L, Santos TG, Souza AB, Nygaard CC, Silva Filho IG. Electrical stimulation for urinary incontinence in women: a

- systematic review. *Int Braz J Urol*. 2013;39:454–64. doi:10.1590/s1677-5538.10.2013.04.02.
96. Berghmans B, van Waalwijk van Doorn E, Nieman F, de Bie R, van den Brandt P, Van Kerrebroeck P. Efficacy of physical therapeutic modalities in women with proven bladder overactivity. *Eur Urol*. 2002;41:581–7.
  97. Jabs CF, Stanton SL. Urge incontinence and detrusor instability. *Int Urogynecol J Pelvic Floor Dysfunct*. 2001; 12:58–68.
  98. Edenfield AL, Amundsen CL, Wu JM, Levin PJ, Siddiqui NY. Posterior tibial nerve stimulation for the treatment of fecal incontinence: a systematic evidence review. *Obstet Gynecol Surv*. 2015;70:329–41.
  99. Eriksen BC, Eik-Nes SH. Long-term electrostimulation of the pelvic floor: primary therapy in female stress incontinence? *Urol Int*. 1989;44:90–5.
  100. Yamanishi T, Yasuda K, Sakakibara R, Hattori T, Ito H, Murakami S. Pelvic floor electrical stimulation in the treatment of stress incontinence: an investigational study and a placebo controlled double-blind trial. *J Urol*. 1997;158:2127–31.
  101. Yamanishi T, Sakakibara R, Uchiyama T, Suda S, Hattori T, Ito H, et al. Comparative study of the effects of magnetic versus electrical stimulation on inhibition of detrusor overactivity. *Urology*. 2000;56:777–81.
  102. Yamanishi T, Yasuda K, Sakakibara R, Hattori T, Suda S. Randomized, double-blind study of electrical stimulation for urinary incontinence due to detrusor overactivity. *Urology*. 2000; 55:353–7.
  103. Govier FE, Litwiller S, Nitti V, Kreder Jr KJ, Rosenblatt P. Percutaneous afferent neuromodulation for the refractory overactive bladder: results of a multicenter study. *J Urol*. 2001;165: 1193–8.
  104. Janknekt RA, Weil EH, Eerdman PH. Improving neuromodulation technique for refractory voiding dysfunctions: two-stage implant. *Urology*. 1997;49:358–62. doi:10.1016/s0090-4295(96) 00506-7.
  105. Van Balken MR, Vandoninck V, Gisolf KW, Vergunst H, Kiemeny LA, Debruyne FM, et al. Posterior tibial nerve stimulation as neuromodulative treatment of lower urinary tract dysfunction. *J Urol*. 2001;166:914–8.
  106. Belanger A-Y. *Therapeutic electrophysical agents: evidence behind practice*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 2010.
  107. Electrotherapeutic Terminology in Physical Therapy. American Physical Therapy Association (APTA), American Physical Therapy Association (APTA). 2000. [https://iweb.apta.org/Purchase/ProductDetail.aspx?Product\\_code=P-72](https://iweb.apta.org/Purchase/ProductDetail.aspx?Product_code=P-72). Accessed 20 November 2015.
  108. Cottenden A, Bliss D, Buckley B, Fader M, Gartley C, Hayder D, et al. Management using continence products. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. *Incontinence, 5th International Consultation on Incontinence, Paris, February 2012*. Paris: ICUD-EAU; 2013. p. 1651–786.
  109. Deutekom M, Dobben AC. Plugs for containing faecal incontinence. *Cochrane Database Syst Rev*. 2012;4, CD005086. doi:10.1002/14651858.CD005086.pub3.
  110. Merriam-Webster. *Webster's new world dictionary*. 3rd ed. New York: Wiley; 2008.
  111. Lipp A, Shaw C, Glavind K. Mechanical devices for urinary incontinence in women. *Cochrane Database Syst Rev*. 2011;7, CD001756. doi:10.1002/14651858.CD001756.pub5.
  112. Adams E, Thomson A, Maher C, Hagen S. Mechanical devices for pelvic organ prolapse in women. *Cochrane Database Syst Rev*. 2004;2, CD004010. doi:10.1002/14651858.CD004010.pub2.
  113. Oliver R, Thakar R, Sultan AH. The history and usage of the vaginal pessary: a review. *Eur J Obstet Gynecol Reprod Biol*. 2011;156:125–30. doi:10.1016/j.ejogrb.2010.12.039.
  114. Urinary tract infection in women—self-care. MedlinePlus <http://www.nlm.nih.gov/medlineplus/ency/patientinstructions/000391.htm>. Accessed 20 November 2015.
  115. Epp A, Larochelle A, Lovatsis D, Walter JE, Easton W, Farrell SA, et al. Recurrent urinary tract infection. *J Obstet Gynaecol Can*. 2010;32:1082–101.
  116. National Vulvodynia Association. <http://www.nva.org>. Accessed 20 October 2015.
  117. Braunstein S, van de Wijgert J. Preferences and practices related to vaginal lubrication: implications for microbicide acceptability and clinical testing. *J Womens Health (Larchmt)*. 2005;14: 424–33. doi:10.1089/jwh.2005.14.424.
  118. NEVDGP. [http://www.nevdgp.org.au/info/incontinence/i\\_aids.htm](http://www.nevdgp.org.au/info/incontinence/i_aids.htm). Accessed 10 October 2015.
  119. Schumm K, Lam TB. Types of urethral catheters for management of short-term voiding problems in hospitalised adults. *Cochrane Database Syst Rev*. 2008;2, CD004013. doi:10.1002/14651858.CD004013.pub1.
  120. Logan K, Shaw C, Webber I, Samuel S, Broome L. Patients' experiences of learning clean intermittent self-catheterization: a qualitative study. *J Adv Nurs*. 2008;62:32–40. doi:10.1111/j. 1365-2648.2007.04536.x.
  121. Shaw C, Logan K, Webber I, Broome L, Samuel S. Effect of clean intermittent self-catheterization on quality of life: a qualitative study. *J Adv Nurs*. 2008;61:641–50. doi:10.1111/j.1365-2648. 2007.04556.x.
  122. Clinical Practice Guidelines Adult Clean Intermittent Catheterization. SUNA, Society of Urologic Nurses and Associates <http://www.suna.org/resources/adultCICGuide.pdf>. Accessed 20 October 2015.
  123. Doggweiler R, Whitmore KE, Meijlink JM, Drake MJ, Frawley H, Nordling J, et al. A standard for terminology in chronic pelvic pain syndromes (CPPS): a report from the Working Group of the International Continence Society Standardisation Steering Committee (ICS-SSC) on Chronic Pelvic Pain. 2016. doi:10.1002/nau.23072.
  124. Quintner JL, Bove GM, Cohen ML. A critical evaluation of the trigger point phenomenon. *Rheumatology (Oxford)*. 2015;54: 392–9. doi:10.1093/rheumatology/keu471.
  125. Leiblum S, Bachmann G, Kemmann E, Colburn D, Swartzman L. Vaginal atrophy in the postmenopausal woman. The importance of sexual activity and hormones. *JAMA*. 1983; 249:2195–8.

126. Lucas N, Macaskill P, Irwig L, Moran R, Bogduk N. Reliability of physical examination for diagnosis of myofascial trigger points: a systematic review of the literature. *Clin J Pain*. 2009;25:80–9. doi:10.1097/AJP.0b013e31817e13b6.
127. Norton C, Whitehead WE, Bliss DZ, Harari D, Lang J. Management of fecal incontinence in adults. *Neurourol Urodyn*. 2010;29:199–206. doi:10.1002/nau.20803.
128. The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) – National Institute for Health (NIH). [http://digestive.niddk.nih.gov/ddiseases/pubs/fecalincontinence/Fecal\\_Incontinence\\_508.pdf](http://digestive.niddk.nih.gov/ddiseases/pubs/fecalincontinence/Fecal_Incontinence_508.pdf). Accessed 20 November 2015.
129. Bo K, Berghmans B, Morkved S, Van Kampen M. *Evidence-based physical therapy for the pelvic floor: bridging science and*

*clinical practice*. 2nd ed. Edinburgh: Churchill Livingstone; 2015.

**How to cite this article:** Bo K, Frawley HC, Haylen BT, Abramov Y, Almeida FG, Berghmans B, Bortolini M, Dumoulin C, Gomes M, McClurg D, Meijlink J, Shelly E, Trabuco E, Walker C, Wells A. 2016. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction. *Neurourol Urodynam* 9999:1–24.



## An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Reporting Outcomes of Surgical Procedures for Pelvic Organ Prolapse

Philip Tooze-Hobson,<sup>1\*</sup> Robert Freeman,<sup>2</sup> Matthew Barber,<sup>3</sup> Christopher Maher,<sup>4</sup> Bernard Haylen,<sup>5</sup> Stavros Athanasiou,<sup>6</sup> Steven Swift,<sup>7</sup> Kristene Whitmore,<sup>8</sup> Gamal Ghoniem,<sup>9</sup> and Dirk de Ridder<sup>10</sup>

<sup>1</sup>Birmingham Women's Hospital, Birmingham, United Kingdom

<sup>2</sup>Plymouth Hospitals NHS Trust, Plymouth, United Kingdom

<sup>3</sup>Cleveland Clinic, Cleveland, Ohio

<sup>4</sup>Wesley Hospital, Brisbane, Queensland, Australia

<sup>5</sup>University of New South Wales, Sydney, North South Wales, Australia

<sup>6</sup>Alexandra Hospital, University of Athens, Athens, Greece

<sup>7</sup>Medical University of South Carolina, Charleston, South Carolina

<sup>8</sup>Drexel University College of Medicine, Philadelphia, Pennsylvania

<sup>9</sup>University of California, Irvine, California

<sup>10</sup>University Hospital, UZ Leuven, Belgium

**Introduction and Hypothesis:** Standardized terminology has yet to be developed for reporting the outcomes for surgery for pelvic organ prolapse (POP). **Methods:** This report combines the input of the Terminology and Standardization Committees of the International Urogynecological Association (IUGA) and the International Continence Society (ICS) and a joint Working Group on this topic, as well as expert external referees. The aim was to present a standardized terminology for the definitions of surgery and propose a structure for reporting the outcomes of surgical procedures for POP. An extensive drafting and review process was undertaken, as well as open review on both IUGA and ICS websites. **Results:** A terminology report was developed outlining the recommended structure for reporting outcomes of surgical trials involving POP. This document does not define success and failure. The report includes patient-reported subjective and objective outcomes to enable researchers to report on their results and compare them with other studies. **Conclusions:** A consensus-based method for standardizing terminology for reporting outcome measures of POP surgery was developed to aid clinicians working in this area of research. *Neurourol. Urodynam.* 31:415–421, 2012. © 2012 Wiley Periodicals, Inc.

**Key words:** terminology; outcomes; surgical procedures; pelvic organ prolapse; female pelvic floor dysfunction

This document is being published simultaneously in *Neurourology and Urodynamics* (NAU) and the *International Urogynecological Journal* (IUJ), the respective journals of the sponsoring organizations, the International Continence Society (ICS) and the International Urogynecological Association (IUGA). *International Urogynecology Journal*, Vol. 23, No. 5, 2012. Copyright 2012. This material is reproduced with permission of Wiley Periodicals, Inc., a subsidiary of John Wiley & Sons, Inc., and the International Urogynecological Association.

### INTRODUCTION

Whereas recommendations for reporting outcomes of surgery for stress urinary incontinence have been reported<sup>1,2</sup> few exist for surgery of pelvic organ prolapse (POP). In addition, there has been ambiguity in reporting of “prolapse surgery outcomes,” particularly with regards to success/failure and further surgery/re-operation. Within the literature, there is limitation in the methodology as evidenced by the recent Food and Drug Administration (FDA) report<sup>3,4</sup> and other reviews.<sup>5</sup> For example, information is often incomplete or limited relative to the inclusion and exclusion criteria and study design. In addition, the power calculation is often poorly described. Issues such as detection bias (lack of blinding), conflict of interest and reporting of adverse events are problematic

Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

**Conflicts of Interest:** Philip Tooze-Hobson—Educational Meetings: Astellas and Pfizer. Robert Freeman—Educational meetings: Astellas and Pfizer (speaker fees). National Institute for Health Research (NIHR) Collaboration (PenCLAHRC). UK (the views expressed are not necessarily those of the NHS, the NIHR or the Department of Health, UK). Matthew Barber—No disclosures. Christopher Maher—Director, Urogynaecology Society of Australia. Bernard Haylen—No disclosures. Stavros Athanasiou—No disclosures. Steven Swift—Pfizer: Acceptance of paid travel expenses or honoraria; Acceptance of payment for research. Astellas: Consultant. Kristene Whitmore—Research grants—Boston Scientific, Pfizer, Allergan, Ortho-McNeill. Gamal Ghoniem—Speaker—Astellas; Consultant—Boston Scientific, Uroplasty, Coloplast. Dirk de Ridder—Consultant—AMS, Bard, Asyellas, Pfizer, Medtronic, Allergan; Speaker—AMS, Astellas, Pfizer, Medtronic, Allergan; Investigator—AMS, Astellas, Allergan; Research grants: AMS, Bard, Astellas, Medtronic, Gynecare, Dynamesh. **Terminology and Standardization Committee IUGA working members:** Philip M. Tooze-Hobson, Bernard T. Haylen, Robert M. Freeman, Christopher Maher, Stephen E. Swift, Stavros Athanasiou. **Standardisation Steering Committee (ICS) members:** Robert M. Freeman, Dirk de Ridder, Kristene Whitmore. **Joint IUGA-ICS Working Group on Outcomes for Female POP Surgery members:** Matthew Barber, Gamal Ghoniem.

\*Correspondence to: Philip Tooze-Hobson, Birmingham Women's Hospital, Birmingham B15 2TG, UK. E-mail: philip.tooze-hobson@bwhct.nhs.uk

Received 8 February 2012; Accepted 10 February 2012

Published online 5 April 2012 in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.22238

© 2012 Wiley Periodicals, Inc.



and make it difficult to interpret the information. In addition, many studies include both primary and repeat prolapse repairs, as well as additional procedures including other prolapse and/or stress incontinence surgery. Long-term follow-up past 2 years is infrequent. As a result, it is difficult to draw conclusions from these studies relative to other studies or populations in order to provide guidance for patient care. Standardized information is required to help answer the important questions regarding efficacy and safety of traditional and new POP procedures. The aim of this report, therefore, is to present a standardized terminology for the definitions of POP surgery and propose a structure for reporting the outcomes of surgical procedures. Consistency in reporting has the potential to help produce meta-analyses and reliable clinical guidelines.

The document does not define success and failure, but outlines the recommended structure for reporting outcomes of surgical trials involving POP. It complements published IUGA-ICS Joint Standardization Reports on (i) Terminology for Female Pelvic Floor Dysfunction<sup>6</sup> and (ii) Terminology and Classification of Complications related directly to the insertion of prostheses and grafts in female pelvic floor surgery<sup>7</sup> and (iii) concomitantly published terminology and classification of complications related to native tissue female pelvic floor surgery.<sup>8</sup>

#### BACKGROUND

The perceived ambiguity in the reporting of POP surgery outcomes might have arisen from two studies assessing success/failure and further surgery/re-operation.<sup>9,10</sup> The former study by Olsen et al.<sup>9</sup> suggested that the lifetime risk of requiring incontinence and/or prolapse surgery was 11% (for prolapse surgery alone, the figure was 6.7%) and 29.2% of patients required repeat surgery/re-operation. The definition of repeat surgery was any operation for prolapse or urinary incontinence following an index (first) procedure, often some years previously. While the 29.2% re-operation rate is still commonly quoted and often interpreted similarly to that stated by the authors (i.e., that this implies a high rate of surgical failure), the failure to adjust for both time and variation in operative site reduces the usefulness of the conclusions and might be misleading with regards to the true failure rate of POP surgery. This observation is borne out when the same cohort was reviewed 10 years later with the authors quoting a 17% re-operation rate.<sup>11</sup> On further analysis of the same compartment recurrence (i.e., repeat anterior repair), the re-operation rate was significantly lower at 4.6%.<sup>12</sup> More recently, several investigators have looked specifically at the issue of site-specific recurrence, with re-operation rates ranging from 2.8% to 9.7%.<sup>13–15</sup> A recent Cochrane review<sup>16</sup> looking at vault suspension suggested that re-operation rates after POP surgery, which includes suspension of the vaginal vault/apex, are 1.3–3.9% at 17–32 months respectively, depending upon the type of vault suspension. These data become more useful in terms of site and timescales.

The second study<sup>10</sup> reported a 58–70% anatomical failure rate for anterior colporrhaphy. This study has recently been subject to further analysis, as the definitions of objective success and failure were based on POP quantification (POPQ) changes of small magnitude. When more clinically relevant criteria for success are used (anatomic recurrence beyond the hymen, symptomatic recurrence and re-operation), the outcome is considerably better with only 10% of subjects developing anatomic recurrence beyond the hymen, and 5% developing symptomatic recurrence and re-operations in <1% (at 23 months follow-up).<sup>17</sup>

The lack of subjective/patient-reported outcomes was highlighted in a systematic review on mesh repairs commissioned by the National Institute for Clinical Excellence (NICE) in the UK.<sup>18,19</sup> As a consequence of this and the uncertainty following further consideration of the studies mentioned above, there is a need for clear definitions and standardization for reporting of outcomes for POP surgery.

#### NEW DEFINITIONS

It is understood that there is close interaction among three commonly defined compartments: apical/vaginal vault, anterior, and posterior, when discussing pelvic organ support or prolapse. However, for ease of use, the definitions are limited to “primary” or “recurrence at specific sites” defined as apical/vaginal vault, anterior and posterior. As our understanding of how these compartments interact improves, the definitions of “primary prolapse surgery/different site” and “repeat surgery/same site” will evolve.

The following standardized terminology is proposed for surgical trials and clinical audit:

- A. **Primary Surgery:** This indicates the first procedure required for the treatment of POP in any compartment.
- B. **Further Surgery:** Provides a global term for the number of subsequent procedures the patient undergoes, directly or indirectly, relating to the primary surgery. Further surgery per se should not be interpreted as a measure of failure as the definitions of success and failure will be defined within the context of the individual study. Further surgery is subdivided into:
  - I. **Primary prolapse surgery/different site:** a prolapse procedure in a new site/compartment following previous surgery (e.g., anterior repair following previous posterior repair).
  - II. **Repeat surgery:** a repeat operation for prolapse arising from the same site. Where combinations of procedures arise, such as new anterior repair plus further posterior repair, these should be reported separately as primary anterior repair and repeat posterior repair.
  - III. **Surgery for complications:** mesh exposure or extrusion, pain, or patient compromise such as hemorrhage (see Complications section).
  - IV. **Surgery for non-POP related conditions:** subsequent surgery for stress urinary incontinence or fecal incontinence.

#### STANDARDIZATION OF REPORTING OUTCOMES—OVERVIEW

One of the major difficulties in reporting the results of prolapse surgery is that, unlike most surgeries, there is a range of outcomes which are not reported in a consistent manner; this makes uniform assessment of procedures difficult.

The International Consultation on Incontinence (ICI) has already suggested that POP and urinary incontinence surgery should report subjective, objective, and quality of life outcomes.<sup>3</sup> This is significant in that there are a number of measures that can be used to generate useful information to benchmark practice for and against a particular procedure, as well as inform patients about potential outcomes. Therefore, it is recommended that in clinical research studies, entry criteria, design, methodology, power, and absence of bias are addressed to allow the reader to assess the reliability of findings which have the potential to influence clinical practice.



Conflict of interest should be reported due to the potential for positive reporting bias and this declaration should be at the start of the paper.

- I. Chronic cough,
- J. Chronic constipation,
- K. Smoking.

#### REPORTING OF METHODOLOGICAL DATA

##### General Criteria

The following should be defined:

- A. Inclusion criteria.
- B. Exclusion criteria.
- C. Recruitment time span.
- D. Flow diagram including<sup>20</sup>
  - (i) Number of patients evaluated.
  - (ii) Number suitable for inclusion.
  - (iii) Number agreed to participate.
  - (iv) Clear documentation accounting for all patients' progress throughout the study period.

##### Comparative Studies

- A. Clear explanation of patient allocation to treatment groups.
- B. Allocation concealment from surgeon and/or patient.
- C. Randomized trials: explanation of randomization process.
- D. Stratification of associated issues utilized such as concomitant continence surgery or hysterectomy.

##### Interventions

- A. Clear documentation of interventions performed, experience level of surgeons and number of interventions performed prior to study commencement.
- B. Criteria for performing concomitant surgery.

##### Evaluation Process

- A. Who performed the evaluation and the training received.
- B. Were reviewers and/or participants blinded.
- C. Evaluation tools: were validated, patient-completed assessments standardized.
- D. Evaluation timeline:
  - i. Very early (up to 3 months).
  - ii. Early (up to 1 year).
  - iii. Intermediate (12–36 months).
  - iv. Late (3–5 years).
  - v. Very late (>5 years).

##### Power Analysis

Details of the assumptions made in the Power calculation, estimate of the type 1 error and sample size should be reported.

#### REPORTING DEMOGRAPHICS IN POP SURGICAL RESULTS

The reporting of minimum demographics in POP surgery should include:

- A. Age,
- B. Parity,
- C. Body mass index (BMI),
- D. Menopause status,
- E. Hormone replacement therapy (HRT) usage,
- F. Prior hysterectomy,
- G. Prior POP surgery,
- H. Prior continence surgery,

Neurourology and Urodynamics DOI 10.1002/nau

#### REPORTING OF RANDOMIZED CONTROLLED TRIALS (RCTs)

There are already accepted standards for reporting RCTs such as the CONSORT (Consolidated Standards of Reporting Trials)<sup>20</sup> which requires detailed information provided by authors to reviewers with a checklist added as an appendix. However, many studies fail to provide complete descriptions of critical information.

#### REPORTING OF SYSTEMATIC REVIEWS AND META-ANALYSES

Due to the lack of consistent descriptions of critical information reported from RCTs, a new instrument, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA),<sup>21</sup> has been introduced to evaluate systematic reviews and meta-analyses. The aim of the PRISMA statement is to give authors an evidence-based minimum set of items to improve the reporting of systematic reviews and meta-analyses in POP issues. Other standards include the Standards for the Reporting of Diagnostic (STARD) accuracy studies,<sup>22</sup> and STROBE (Strengthening the Reporting of Observational studies in Epidemiology).<sup>23</sup> Researchers should quote which standard they adopt and reference accordingly.

#### REPORTING OF PATIENTS' PRE-OPERATIVE GOALS AND EXPECTATIONS

To date, few studies have provided data on patients' preoperative goals and expectations.<sup>24–27</sup> These might have advantages over objective measures of outcome. With this in mind, goals should be reported using SMART criteria.<sup>28</sup> The aim of the SMART criteria is to help clinicians review and confirm the utility of the chosen endpoint and how it will relate to other studies and reports. Criteria comprise:

Specific	Defining goal (for POP: absence of bulge)
Measureable	Validated symptom scale or objective measure such as the POPQ
Appropriate	Relevant to improving patient lifestyle
Realistic	Achievable by treatment
Timely	For example at 6 months/2 years

The following is an example of good and poor reporting of patient expectations and outcomes, using the SMART Schema:

*Good example:* "The absence of bother from a vaginal bulge as measured using a defined tool at 2 years." This statement has Specific, Measurable, Appropriate, Realistic, and Timely attributes.

*Poor example:* "Feeling perfect" when followed-up. "Perfect" is not specific (OB compared with absence of bulge), is less measurable (because it is difficult to define), has no defined timepoint and is not appropriate or relevant to the surgery as many factors define "perfect."

Definitions relating to the SMART criteria should be derived from the symptoms the researchers feel are important. When designing a study, the symptoms should be listed and then SMART should be applied. Authors should use this as a *checklist* to ensure that the methodology is sound and relevant.

## REPORTING OF OUTCOMES FOLLOWING SURGICAL TREATMENT OF POP

### Perioperative Data

Perioperative data includes blood loss (ml) and/or hemoglobin change, operating time, length of hospital stay, return to normal daily activities and complications.

### Patient Reported Outcomes

The primary patient reported outcome should be subjective and would usually be the absence of a bulge.<sup>29</sup> This can be regarded as a “subjective cure”<sup>29</sup> and can be recorded as part of a symptom scale. Details of validated questionnaires for patient reported outcomes can be found on ICI’s website.<sup>30</sup> To adhere with the SMART criteria, patient/subjective outcomes should be defined at a specific time interval and classified on a 7-point Likert scale (i.e., very much better, moderately better, a little better, no change, slightly worse, moderately worse, very much worse) such as the Patient Global Impression of Improvement (PGI-I) scale.<sup>31</sup>

### Patient Satisfaction

Patient satisfaction can be measured using qualitative measures, such as a patient-defined measure or a validated instrument (PGI-I scale).<sup>31</sup> Qualitative assessment can include Expectations, Goal setting, Goal achievement and Satisfaction (EGGS).<sup>32</sup> Again these should be in accordance with the SMART acronym. The number of pre-specified goals and the number achieved post-operatively should be recorded and reported for responsiveness and reliability of goal achievement.<sup>24</sup>

### Quality of Life

Appropriate and fully validated quality of life instruments should be used to cover prolapse, urinary, bowel and sexual function.<sup>30</sup>

New questionnaires can be included when they have demonstrated good psychometric properties (i.e., validity, reliability and responsiveness) in women with POP. It is important to verify that the questionnaire has been validated in the language of the trial investigator(s).

### Objective Outcomes

Objective outcomes (e.g., POPQ<sup>33</sup>) should be tabulated with percentages achieving each level to allow studies to compare results, as definitions of success will vary among studies (see below). This report does not attempt to provide a definition for success and failure, as these are unknown. However, authors should report data on the leading edge of the prolapse for each site (e.g., patients who achieve points −1 and 0 post-operatively having had prolapse greater than −1 or 0 before surgery). These data, which may help identify the level of anatomical restoration that leads to improvement in symptoms, should be reported separately.

When possible, raw data should be provided for POPQ, quality of life measures and all primary symptoms. These should be reported in separate tables, which can be published as supplementary material in the electronic (online) version rather than the printed version.

### Reoperation or Further Surgery

See Further Surgery in “New Definitions” above.

*Neurourology and Urodynamics* DOI 10.1002/nu

### Timelines

Timelines should be described chronologically, as outlined below, using the classification above. Of note, these timescales are different to those described in the classifications of complications reports related to female pelvic floor surgery using either prostheses and meshes<sup>7</sup> or native tissue.<sup>8</sup>

- I. Very early (up to 3 months).
- II. Early (up to 1 year).
- III. Intermediate (12–36 months).
- IV. Late (3–5 years).
- V. Very late (>5 years).

### Economic Evaluation/Cost Analysis

Despite considerable cost, sparse cost-effectiveness data exists related to POP surgery. Investigators are encouraged to include economic analyses in their studies whenever possible. Further details are below in the section Reporting on Economic Evaluation/Cost Analysis.

### COMPLICATIONS

Complications specifically related to prostheses and grafts<sup>7</sup> and native tissues<sup>8</sup> should be reported as per the IUGA-ICS classifications of complications directly related to the insertion of prostheses and grafts or the use of native tissue in female pelvic floor surgery.<sup>5,6</sup> These classifications both use the CTS Classification System:

- (C) Category of complication.
- (T) Time the complication was diagnosed in relation to primary surgery.
- (S) Site of the complication.

There are seven Categories with subdivisions of (A–D). For the majority of complications, this would mean:

- (A) Asymptomatic,
- (B) Symptomatic,
- (C) Infection,
- (D) Abscess.

For complications involving bowel or bladder injury or patient compromise, variations in the pattern of the increasing index of severity exist: e.g., Category 5: rectal or bowel injury (both classifications—<sup>7,8</sup>) (A) Small intraoperative defect; (B) rectal injury or compromise; (C) small or large bowel injury or compromise; (D) abscess.

Studies, in particular of a specific surgical procedure, should have a procedure-specific list of complications using the CTS Classification Systems<sup>7,8</sup> as part of the reporting. Only in this way can the nature and chronology of possible complications be determined (in relation to time of surgery) and at which sites they might most commonly occur.

Note is also made of the generic Clavien-Dindo complication classification<sup>34</sup> which consists of four severity grades of complications. This has been modified to include a fifth category:<sup>35</sup>

- |           |  |
|-----------|--|
| Grade I   | Requires no treatment  |
| Grade II  | Requires drug therapy  |
| Grade III | Requires a procedure or intervention (a: in local;<br>b: general anesthesia) |

Grade IV	IC/ICU organ or system dysfunction (a: single organ; b: multi-organ dysfunction)
Grade V	Death

### POSTOPERATIVE PAIN

Pain associated with surgical complications is addressed separately in the IUGA-ICS classifications of complications of female pelvic floor surgery (7,8). The addition of a letter (a to e), as part of a subclassification to the CTS Classification System, specifies the presence of pain as part or all of the abnormal finding or complication and the grade in terms of the presence and severity of symptoms.

- (a) Asymptomatic or no pain.
- (b) Provoked pain only (during vaginal examination).
- (c) Pain during sexual intercourse.
- (d) Pain during physical activities.
- (e) Spontaneous pain.

Additional information on pain may include “permanent or temporary” and “severity” as measured by impact on quality of life and treatment required (e.g., simple oral analgesia, compound analgesia, opiates, referral and management by pain team or further surgery).

### REPORTING OF SECONDARY OUTCOMES

Secondary outcomes to be reported include an assessment of other symptoms known to be associated with prolapse:

**Lower urinary tract symptoms (LUTS):** Overactive bladder, stress urinary incontinence (either pre-existing or de-novo) and voiding dysfunction.

**Bowel dysfunction:** Obstructed defecation, feeling of incomplete emptying, constipation and digitation.

**Sexual dysfunction:** Dyspareunia, loss of libido, abstinence due to prolapse symptoms and change in sexual satisfaction. Authors should report numbers of all patients who are sexually active with and without pain, pre and post-intervention.

Figure 1 has been developed to illustrate the reporting of these data. All participants in trials should be accounted for pre- and post-intervention.

**De novo/new onset symptoms (if not previously reported):** LUTS, sexual dysfunction, pain and bowel dysfunction.

**Backache:** Backache is a common presenting symptom, the resolution of this may be an important outcome.



Fig. 1. Reporting of sexual function.

Neurology and Urodynamics DOI 10.1002/nau

### REPORTING ON ECONOMIC EVALUATION AND COST ANALYSIS

Economic evaluation techniques provide systematic methods of comparing the costs and consequences of clinical and other health sector interventions. Cost-utility analysis (CUA), a form of cost-effectiveness analysis (CEA), is by far the most commonly used and requires quantifying the effects of interventions on both morbidity and mortality.

In a CUA, benefits are measured in units of health gain (or loss), most commonly using quality-adjusted life-years (QALYs) and combined with estimates of cost to create a ratio of incremental costs to incremental consequences (e.g., “incremental cost per QALY”). QALYs are usually calculated using a generic health status measure, such as Short Form (SF)36 or EuroQOL/EQ-5D, which can be used with a standard set of health state values or by other measures of utility, such as the standard gamble or time-trade off technique. These incremental cost effectiveness ratios (ICERs) enable comparison of competing interventions on the basis of the cost at which they create improvements in health-related quality-of-life.

In economic evaluations, it is important to consider the perspective (e.g., patients, hospital, third-party payer, government and society) of the evaluation, as this will have significant influence on which costs should be included in the analysis. For example, the perspective of the analysis will influence whether it should include both direct and indirect costs. Direct medical costs typically relate to the intervention and the immediate impact of the intervention on the health system: e.g., personnel costs/time (physician, nurse, technician), diagnostic and laboratory tests, hospital costs, treatment costs (drugs, operating room time, etc.), treatment of side effects and outpatient visits. Indirect costs will be of more relevance to a patient and/or societal perspective (e.g., loss of productivity, time lost from work, loss of service to family and community and premature mortality) and are often more difficult to quantify and to put a monetary value on.

### DISCUSSION

This document was born from the recognition that contemporary practice lacks sufficient reproducible evidence to help clinicians translate published literature into clinical practice and enable patients to be aware of likely outcomes.

For example, the assessment of prolapse surgery has been subject to a number of limitations. First, and perhaps most important, is the quality of the studies. The majority are case series, with very few well-constructed and sufficiently powered RCT. As a result, the quality of the available evidence is questionable.<sup>3,4</sup> The emphasis then lies within systematic reviews and meta-analyses, which may be less robust due to the lack of good quality data.

New surgical procedures for POP reconstructive surgery have evolved dramatically in recent years, suggesting that the perceived dissatisfaction with conventional/traditional surgery as expressed by White<sup>36</sup> at the turn of the twentieth century persists. This perception is based on clinical experience and reports of anatomical failure and re-operation.<sup>9,10</sup> As the findings of these studies<sup>9,10</sup> have been questioned by more recent studies,<sup>12,13,17</sup> this highlights the need for a standardized method of reporting surgical outcomes so that appropriate recommendations for patient care can be provided from meta-analyses and systematic reviews. This report sets out to provide a framework through which researchers and clinicians can standardize reporting and allow results to become more transferable.

**TABLE 1. Recommendations for Reporting in Audit of Clinical Practice and Surgical Trials**

	Audit	Research trial
Type of surgery	R	R
Primary outcome including patient satisfaction	R	R
Secondary outcomes	O	R
Timelines	O	R
Cost analysis	N	O <sup>a</sup>
Complications	R	R
Commitment to longer term follow-up	O	R
Audit database	R	O

R, routine; O, optional; N, not required.

<sup>a</sup>It is recognized that this is ideal and not all researchers will be able to do this, but it is recommended.

History has taught that surgical complications (particularly in the case of implants) may be long-term and researchers should be encouraged to revisit early results (e.g., 1 year) and include long-term data of 5–10 years.

The Austrian and Finnish experiences with mid-urethral slings have demonstrated that, in addition to properly constructed prospective trials, there is a moral and ethical responsibility for users of advanced techniques, such as those employing implants, to contribute to clinical governance and audit through local, regional or national databases.

#### SUMMARY OF RECOMMENDATIONS FOR POP SURGICAL OUTCOMES

In all surgical trials of POP surgery, authors should clearly report their Methodology. These should follow CONSORT/STROBE and type of surgery (primary or further using the agreed definitions, see above) should be stated. Table 1 outlines what should be reported in both clinical audit and surgical trials. In addition, researchers should give a commitment in the original trial design and at publication of early results, to publish longer term data at a minimum of 5 years.

#### ACKNOWLEDGMENTS

This final document has undergone 23 versions and 7 collations prior to being available for review on both the IUGA and ICS websites to allow members to submit comments and recommendations which have enabled appropriate revisions. We acknowledge the comments of Dr. Annette Holden, Dr. Giuseppe Di Paola, Dr. Rufus Cartwright, Prof. Hans Peter Dietz, Dr. Joseph Gault, Dr. Jian Wein, and Dr. Alexandros Derpapas. In particular, we thank Elektra McDermott, managing editor of the International Urogynecology Journal for her support and help in the preparation of the final draft and proof reading, and the Peninsula College of Medicine and Dentistry (UK) for the section on Economic Evaluation and Cost Analysis. We acknowledge the support of the IUGA and ICS leadership in this Joint Report from the two societies, following on from the Joint Reports on Terminology for Female Pelvic Floor Dysfunction, and Prostheses and Mesh Complications and, concurrently, Complications Related to Native Tissue Female Pelvic Floor Surgery.

#### REFERENCES

- Abrams P, Andersson KE, Bider L, et al. Fourth International Consultation on Incontinence Recommendations of the International Scientific Committee: Evaluation and treatment of urinary incontinence, pelvic organ prolapse, and fecal incontinence. *Neurourol Urodyn* 2010;29:213–40.
- Lose G, Fantl JA, Victor A, et al. Outcome measures for research in adult women with symptoms of lower urinary tract dysfunction. *Neurourol Urodyn* 1998;17:255–62.
- <http://www.fda.gov/MedicalDevices/Safety/AlertandNotices/ucm262435>
- <http://www.fda.gov/MedicalDevices/Safety/AlertandNotices/ucm262760.pdf>
- Cavadas V, Branco F, Carvalho F, et al. The quality of reporting of randomized controlled trials in pelvic organ prolapse. *Int Urogynecol J* 2011;22:1117–25.
- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J* 2010;21:5–26; & *Neurourol Urodyn* 29:4–20.
- Haylen BT, Freeman RM, Swift S, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related directly to the insertion of prostheses (meshes, implants, tapes) & grafts in female pelvic floor surgery. *Int Urogynecol J* 2011;22:3–15; & *Neurourol Urodyn* 30:2–12.
- Haylen BT, Freeman RM, Lee J, et al. An international Urogynecological Association (IUGA)/International Continence Society (ICS) joint terminology and classification of the complications related to native tissue female pelvic floor surgery. *Int Urogynecol J* 2011;22:3–15; & *Neurourol Urodyn* (in press).
- Olsen A, Smith V, Bergstrom J, et al. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol* 1997;89:501–6.
- Weber AM, Walters MD, Piedmonte MR, et al. Anterior colporrhaphy: A randomized trial of three surgical techniques. *Am J Obstet Gynecol* 2001;185:1299–304.
- Denman M, Gregory W, Boyles S, et al. Reoperation rate 10 years after surgically managed pelvic organ prolapse and urinary incontinence. *Am J Obstet Gynecol* 2008;198:555.
- Kapoor DS, Freeman RM. Reoperation rate following prolapse surgery. *Am J Obstet Gynecol* 2009;200:e15 (author reply e15).
- Diwadkar GB, Barber MD, Feiner B, et al. Complications and reoperation rates following surgical repair for apical vaginal prolapse: A meta-analysis. *Obstet Gynecol* 2009;113:3670–3.
- Kapoor DS, Nemcova M, Pantazis K, et al. Re-operation rate for traditional anterior repair: Analysis of 207 cases with a median 4 year follow up. *Int J Urogynecol J Pelvic Floor Dysfunct* 2010;21:27–31.
- Miedel A, Tegerstedt G, et al. A 5-year prospective follow-up study of vaginal surgery for pelvic organ prolapse. *Int Urogynecol J Pelvic Floor Dysfunct* 2008;19:1593–601.
- Maher C, Baessler K, Glazener C, et al. Surgical management of pelvic organ prolapse in women: A short version Cochrane review. *Neurourol Urodyn* 2008;27:3–12. DOI: 10.1002/nau.20542.
- Chmielewski L, Walters MD, Weber AM, et al. Reanalysis of a randomized trial of three techniques of anterior colporrhaphy using clinically relevant definitions of success. *Am J Obstet Gynecol* 2011;205:69.e1–69.e8.
- Jia X, Glazener C, Mowatt G, et al. Systematic review of the efficacy and safety of using mesh or grafts in surgery for anterior and/or posterior vaginal wall prolapse; 2008. <http://www.nice.org.uk/guidance/index.jsp?action=download&co=39669>
- Jia X, Glazener C, Mowatt G, et al. Efficacy and safety of using mesh or grafts in surgery for anterior and/or posterior vaginal wall prolapse: Systematic review and meta-analysis. *BJOG* 2008;115:1350–61.
- [www.consort-statement.org/](http://www.consort-statement.org/)
- <http://www.prisma-statement.org/>
- <http://www.stard-statement.org/>
- <http://www.strobe-statement.org/>
- Hullfish KL, Bobbjerg VE, Gibson J, et al. Patient-centered goals for pelvic floor dysfunction surgery: What is success, and is it achieved? *Am J Obstet Gynecol* 2002;187:88–92.
- Hullfish KL, Bobbjerg VE, Steers WD. Patient-centered goals for pelvic floor dysfunction surgery: Long-term followup. *Am J Obstet Gynecol* 2004;191:201–5.
- Srikrishna S, Robinson D, Cardozo L, et al. Experiences and expectations of women with urogenital prolapse: A quantitative and qualitative exploration. *BJOG* 2008;115:1362–8.
- Srikrishna S, Robinson D, Cardozo L. A longitudinal study of patient and surgeon goal achievement 2 years after surgery following pelvic floor dysfunction surgery. *BJOG* 2010;117:1504–11.
- Doran George T. "There's a S.M.A.R.T. way to write management's goals and objectives." *Management Review* 1981; 70.
- Barber M, Brubaker L, Nygaard I, et al. Defining success after surgery for pelvic organ prolapse. *Obstet Gynecol* 2009;114:600–9.
- Staskin D, Kelleher C, Avery K, et al. Recommended PRO questionnaires. In: Abrams P, Cardozo L, Khoury S, Wein A, editors. 4th International Consultation on Incontinence. Health Publication Ltd, Paris; 2009. pp 368–403.

## Efficacy of Desmopressin Orally Disintegrating Tablet 421

31. Srikrishna S, Robinson D, Cardozo L. Validation of the Patient Global Impression of Improvement (PGI-I) for urogenital prolapse. *Int Urogynecol J Pelvic Floor Dysfunct* 2010;21:523–8.
32. Brubaker L, Shull B. EGS for patient centred outcomes. *Int Urogynecol J Pelvic floor Dysfunct* 2005;16:171–3.
33. Bump KC, Maittiason A, Bo K, et al. The standardisation of terminology of female organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol* 1996;75:10.
34. Dindo D, Demartines N, Clavien P. Classification of surgical complications. A New proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240:205–13.
35. Clavien PA, Barkun J, de Oliveira ML. The Clavien-Dindo Classification of surgical Complication: 5 years experience. *Ann Surg* 2009;250:187–96.
36. White GR. Cystocele. A radical cure by suturing the lateral sulci of vagina to the white line of pelvic fascia. *JAMA* 1909;LIII:1707–10.



## An International Urogynecological Association (IUGA)/ International Continence Society (ICS) Joint Terminology and Classification of the Complications Related Directly to the Insertion of Prostheses (Meshes, Implants, Tapes) and Grafts in Female Pelvic Floor Surgery

Bernard T. Haylen,<sup>1\*</sup> Robert M. Freeman,<sup>2</sup> Steven E. Swift,<sup>3</sup> Michel Cosson,<sup>4</sup> G. Willy Davila,<sup>5</sup> Jan Deprest,<sup>6</sup>  
Peter L. Dwyer,<sup>7</sup> Brigitte Fattton,<sup>8</sup> Ervin Kocjancic,<sup>9</sup> Joseph Lee,<sup>10</sup> Chris Maher,<sup>11</sup> Eckhard Petri,<sup>12</sup>  
Diaa E. Rizk,<sup>13</sup> Peter K. Sand,<sup>14</sup> Gabriel N. Schaer,<sup>15</sup> and Ralph Webb<sup>16</sup>

<sup>1</sup>University of New South Wales, Sydney, NSW, Australia

<sup>2</sup>Derriford Hospital, Plymouth, Devon, UK

<sup>3</sup>Medical University of South Carolina, Charleston, South Carolina

<sup>4</sup>University Hospital, Lille, France

<sup>5</sup>Cleveland Clinic, Weston, Florida

<sup>6</sup>University Hospital, UZ Leuven, Belgium

<sup>7</sup>Mercy Hospital, Melbourne, Victoria, Australia

<sup>8</sup>University Hospital, Clermont-Ferrand, France

<sup>9</sup>Department of Urology, University of Illinois, Chicago, Illinois

<sup>10</sup>Monash Hospital, Melbourne, Victoria, Australia

<sup>11</sup>Wesley Hospital, Brisbane, Queensland, Australia

<sup>12</sup>Urogynaecology Department, University of Greifswald, Greifswald, Germany

<sup>13</sup>Ain Shams University, Cairo, Egypt

<sup>14</sup>Evanston Continence Centre, Evanston, Illinois

<sup>15</sup>Kantonsspital, Aarau, Switzerland

<sup>16</sup>Norfolk & Norwich University Hospital, Norfolk, UK

**Introduction and hypothesis:** A terminology and standardized classification has yet to be developed for those complications arising directly from the insertion of synthetic (prostheses) and biological (grafts) materials in female pelvic floor surgery. **Methods:** This report on the above terminology and classification combines the input of members of the Standardization and Terminology Committees of two International Organizations, the International Urogynecological Association (IUGA) and the International Continence Society (ICS) and a Joint IUGA/ICS Working Group on Complications Terminology, assisted at intervals by many expert external referees. An extensive process of 11 rounds of internal and external review took place with exhaustive examination of each aspect of the terminology and classification. Decision-making was by collective opinion (consensus). **Results:** A terminology and classification of complications related directly to the insertion of prostheses and grafts in female pelvic floor surgery has been developed, with the classification based on category (C), time (T) and site (S) classes and divisions, that should encompass all conceivable scenarios for describing insertion complications and healing abnormalities. The CTS code for each complication, involving three (or four) letters and three numerals, is likely to be very suitable for any surgical audit or registry, particularly one that is procedure-specific. Users of the classification have been assisted by case examples, colour charts and online aids ([www.icsoffice.org/complication](http://www.icsoffice.org/complication)). **Conclusion:** A consensus-based terminology and classification report for prosthesis and grafts complications in female pelvic floor surgery has been produced, aimed at being a significant aid to clinical practice and research. *NeuroUrol. Urodynam.* 30:2–12, 2011. © 2010 Wiley-Liss, Inc.

This document is being published simultaneously in *Neurourology and Urodynamics* (NAU) and the *International Urogynecology Journal* (IJU), the respective Journals of the sponsoring organizations, the International Continence Society (ICS) and the International Urogynecological Association (IUGA) in the January 2011 issue of each Journal.

**Conflicts of interest:** BT Haylen: Assistance from Boston Scientific to attend London June 2008 Meeting of the Authors of the IUGA-ICS Report on Terminology for Female Pelvic Floor Dysfunction; RM Freeman: Educational meetings: Astellas and Pfizer. All income from commercial trials and some of the honoraria go to his research fund. Locality lead for the NIH Peninsula Collaboration for Leadership in Applied Health Research and Care (PenCLAHRC).

**PROSPECT:** A grant holder for this nationally funded trial of prolapse surgery; SE Swift: No disclosures; M Cosson: Consultant: Ethicon. Educational sessions: Ethicon, Ipsen. Unconditional grant for fundamental research: Ethicon; G Willy Davila: Travel expenses or honoraria and consultant: AMS, Novosys. Holds a position of influence in IUGA and NAFC; J Deprest: Consulting or lecturing: American Medical Systems, Bard, Johnson and Johnson, (Ethicon Gynaecare). His laboratory has received unconditional grants from the same companies, as well as Covidien (formerly Tyco Healthcare); PL Dwyer: Departmental research grant from American Medical Systems (AMS); B Fattton: Consulting or lecturing: Boston Scientific, Astellas and Tena; E Kocjancic: Consultant: AMS, Coloplast and Bard. Speaker: Astra Zeneca; Joseph Lee: Travel fellowship awarded by national

society; grant sponsored by American Medical Systems; C Maher: No disclosures; E Petri: No disclosures; DE Rizk: No disclosures; PK Sand: Advisor: Allergan, Astellas, GSK, Coloplast, Ortho, Pfizer, Sanofi, Aventis, Watson. Speaker: Allergan, Astellas, GSK, Ortho, Pfizer, Watson. Investigator: Boston Scientific, Pfizer, Watson, Ortho, Bioform; GN Schaer: Advisor (in Switzerland): Astellas, Novartis, Pfizer, Gynecare; R Webb: Travel bursaries: Ethicon, AMS, Pfizer, Astellas. Lecture fees: (departmental) Pfizer, Astellas. Research: Allergan Astellas.

– Standardization and Terminology Committee (IUGA): Bernard T. Haylen, Robert M. Freeman, Steven E. Swift, Peter L. Dwyer, Joseph Lee, Diaa E. Rizk, Eckhard Petri, Peter K. Sand, Gabriel N. Schaer.

– Standardization and Terminology Committee (ICS): Robert M. Freeman, Ralph J. Webb.

– Joint IUGA/ICS Working Group on Complications Terminology: Bernard T. Haylen, Robert M. Freeman, Steven E. Swift, Michel Cosson, Chris Maher, G. Willy Davila, Jan Deprest, Peter L. Dwyer, Brigitte Fattton, Ralph J. Webb.

\*Correspondence to: Bernard T. Haylen, Associate Professor, Suite 904, St Vincent's Clinic, 438 Victoria Street, Darlinghurst, 2010 NSW, Australia.  
E-mail: haylen@optusnet.com.au

Received 22 October 2010; Accepted 26 October 2010

Published online 15 December 2010 in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI 10.1002/nau.21036

© 2010 Wiley-Liss, Inc.



**Key words:** classification; complication; female pelvic floor surgery; graft; mesh; prosthesis

## PREFACE

The Standardization and Terminology Committees of the International Urogynecological Association (IUGA) and the International Continence Society (ICS) and the Joint IUGA/ICS Working Group on Complications Terminology seek to provide a terminology and a standardized classification for those complications arising directly from the insertion of prostheses and grafts in female pelvic floor surgery. This document would then be, amongst its various other possible applications such as medical records and surgical audits (often procedure-specific), the basis for a registry of such complications. As the first aim is to standardize the terminology used in this classification, the terms used in the title need to be initially defined.

- **Classification:** A systematic arrangement into classes or groups based on perceived common characteristics.<sup>1</sup> N.B. *Division:* A separation into two or more parts.
- **Complication:** A morbid process or event that occurs during the course of a surgery that is not an essential part of that surgery ("surgery" replacing "disease" in the definition; "course" includes postoperative of whatever duration).<sup>1</sup>
- **Directly:** Without an intermediary or intervening factor.<sup>2</sup>
- **Related:** Connected.<sup>2</sup>
- **Insertion:** Putting in.<sup>1</sup>
- **Prosthesis:** A fabricated substitute to assist a damaged body part or to augment or stabilize a hypoplastic structure.<sup>1</sup>
- **Mesh:** A (prosthetic) network fabric or structure; open spaces or interstices between the strands of the net.<sup>2</sup> The use of this term would be for *prolapse surgery with synthetic materials*.
- **Implant:** A surgically inserted or embedded prosthesis.<sup>1</sup> (*Explant:* a surgically excised prosthesis).
- **Tape (Sling):** A flat strip of synthetic material.<sup>1</sup> The use of this term would be for *incontinence surgery with synthetic materials*.
- **Graft:** Any tissue or organ for transplantation.<sup>1,2</sup> This term will be used to refer to *biological materials inserted*<sup>3</sup>:
  - (a) *Autologous grafts:* From patient's own tissues, for example, dura mater, rectus sheath, or fascia lata.
  - (b) *Allografts:* From post-mortem tissue banks.
  - (c) *Xenografts:* From other species, for example, modified porcine dermis, porcine small intestine, and bovine pericardium.
 Terminology for grafts has not been separated into the different applications for prolapse and continence surgery.
- **Trocar:** A surgical instrument with either a pyramidal, conical, or needle-type cutting or dissecting point.

## INTRODUCTION

A significant increase in the use of an ever-widening array of prostheses and grafts has occurred in female pelvic floor surgery over the last 30 years. In the 1980s, silastic slings and artificial urinary sphincters<sup>4</sup> were used for urodynamic stress incontinence (USI). McGuire repopularized the rectus sheath fascial sling (an autologous graft) described originally by Aldridge.<sup>5</sup> In the early 1990s, variations on the Stamey-type<sup>6</sup> needle suspension procedures were used involving permanent sutures and modified needles or bone anchors.

In the mid to late 1990s, suburethral synthetic slings for USI using mesh were introduced, the tension-free vaginal tape (polypropylene mesh) being the most notable.<sup>7</sup> Trocars were used both retropubically and, over the last 8–10 years, laterally passing the obturator membrane and the insertion of the obturator internus muscle.<sup>8</sup> These trocars have the potential for causing trocar insertion-related complications in addition to complications due to the use of the prostheses or grafts themselves.

The prosthetic materials used to date have, in retrospect, been of different surgical propriety, not appreciated at the time of their introduction. Amid<sup>9</sup> has presented a classification for different types of meshes for repair of abdominal wall herniae (the behavior of meshes around the vagina may differ) based on pore size and fiber type used and the likelihood of complications according to these factors. This has been extremely useful in directing clinicians and the mesh and/or device manufacturers to more appropriate mesh types and designs. The consensus today is that the least morbidity will be achieved by using a low weight, inert, large pore, monofilament prosthesis, with an elasticity between 20% and 35%.<sup>10,11</sup>

Deprest et al.<sup>11</sup> have presented an excellent analysis of the biology behind the use of prostheses (synthetic) and grafts (biological) in pelvic organ prolapse repair. The classification to be outlined will cover insertion issues as well as infection, healing abnormalities, and other signs of poor integration of these materials, though not the materials themselves.

In terms of prolapse surgery, there has been at times a quest to achieve a prolapse repair with as close to 100% efficacy (anatomical success) and reduce the 29% long-term risk for a woman to undergo a subsequent prolapse surgery after prior prolapse or continence surgery.<sup>12</sup> Anatomical benefits have not been necessarily matched by subjective benefits, that is, functional acceptability for the patient. "Kits" (defined as a set of articles or equipment needed for a specific purpose<sup>2</sup>) have been introduced for all types of prolapse repairs, again involving the use of different materials with different fixation devices or trocars. Papers on such procedures meeting the scientific criteria for randomized prospective trials have been relatively slow to emerge. In addition to "kits," the same materials have also been independently laid in place or fixed with surgical sutures. The use of prostheses or grafts has progressed questionably in some areas from an indication for recurrent prolapse to that of using them in primary procedures.<sup>13</sup>

Historically, discontinuation of a surgical procedure occurs generally due to either (i) a lack of efficacy or (ii) the nature or frequency of complications. Native [patient's own, not an autologous (transplanted) graft] tissue repairs are also not without complications. Prostheses or grafts potentially add to the complication profile the aspects of (i) trauma of insertion; (ii) reaction of the body to the prosthesis in terms of inflammation or infection; (iii) the stability of the prosthesis over time; (iv) morbidity at the donor site from harvesting an autologous graft.

One key precept in the Hippocratic oath, often quoted in Latin, is *primum non-nocere* (first, to do no harm). Surgeons need to know the possible complications that their surgeries might cause and when and where they might occur. In respect of the use of prostheses and grafts, such information might be

Neurology and Urodynamics DOI 10.1002/nau



## 4 Haylen et al.

generated from a table of complications (personal, institutional, or multi-center), classified according to three aspects: category, time, and site (defined below). In addition, there have been examples of personal, multi-center, national, and industry-coordinated registries. It is a simultaneous aim, with the production of this document, to initiate the development of a user-friendly, online accessible joint ICS-IUGA web-based registry of the complications referred in this document. With the information from a codified table of procedure-specific complications, possibly involving a registry (at whatever level): (i) a surgeon might better know the value and risk of a certain procedure; (ii) informed counseling might be provided before a woman embarks on that procedure; (iii) if the procedure involves a prosthesis supported by industry, then that group would have detailed feedback on the complications of that procedure. Should the overview in terms of complications be sufficiently adverse, the procedure and/or the prosthesis or graft should be abandoned.

In drawing up such a classification of complications based on category, time, and site, the bias would be towards optimizing sensitivity, clarity, and interpretability. Increasing sensitivity comes with the natural risk of the classification appearing overly complex. It is hoped that the following outline and explanatory notes, user-friendly tables, case examples, and some online aids (to be introduced in conjunction with the publication of this document – see abstract and discussion for web reference) might alleviate any such concern. It would be of greater concern if the classification did not cover all the different complication scenarios, such that previously undefined additional terminology might be needed.

#### PROPOSED NEW DEFINITIONS

Complications involving the use of meshes, tapes, and grafts in female pelvic floor surgery need to involve the following viewpoints of (i) local complications; (ii) complications to surrounding organs; and (iii) systemic complications. The generic term of “erosion” (medically defined as the “state of being worn away, as by friction or pressure”), does not necessarily suit the clinical scenarios encountered. Its use is best avoided, to be replaced by terms with greater physical specificity and clarity.

The additional terms to be used are (see also Table 1):

- **Contraction:** Shrinkage or reduction in size.<sup>1</sup>
- **Prominence:** Parts that protrude beyond the surface<sup>1</sup> (e.g., due to wrinkling or folding with no epithelial separation).
- **Separation:** Physically disconnected,<sup>2</sup> for example, vaginal epithelium.
- **Exposure:** A condition of displaying, revealing, exhibiting, or making accessible<sup>1</sup> (e.g., vaginal mesh visualized through separated vaginal epithelium; Fig. 4).
- **Extrusion:** Passage gradually out of a body structure or tissue<sup>1</sup> (e.g., a loop of tape protruding into the vaginal cavity; Fig. 5).
- **Compromise:** Bring into danger.<sup>2</sup>
- **Perforation:** Abnormal opening into a hollow organ or viscus.<sup>1</sup>
- **Dehiscence:** A bursting open, splitting, or gaping along natural or sutured lines.<sup>1</sup>
- **Sinus tract formation:** (Localized) formation of a fistulous tract towards vagina or skin, where there is no visible implant material in the vaginal lumen or overlying skin.

Neurourology and Urodynamics DOI 10.1002/nau

#### CATEGORY, TIME, AND SITE (CTS) CLASSIFICATION

The overall aim of the classification is to summarize any of a large range of possible clinical scenarios into a code (“a numeric system for ordering and classifying information”<sup>1</sup>) using as few as three numerals and three (or four) letters. No additional verbal description, possibly involving undefined terminology, should be necessary (see Table 2).

#### SELECTION OF CATEGORIES

The selection of category (C) has used the principal that the least severe complication would involve the prosthesis remaining within the anatomical site into which it was inserted. More severe complications would involve (i) increasing exposure in surrounding anatomical structures; (ii) opening into surrounding organs; and (iii) systemic compromise. The following seven categories (by number) have been formed:

1. *Vaginal complication—no epithelial separation:* This incorporates the terms prominence (e.g., due to wrinkling or folding) or contraction (shrinkage). Also incorporated here is the palpation of mesh fibers.
2. *Vaginal complication—(smaller) exposure:* A smaller (1 cm or less) degree of vaginal epithelial separation is involved.
3. *Vaginal complication—(larger) exposure or extrusion:* A larger degree (>1 cm) of vaginal epithelial separation or prosthesis or graft extrusion is involved.

Categories 1–3 have been separated into the following divisions:

**1A–3A: Asymptomatic—abnormal mesh finding:** These are generally physician-diagnosed at any episode of clinical care. It can be argued that the “abnormal prosthesis or graft finding” aspects of category **1A**, in particular, aren’t really complications as the patient isn’t bothered by the potential problem. It may be, however, that the woman may not have engaged in an activity that is likely to provoke symptoms for herself, for example, pain or bleeding during sexual intercourse (or for her partner), which would convert these complications to category **1B**.

**1Aa–3Aa: Asymptomatic—abnormal mesh finding—no pain:** The addition of an “a” specifies that the patient experiences no pain in association with the abnormal finding.

**1B–3B: Symptomatic—unusual discomfort or pain; dyspareunia (for either partner):** Bleeding or discharge may be possible symptoms.

**1Bb–3Bb: Symptomatic—provoked pain only (during vaginal examination):** The addition of a “b” to the category code specifies that pain, provoked only during vaginal examination, is associated with the abnormal finding.

**1Bc–3Bc: Symptomatic—pain during sexual intercourse:** The addition of a c to the category code specifies that pain, provoked during sexual intercourse (patient only), is associated with the abnormal finding.

**1Bd–3Bd: Symptomatic—pain during physical activities:** The addition of a d to the category code specifies that pain, provoked during physical activities, is associated with the abnormal finding.

**1Be–3Be: Symptomatic—spontaneous pain:** The addition of an e to the category code specifies that pain, spontaneously

TABLE 1. Terminology Involved in the Classification

TERMS USED	DEFINITION
<b>PROSTHESIS</b>	A fabricated substitute to assess a damaged body part or to augment or stabilize a hypoplastic structure
A: Mesh	A (premade) synthetic fabric or structure
B: Implants	A surgically inserted or embedded prosthesis
C: Tape (Slap)	A flat strip of synthetic material
<b>GRAFT</b>	Any tissue or organ for transplantation. This term will refer to biological materials created
A: Autologous Grafts	From the patient's own tissues e.g. dura mater, rectum, skin or fascia lata
B: Allografts	From post-mortem tissue banks
C: Xenografts	From other species e.g. modified porcine dermis, porcine small intestine, bovine pericardium
<b>COMPLICATION</b>	A medical process or event that occurs during the course of a surgery that is not an essential part of that surgery
<b>CONTRACTION</b>	Decrease or reduction in size
<b>PROTRUSION</b>	Parts that protrude beyond the surface (e.g. due to swelling or bulging with no epithelial separation)
<b>SEPARATION</b>	Physically disconnected (e.g. vaginal epithelium)
<b>EXPOSURE</b>	A condition of displaying, revealing, exhibiting or making accessible e.g. vaginal mesh visible off through separated vaginal epithelium
<b>EXTRUSION</b>	Passage gradually out of a body structure or tissue
<b>COMPROMISE</b>	Bring into danger
<b>PERFORATION</b>	Abnormal opening into a hollow organ or vessel
<b>DEFISTULA</b>	A tunnel, open or going along natural or sutured line

present (i.e., without physical activity), is associated with the abnormal finding.

1C–3C: *Clinical infection*: This is always a possibility with a synthetic prosthesis or graft. Signs of local tenderness are suggestive with the combination of redness and a purulent discharge being more conclusive.

1C–3C (b–e): *Infection–pain*. The addition of the letters *b* through to *e* specifies that pain (as defined in Table 4) is part or all of the infected abnormal finding.

1D–3D: *Abscess formation*: This is a more serious possibility with a synthetic prosthesis or graft.

1D–3D (b–e): *Infection–pain*: The addition of the letters *b* through to *e* specifies that pain (as defined in Table 3) is

part of the abnormal finding associated with abscess formation.

Category 4: Urinary tract compromise or perforation. This category class has been subdivided into:

4A: *Small intraoperative defect*: For example, bladder perforation. Such a complication does not generally create longer-term compromise for the bladder if recognized, prosthesis (graft) removed as indicated, defect oversewn (if necessary), and some minor precautions are taken, for example, short-term bladder drainage, with suitable antibiotics commenced.



TABLE 3. Subclassification of Complication Categories to Specify the Presence of Pain (by the Patient only, not the Partner) Associated with the Abnormal Finding and the Grade in Terms of the Presence and Severity of Symptoms

GRADE OF PAIN	SYMPTOMS
a	Asymptomatic or no pain
b	Provoked pain only (during vaginal examination)
c	Pain during intercourse
d	Pain during physical activities
e	Spontaneous pain

4B: *Other lower urinary tract (bladder or urethral) complication or compromise:* This division would incorporate injuries causing longer-term bladder issues, for example, ongoing prosthesis or graft perforation, fistula, calculus around the prosthesis, or graft. This category also incorporates urinary retention directly related to the procedure requiring subsequent surgical intervention (apart from any form of bladder drainage). The time and site divisions relates to those for the surgical intervention.

4C: *Ureteric or upper tract complication or compromise:* This division is self-explanatory.

Category 5: Rectal or Bowel compromise or perforation. This category class has been subdivided into:

5A: *Small intraoperative defect:* Such a complication may not generally be expected to cause compromise if the defect is recognized, prosthesis (graft) removed as indicated, defect oversewn (as necessary) with appropriate precautions taken, for example, short-term bowel rest is instituted with suitable antibiotics commenced.

5B: *Rectal injury or compromise:* This division would incorporate injuries causing longer-term rectal issues, for example, ongoing prosthesis (graft) perforation, fistula.

5C: *Small or large bowel injury or compromise:* This division would incorporate injuries causing longer-term bowel issues, for example, ongoing prosthesis (graft) perforation, fistula, obstruction.

5D: *Abscess formation from bowel injury/compromise.*

Category 6: Skin and/or musculoskeletal complications:

6A: *Asymptomatic:* Physician-diagnosed complication at any episode of care.

6B: *Symptomatic:* For example, discharge, pain, lump.

6C: *Infection from skin or musculoskeletal complication:* Including sinus tract formation.

6D: *Abscess formation from skin or musculoskeletal complication.*

Category 7: Patient compromise. This category recognizes that the patient might be brought into systemic danger with some of the complications in addition to any localized issue.

7A: *Bleeding complication including hematoma:* This division refers to any clinically diagnosed hematoma as well as those where blood transfusion or surgical intervention is a consideration.

7B: *Major degree of resuscitation or intensive care:* This division refers to significant hemodynamic or cardiopulmonary resuscitation directly related to the procedure, and/or patient transfer for management in intensive care facilities.

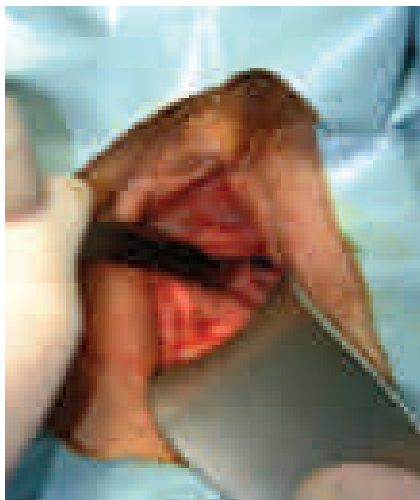
7C: *Mortality:* The insertion of the prosthesis, whilst not necessarily fatal at the time, has set in train further morbid events leading to mortality.

N.B. Because of their systemic nature, 7B and 7C will not have a specific site division. They will be denoted 50.

SELECTION OF TIME (T) DIVISIONS

The time (T) for the complication is when it is *clinically diagnosed*. This section incorporates four time periods, all of the possible episodes where clinical care might be given by the physician or sought by the patient. It might not always be possible to predict with any prosthesis or graft when complications might be more frequently seen. This would depend on the results of a procedure-specific surgical audit using the classification. The earliest time division (T1) might involve more insertion issues, whilst later divisions (T2–T4) might be biased towards healing abnormality issues.

T1: *Intraoperative—48 hr:* Insertion complications more likely.



**Fig. 1.** 52-year-old female underwent a transobturator tape. At 6 weeks, she was cured of her USI and reported no vaginal discharge. Vaginal examination revealed a smaller mesh exposure away from vaginal suture line. **Classification:** 2A T2 S2.



**Fig. 3.** 65-year old with urinary incontinence, underwent a multifilament transobturator sling. At 14 months follow up, she experienced severe pelvic pain and vaginal discharge. Clinical examination revealed hyperthermia to 40°C, (i) sling exposure at right vaginal sulcus and (ii) severe cellulitis in the genito-crural fold. **Classification:** (i) 3C T4 S2; (ii) 6C T4 S3.

*T2: 48 hr–2 months:* Healing or infection complications more likely.

*T3: 2–12 months:* Later healing abnormalities more likely.

*T4: Over 12 months:* Late healing abnormalities and other mesh complications more likely.



**Fig. 2.** 55-year-old female had a retropubic tape. At 2 years follow up, she reported vaginal discharge. Examination revealed a palpable but unseen lateral mesh exposure, together with a cutaneous fistula with local purulent discharge. **Classification:** (i) 2B T4 S2; (ii) 6C T4 S4.

*Neurourology and Urodynamics* DOI 10.1002/nau

#### SELECTION OF SITE (S) DIVISIONS

The selection of these divisions incorporates the current sites where prosthesis or graft complications have been noted:

*S0: Systemic complications (no specific site):* As mentioned earlier, category divisions 7B and 7C which are systemic complications will be denoted S0.

*S1: Vaginal: area of suture line:* Perhaps the commonest site for prosthesis and graft complications from vaginal surgery is close to the vaginal suture line.

*S2: Vaginal: away from the vaginal suture line:* As most suture lines would be midline, this would generally be lateral in the vagina.

*S3: Trocar passage:* The passage of any sharp surgical instrument can cause damage along the path of insertion. This division incorporates any extraperitoneal, bladder, or rectal complication, but not intra-abdominal complications which are S5.

*S4: Other skin or musculoskeletal site:* This division is relevant to any skin or musculoskeletal complications away from the sites of trocar entry or exit. Included might be cutaneous sinus or fistula formation.

*S5: Intra-abdominal:* Included in this section would be bowel perforation or obstruction.

*CTS Classification:* (Complete code):

- Example of complete CTS code: 3B/T2/S3 (for simplicity, there is no “C” in front of the category class and division). The letters *a–e* may be added to the category code, for example, 3Bc/T2/S3 to indicate that pain is part of the abnormality (*c*—pain with intercourse).



**Fig. 4.** A 67 year old woman had undergone a vaginal prolapse repair with hysterectomy. She subsequently had a transvaginal mesh repair for a large recurrent cystocele. At 5 months follow up, she complained of dyspareunia. Vaginal examination revealed a mesh exposure of 20 mm by 15 mm at anterior vaginal wall and vaginal cuff. **Classification: 3Bc T3 S1.**

**CLASSIFICATION GUIDELINES**

The following should be noted:

- *Multiple complications may occur in the same patient:* These should be reported separately as noted in Table 3.
- *There may be early and late complications in the same patient:* again, these should be reported separately.
- *All complications should be listed.*
- *If there is progression of a particular complication over time, the highest final category is to be used:* progression of a

vaginal tape exposure from asymptomatic to symptomatic; an exposure progresses from smaller to larger.

**CLASSIFICATION LIMITATIONS**

- *The classification does not note the specific type of mesh:* Use of prostheses other than those with the least morbidity (as described in the Introduction Section) might be further reflected in an increased rate of the healing abnormalities.



**Fig. 5.** A 47-year-old woman underwent a transoburator tape for USI. At 5 months follow-up, she reported vaginal discharge. Clinically she was febrile at 38°C with a large sling extrusion as depicted. **Classification: 3C T3 S1.**



**Fig. 6.** A 65-year-old woman underwent a transvaginal mesh repair for a grade 3 prolapse. At 32 months, she had recurrent urinary tract infections, urgency and urge incontinence, pelvic pain and deep dyspareunia, bladder pain, and lumbar pain. Radiology: right hydronephrosis and ureteral obstruction. (i) Cystoscopy: mesh extrusion (<0.5 cm) with stone. No right ureteric patency. (ii) Vaginal examination: severe anterior mesh shrinkage and pain during anterior vaginal wall palpation. **Classification: (i) 4C T4 S3; (ii) 1Bc T4 S1.**



**Fig. 7.** A 56-year-old woman underwent a posterior vaginal mesh procedure using a trocar. At 3 months, clinical examination confirmed an (i) infected midline 15 mm vaginal mesh exposure together with (ii) a recto-vaginal fistula. There had been mesh penetration of the rectum. **Classification:** (i) **3C T3 S1**; (ii) **5B T3 S3**.

- **Functional issues** (e.g., voiding dysfunction) are not included: Voiding dysfunction can be defined as abnormally slow (assessed by urine flow rate data) and/or incomplete (assessed by postvoid residual) micturition.<sup>14</sup> Surgical intervention for severe voiding dysfunction, namely urinary retention is included in Section 4B.



**Fig. 8.** A 62-year old woman underwent a transobturator anterior vaginal mesh procedure. At 24 months follow up, she reported no vaginal discharge. Clinical examination revealed skin erosion with local inflammation and some discomfort at (trocar) exit point. **Classification:** **6B T4 S3**.

*Neurourology and Urodynamics* DOI 10.1002/nau

- **Urinary tract infections** have not been included.
- The small risk (about 1 in 2 million) of prion or viral infection associated with a xenograft<sup>15</sup> is not included.
- **Recurrences:** It is claimed that meshes are used to prevent recurrence of pelvic organ prolapse. However, a mesh procedure might fail resulting in a recurrence. This can be either by degradation or local release of sutures, the clinical result being the same. Sometimes local complications can lead to the removal of the mesh, which could further increase the risk for recurrence. However, it should be emphasized that recurrence is not a complication.
- **Intraperitoneal adhesions:** Some procedures involve the use of implant material into the abdomen. As a consequence, intraperitoneal adhesions can arise either on the implant or remotely.
- **Bulking agents:** Complications related to bulking agents including migration are not included.

## DISCUSSION

The present classification has been developed to be sensitive to all possible physical complications involving the use of a prosthesis or graft in a female pelvic floor surgical procedure. Both insertion complications (e.g., trocar related) and healing abnormalities are covered. Whilst this creates a large number of possible complication scenarios, appropriate organization has still been possible by category, time and site. The end-point is a code of three letters (4 if *a–e* are used) and three numerals. The addition of the pain subclassification reflects the recognition of the authors that chronic pain, especially if in the higher subclasses (*c–e*), can be amongst the most disabling surgical outcomes from the use of prostheses or grafts in female pelvic floor surgery.

A key advantage of a standardized classification is that all parties involved in female pelvic floor surgery including surgeons, physicians, nurses, allied health professionals, and industry will be referring to the same clinical issue. It is anticipated that a (CTS) codified table of complications will be a necessary part of reports of surgical procedures relevant to this document. Many countries already have national databases for new surgical devices. It is inevitable that there will be more regulation over time for their introduction. With a standardized classification in place, quicker assessment of adverse events will be achieved together with uniform reporting of prosthetic-related complications. Any procedure showing a consistently high rate of complications in a surgical audit would need closer scrutiny and/or possible abandonment. As result of the use of such a classification, in terms of patient care, the principle from the Hippocratic oath, “first, to do no harm” is more likely to be observed.

It is acknowledged that to optimize the coverage of complications, the classification might still appear complex and not immediately mastered. However, as noted in the Introduction Section, we anticipate that the case examples provided below, the color charts and the online ICS-IUGA Complication Classification Calculator ([www.icsoffice.org/complication](http://www.icsoffice.org/complication)) will ameliorate any initial concerns.

It has been a consensus view of the authors that a formal academic terminology and classification should be completed prior to attempts at further simplification. This otherwise might run the risk of compromising coverage of complications.



TABLE 4. An Example of a *Non-Procedure Specific* Table of Complications Related Directly to the Insertion of Prostheses (Meshes, Implants, Tapes) or Grafts in Female Pelvic Floor Surgery using the Category (C), Time (T) and Site (S) system. The CTS Classification Code is Placed Adjacent to the Description of the Complication. One Might Expect these Tables to be Often Procedure-Specific.

Report Number	Description of Complication	Date	Code
840	Retropubic (Marsden-type) following a tape procedure (less than 24 hours)	7/1/1982	
911	Constant high pain site swelling after an obturator tape	10/12/84	
124	Bowel obstruction and 2cm vaginal vault exposure. With increasing symptoms after a mesh sacrospinopexy	10/19/85	10-11-81
233	Mesh (Marlex) exposed (internal vaginal) in a woman at a 2-week postop review whose partner is describing intercourse with intercourse	10/12/82	
444	A medial vaginal exposure of mesh (4.5cm) with infection, dyspareunia, discharge (5 received infection anterior-subpubic ligament mesh)	20/1/1994	
599	Lateral vaginal exposure with malodorous discharge and a chronic sacrospinous ligament 8 months after a posterior vaginal tape	10/18/82	10-11-81
640	Intergroinular (obturator) vessel injury during a reconstructive tape procedure resulting water reconstruction	10/11/80	
777	Peritoneal (retroperitoneal) tape (Lichtenstein) hernia (hernia) 2 years after a reconstructive tape procedure	10/14/80	
880	Major urinary incontinence 8 days after a mesh sacrospinopexy complicated by an intraoperative wound (upper third) vaginal (lower third) mesh 10/1/1985	10/1/1985	
999	Tension prosthesis mesh (retroperitoneal) noted 10 months after an anterior mesh repair (no symptoms, peritoneal (retroperitoneal))	10/11/1981	
1111	Constant pain (retroperitoneal) of 10 months with recurrent UTI requiring antibiotic treatment of sacrospinous tape 8 months after procedure	10/11/1981	

#### ACKNOWLEDGMENTS

The co-authors acknowledge the support and goodwill of the IUGA and ICS leadership in this second Joint Report from the two societies, following on from the Joint Report on Terminology for Female Pelvic Floor Dysfunction.<sup>14</sup> We thank Mr. Dominic Turner and Mr. Ashley Brookes from the ICS Office for their assistance and expertise in developing the online aids and the progress towards an ICS-IUGA Registry. This document has involved 11 rounds of full review by co-authors. Following website publication (Version 8), there have been four rounds of further review. Versions 3 and 10 were subject to live meetings in Cancun (June 2007) and Toronto (August 2010). The valuable input of Professor Bernard Jacquetin is gratefully acknowledged. The comments of the following reviewers in response to website publication (April–June, 2010) are also much appreciated: Dr. Angamuthu

Arunkalaivanan, Dr. Kiran Ashok, Professor Peter Dietz, Dr. Nathan Guerette, Professor Don Ostergard, and Professor Peter Petros.

#### REFERENCES

1. Stedman's Medical Dictionary. Baltimore: Lippincott, Williams and Wilkins; 2006.
2. Concise Oxford Dictionary. Oxford: Clarendon Press; 1995.
3. Dwyer PL. Evolution of biological and synthetic grafts in reconstructive pelvic surgery. *Int Urogynecol J* 2006;17:S10–5.
4. Duncan HJ, Nurse DE, Mundy AR. Role of the artificial urinary sphincter in the treatment of stress incontinence in women. *Brit J Urol* 1992;69:141–3.
5. Aldridge AH. Transplantation of fascia for relief of urinary stress incontinence. *Am J Obstet Gynecol* 1942;44:398.
6. Stamey TA. Endoscopic suspension of the vesical neck for urinary incontinence. *Surg Gynecol Obstet* 1973;136:547–54.
7. Ulmsten UJ, Johnson P, Rezapour M. A three-year follow-up of tension-free vaginal tape for surgical treatment of stress urinary incontinence. *Br J Obstet Gynaecol* 1999;106:345–50.

## 12 Haylen et al.

8. Delorme E, Droupy S, de Tayrac R, et al. Transobturator tape (Urotape). A new minimally invasive procedure to treat female urinary incontinence. *Eur Urol* 2004;45:203–7.
9. Amid P. Classification of biomaterials and their relative complications in an abdominal wall hernia surgery. *Hernia* 1997;1:15–21.
10. Rosch R, Junge K, Hölzl F, et al. How to construct a mesh. In: Schumpelick V, Nyhus LM, editors. *Meshes: benefits and risks*. Berlin: Springer; 2004. p. 179–84.
11. Deprest J, Zheng F, Konstantinovic M, et al. The biology behind fascial defects and the use of implants in pelvic organ prolapse repair. *Int Urogynecol J Pelvic Floor Dysfunct* 2006;17:S16–25.
12. Olsen AL, Smith VJ, Bergstrom JO, et al. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol* 1997;89: 501–6.
13. Davila GW. Introduction to the 2005 IUGA Grafts Roundtable. *Int Urogynecol J* 2006;17:S4–5.
14. Haylen BT, Freeman RM, De Ridder D, et al. An International Urogynecological Association (IUGA) – International Continence Society (ICS) Joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J Pelvic Floor Dysfunct* 2010;21:5–26. *Neurourol Urodyn* 2010;29:4–20.
15. Simonds RJ, Homberg SD, Hurwitz RL. Transmission of human immunodeficiency virus type 1 from seronegative organ tissue donor. *N Eng J Med* 1992; 326:726–30.



## Developing Evidence-Based Standards for Diagnosis and Management of Lower Urinary Tract or Pelvic Floor Dysfunction

Peter F.W.M. Rosier,<sup>1</sup> Dirk de Ridder,<sup>2</sup> Jane Meijlink,<sup>3</sup> Ralph Webb,<sup>4</sup>  
Kristene Whitmore,<sup>5</sup> and Marcus J. Drake<sup>6\*</sup>

<sup>1</sup>University Medical Centre Utrecht, The Netherlands

<sup>2</sup>Department of Urology, University Hospitals KU Leuven, Leuven, Belgium

<sup>3</sup>Chairman, International Painful Bladder Foundation, The Netherlands

<sup>4</sup>Department of Urology, Norfolk & Norwich University Hospital, Norwich, United Kingdom

<sup>5</sup>Pelvic & Sexual Health Institute, Philadelphia, Pennsylvania

<sup>6</sup>Bristol Urological Institute, University of Bristol, Bristol, United Kingdom

The International Continence Society (ICS) has a key role in standardizing terminology related to lower urinary tract and pelvic organ dysfunction. The ICS Standardization Steering Committee (SSC) presents the new structure and process by which future ICS Standards will be developed. The new processes aim to meet present-day evidence-based practice requirements, and to foster unbiased, inclusive, and transparent development. For each new ICS Standard, the SSC will oversee a dedicated ad hoc Working Group (WG). Applications to chair or contribute to a WG will be invited from the ICS membership. The SSC will select the Chairperson, and work with him or her to select the WG composition, balanced to represent key disciplines, stakeholders, and regions. Consultants can be invited to contribute to the WG where specific need arises. Every WG will review current knowledge, adhering to evidence-based medicine requirements. Progress reports will be reviewed by the SSC, and amendments recommended, culminating in a first draft. The draft will be offered to the ICS membership and additional relevant experts for comment. Further revision, if needed, will result in a document, which the SSC will submit to the ICS Trustees, as arbiters of whether the document should be adopted as an ICS Standard. The SCC will then coordinate with the WG to ensure that the new ICS Standard is published and disseminated. Implementation strategies, such as education, audit, accreditation, and research initiatives will be linked to the Standards where appropriate. Revisions of ICS Standards will be undertaken to maintain contemporaneous relevance. *Neurourol. Urodynam.* 31:621–624, 2012. © 2012 Wiley Periodicals, Inc.

**Key words:** standards; evidence-based medicine

### INTRODUCTION

One of the most recognized activities of the International Continence Society (ICS) has been the publication of standardizations of terminology for diagnosis and testing in functional urology. This work started in 1976, with subsequent updates. The 1988<sup>1</sup> and the 2002<sup>2</sup> reports, with  $\pm 1,000$  and  $\pm 2,500$  citations, respectively, are amongst the most widely quoted publications in urology.

There have been two particularly important categories of publication. The first is the standardization of terminology, such as the “Standardization of Terminology of Lower Urinary Tract Function.”<sup>2</sup> Standardized definitions of key medical terms with international consensus are increasingly needed as analysis and registration in healthcare become ever more automated and communication increasingly global. The establishment of the International Health Terminology Standards Development Organization (IHTSDO; <http://www.ihstdo.org/index.php?id=502>) signifies the increasing weight attached to the agreed definitions of terminology to describe conditions at a fundamental level in medicine. The second category deals with the provision of guidelines for quality control and improvement of standards, which serve as a benchmark for professional activity, exemplified by the “Good Urodynamic Practice” document.<sup>3</sup>

ICS standards and standardization have led the way and have been widely accepted. The process by which they have been produced has been based on intensive expert discussion

and consensus with input from the ICS membership, but without inclusion of the published evidence in a systematically weighed and transparent manner. The most recent report, a joint report with the International Urogynecological Association,<sup>4,5</sup> was developed in a similar manner. Ease of modern electronic communication has allowed more experts to monitor the content of draft editions of newer documents. This has meant that expert opinions were included in a “numerically” more balanced manner. However, no “methods” paragraph was given to explain explicitly how decisions on topics to include were made, nor how evidence and expert opinion were prioritized, included or excluded beyond acknowledgement of the commenting experts in a final paragraph.

Ideally, only “genuine evidence” is included in standards and guidelines. Where genuine evidence is lacking or conflicting, it is preferable that expert opinion is separately added to

Peter F.W.M. Rosier and Dirk de Ridder contributed equally to this work.

Conflict of interest: M. Drake, Advisory boards/research/speaker engagements with Allergan, Astellas, Ferring, J&J, Pfizer.

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

\*Correspondence to: Marcus J. Drake, International Continence Society Standardization Steering Committee, International Continence Society, 19 Portland Square, Bristol, BS2 8SJ, UK. E-mail: [marcus\\_drake@bui.ac.uk](mailto:marcus_drake@bui.ac.uk)

Received 25 September 2011; Accepted 21 November 2011

Published online 6 March 2012 in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI 10.1002/nau.21253



Fig. 1. Summary diagram of the key stages in development of an ICS Standard. (SSC, Standardization Steering Committee; WG, Working Group).

recommendations in a transparent and explicit manner. In the mid-eighties a group around David Sackett, a key figure in evidence-based medicine (EBM),<sup>6</sup> developed a systematic approach to evaluate published evidence, after he analyzed the problem of “observer error” in the interpretation of medical literature.<sup>7</sup> “EBM is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of EBM means integrating individual clinical expertise with the best available external clinical evidence from systematic research.”<sup>8</sup> Standards to produce evidence-based clinical practice guidelines have been developed,<sup>9</sup> with guidance manuals.<sup>10</sup>

EBM as a strategy to improve healthcare is not disputed, but the implications in a rapidly expanding field of knowledge are

substantial.<sup>11</sup> In the modern era of information technology, transparency, accountability, and complex multidisciplinary responsibilities cannot be ignored; expert opinion is only acceptable where evidence is lacking and must be clearly marked and explained as being expert opinion.

The ICS Standardization Committee recognized the importance of adhering to EBM principles. In 2010, a reorganization took place from which the renamed Standardization Steering Committee (SSC) emerged. A key difference between the new SSC and the old Standardization Committee is that the SSC does not itself deliver standardization documents; instead it oversees ad hoc Working Groups (WGs) (see below) which deliver the documents, aiming to ensure transparency, balance, and adherence to the methods and principles of EBM. The SSC Chairman is elected from the ICS membership according to the ICS articles and bylaws. The Chairman and the SSC members serve for a term of 3 years, once renewable.

The ICS SSC aims to ensure ongoing development of high quality terminology and/or practice standards, for guidance of professionals dealing with the basic scientific investigation, diagnosis, and management of lower urinary tract, pelvic floor, genital, and anal function and dysfunction. Developing these standards requires transparency and integrity; the SSC’s process and expectations for modern-day development of some of the most important ICS documents are described below and illustrated in Figure 1.

#### PROCESS OF DEVELOPING AN ICS STANDARD

Topics selected by the SSC for development or revision of standardization reports will be based on areas of priority need, whether identified by the SSC itself, or in response to stakeholder suggestions. The delivery of a standardization document on a selected topic will be the remit of a specifically created ad hoc WG, which will focus on that specific subject (see Table I). The SSC’s role is to agree the scope of the WG’s activity, instigating and steering activity, checking compliance with suitable working practices, monitoring progress, ensuring adequate stakeholder input and evaluating the end result.

Once the need for a new or revised standard has been identified, the SSC will invite applications from ICS members wishing to chair the relevant WG. The person selected will have submitted the proposal with the best strategy for developing the document in the opinion of the majority of SSC members.

TABLE I. Structure and Function of Standardization Document WG

The composition needs to be multidisciplinary and multinational, representing the most important stakeholders (including, e.g., patient representatives, health economists, and others as appropriate)
Non-ICS members can be part of the WG as experts or representatives of specific stakeholders
The WG should generally not include more than 15 people
Selection of WG members should follow a transparent process, which is recorded and publicly available
Additional contributions to a WG’s deliberations can be received from outside individuals
The WG should not receive any sponsorship from industry and the members should disclose all relationships
All members of the WG will be responsible for the entire content of the document as a group.
The WG has a chairman who:
will propose the key question or topics of discussion to the SSC, together with a strategic plan.
will keep a digital working log of the WG activities
will make sure that the composition of the WG is well balanced and that the process of standardization is transparent
will use web-based and e-mail exchange of information and monitor the execution of assignments within the assigned timeline
will adhere to EBM principles, where appropriate
will report to the SSC
will be responsible for production of a first draft of the report within a stipulated time frame (generally 18 months)
will be responsible for submission for publication and dissemination.
After publication of the standard, the WG will be dissolved.
A typical lifespan for an ad hoc WG will maximally be 36 months. If the WG fails to be productive, the SSC dissolves the WG.
The ICS or ICS SSC will not provide financial budget for face-to-face meetings of any ad hoc WG.

TABLE II. SSC Criteria for Assessing WG Proposals

Title of the project
Name of applicant
Description of the topic: The arguments for creating the WG are: (Explain why one or more of the following arguments is relevant)
area of clinical uncertainty or "debate" exists
evidence of better treatment is available
evidence for renewal of the existing standard is available
evidence of practice variation is available
other clinical or scientific relevance
there is significant controversy in practice or literature
there is conflicting or incomplete evidence
there are cultural differences in practices or viewpoints
there is socio-economic relevance
List of proposed names (with CVs):
confirmation that individuals have agreed to contribute
evidence of multinational and interdisciplinary balance
opportunity for ICS members to apply to join the WG and transparent, documented process for selection
process to register contributions from individuals or groups not in the WG
Description of the methodology and how it will be used:
web-based approach
e-mail
conference calls or webcasts
face-to-face meeting (mainly during ICS international meetings)
proposed timeline
Description of topic, proposed WG composition, likelihood of implementation, likelihood of publication, innovation of approach, realistic timeline, use of electronic tools.

The SSC will evaluate proposals according to key criteria (Table II).

WG Composition

The selected Chairperson will establish a WG of interested and knowledgeable individuals from a multinational and interdisciplinary background, representing all key stakeholder groups. Technical expertise relevant to the WG's remit will be taken into consideration in the selection of members. The WG will also be permitted or asked by the SSC to invite input from outside consultants where this is needed. This will typically be applicable in specialist contexts that are not widely represented within the ICS, such as engineering, computer sciences, or data handling. It may also be relevant in other fields, such as consumer perspectives, or economic issues, for example.

TABLE III. Development of an ICS Standard

	Timescale (months)	WG	SSC
Proposal stage	–6 to 0	Applications for Chairmanship or membership.	Call for applications. Review subject, Chair, Group, criteria, timeline and starting date.
Preparatory stage	0 to 18	WG constituted. Development of draft.	Evaluate progress. Appoint mentor. Evaluation (at least every 6 months).
Committee stage	18 to 21	Draft submitted to SSC.	Review of the process and document against criteria. Approval by consensus.
Enquiry stage	21 to 24	Draft on ICS website.	Internal and external review. Comments by ICS members and stakeholders.
Approval stage	24 to 27	Submit final document to SSC.	Process review. Submission to ICS Board of Trustees.
Publication	27 to 36	Final text to ICS office for web publication. Journal submissions.	Official ICS document. WG dissolved.
Implementation stage	>36		Support implementation. Education (with ICS Education Committee). Register of comments. Identify research needs. Support health technology and economic assessment.
Revision stage		Submit proposal to SSC.	Start new process.

Neurourology and Urodynamics DOI 10.1002/nau

The SSC will ensure a transparent process for selection of WG members, and will evaluate and adapt the composition to ensure a balance between different viewpoints (professional, patient, and other stakeholders' perspectives). Once agreed, the proposal and the names of the WG's members will be published on the ICS website. If a member of the SSC is also a member of a WG, he/she will not be included in SSC decisions related to that particular WG. All (potential) conflicts of interest will be published on the ICS website.

Stages of a Standard

Stages through which a standardization document will progress are summarized in Table III. These will be listed in the project management-working log of the WG and the Chairperson of the WG should report progress to the SSC. The SSC will provide a mentor for the WG, who will evaluate the progress at least every 6 months and be available if any problems arise. The mentor will keep a log of these contacts.

Preparation of a Draft Report

The WG will prepare successive working drafts, circulating the drafts, and amending according to comments, until the group is satisfied that it has developed the best solution for the subject being addressed. Standards should adhere to EBM principles, where appropriate and possible. At an early stage, therefore, the WG has to devise a strategy for a comprehensive review of published literature and use an inclusive and transparent approach to derivation of expert opinion. It might sometimes be necessary to use the Delphi method.<sup>12</sup> Each WG will ensure a strategy for capturing and assimilating the views of all groups of stakeholders and criteria for inclusion or exclusion of these views in the finished document.

Throughout, the WG's Chairperson is responsible for:

- keeping a digital log of the WG's activities
- documenting the methods that were used to produce the draft document
- promoting web-based and e-mail exchange of information and monitoring the execution of assignments within the agreed timeline
- reporting to the SSC
- producing a first draft of the report within 18 months.

### Committee Stage (Assessing the Process of Standardization)

As soon as a draft is available, the Chairperson of the SSC will forward it to all the members of the SSC for internal process review. The process by which the draft standard was created will be evaluated according to preset criteria. The document requires SSC approval prior to progressing to the next stage of development. The SSC may require revisions or amendments which will need to be undertaken by the WG in a defined time frame. A document that fails to meet the objectives or was not developed in accordance with the appropriate approach will be rejected, and the WG will be dissolved.

### Enquiry Stage (Wider Assessment of the Content of the Document)

The actual assessment of the content of the document will be undertaken by internal and external experts (invited by the SSC) and the ICS membership. The draft standard will be circulated to all members by website publication for commenting over a period of 3 months.

### Approval Stage

The WG should resubmit the final version based on the comments received. Explicit criteria for the inclusion or exclusion of comments should be developed and each comment should be accompanied by a narrative explaining the reason why it was either included in or excluded from the final version. All comments and accompanying narrative will be published on the relevant document web forum. The revised version should be resubmitted to the SSC for process review and assessment of the amendments. If approved, the document and the log of the development process will be sent to the ICS Board of Trustees for confirmation and adoption.

### Publication

Once the Board has confirmed and adopted the document and the process, the final text will be published on the ICS website and will then be referred to as the new ICS Standard, superseding previous Standards. Thus, the new report must outline where it differs from previous reports. The WG will be encouraged to submit the document as an ICS Standard to *Neurourology and Urodynamics*, and the SSC will advise in this process. Co-publication with other journals can be considered if relevant, within copyright regulations. Publication of the respective ICS Standard will conclude the WG's activities.

### Implementation Stage

The ICS SSC will promote implementation of the standards by publication, dissemination and education, and the proposing of new standards to its affiliate and collaborating societies and organizations. Additionally, the SSC will monitor the undertaking of clinical audit based on the ICS Standards' recommendations as a key aspect of successful introduction of the documents into mainstream practice,<sup>13</sup> and the undertaking of the research and development necessary for ongoing development of the evidence base.

Standards will be written in UK English. Translation into other languages will be supported; for terminology standards, this will require that appropriate linguistic validation procedures are followed (for an example of the application of linguistic validation in the context of translation of symptom assessment tools, see Acquadro et al., 2006).

### Revision of Standards

The ICS SSC will also keep track of comments that are received for consideration during a future revision of the standard text, as well as identifying future research needs. A revision or update can be proposed by the SSC or any ICS member or group of ICS members when there is a perceived need, and the timescale for anticipated revision of a standard will be specified at the time of adoption—subject to future developments in the field. The SSC can discuss not to revise outdated documents and declare them obsolete.

### CONCLUSIONS

In developing evidence-based standardization documents, the ICS SSC aims to ensure inclusiveness, responsiveness, transparency, accessibility, flexibility, and evolution. The ICS SSC presents a structured process for ad hoc WGs to develop ICS standards, and a strategy to guide that process. Consequently, each WG will be responsible for several stages of development, each clearly documented, until a high quality document has been approved as an ICS standard.

The presented structure and strategy place emphasis on the principles of EBM and transparency in the development of ICS standards. They also provide the flexibility necessary for the varied nature of the initiatives established by the ICS, where multiple stakeholders are generally present, and also circumstances in which the evidence base may be limited. ICS standards will continue to be adopted and promoted as the basis for good professional practice, suitable for the demands of the modern era of EBM.

### REFERENCES

1. Abrams P, Blaivas JG, Stanton SL, et al. The standardisation of terminology of lower urinary tract function. The International Continence Society Committee on Standardisation of Terminology. *Scand J Urol Nephrol Suppl* 1988;114:5–19.
2. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: Report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
3. Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
4. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010a;29:4–20.
5. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J Pelvic Floor Dysfunct* 2010b;21:5–26.
6. Sackett DL, Straus SE, Richardson WS, et al. editors. Evidence-based medicine: How to practice and teach EBM 2nd edition. Edinburgh & New York: Churchill Livingstone; 2000.
7. Haynes RB, Sackett DL, Tugwell P. Problems in the handling of clinical and research evidence by medical practitioners. *Arch Intern Med* 1983;143:1971–5.
8. Sackett DL, Rosenberg WM, Gray JA, et al. Evidence based medicine: What it is and what it isn't. *BMJ* 1996;312:71–2.
9. Grimshaw J, Eccles M, Russell I. Developing clinically valid practice guidelines. *J Eval Clin Pract* 1995;1:37–48.
10. Coopey M, Nix MP, Clancy CM. Evidence-based practice: AHRQ's role in generating and disseminating knowledge. *AORN J* 2007;86:857–60.
11. Browman GP. Development and aftercare of clinical guidelines: The balance between rigor and pragmatism. *JAMA* 2001;286:1509–11.
12. Jones J, Hunter D. Consensus methods for medical and health services research. *BMJ* 1995;311:376–80.
13. SIGN. SIGN50 a guideline developer's handbook. Edinburgh: Scottish Intercollegiate Guidelines Network; 2008.

## 2. FUNDAMENTALS

The Fundamentals of Assessment articles are commissioned by the ICS Board of Trustees, setting out the core knowledge for any practitioner needing to assess lower urinary tract dysfunction (LUTD) in their clinical work. The documents aim to give a solid knowledge basis for several different aspects of LUTD, suitable for trainees, allied health professionals, and people working in related disciplines like neurology, primary care, and care of the elderly. They describe what any practitioner really must know for everyday practice, and provide examples, covering;

- Urinary symptoms in general.
- Specific patient groups: nocturia; neurological disease; chronic pelvic pain
- Pelvic organ prolapse quantification
- Urodynamic tests: flow rate testing; urodynamics; videourodynamics
- The relevance of Standardisation

As well as a knowledge base, the Fundamentals are a starting point for the ICS Standardisations, which are the basis of specialist practice in LUTD in substantial detail.



**Marcus Drake**  
ICS Trustee



# Neurourology Urodynamics

**Disclaimer.** The Publisher, ICS, SUFU and Editors cannot be held responsible for errors or any consequences arising from the use of information contained in this journal; the views and opinions expressed do not necessarily reflect those of the Publisher, ICS, SUFU and Editors, neither does the publication of advertisements constitute any endorsement by the Publisher, ICS, SUFU and Editors of the products advertised.

**Copyright and Copying (in any format).** Copyright © 2017 Wiley Periodicals, Inc., a Wiley Company. All rights reserved. No part of this publication may be reproduced, stored or transmitted in any form or by any means without the prior permission in writing from the copyright holder. Authorization to copy items for internal and personal use is granted by the copyright holder for libraries and other users registered with their local Reproduction Rights Organisation (RRO), e.g. Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923, USA ([www.copyright.com](http://www.copyright.com)), provided the appropriate fee is paid directly to the RRO. This consent does not extend to other kinds of copying such as copying for general distribution, for advertising or promotional purposes, for republication, for creating new collective works or for resale. Permissions for such reuse can be obtained using the RightsLink "Request Permissions" link on Wiley Online Library. Special requests should be addressed to: [permissions@wiley.com](mailto:permissions@wiley.com)

For submission instructions, subscription, and all the latest information, visit [http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1520-6777](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1520-6777)

## T A B L E O F C O N T E N T S

**EDITORIAL COMMENT****S6 Editorial Comment**

Sherif Mourad, Roger Dmochowski, and Marcus Drake

**SOUNDING BOARD****S7 A Commentary on Expectations of Healthcare Professionals When Applying the International Continence Society Standards to Basic Assessment of Lower Urinary Tract Function**

Marcus J. Drake and Paul Abrams

**S13 Fundamentals of Terminology in Lower Urinary Tract Function**

Marcus J. Drake

**S20 Basic Concepts in Nocturia, Based on International Continence Society Standards in Nocturnal Lower Urinary Tract Function**

Hashim Hashim and Marcus J. Drake

**S25 Neurological Lower Urinary Tract Dysfunction Essential Terminology**

Jerzy B. Gajewski and Marcus J. Drake

**S32 The Fundamentals of Chronic Pelvic Pain Assessment, Based on International Continence Society Recommendations**

Neha Rana, Marcus J. Drake, Rebecca Rinko, Melissa Dawson, and Kristene E. Whitmore

**S39 How to Use the Pelvic Organ Prolapse Quantification (POP-Q) System?**

Chendrimada Madhu, Steven Swift, Sophie Moloney-Geany, and Marcus J. Drake

**S44 The Fundamentals of Uroflowmetry Practice, Based on International Continence Society Good Urodynamic Practices Recommendations**

Andrew Gammie and Marcus J. Drake

**S50 Fundamentals of Urodynamic Practice, Based on International Continence Society Good Urodynamic Practices Recommendations**

Marcus J. Drake, Stergios K. Doumouchtsis, Hashim Hashim, and Andrew Gammie

**S61 Basics of Videourodynamics for Adult Patients With Lower Urinary Tract Dysfunction**

Michel Wyndaele and Peter F. W. M. Rosier

## T A B L E O F C O N T E N T S

### **EDITORIAL COMMENT**

#### **S67** Why ICS Standardization of Lower Urinary Tract Symptoms Matters

Dirk De Ridder and Marcus Drake

### **SOUNDING BOARD**

#### **S69** Critical Steps in Developing Professional Standards for the International Continence Society

Peter F. W. M. Rosier

## EDITORIAL COMMENT



The International Continence Society (ICS) Board of Trustees is glad to present a special supplement of *Neurourology and Urodynamics* which sets out the core knowledge for any practitioner needing to assess lower urinary tract dysfunction (LUTD) in their clinical work. The material will be useful to trainees, allied health professionals, and people working in related disciplines like neurology, primary care, and care of the elderly. The documents are written in a simplified way to offer a helpful source of education and knowledge of several different aspects of LUTD.

A significant motivation for this effort is the need to be concise, explicit, and definitionally correct when using a common lexicon, as with the ICS Standardization documents, that govern the manner in which professionals in our field define their research and report results thereof. A sequence of documents is included which covers;

- Urinary symptoms in general, and in specific patient groups (nocturia; neurological disease; chronic pelvic pain)
- Pelvic organ prolapse quantification
- Urodynamic tests (flow rate testing; filling cystometry with pressure flow studies; videourodynamics)
- The importance of standardization and how the ICS Standards are developed

The knowledge base is drawn from the ICS Standards, which constitute the basis of specialist practice in LUTD, supplemented by practical application. The authors were

asked to write succinct and approachable documents, describing what they feel any practitioner really must know for everyday practice, and providing examples. Thus, these documents are derivatives of the many reports and publications that represent the ICS Standards but are not in themselves ICS Standardization documents. Inevitably, the choice of content is subjective, but each document seeks to offer simplicity and clarity. For those working to become specialists in the area, this supplement is a starting point for getting to grips with the comprehensive repository of detailed professional consensus documents established by the ICS over the course of several decades and available on the ICS website (<https://www.ics.org/folder/189>).

A significant aspect of the knowledge transfer is the education of those who are students or early career clinicians and investigators. Thus, the supplement aims to facilitate clarity, accuracy, and specificity of reports in the fields of urodynamics, neurourology, pelvic floor disorders, and urogenital reconstruction. Health care practitioners and clinicians will benefit from these documents, which give a brief review of those subjects related to LUT dysfunction, and as their knowledge grows, we hope they will feel enthused to engage with the full ICS Standards.

Sherif Mourad  
Roger Dmochowski  
Marcus Drake

## A commentary on expectations of healthcare professionals when applying the international continence society standards to basic assessment of lower urinary tract function

Marcus J. Drake<sup>1,2</sup>  | Paul Abrams<sup>2</sup>

<sup>1</sup> Translational Health Sciences, Bristol Medical School, Bristol, UK

<sup>2</sup> Bristol Urological Institute, Southmead Hospital, Bristol, UK

### Correspondence

Marcus J. Drake, Bristol Urological Institute, 3rd Floor L&R building, Southmead Hospital, Bristol, BS10 5NB, UK.  
Email: marcus.drake@bristol.ac.uk

The Continence Society (ICS) has sustained a drive to improve the clinical assessment of lower urinary tract function for many years. Increasingly, healthcare professionals (HCPs) engage with the guidance, and patients benefit from the precision that results when their carers apply a sensible and logical approach to assessment. The current supplementary issue of *Neurourology and Urodynamics* (NAU) summarizes the fundamentals derived from major ICS initiatives, emphasizing what HCPs must know when dealing with these patients, regardless of the medical discipline in which they work. It also introduces the basics of urodynamics testing to trainees and HCPs who may refer patients for testing. In this editorial review we draw out some additional points of consideration. We emphasize the need to avoid using terms in a clinical context that could imply causative mechanism, until the mechanism has actually been identified. We caution against the use of severity thresholds, until there is proper data to justify their application for any given patient group. Finally, we provide a description of the philosophical basis of urodynamics testing, including videourodynamics. This commentary should be read in the context of the other articles provided in the NAU supplement.

### KEYWORDS

LUTS, overactive bladder, standardization, urodynamics

## 1 | INTRODUCTION

LUTD is encountered in some form by a wide range of healthcare practitioners (HCPs), notably medical, nursing, and allied professionals working in Primary Care, Gerontology and Neurology. For these, awareness of a fundamental knowledge base should include the correct use of the terminology for lower urinary tract symptoms (LUTS), and the relevant signs and urodynamic observations. Likewise, residents in urology and gynaecology need to appreciate the fundamentals of LUTS and lower urinary tract dysfunction (LUTD), as a stepping stone for the more

detailed knowledge used in specialist practice. The International Continence Society (ICS) has developed standards which set the specialist terminology and diagnostic methodology in great precision for the full scope of practice in LUTD with considerable detail as needed by specialists in the area. These documents produced by the Standardization Steering Committee and other ICS Committees meet the needs of specialists, and professionals who have mastered the fundamentals and who are strongly encouraged to engage with the full standards.

The ICS approach is founded on the importance of logical and clear-thinking clinical diagnosis and therapy selection,

Dr. Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

making sure that treatment options are specifically matched to the individual patient. Well-worded terminology has steadily evolved over the years to make sure that it is suited to the potential presentations. Standards for testing in Urodynamics have been refined to give practitioners the best chance to identify abnormalities in their patients and interpret the features appropriately. This supplement of Neurourology and Urodynamics was commissioned by the Trustees of the ICS to introduce a new generation of residents and recently appointed consultants to the important work of standardization in functional urology. It aims to set out and exemplify the fundamentals as a starting point to engaging with the ICS Standards. Experts have been asked to extract pertinent aspects from some of the most widely used Standards, to facilitate awareness of key points in LUTS, nocturia, neuro-urology, chronic pelvic pain, pelvic organ prolapse quantification, flow rate testing, urodynamics, and videourodynamics.

## 2 | LOWER URINARY TRACT FUNCTION

The description of lower urinary tract function breaks it down into symptoms, signs, and urodynamic observations. The terminology is phrased to ensure that patients and doctors can align their discussions appropriately. A key requirement is to ensure that the words HCPs use do not imply a mechanism without good justification. In male patients, words or phrases like “obstructive,” “prostatism,” or “prostate symptom score” insinuate that the mechanism of symptoms is already known, and caused by the prostate. Yet it is wrong to imply this at the start of the patient's assessment; it innately biases the doctor (and sometimes the patient) to expect therapy aimed at relieving obstruction and dealing with the prostate. That may come later, but only once other causes which can lead to very similar symptoms have been excluded. Weak or slow stream may be due to the prostate and the possibility of an underactive detrusor being the cause must also be considered. Likewise, “irritative” is not appropriate, given that there is generally no evidence for irritation in the context of storage LUTS. Fundamentally, the potential to misrepresent mechanism by careless use of terminology needs to be avoided.

Two areas where clinicians can get a little bit muddled by terminology are frequency and overactivity. “Frequency” indicates how often a person passes urine in a given time period, so it is a sign. “Increased daytime frequency” indicates that the patient feels he or she voids too often by day, so it is the correct phrase to describe a symptom reported by a patient. The word “Overactivity” is used in two terms: firstly, it is used in the context of overactive bladder (OAB), which is a symptom syndrome, and by its definition, everyone with OAB experiences urinary urgency. Secondly, detrusor overactivity (DO), is a urodynamic observation of a bladder contraction during filling, which is usually, but not always,

associated with urgency. Therefore, DO and OAB are not interchangeable terms.

The categorization of LUTS relates the timing of the symptom to the micturition cycle, hence storage LUTS, voiding LUTS, and LUTS happening straight after voiding has finished (post-micturition symptoms). Many individuals present with several LUTS, and these can be grouped into symptom syndromes. OAB is one, in which storage LUTS are principal features. Underactive bladder (UAB) is another, in which voiding LUTS are prominent. Because OAB and UAB occur mainly in the storage and voiding phases, respectively, it is perfectly possible for one person to have both overactive and underactive symptoms, that may or may not be shown by urodynamics to be due to DO and detrusor underactivity (DU).

## 3 | SEVERITY THRESHOLDS

The HCPs need to be careful in setting thresholds to “qualify” someone as having symptoms (eg, not counting someone as having nocturia because they only get up once per night to pass urine). Unfortunately, there is only limited robust evidence to warrant thresholds. Furthermore, quantifying the significance of symptoms can be difficult as symptoms are subjective, and may vary a lot from day to day, so even a 3 day observation period of a bladder diary may not capture the full story. Furthermore there is considerable variation from person to person, so values are difficult to compare. Thus the ICS emphasises the need to distinguish a symptom's frequency from the impact on quality of life and bother it brings, as they are not necessarily correlated. For example, many men report a relatively severe level of slow stream, but do not describe themselves as particularly bothered by it. In contrast, symptoms like urgency and post micturition dribble can be highly bothersome even if severity appears relatively mild to the impartial observer. For nocturia, people who generally experience a single episode on average each night should be cataloged as having nocturia; it will be non-bothersome for many patients, but that does not mean nocturia is absent.

In practice, it seems reasonable to suggest;

- A symptom is important if the patient says it is bothersome. For example, the symptom of increased daytime frequency (the complaint by the patient who considers that he/she voids too often by day<sup>1</sup>) is very much dependent on the patient's attitude, and there is a large variation in what patients consider intrusive.
- A symptom or sign is important if it can explain mechanism or identify disease. For example, nocturia (**symptom**: the complaint that the individual has to wake at night one or more times to void; **sign**: the number of times an individual passes urine during their main sleep period<sup>1</sup>) may be non-bothersome to the patient if they only void once per night,

but it might identify the early stages of a systemic medical condition, such as chronic kidney disease, needing diagnosis and therapy.<sup>2</sup>

- All urodynamic observations should be noted, as they may explain symptoms or signs, and guide treatment selection. The urodynamic observation of detrusor overactivity (involuntary detrusor contractions during the filling phase) should be noted, even if the contraction is only very low amplitude.

#### 4 | FUNDAMENTALS OF URODYNAMIC PRACTICE

Practitioners must show due consideration to their patients. It is important that staff recognize that somebody attending to do a flow rate test may be a patient experiencing urgency in their day to day life, so it is not appropriate to demand of them that they must pass a minimum voided volume of 150 mL, if they say that they are desperate to go! Furthermore, it is not appropriate to load somebody with very large volumes of liquid in an attempt to try to make them pass urine a bit more quickly for the convenience of the flow rate clinic. This is an unrealistic expectation, and is often detrimental to reliable voiding behavior. For filling cystometry and pressure flow studies, patients are apprehensive about undertaking a test in which their urethra and anus are going to be cannulated. People may feel the whole process is very undignified and compassionate handling by staff is essential. Patients are much more satisfied after urodynamics if they received an information leaflet before they come for their tests.

In flow rate testing, some key points are;

- Calibrate the equipment for reliable results.

- Ask the patient to complete a 3 day bladder diary in advance.
- Provide a suitable environment for testing (a place to wait, rapid access to the meter when needing to pass urine, privacy, a hygienic setting).
- Validate that the voided volume is representative, by comparing with the bladder diary.
- Check that bladder volume at the start of voiding (derived by adding voided volume and post void residual) is in a suitable range (150-500 mL).
- Identify key artefacts; knock, squeeze, and release, to ensure the values reported are indicative of the patient rather than an artefact.

Some basic principles are important for urodynamic units;

1. A urodynamic unit must follow the appropriate instructions given by the equipment manufacturers, and practitioners should calibrate and check their equipment regularly. All staff must be trained and properly supported by experienced clinicians.
2. Before a test, each patient's symptoms should be fully understood, with a symptom score and bladder diary completed. Ideally, potential treatment options should be considered before the test by the referring clinician, who has already discussed them with the patient. Thereby, the test can be done so as to help select the treatment, based on chance of success and identification of potential adverse outcome.
3. When running a test, the pressure traces should be scrutinized throughout the study to be confident recordings are genuinely picking up the pressures. This requires looking to see that the bladder and abdominal pressure lines detect breathing and movement similarly, and that

**TABLE 1** Contents of a urodynamics report proposed in the UK continence society (UKCS) minimum standards for urodynamics<sup>3</sup>

UKCS recommendation	Possible urodynamic observations
Record of the urodynamic findings during filling, whether normal or abnormal	
Detrusor function during filling	Normal/detrusor overactivity
Urethral function during filling	Competent/incompetent
Bladder and urethral sensation	<ul style="list-style-type: none"> <li>• At what volume did the patient report FSF, NDV and SDV?</li> <li>• Did they experience urgency?</li> </ul>
Bladder capacity	Report volume
Record of the urodynamic findings during voiding, whether normal or abnormal	
Detrusor function during voiding	Normal/underactive or acontractile
Urethral function during voiding	Normal/obstructed
Post void residual	Report volume
Statement on whether the patient's everyday symptoms were reproduced <sup>a</sup>	

FSF: first sensation of filling; NDV: normal desire to void; SDV: strong desire to void?

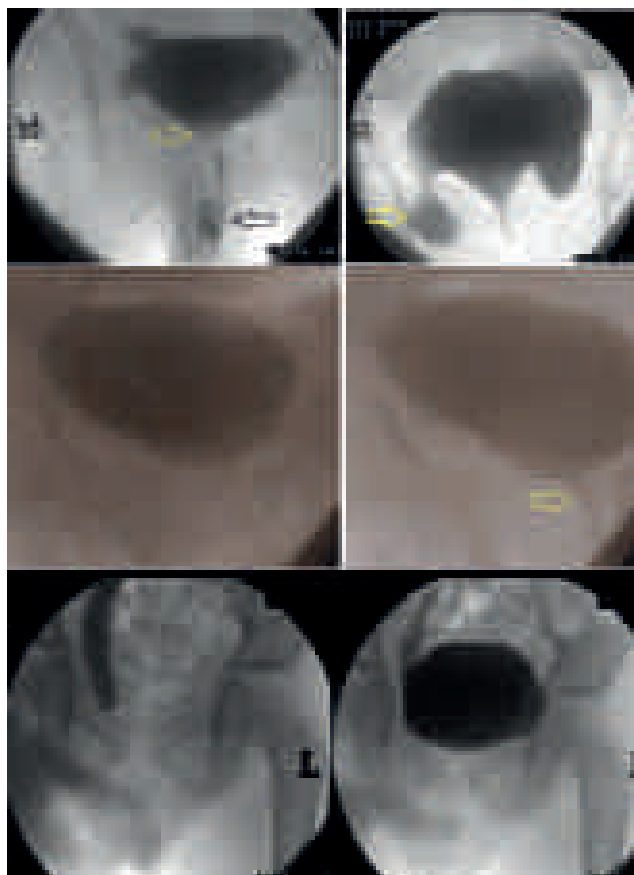
<sup>a</sup>The report should document whether the patient's everyday symptoms were fully reproduced/ partly reproduced/ not reproduced.



coughs are done throughout filling, plus before and after voiding to monitor trace quality.

- a) Regular labels must be applied during the study; these annotations will help anyone not present at the study to interpret the findings later on.
- b) The “zero” button is a software button which drops the vesical and abdominal pressure lines onto zero. This must only be clicked when recording from atmosphere, not when the transducers are connected to the patient—this is a common mistake.

4. After the test, the trace must be scrutinized to make sure that crucial pressure and flow values are genuinely indicative of the patient's urinary tract function. High pressures caused by knocking the equipment, or low pressures because a tube got blocked, must be identified, corrected if possible, and interpreted accordingly. Urodynamic machines and software are not reliably able to identify artefacts with current technology. Key parameters such as maximum flow rate, bladder outlet obstruction (BOO) index or bladder contractility index



**FIGURE 1** Additional information with radiological imaging during urodynamics. Top left; identifying the site of BOO in a man with Parkinson's disease. In this case, the obstruction is at the bladder neck (yellow upper arrow). This man also had significant pooling in the bulbar urethra (black lower arrow), which caused post micturition dribble. Top right; a man with large bladder diverticula, the one on the right entering an inguinal hernia (arrow). These diverticula made it very difficult to measure bladder pressure. Middle pictures; a man with prior transurethral resection of the prostate (TURP) whose presenting complaint was urgency. He did not have detrusor overactivity. During filling cystometry, contrast was not present in the proximal urethra to begin with (middle left image), but it was seen to enter the urethra (arrow, middle right) synchronous with the patient's report of urgency, which was the typical sensation of his presentation. Lower pictures; images taken at the end of voiding in a boy with vesico-ureteric reflux. The left hand image confirmed bladder emptying was complete. The right hand image was taken 30 s later, and a lot of contrast had re-entered the bladder— a “pseudo-residual.” If this patient had been studied with a bladder scanner instead of videourodynamics, a post void residual might wrongly have been presumed

may be reported by a urodynamic machine, but practitioners must check the source traces for plausibility, noting any spikes which the machine may inappropriately have used for deriving those parameters, and moving the cursors to instruct the machine where the values can be taken.

The final report must be carefully phrased, describing whether symptoms reported by the patient were actually encountered during the test, and what was the urodynamic observation at that time (Table 1). Of course, certain symptoms simply cannot be reproduced during a urodynamic test—obvious examples being nocturia, nocturnal enuresis, and coital incontinence. For these symptoms, observations made during urodynamics must not be claimed as the cause of the symptom. The “only report what you see” approach is crucial for safer consideration to making treatment recommendations.

## 5 | VIDEOURODYNAMICS

Conventional urodynamic tests principally can be used if there is a relatively evident underlying mechanism. The main situations are;

- Post-obstetric stress incontinence in a healthy woman, where urethral hypermobility has been identified on physical examination.
- Voiding LUTS in a man in the right age range, where benign prostate enlargement is identified on rectal examination.

For these individuals, the underlying mechanism can be assumed with reasonable confidence. Thus, if stress urinary incontinence is seen in the first situation, the hypermobility is probably the cause. In the second, if BOO is seen, the prostate enlargement is probably the cause. However, many other presentations throw up more complex possibilities and a range of causes should be considered. Using X-ray contrast as the urodynamic filling medium, and taking images at key moments during the tests (“videourodynamics”) allows greater confidence when deciding what mechanism(s) are present, and potentially linking them to symptoms. The additional information that X-ray screening can achieve includes;

1. Instantaneous detection of leakage.
  - a) If there is delay for the leakage reaching the flow meter, for example, in men with post prostatectomy incontinence due to sphincter damage.
  - b) When evaluating leak point pressures in a patient with neurological disease.

This precision on identifying timing of leakage allows the urodynamicist to know the detrusor pressure at the precise moment when it matters.

2. Identifying the exact location of bladder outlet obstruction; bladder neck (Figure 1a), prostate, urethral sphincter/pelvic floor, stricture. This can be very valuable for establishing the cause of BOO, and hence deciding on treatment.
3. Detecting muscle function deficits in patients with neurological disease.
  - a) An open bladder neck may indicate a deficit in sympathetic innervation.
  - b) A poorly supported bladder base and proximal urethra, which can be seen to descend on straining, may be due to pelvic floor weakness and may reflect muscle denervation in men, or women with no obstetric history.
4. Explaining difficulty in detecting expected increased pressure change, due to dispersal into a low pressure region.
  - a) A large bladder diverticulum (Figure 1b).
  - b) Significant vesico-ureteric reflux (VUR).
5. Identifying VUR in its early stages; potentially it may be possible to treat early VUR with a bulking injection of the ureteric orifice.
6. Correlating a patient's reported urgency sensation with urine entering the proximal urethra (Figure 1c); this might help explain why some people with urgency do not gain benefit from medical therapy of OAB.
7. Demonstrating whether the bladder empties fully; a well-timed X-ray taken at the exact end of voiding confirms whether the bladder has emptied fully. This is more accurate than bladder scanning, since the scanner takes a while to get in position, during which time people with VUR may have had enough liquid come back in to the bladder to show up on a scanner— a “pseudo-residual” (Figure 1d).
8. Identifying pooling in patients with post micturition dribbling.
  - a) Pooling in the male urethral bulb (Figure 1a).
  - b) Vaginal pooling.

## 6 | CONCLUSIONS

The ICS has pushed a logical and systematic approach to terminology and assessment in lower urinary tract function. In the current review we emphasize the importance of being specific with the language used, the need to justify severity thresholds, the philosophy underlying urodynamic testing and the potential benefits of videourodynamics in patients whose underlying pathophysiology is potentially complex.

**ORCID**

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

**REFERENCES**

1. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21(2):167–178.
2. Drake MJ. Should nocturia not be called a lower urinary tract symptom?. *Eur Urol*. 2015;67(2):289–290.
3. Abrams P, Personal Communication, on behalf of the Working Group on the UK Continence Society Minimum Standards for Urodynamics 2018.

**How to cite this article:** Drake MJ, Abrams P.

A commentary on expectations of healthcare professionals when applying the international continence society standards to basic assessment of lower urinary tract function. *Neurourology and Urodynamics*. 2018;37:S7–S12.  
<https://doi.org/10.1002/nau.23732>

# Fundamentals of terminology in lower urinary tract function

Marcus J. Drake<sup>1,2</sup> 

<sup>1</sup> Translational Health Sciences, Bristol Medical School, Bristol, UK

<sup>2</sup> Bristol Urological Institute, Southmead Hospital, Bristol, UK

## Correspondence

Marcus J. Drake, Bristol Urological Institute, 3rd Floor L&R Building, Southmead Hospital, Bristol BS10 5NB, UK.  
Email: marcus.drake@bristol.ac.uk

**Aims:** To summarize basic definitions in the International Continence Society (ICS) Standardization of Terminology in lower urinary tract (LUT) function and their application.

**Methods:** Fundamental terminology in the ICS Standardization of Terminology LUT Function was identified and summarized.

**Results:** Evaluation of LUT requires appreciation of symptoms, signs and urodynamic observations. Symptoms are categorized according to their occurrence during the micturition cycle into storage symptoms (eg, increased daytime frequency [IDF], urgency, nocturia, or incontinence) or voiding and post-voiding symptoms (eg, slow stream or post micturition dribbling). Several problems may be present, giving rise to symptom syndromes, notably overactive bladder (during the storage phase) or underactive bladder (during the voiding phase). Signs may be derived from a bladder diary or may be elicited on physical examination. Urodynamic observations may be made by assessing flow rate, and this is combined with pressure measurement when undertaking filling cystometry and pressure flow studies. Key elements of flow and pressure measurement are described.

**Conclusions:** The review provides a succinct summary of symptoms, signs, and urodynamic observations as set out in the ICS Standard on LUT Function.

## KEY WORDS

LUTS, overactive bladder, standardization, urodynamics

## 1 | INTRODUCTION

The International Continence Society (ICS) has for many years led the development of standardized definitions of the symptoms, signs, urodynamic observations, and conditions associated with lower urinary tract dysfunction (LUTD). The current document is a summary of core terminology related to LUTD for use in a general medical context. For example, LUTD is commonly encountered by healthcare professionals working in gerontology, neurology, and nephrology. The terminology is also useful for residents in urology or gynaecology preparing for examinations. This document is not intended for subspecialists working in functional urology,

urogynaecology, and neuro-urology, for whom the ICS has developed a range of standardizations (see [www.ics.org](http://www.ics.org)). These cover the full scope terms in different contexts and patient groups for use in subspecialty research and clinical practice, which are beyond the scope of the current review.

## 2 | METHODS

Recommendations in the ICS Standard on LUTD<sup>1</sup> were reviewed and summarized, this document being selected as the terminology is applicable to all patients regardless of gender. Definitions of nocturia,<sup>2</sup> underactive bladder,<sup>3</sup> and pelvic organ

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

prolapse (POP)<sup>4</sup> are those given in subsequent context-specific ICS consultations or documents. Definitions and key terms are generally transcribed verbatim. In the original document, many of the definitions are accompanied by explanatory or exemplary footnotes. The footnotes have been adapted (non-verbatim) in certain cases for the current review, or have been excluded for the sake of brevity, and additional explanatory text is included. Readers should note that in urogynaecology practice, some terms have been updated in the International Urogynecology Association/ICS joint report on the terminology for female pelvic floor dysfunction,<sup>4</sup> where there is some divergence from the reported definitions in the current review. Accordingly, users are advised to specify the source of the definitions they employ when publishing in the area.

### 3 | LOWER URINARY TRACT SYMPTOMS

Normal lower urinary tract (LUT) function relies on the facility for storage of urine in the bladder, and the ability to pass urine (voiding) at a time to suit the individual. The alternation between these two modes of storage and voiding is known as the micturition cycle (Figure 1). Lower urinary tract symptoms (LUTS) are categorized according to the time at which they are experienced in relation to the micturition cycle;

#### 1. Storage symptoms

- a) Increased daytime frequency (IDF) is the complaint by the patient who considers that he/she voids too often by day.<sup>1</sup> There is no minimum voiding frequency serving as a threshold for the symptom, since it is highly subjective, and there is a wide overlap between normal and symptomatic.



**FIGURE 1** The micturition cycle as anchor for categorizing LUTS. Each individual person stores urine until they make an active decision to switch to voiding in response to a sensation or a social reason (eg, anticipation that toilets will be difficult to access in the foreseeable future as a result of a meeting or journey, or when going to bed for sleep). Once voiding is complete, storage mode is re-established. Voiding occupies only a very small part of the cycle (eg, if frequency is six times daily, and duration of each void is 20 s, then only 2 min of 24 h may be in voiding mode). NDV, normal desire to void; SDV, strong desire to void

- b) Nocturia is waking at night to pass urine.<sup>2</sup> If a person typically passes urine once per night, they should be documented as having nocturia even if it does not cause them impairment of quality of life.

“Day” and “night” for IDF and nocturia refer to the patient’s sleeping pattern, not environmental daylight and night-time.

These symptoms are strongly influenced by fluid intake, and healthcare practitioners need to factor in whether the symptom reflects LUTD, or rather a physiological mechanism dealing with excessive intake of free water or salt, or a pathological consequence of a systemic medical condition (eg, chronic kidney disease).<sup>5</sup>

- c) Urgency is the complaint of a sudden compelling desire to pass urine which is difficult to defer.<sup>1</sup>
- d) Urinary incontinence is the complaint of any involuntary leakage of urine.<sup>1</sup>

Incontinence is subclassified according to the circumstances most typically eliciting the problem

- (i) Urgency urinary incontinence is the complaint of involuntary leakage accompanied by or immediately preceded by urgency.
- (ii) Stress urinary incontinence is the complaint of involuntary leakage on effort or exertion, or on sneezing or coughing.
- (iii) Mixed urinary incontinence is the complaint of involuntary leakage associated with urgency and also with exertion, effort, sneezing, or coughing.

#### 2. Voiding and post-voiding symptoms

##### *Voiding symptoms*

- a) Hesitancy is the term used when an individual describes difficulty in initiating micturition resulting in a delay in the onset of voiding after the individual is ready to pass urine.<sup>1</sup>
- b) Slow stream is reported by the individual as his or her perception of reduced urine flow, usually compared to previous performance or in comparison to others.<sup>1</sup>
- c) Intermittency is the term used when the individual describes urine flow which stops and starts, on one or more occasions, during micturition.<sup>1</sup>

In addition, a person may report splitting of the stream, or spraying. They may also describe straining to void, which is muscular effort used to either initiate, maintain, or improve the urinary stream.

Post-voiding symptoms are experienced immediately after voiding.

- d) Feeling of incomplete emptying is experienced by the individual after passing urine.<sup>1</sup>

- e) Post-micturition dribble describes the involuntary loss of urine immediately after an individual has finished passing urine.<sup>1</sup>

All these symptoms may vary considerably over time, even fluctuating on successive days. The healthcare professional needs to take into account this variability, and clarify with the patient how often each symptom may be experienced to try to build a representative picture. Likewise, the presence of a symptom (severity) does not always lead to impact on quality of life (bother), and healthcare professionals should consider both severity and bother for a complete evaluation of LUTS.

### 3.1 | Symptom syndromes

Initial management may rely on empirical diagnoses applied after clinical assessment of a patient's LUTS, combined with basic investigations, such as urinalysis. These may be used for the purposes of applying initial conservative management, and do not rely on invasive urodynamic observations.

1. Overactive bladder syndrome (OAB) is characterized by urinary urgency, with or without urgency urinary incontinence, usually with IDF and nocturia, if there is no proven infection or other obvious pathology.<sup>6</sup>
2. Underactive bladder syndrome (UAB) is characterized by a slow urinary stream, hesitancy, and straining to void, with or without a feeling of incomplete bladder emptying sometimes with storage symptoms.<sup>3</sup>

OAB is applicable during the storage phase of the micturition cycle, and UAB during the voiding phase, so it is possible for one individual to manifest both symptom syndromes.

## 4 | SIGNS SUGGESTIVE OF LOWER URINARY TRACT DYSFUNCTION

### 4.1 | Voiding frequency

Frequency refers to the number of voids observed in a defined time period<sup>1</sup>; it is not a symptom (ie, it should not be confused with IDF). The frequency of voiding is generally identified by asking the patient to complete a record;

1. A micturition time chart, which records only the times of micturitions for at least 24 h.
2. A frequency volume chart (FVC), which also records the volumes voided, as well as the time of each micturition, day and night, for at least 24 h.
3. A bladder diary: this records the times of micturitions and voided volumes (VV), and additional information

appropriate for the individual being evaluated. It could include incontinence episodes, pad usage, fluid intake, the degree of urgency, and the degree of incontinence.

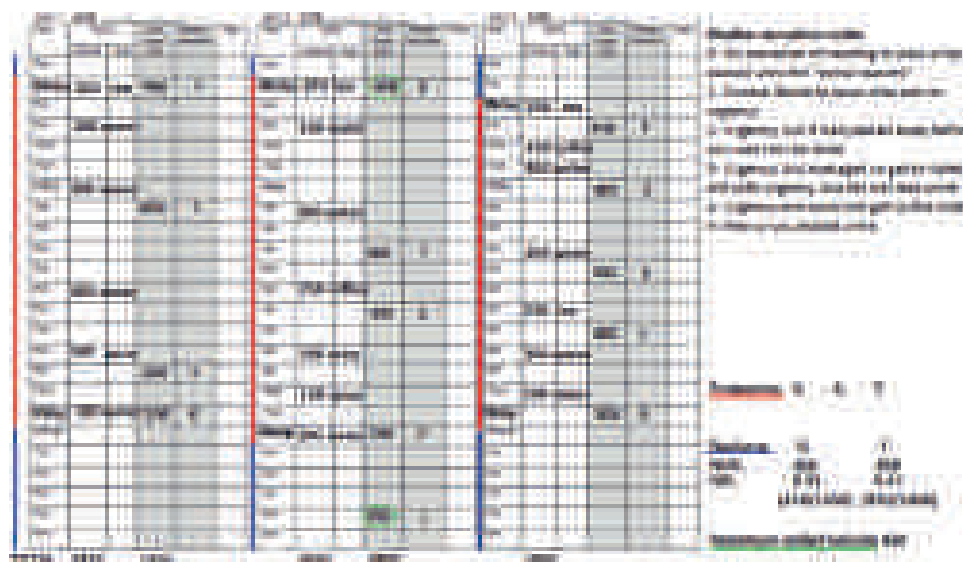
Three-day recordings are generally used in clinical practice. Any of these charts make it possible to identify 24-h frequency of voiding; provided the waking and sleeping times are marked, this can be broken down into the daytime frequency and nocturia (Figure 2). The sign of nocturia is the number of times an individual passes urine during their main sleep period.<sup>2</sup> Polyuria is the measured production of more than 2.8 L of urine in 24 h in adults.<sup>1</sup> Nocturnal polyuria is present when an increased proportion of the 24-h output occurs at night. If polyuria or nocturnal polyuria is present, the observation of a high voiding frequency may reflect a cause other than LUTD (eg, systemic illness or behavioral factors such as a high fluid intake).

A diary that includes fluid intake and urine output measurement generally shows the former exceeds the latter each day, but on some days there can be a discrepancy (as seen on the totals for the second day in Figure 2). Such discrepancies generally even out if the diary is completed over a longer time. Alternatively, they may suggest inaccurate completion of the diary, or inability to measure the liquid content of the person's food intake.

### 4.2 | Physical examination

In LUTD, examination should cover abdominal, pelvic, and perineal examination. In general, a focused neurological examination is needed, and this will be more extensive for patients with possible neurogenic LUTD.<sup>7</sup>

1. Urinary incontinence (the sign) is urine leakage seen during examination.<sup>1</sup>
  - a) Stress urinary incontinence is the observation of involuntary leakage from the urethra, synchronous with exertion/effort, or sneezing or coughing
  - b) Extra-urethral incontinence is the observation of urine leakage through channels other than the urethra.
2. POP is the descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix), or the apex of the vagina (vaginal vault or cuff scar after hysterectomy).<sup>4</sup> The presence of any such sign should be correlated with relevant POP symptoms. More commonly, this correlation would occur at the level of the hymen or beyond.<sup>4</sup>
3. Pelvic floor muscle function can be qualitatively evaluated according to the tone at rest, and the strength of a voluntary or reflex contraction.<sup>1</sup> Strength, duration, displacement, and repeatability should be considered. It may be reported qualitatively as strong, weak, or absent, and there are validated grading systems.



**FIGURE 2** Information abstracted from a bladder diary,<sup>10</sup> showing some commonplace features. “Woke” indicates the start of each day, “sleep” for the start of each night. Daytime frequency is the number of voids recorded during waking hours and includes the last void before sleep and the first void after waking and rising in the morning. Frequency was 4-5 over the three complete days of the study period. Twenty-four hour production is measured by collecting all urine for 24 h. This is usually commenced after the first void produced after rising in the morning and is completed by including the first void on rising the following morning. The range in the current example was 1450-1800 mL for the two complete 24 h using this definition. Nocturia (nocturnal frequency) is the number of voids recorded during a night's sleep: each void is preceded and followed by sleep. It was 0-1 over the two complete nights of the study period. Nocturnal urine volume (NUV) is the total volume of urine passed between the time the individual goes to bed with the intention of sleeping and the time of waking with the intention of rising; it excludes the last void before going to bed but includes the first void after waking. NUV was high on the second night, perhaps due to alcohol consumption in the preceding evening. This also is associated with a high nocturnal polyuria index (NPI, calculated from  $NPI = NUV/24\text{ h volume}$ ) at 0.47. The maximum VV was normal (450 mL). Bladder sensation was generally 1 or 0; the only 2 was on day 3, and followed a couple of caffeine drinks

4. Pad testing may be used to quantify the amount of urine lost during incontinence episodes and methods range from a short provocative test to a 24-h pad test.<sup>2</sup>

## 5 | URODYNAMIC OBSERVATIONS

Bladder and bladder outlet function both need to be considered for a full understanding of a person's LUT. Urodynamics is a general term for tests that assess bladder and urethra function during the micturition cycle, and includes tests such as uroflowmetry, ambulatory urodynamics and videourodynamics. Urodynamics is also commonly used more specifically to indicate filling cystometry and pressure flow studies (PFS).

### 5.1 | Measurement of urine flow

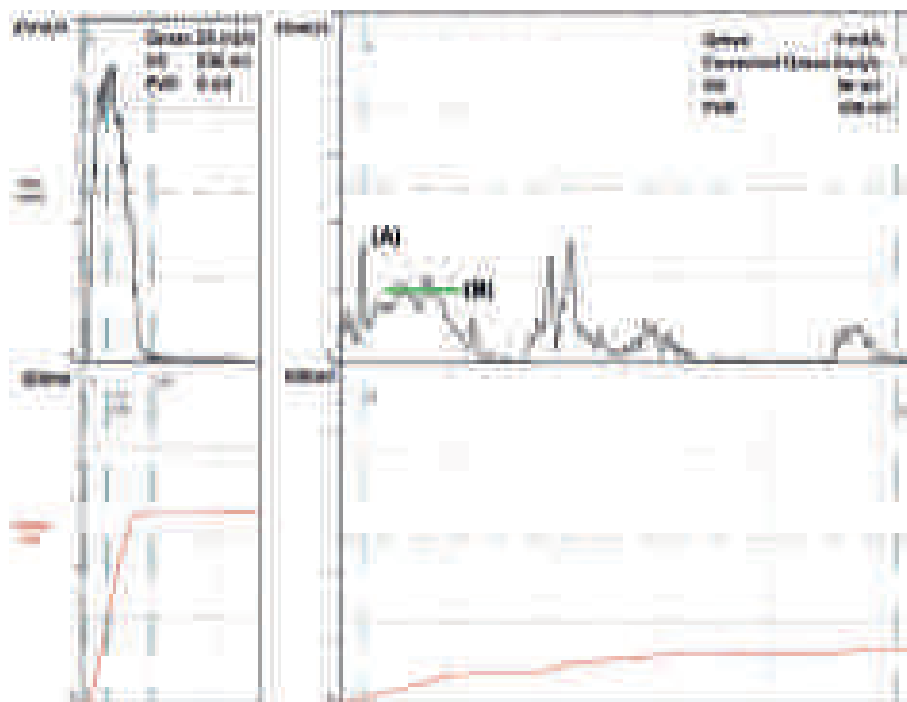
Flow rate is defined as the volume of fluid expelled via the urethra per unit time (in mL/s) (Figure 3). “Free flow rate”

means that no tube is present for recording bladder pressure. Urine flow is either continuous or intermittent, depending on whether any interruptions happen during flow. A continuous flow curve may be a smooth arc-shaped curve, or it may be fluctuating, when there are multiple peaks during a period of continuous urine flow. Maximum flow rate ( $Q_{\max}$ ) is the maximum measured value of the flow rate after correction for artefacts. VV is the total volume expelled via the urethra. Post void residual (PVR) is the volume of urine left in the bladder at the end of micturition.<sup>1</sup> If, after repeated voiding, no residual urine is demonstrated, then the finding of a PVR should be considered an artifact, due to the circumstances of the test.

### 5.2 | Measurement of bladder pressure

Both vesical pressure in the bladder ( $p_{\text{ves}}$ ) and abdominal pressure ( $P_{\text{abd}}$ ) are measured together, since the bladder is an abdominal organ.  $P_{\text{abd}}$  is generally estimated from rectal or vaginal recordings. Detrusor pressure ( $P_{\text{det}}$ ) is that component of intravesical pressure that is created by forces





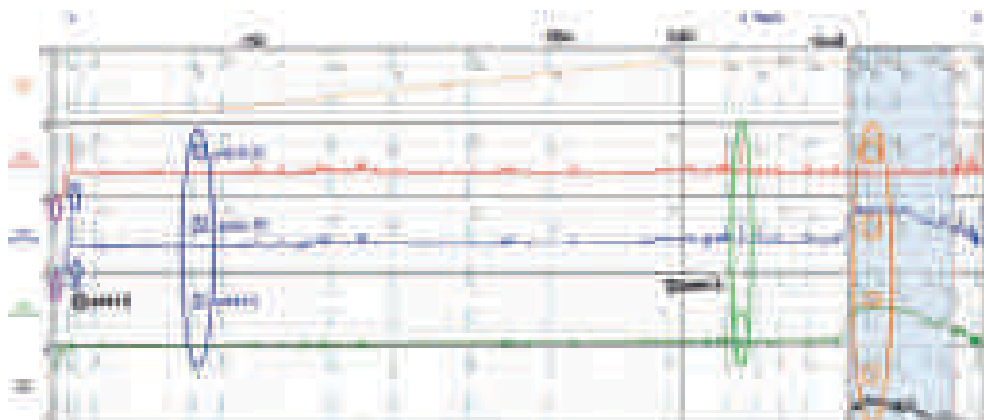
**FIGURE 3** Uroflowmetry (free flow rate testing). On the left is a normal flow rate test for a women. It shows a continuous flow, with a good maximum flow rate ( $Q_{\max}$ ) and complete emptying, with a suitable VV. On the right is an abnormal test suggesting voiding dysfunction. The pattern of flow is interrupted. The  $Q_{\max}$  reported by the machine was 9 mL/s, but inspection of the trace shows the machine interpreted a spike (A) as the maximum flow, which will not be indicative of the patient's own urinary tract function, but rather is likely to be an artefact (eg, an aberration of flow delivery to the meter, a strain by the patient, or the patient moving on the commode). By definition,  $Q_{\max}$  must be corrected to exclude artefacts.<sup>1</sup> Correcting the  $Q_{\max}$  to a part of the curve (B) that is likely to be properly representative of urinary tract function gives a lower  $Q_{\max}$  of 6 mL/s. The VV was low, but when the PVR of 108 mL is factored in, the bladder volume can be considered adequate when the flow test was done ( $96 + 108 = 204$  mL)

in the bladder wall (passive and active), and it is calculated by subtracting  $P_{\text{abd}}$  from  $P_{\text{ves}}$ .<sup>1</sup>  $P_{\text{det}}$  is computed throughout filling cystometry and PFS, and is plotted alongside the two measured pressures ( $P_{\text{ves}}$  and  $P_{\text{abd}}$ ) and flow ( $Q$ ) (Figure 4).

Filling cystometry assesses the storage phase of the patient's micturition cycle. Filling cystometry should be described according to bladder sensation, detrusor activity, bladder compliance, and bladder capacity. Bladder compliance describes the relationship between change in bladder volume and change in detrusor pressure, and is calculated by dividing the volume change by the change in  $p_{\text{det}}$  during that change in bladder volume<sup>1</sup> (Figure 4). The standards points are (i)  $p_{\text{det}}$  at the start of bladder filling and the corresponding bladder volume (usually zero) and (ii) the  $p_{\text{det}}$  and bladder volume at cystometric capacity or immediately before the start of any detrusor contraction that causes significant leakage.

Both points are measured excluding any detrusor contraction. Detrusor overactivity (DO) is a urodynamic observation characterized by involuntary detrusor contractions during the filling phase which may be spontaneous or provoked. Provocative maneuvers are techniques used during urodynamics in an effort to provoke DO, for example, rapid filling, use of cooled medium, postural changes, and hand washing.<sup>1</sup>

Cystometric capacity is the bladder volume at the end of the filling cystometrogram. It is the volume voided, plus any PVR. The PFS starts when "permission to void" is given (Figure 4), or when uncontrollable voiding begins, and ends when the patient considers voiding has finished. PFS is a model of the patient's voiding phase and combines synchronous flowmetry with measurement of  $p_{\text{ves}}$ . Thus, flow rate testing in PFS differs from free flowmetry by the presence of a fine tube to enable pressure measurement. Normal voiding is achieved by a voluntarily initiated



**FIGURE 4** Pressure measurement. The record shows continuous tracings of two measured pressures; the abdominal pressure  $p_{abd}$  in red, and the vesical bladder pressure  $p_{ves}$  in blue. These are continuously subtracted ( $p_{ves}-p_{abd}$ ) to give the detrusor  $p_{det}$  in green. Also shown are the volume instilled in orange, and flow rate in black. Filling cystometry precedes permission to void (indicated with “void”), and the pressure flow study (PFS) follows it. The zero reference point is atmospheric pressure (purple arrows), so when the transducers are connected to the patient (blue arrows), there is an obvious rise in  $p_{abd}$  and  $p_{ves}$ , referred to as “resting pressures”—the blue oval indicates the resting pressures for this patient at one timepoint. Coughs (indicated with “c”) are used to check that  $p_{abd}$  and  $p_{ves}$  detect a short spike of pressure (larger green oval), and that the  $p_{det}$  has a deflection which is equal above and below the line, the biphasic artefact (smaller green oval). It is important to check pressure recording with a cough at the start of filling, and on each side of the PFS. Normal detrusor function allows bladder filling with little or no change in pressure, and there should be no involuntary phasic contractions despite provocation.<sup>1</sup> In this study, the  $p_{det}$  was 2 cmH<sub>2</sub>O at the beginning of the filling cystometry, and eight at the end; since filled volume was 500 mL, the compliance (change in volume/change in pressure = 100/[8-2]) was 17 mL/cmH<sub>2</sub>O. Sensations are reported by the patient and annotated on the trace. First sensation of bladder filling (FSF) is the feeling the patient has, during filling cystometry, when he/ she first becomes aware of the bladder filling. First desire to void (FDV) is the feeling that would lead the patient to pass urine at the next convenient moment, but voiding can be delayed if necessary. Strong desire to void (SDV) is a persistent desire to void without the fear of leakage.<sup>1</sup> A provocation was applied to try to elicit DO by making the sound of running water “taps”; no change in  $p_{ves}$  or  $p_{det}$  was seen, so this patient had a stable detrusor. In the PFS, the key parameters derive from the time of maximum flow rate ( $Q_{max}$ ). The current patient had a  $Q_{max}$  of 8 mL/s and detrusor pressure at  $Q_{max}$  of 51 cmH<sub>2</sub>O, so his BOO Index was 35 and Bladder Contractility Index was 91.  $p_{abd}$  did not change at that time, so no allowance has to be made for the effect on  $p_{det}$ .

continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in the absence of obstruction. Detrusor underactivity (DUA) is a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete emptying within a normal time span. Bladder outlet obstruction (BOO) is the generic term for obstruction during voiding and is characterized by increased detrusor pressure and reduced urine flow rate.<sup>1</sup> For male patients, BOO and DUA can be quantified using the BOO Index and the Bladder Contractility Index.<sup>8</sup> They rely on measuring  $Q_{max}$  and detrusor pressure at maximum flow, which is the lowest pressure recorded at maximum measured flow rate (see <sup>9</sup>).

## 6 | CONCLUSIONS

The ICS Standardization provides a logical framework and definitions to describe symptoms, signs, and urodynamic observations in relationship to the micturition cycle.

## ORCID

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

## REFERENCES

1. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
2. Hashim H, Drake MJ. Basic concepts in nocturia, based on International Continence Society standards in nocturnal lower urinary tract function. *Neurourol Urodyn*. 2018;37:S20–S24.
3. Chapple CR. Terminology report from the International Continence Society (ICS) working group on underactive bladder (UAB). *Neurourol Urodyn*. 2018;In press.
4. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
5. Cornu JN, Abrams P, Chapple CR, et al. A contemporary assessment of nocturia: definition, epidemiology, pathophysiology,

- and management—a systematic review and meta-analysis. *Eur Urol*. 2012;62:877–890.
6. Drake MJ. Do we need a new definition of the overactive bladder syndrome? ICI-RS 2013. *Neurourol Urodyn*. 2014;33:622–624.
  7. Gajewski JB, Schurch B, Hamid R, et al. An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). *Neurourol Urodyn*. 2018;37:1152–1161.
  8. Abrams P. Bladder outlet obstruction index, bladder contractility index and bladder voiding efficiency: three simple indices to define bladder voiding function. *BJU Int*. 1999;84:14–15.
  9. Drake MJ, Doumouchtsis SK, Hashim H, Gammie A. Fundamentals of urodynamic practice, based on international continence society good urodynamic practices recommendations. *Neurourol Urodyn*. 2018;37:S44–S49.
  10. Bright E, Cotterill N, Drake M, Abrams P. Developing and validating the International Consultation on Incontinence Questionnaire bladder diary. *Eur Urol*. 2014;66:294–300.

**How to cite this article:** Drake MJ. Fundamentals of terminology in lower urinary tract function. *Neurourology and Urodynamics*. 2018;37:S13–S19. <https://doi.org/10.1002/nau.23768>

# Basic concepts in nocturia, based on international continence society standards in nocturnal lower urinary tract function

Hashim Hashim<sup>1</sup>  | Marcus J. Drake<sup>2</sup> 

<sup>1</sup> Bristol Urological Institute, Bristol, United Kingdom

<sup>2</sup> University of Bristol and Bristol Urological Institute, Bristol, United Kingdom

## Correspondence

Hashim Hashim, Bristol Urological Institute, Office 4, Gate 38, Level 3, Pink Atrium, Brunel Building, Southmead Hospital, Bristol, BS10 5NB, United Kingdom.  
Email: h.hashim@gmail.com

**Aims:** To review the recommendations on nocturia in the International Continence Society (ICS) Standardization documents, setting out key definitions and parameters for use in clinical practice.

**Methods:** Definitions and evaluations described in the ICS Standards on Nocturia and Terminology for Lower Urinary Tract Function were identified and summarized.

**Results:** The terms have been divided into signs and symptoms. Nocturia as a symptom is waking at night to pass urine and as a sign is the number of times an individual passes urine during their main sleep period. Nocturnal polyuria as a symptom is passing large volumes of urine at night and as a sign is the excessive production of urine during the individual's main sleep period. These should be quantified using a 3-day bladder diary, thereby facilitating identification of 24-h polyuria, nocturnal polyuria, lower urinary tract dysfunction, or sleep disorder.

**Conclusions:** The summary reflects the multifactorial influences in nocturia and provides a pragmatic insight into bladder diary analysis for deriving key parameters relevant to clinical therapy.

## KEYWORDS

enuresis, International Continence Society, nocturia, nocturnal polyuria, terminology

## 1 | INTRODUCTION

Nocturia is a significant problem affecting a large proportion of the population, especially in older age groups.<sup>1,2</sup> Increasing recognition of its prevalence and potential health impact for individual patients and for population health has led to recognition of the need to establish the specific underlying mechanisms relevant for anyone presenting with the symptom. Crucially, a range of observations need to be properly understood by any clinician responsible for caring for these patients.

In 2002, the International Continence Society (ICS) defined nocturia as the complaint that the individual has to

wake at night one or more times to void.<sup>3</sup> In 2014, a new ICS Nocturia working group was set up to review the terminology related to that document and will be reporting in 2018. The current review sets out the principles underlying the fundamental nocturia terminology, and describes how they are applied in an example bladder diary to help direct healthcare professionals toward the most logical approach to investigation and therapy. The aim is for this to be a practical and pragmatic guide for use in both clinical and research settings.

## 2 | METHODS

Recommendations in the ICS standards on Nocturia<sup>4</sup> and Lower Urinary Tract Function,<sup>5</sup> and the 2018 ICS consultation on nocturia terminology, were reviewed and

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

summarized. From these, definitions and key terms are generally transcribed verbatim. Additional explanatory text is included for context. Explanatory or exemplary footnotes from the original documents have been adapted or excluded for the sake of brevity. Users are advised to refer to the source documents and specify the source of the definitions they employ when citing definitions.

The terminology is broken into symptoms, that is, as reported by the patient, and signs. Lower urinary tract symptoms (LUTS) are broken down into storage, voiding and post-voiding symptoms, depending on their timing in relation to the micturition cycle. Nocturia is categorized as a storage symptom, based on the fact that a person is in the storage phase of the micturition cycle when asleep. For nocturia, the key signs are the voiding frequency and the voided volumes during the main sleep period; these are usually captured from a frequency/volume chart (FVC) or bladder diary.

“Night-time” for the purposes of the nocturia terminology refers to the individual's sleep cycle, rather than the solar cycle (from sunset to sunrise). For this reason, a shift worker sleeping between shifts may experience nocturia during daylight hours.

### 3 | URINE OUTPUT

The production of urine by the kidneys is a continuous process of filtration in the glomeruli, and reabsorption (water and soluble nutrients) in the tubules. Urine production serves to balance water, salt, and acid levels according to the homeostatic needs of the person, and this is principally a result of adjustments to the tubular reabsorption. Surplus water increases urine production (diuresis), and surplus salt also increases urine production (natriuresis). Making urine also serves to dispose of toxins and by-products.

The rate of urine production increases if there is;

- Diuresis
- Natriuresis
- Products in the glomerular filtrate in such large quantities that the tubules cannot reabsorb it all (poorly controlled diabetes mellitus can cause this, due to glucosuria)
- Dysfunction of the renal tubules

Tubular dysfunction can occur in chronic kidney disease. If associated with disease affecting the glomeruli, estimated glomerular filtration rate (eGFR), and creatinine levels will be abnormal. If it is a selective tubular dysfunction, eGFR and creatinine levels may be normal.

The continuous production of urine is the task of the upper urinary tract (UUT). Expelling the urine at appropriate times, and storing at other times, is the task of the lower urinary tract (LUT). The “micturition cycle” is a concept describing how

the LUT serves these two contrasting tasks of urine storage and voiding. Voiding generally can be initiated by someone at any time that suits them, but the main driver prompting people to take active steps to pass urine is when they feel their bladder is “full.”

The number of times someone has to pass urine over a specified time period reflects;

1. How fast the UUT is producing urine
2. The bladder volume at which the LUT signals “fullness”

Renal regulation tends to see the rate of urine production reduced when the person is asleep. In young people living a healthy lifestyle, rate of UUT urine production is low and LUT storage volume is high, so nocturia is uncommon.

#### 3.1 | Voiding frequency

The symptom of nocturia is present if the patient reports waking at night to pass urine. Nocturia is also a sign indicated by the number of times an individual passes urine during their main sleep period.

#### 3.2 | Volume of voiding

In order to decide whether the presence of nocturia reflects production of large quantities of urine from the UUT, an estimate of urine output is needed. 24-h voided volume is the total volume of urine passed during a 24-h period excluding the first morning void of the period. A 24-h polyuria indicates that 24-h urine output is more than 40 mL/kg, in men and women. The general increase in urine output will elevate the voiding frequency in the daytime and night-time, outstripping even normal bladder capacity. The symptom of nocturnal polyuria is present if the patient reports passing large volumes of urine at night. Nocturnal polyuria is also a sign indicated by excessive production of urine during the individual's main sleep period. It is often expressed as a proportion of the 24-h voided volume. The nocturnal polyuria index is the nocturnal urine volume/24-h voided volume, expressed as a percentage. NP is said to be present if the NP<sub>i</sub> is more than 33% in the elderly (eg, aged more than 65), and more than 20% in younger individuals.

### 4 | CAPTURING THE SYMPTOMS

The ICS emphasises the need to distinguish a symptom's severity from the bother it brings, as they are not necessarily correlated. In nocturia, there are various symptom scores which can assess both the severity and associated bother of nocturia and other LUTS, such as the International Consultation on Incontinence Questionnaires (ICIQ).<sup>6</sup> There

is a specific score for quality of life in nocturia (ICIQ-NQoL<sup>7</sup>). Practitioners need to be clear that waking once per night to pass urine, on average, means nocturia is present. Research shows that a single episode of nocturia is generally of relatively low bother to the patient (assuming they return to sleep satisfactorily). However, even if causing low bother, it still constitutes nocturia. Future research is needed to identify whether nocturia once per night might actually be medically significant (eg, the start of a medical problem for which early identification and treatment might avoid future progression).

Direct questioning is needed to establish the symptom of NP. Some discussion is also needed to review “reason for waking”; the symptom of nocturia implies that the need to pass urine was the reason for waking. This is distinct from the situation that sleep disturbance may actually have been for some other reason, but the person went to pass urine because they happened to be awake.

## 5 | ASSESSING THE SIGNS

The fundamental tools for assessing signs in LUTS are the physical examination and the bladder diary. Examination can

identify whether the person has risk factors for NP (eg, a physical body habitus suggesting risk of obstructive sleep apnoea or the presence of peripheral oedema), or whether they have chronic urinary retention.

A well-completed FVC or bladder diary<sup>8</sup> recorded for three days<sup>9</sup> is invaluable. The time of going to bed and the time of waking up from sleep must be clearly marked by the patient (it is rather common for patients to overlook noting these, rendering the diary uninterpretable for analyzing nocturia). From the chart or diary the following can be calculated (Figure 1):

- The daytime and night-time voiding frequency
- 24-h voided volume: the total volume of urine passed during a 24-h period excluding the first morning void of the period.
- Nocturnal urine volume: the total volume of urine produced during the individual's main sleep period.
- Nocturnal polyuria index: the nocturnal urine volume/24-h voided volume.
- Maximum voided volume, average voided volume, and bladder sensation scores



**FIGURE 1** Analysis of a 3-day bladder diary. On the first day, the person woke at 9 am (1), went to bed at 10 pm (3), and woke the following morning at 9 am (5). To calculate the first complete 24-h voided volume, we need to exclude the first morning void of Day 1 as that is part of the previous night's volume. Thus, the first 24 h voided volume includes the voids between points 2 and 5 ( $400 + 300 + 300 + 400 + 200 + 200 + 250 + 400$  [1st morning void from Day 2]) = 2450 mL. The contribution of night-time voided volume is from point 4 to 5 ( $200 + 250 + 400$ ) = 850. The nocturnal polyuria index (NPI) was  $850/2450 = 35\%$ . Nocturia is the voids between points 3 and 5 but excludes the voids at points 3 and 5 (so the voids at 2 am and 5 am), that is, nocturia was twice. For the second complete 24-h period, the voided volume should be taken from points 6 to 9, and totals 4050 mL. The nocturnal voided volume is from points 8 to 9, totaling 1050 mL. The NPI was  $26\%$  ( $1050/4050$ ), and nocturia was twice (3 am and 6 am). This patient was 32 years old, so they had nocturnal polyuria (NPI  $>20\%$  in a patient below the age of 65). Their body weight was 60 kg, so they also had 24-h polyuria ( $>40$  mL/kg/24 h). A 3-day diary contains two complete 24-h periods and two complete nights, since there is no information to complete the third night (unless the patient keeps recording up until they wake on Day 4)

## 6 | EXPLAINING THE PROBLEMS

For anyone with nocturia, a basic interpretation of the bladder diary can be used to categorise likely contributory factors,<sup>10</sup> and thereby guide subsequent evaluation and treatment.<sup>11,12</sup>

- 24-h polyuria; caused by a range of medical problems, such as diabetes insipidus, salt loss, or poorly controlled diabetes mellitus. These people often report constant thirstiness.
- NP; caused by problems such as obstructive sleep apnoea or peripheral oedema.
- LUTD; generally associated with storage LUTS, and with increased bladder sensation scores on the bladder diary.
- Sleep disturbance; should be considered if the patient describes anxiety, restless legs, nightmares, and sleep-walking.

Simple behavioral tendencies should be considered, for example identification of a high fluid intake in someone who does not experience constant thirst. LUTD is actually a relatively uncommon explanation for nocturia in the wider population, so urologists or urogynecologists should identify the other possible situations and avoid urological or gynecological interventions, where not specifically indicated.

## 7 | ENURESIS

Enuresis is a symptom in which the patient complains of intermittent incontinence that occurs during periods of sleep. It is also a sign of “wetting” while asleep. This is not the same as waking with urinary urgency and having insufficient time to reach the toilet, which is urgency urinary incontinence.

Enuresis may have more in common with voiding dysregulation (urination in situations which are generally regarded as socially inappropriate) or involuntary voiding (sporadic bladder emptying when awake)<sup>13</sup> than nocturia. Thus, they must be clearly distinguished when both nocturia and enuresis are reported by a patient.

## 8 | CONCLUSION

The symptom of nocturia is present if the patient reports waking at night to pass urine and nocturia is also a sign indicated by the number of times an individual passes urine during their main sleep period. NP is present if the patient reports passing large volumes of urine at night, and this can be quantified with the nocturnal polyuria index. The bladder diary is an important diagnostic tool, helping identify 24-h polyuria, NP, LUTD, and sleep disturbance. Enuresis is distinguished from nocturia, as the patient fails to wake up for passing urine.

## CONFLICT OF INTEREST

Dr. Hashim reports personal fees and non-financial support from Ferring, personal fees from Astellas, personal fees from Medtronic, personal fees from Boston, personal fees and non-financial support from Allergan, outside the submitted work. Dr. Drake reports grants, personal fees and non-financial support from Ferring, during the conduct of the study; grants, personal fees and non-financial support from Astellas, grants, personal fees and non-financial support from Allergan, outside the submitted work.

## ORCID

Hashim Hashim  <http://orcid.org/0000-0003-2467-407X>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

## REFERENCES

1. Tikkinen KA, Johnson TM, Tammela TL, et al. Nocturia frequency, bother, and quality of life: how often is too often? A population-based study in Finland. *Eur Urol*. 2010;57:488–496.
2. van Doorn B, Blanker MH, Kok ET, Westers P, Bosch JL. Prevalence, incidence, and resolution of nocturnal polyuria in a longitudinal community-based study in older men: the Krimpen study. *Eur Urol*. 2013;63:542–547.
3. van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology in nocturia: report from the Standardisation Subcommittee of the International Continence Society. *Neurourol Urodyn*. 2002;21:179–183.
4. Van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardization of terminology in nocturia: report from the standardization subcommittee of the International Continence Society. *BJU Int*. 2002;90:11–15.
5. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
6. Abrams P, Avery K, Gardener N, Donovan J. The international consultation on incontinence modular questionnaire: www.icic.net. *J Urol*. 2006;175:1063–1066. discussion 1066.
7. Abraham L, Hareendran A, Mills IW, et al. Development and validation of a quality-of-life measure for men with nocturia. *Urology*. 2004;63:481–486.
8. Bright E, Cotterill N, Drake M, Abrams P. Developing and validating the International Consultation on Incontinence Questionnaire bladder diary. *Eur Urol*. 2014;66:294–300.
9. Bright E, Drake MJ, Abrams P. Urinary diaries: evidence for the development and validation of diary content, format, and duration. *Neurourol Urodyn*. 2011;30:348–352.
10. Cornu JN, Abrams P, Chapple CR, et al. A contemporary assessment of nocturia: definition, epidemiology, pathophysiology, and management—a systematic review and meta-analysis. *Eur Urol*. 2012;62:877–890.
11. Sakalis VI, Karavitakis M, Bedretinova D, et al. Medical treatment of nocturia in men with lower urinary tract symptoms: systematic



- review by the european association of urology guidelines panel for male lower urinary tract symptoms. *Eur Urol*. 2017;72:757–769.
12. Gratzke C, Bachmann A, Descazeaud A, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *Eur Urol*. 2015;67:1099–1109.
  13. Gajewski JB, Schurch B, Hamid R, et al. An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). *Neurourol Urodyn*. 2018;37:1152–1161.

**How to cite this article:** Hashim H, Drake MJ. Basic concepts in nocturia, based on international continence society standards in nocturnal lower urinary tract function. *Neurourology and Urodynamics*. 2018;37:S20–S24. <https://doi.org/10.1002/nau.23781>

# Neurological lower urinary tract dysfunction essential terminology

Jerzy B. Gajewski<sup>1</sup>  | Marcus J. Drake<sup>2,3</sup> 

<sup>1</sup> Dalhousie University, Halifax, Nova Scotia, Canada

<sup>2</sup> Translational Health Sciences, Bristol Medical School, Bristol, UK

<sup>3</sup> Bristol Urological Institute, Southmead Hospital, Bristol, UK

## Correspondence

Marcus J. Drake, Bristol Urological Institute, 3rd Floor L&R building, Southmead Hospital, Bristol, BS10 5NB, UK.

Email: marcus.drake@bristol.ac.uk

**Aims:** To introduce basic concepts and definitions in the International Continence Society (ICS) Standardisation of Terminology in adult Neurogenic Lower Urinary Tract Dysfunction (NLUTD).

**Methods:** Fundamental terminology in the ICS Standardisation of Terminology of Adult NLUTD was identified and summarized.

**Results:** NLUTD is often associated with impairment of cognitive, motor, sensory, and/or autonomic functions. Lesions are categorized into suprapontine, pontine/suprasacral spinal, sacral spinal, cauda equina/peripheral nerve, or mixed lesions. People affected with neurological disease are also at risk of the conditions seen in the general population, such as benign prostate enlargement. Symptoms of NLUTD include alterations in bladder or urethral sensation and incontinence. Loss of urine can result from incontinence, involuntary passing of urine and factors that impair toilet use, incorporating problems such as impaired cognition urinary incontinence, impaired mobility urinary incontinence, and voiding dysregulation. Signs may be discerned by physical examination and recording of a frequency volume chart or bladder diary. Urodynamic observations during filling cystometry may include altered sensations, neurogenic detrusor overactivity, and reduced bladder compliance. During pressure flow studies, there may be detrusor underactivity or bladder outlet obstruction (BOO). BOO may be caused by various forms poorly co-ordinated muscle activity in the bladder outlet. Symptoms, signs, and urodynamic observations may be useful in diagnosing the presence and specific location of neurological impairment.

**Conclusion:** The review provides a succinct summary of symptoms, signs, and urodynamic observations as set out in the ICS Standard on Adult NLUTD.

## KEYWORDS

incontinence, LUTS, neurological disease, standardization

## 1 | INTRODUCTION

Adult neurogenic lower urinary tract dysfunction (NLUTD) refers to abnormal or difficult function of the bladder, urethra

(and/or prostate in men) in mature individuals in the context of clinically confirmed neurologic disorder. NLUTD is a key subgroup of the broad range of lower urinary tract symptoms (LUTS), due to the severity of the symptoms, and the implications of urinary dysfunction for wider health. The International Continence Society (ICS) categorizes symptoms, signs, urodynamic observations, and conditions

Alan Wein led the peer-review process as the Associate Editor responsible for the paper.

associated with lower urinary tract dysfunction (LUTD) in relationship to the storage and voiding phases of the micturition cycle. Neurological disease brings additional dimensions to the LUTD as experienced in the lives of affected individuals. The current document is a summary of core terminology in NLUTD for use in the wider context of LUTS in people known to have a neurological disease, or suspected of potentially having one which has not yet been diagnosed.

## 2 | METHODS

Recommendations in the ICS Standard on Adult Neurogenic Lower Urinary Tract Dysfunction<sup>1</sup> were reviewed and summarized. Definitions and key terms are generally transcribed verbatim and highlighted in bold. In the original document, many of the definitions are accompanied by explanatory or exemplary footnotes which have been adapted or excluded for the current review for the sake of brevity. Readers requiring more detailed information are referred to the full ICS Standard, and other documents produced by the ICS Standardisation Steering Committee.

## 3 | NEUROLOGICAL CONTROL

The nervous system controls many facets that are essential for the normal micturition cycle (storage and voiding). Particularly crucial are cognition (eg, decision making, anticipation, awareness of environment/social context, and conscious perception of sensation), motor functions (eg, mobility, balance, and dexterity), sensory nerve activity, and autonomic functions (eg, regulation of the detrusor and sphincter). The neurological functions act together to make sure that both urine storage and voiding reflect timings and contexts appropriately, with full voluntary control (Figure 1).

Neurological diseases are diverse and differ in terms of the parts of the nervous system affected (eg, the cognitive-predominant effects of dementia) and their behavior (eg, progressive, such as multiple sclerosis, or non-progressive, such as spinal cord injury). Thus, neurological disease may have differing effects on cognitive, sensory, motor, and autonomic functions which manifest in the specific NLUTD experienced by the patient. Inevitably, the consequences of neurological disease extend beyond LUTD, and mean that affected patients have a range of issues that influence treatment potential and health risk. Problems with bowel function, sexual and reproductive function, cognition, mobility, and blood pressure control are particularly relevant.

In describing the features of an individual patient's dysfunction, clinicians should appreciate the distinction between symptoms, signs, and urodynamic observations as

set out in the ICS Standardisation of Terminology of Lower Urinary Tract Function<sup>2</sup> (for summary see<sup>3</sup>). A summary of the classification of neurological lesions,<sup>1</sup> including the potential clinical and urodynamic features, is given in Figure 2.

## 4 | NLUTD SYMPTOMS

People with NLUTD may describe storage, voiding, and post voiding symptoms consistent with the definitions used for the general population.<sup>2,3</sup> Sometimes, a patient may not express that a symptom is present, so it is appropriate to discuss with the caregiver as well when establishing the presenting complaint. Storage symptoms may converge in **Neurogenic Overactive Bladder**, which is a symptom syndrome characterized by urgency, with or without urgency urinary incontinence, usually with increased daytime frequency and nocturia in the setting of a clinically relevant neurologic disorder with at least partially preserved sensation.

### 4.1 | Bladder and urethral sensation

Neurologically healthy people are intermittently aware of bladder sensations related to filling and voiding, and urethral sensation with voiding. Someone with NLUTD may describe alterations, for example:

**Increased bladder sensation:** the desire to void during bladder filling occurs earlier or is more persistent than that previously experienced. **Reduced:** the definite desire to void occurs later to that previously experienced despite an awareness that the bladder is filling. **Absent:** the individual reports no sensation of bladder filling or desire to void. Such patients may have a significant post voiding residual in the bladder, without any sensation of incomplete emptying.

**Non-specific bladder awareness:** the individual reports no specific bladder sensation, but may perceive, for example, abdominal fullness, vegetative symptoms, urethral sensations, or spasticity as bladder filling awareness or a sign of bladder fullness. This may indicate that the usual sensory nerve pathways are not communicating centrally. Instead anatomical routes which do not usually contribute to everyday sensations may be intact and functional.

In addition, some people report they are unable to feel flow of urine along the urethra. They may report that they can only discern whether bladder emptying is finished by looking, or listening for the splash of urine in the toilet to stop.

### 4.2 | Loss of urine

Mature CNS regulation ensures storage (detrusor relaxation with outlet contraction) and the transition to voiding (detrusor



**FIGURE 1** The micturition cycle viewed from the context of the person's social and environmental context. PMC, pontine micturition center

contraction with outlet relaxation) is under voluntary control. Various situations in NLUTD may lead to a loss of urine:

1. Incontinence; categorized into stress urinary incontinence, urgency incontinence and mixed urinary incontinence, and reflecting LUT dysfunction. Definitions used in NLUTD are the same as those used in the general population.
2. Involuntary passing of urine; no LUT abnormality is necessarily present, but instead the voiding reflex may activate at times not consciously initiated by the patient. This may be during occasions generally considered socially inappropriate. It may reflect a dysfunction in the cerebrum, for example, a stroke or dementia. Abnormal voiding reflexes, or disinhibition, may result in the person passing urine without voluntary control.
3. Factors that impair toilet use, such as immobility, cognitive disability, and decreased motivation.

Thus, some additional incontinence definitions are standardized in NLUTD:

- **Impaired cognition urinary incontinence** is periodic urinary incontinence that the individual with cognitive impairment reports to have occurred without being aware of it.
- **Impaired mobility urinary incontinence** is inability to reach the toilet on time for voiding because of physical or medical disability. This inability includes (any combination of) the individual's physical as well as social causes or reasons. Other signs or symptoms of LUTD should not be present, or should be reported by the professional (as primary or as accessory) (eg, "Urgency urinary incontinence" with "mobility impairment"; or

"Mobility impairment urinary incontinence" with "stress urinary incontinence).

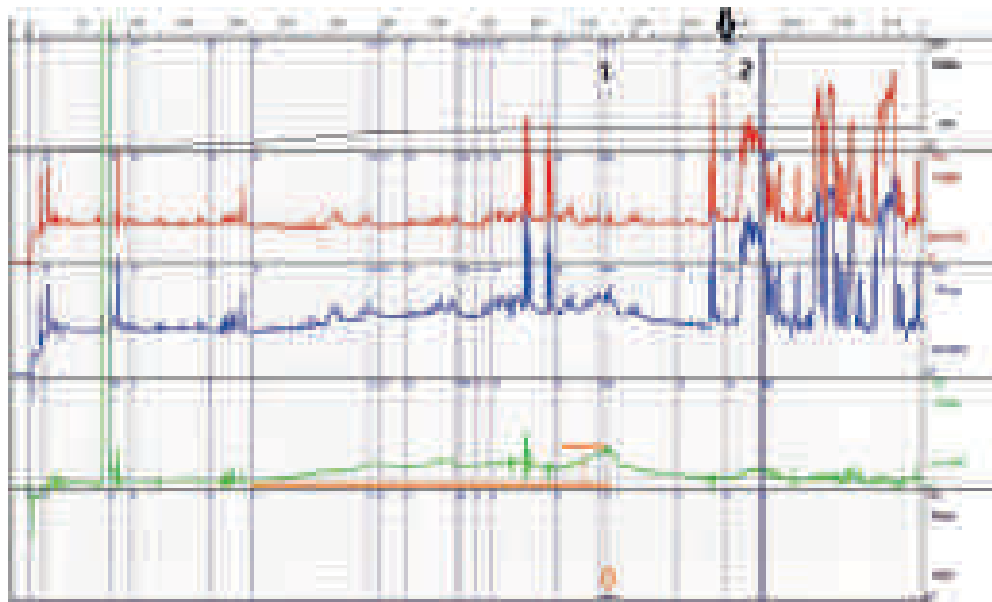
- **Voiding dysregulation** is urination in situations which are generally regarded as socially inappropriate, such as while still fully dressed, or in a public setting away from toilet facilities.
- **Involuntary voiding** is both a symptom and a diagnosis of sporadic bladder emptying when awake, without intention to void. Usually the voiding reflex is preserved, and there is only lack of proper inhibition of the voiding reflex. If that happens when asleep it is called Acquired Enuresis.
- **Enuresis** is intermittent incontinence that occurs during periods of sleep. Enuresis is considered different from urgency urinary incontinence. Confirming the precise underlying mechanism(s) is often not possible in routine clinical practice.
- **Continuous (urinary) incontinence:** complaint of continuous involuntary loss of urine.

#### 4.3 | Signs

NLUTD evaluation incorporates the examination used for the general population, since people with neurological disease are the same risk of aging-related and other changes as any other person. Accordingly, physical examination must include abdominal, pelvic and perineal examination, and should elicit the following where present:

- Incontinence
- Pelvic organ prolapse
- Pelvic floor muscle function





**FIGURE 3** Filling cystometry in a sacral spinal cord lesion (SSCL) showing reduced compliance; the lower orange line indicates the phase during which the detrusor pressure (green trace, second from bottom) is climbing, even though the filling rate is slow (10 mL/min). The upper orange line indicates the detrusor leak point pressure. The change in volume over this time was  $123 - 34 = 89$  mL, and the change in pressure was  $33 - 7 = 26$  cm H<sub>2</sub>O. Compliance (change in volume divided by change in pressure) was thus  $89/26 = 3.4$  mL/cm H<sub>2</sub>O. Detrusor Leak Point Volume (DLPV) is defined as a bladder volume at which first urine leakage occurs (1), either with detrusor overactivity or low compliance (orange arrow). The leakage is seen in the flow trace (black, bottom trace), and the leakage causes the elevated detrusor pressure to dissipate. The arrow indicates permission to void. However, there is no flow generated, and the patient does several Valsalva strains, shown by the substantial pressure rises in both abdominal pressure, and hence bladder pressure (2), signifying neurogenic acontractile detrusor. At time of urodynamics, neurological diagnosis had not previously been suspected, and subsequently he was identified to have multiple system atrophy

## 5.2 | Pressure flow studies

When passing urine, a slow stream may be explained by impaired detrusor contraction, bladder outlet obstruction (BOO), or a combination of both. Potential causes of neurogenic BOO include:

- **Non-relaxing urethral sphincter**, characterized by a non-relaxing, obstructing urethral sphincter resulting in reduced urine flow.
- **Delayed relaxation of the urethral sphincter**, characterized by impaired and hindered relaxation of the sphincter during voiding attempt resulting in delay of urine flow.
- **Detrusor-Sphincter Dyssynergia (DSD)**, which describes a detrusor contraction concurrent with an involuntary contraction of the urethral and/or peri-urethral striated muscle. Occasionally flow may be prevented altogether.

DSD is an indicator that the pontine micturition center is not communicating effectively with the sacral spinal cord, and occurs in people with a suprasacral spinal cord/pontine lesion. The term should not be used in other forms of NLUTD, and it is not a general term for neurogenic BOO.

Other causes of BOO present in the general population, such as benign prostatic obstruction, bladder neck obstruction, or urethral stricture in men, can also be present in people with neurological disease, and videourodynamics may be appropriate to discern the proximal site of BOO.

Impaired detrusor contraction can indicate:

- **Neurogenic detrusor underactivity**; a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span in the setting of a clinically relevant neurologic disorder.

- **Neurogenic acontractile detrusor:** the detrusor cannot be demonstrated to contract during urodynamic studies in the setting of a clinically relevant neurologic lesion (Figure 3).

Balanced bladder emptying is a bladder emptying with physiological detrusor pressure and low residual as perceived by the investigator, and should be defined in the report.

## 6 | NLUTD CLINICAL DIAGNOSES

- **Spinal Shock Phase** is usually temporary following acute neurologic insult or SCI that is characterized by loss of sensory, motor, and reflex activity below the level of injury. NLUTD in Spinal Shock is usually a temporary complete painless urinary retention.
- **Autonomic Dysreflexia** is a syndrome resulting from an upper thoracic or cervical spinal cord injury above T6, elicited by a stimulus in the field of distribution of the autonomous sympathetic nucleus, characterized by unregulated sympathetic function below the lesion and compensatory autonomic responses. It is potentially a medical emergency characterized by hypertension, bradycardia, severe headaches, and flushing above, with pallor below the cord lesion, and sometimes convulsions. An increase of blood pressure without any other symptoms is called Asymptomatic Autonomic Dysreflexia.

**Urinary retention** is an inability to properly empty the bladder. Retention may be complete or incomplete:

- **Acute retention of urine** is an acute event of painful, palpable or percussable bladder, when the patient is unable to pass any urine when the bladder is full. Although acute retention is usually thought of as painful, in certain circumstances pain may not be a presenting feature, for example, when due to prolapsed intervertebral disc, post-partum, or after regional anesthesia such as an epidural anesthetic. The retention volume should be significantly greater than the expected normal bladder capacity.
- **Chronic retention** is a non-painful bladder, which remains palpable or percussable after the patient has passed urine. Such patients may be incontinent. Chronic retention, excludes transient voiding difficulty, for example, after surgery for stress incontinence, and implies a significant residual urine.

## 7 | DIAGNOSING NEUROLOGICAL DYSFUNCTION

In order to understand the full picture of the neurological deficit, the history may be used to identify features which could localize the site of a problem or suggest the causative condition and its behavior. Such observations can be helpful to a patient's neurologist in localising areas of deficit. These features are important in defining a patient's condition, since it guides subsequent testing (such as the anatomical sites and scan protocols for MRI). For example, retrograde ejaculation reported by a man who has not had bladder neck or prostate surgery may indicate a neurological deficit in the thoracolumbar spine or related peripheral nerves; this may be accompanied by visualization of an open bladder neck during videourodynamic filling cystometry. Signs can also help; for example, loss of the anal reflex indicates a lesion affecting the sacral spinal cord or its sensory or motor nerves.

In rare but important cases, urinary dysfunction may present for urological evaluation in a patient with no known neurological background whose ultimate cause may subsequently prove to be a neurological disease. This can occur for example in MS, normal pressure hydrocephalus, multiple system atrophy, and early Parkinson's disease.<sup>4</sup> Key symptoms include erectile dysfunction, retrograde ejaculation, enuresis, loss of filling sensation, or unexplained stress urinary incontinence.<sup>4</sup> If there is any suspicion that an undiagnosed neurological disease could be present, questioning should enquire about visual symptoms, back pain, anosmia, bowel dysfunction and incontinence, or memory loss.<sup>4</sup> Specialist evaluation is likely to be needed.

## 8 | CONCLUSIONS

NLUTD is categorized into: suprapontine; pontine/suprasacral spinal; sacral spinal; cauda equina/peripheral nerve; mixed lesions. Loss of urine can result from impaired cognition urinary incontinence, impaired mobility urinary incontinence, and voiding dysregulation. Urodynamic observations during filling cystometry may include altered sensations, neurogenic detrusor overactivity, and reduced bladder compliance. During pressure flow studies, there may be detrusor underactivity or bladder outlet obstruction (BOO). BOO may be caused by various forms poorly co-ordinated muscle activity in the bladder outlet. Symptoms, signs, and urodynamic observations may be useful in diagnosing the presence and specific location of neurological impairment.



## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## ORCID

Jerzy B. Gajewski  <http://orcid.org/0000-0003-0769-583X>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

## REFERENCES

1. Gajewski JB, Schurch B, Hamid R, et al. An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). *Neurourol Urodyn*. 2018;37:1152–1161.
2. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the

Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.

3. Drake MJ. Fundamentals of terminology in lower urinary tract function. *Neurourol Urodyn*. 2018;37:S13–S19.
4. Wei DY, Drake MJ. Undiagnosed neurological disease as a potential cause of male lower urinary tract symptoms. *Curr Opin Urol*. 2016;26:11–16.

**How to cite this article:** Gajewski JB, Drake MJ. Neurological lower urinary tract dysfunction essential terminology. *Neurourology and Urodynamics*. 2018;37:S25–S31. <https://doi.org/10.1002/nau.23758>

# The fundamentals of chronic pelvic pain assessment, based on international continence society recommendations

Neha Rana<sup>1</sup> | Marcus J. Drake<sup>2,3</sup>  | Rebecca Rinko<sup>1</sup> | Melissa Dawson<sup>1</sup> |  
Kristene E. Whitmore<sup>1,4</sup> 

<sup>1</sup> Division of Female Pelvic Medicine and Reconstructive Surgery, Department of Obstetrics and Gynecology, Drexel University College of Medicine, Philadelphia, Pennsylvania

<sup>2</sup> Translational Health Sciences, Bristol Medical School, Bristol, UK

<sup>3</sup> Bristol Urological Institute, Southmead Hospital, Bristol, UK

<sup>4</sup> Division of Female Pelvic Medicine and Reconstructive Surgery and Urology, Drexel University College of Medicine, Philadelphia, Pennsylvania

## Correspondence

Kristene E. Whitmore, Division of Female Pelvic Medicine and Reconstructive Surgery and Urology, Department of Obstetrics and Gynecology, Drexel University College of Medicine, 207 North Broad Street, 4th Floor Philadelphia, PA 19107.  
Email:bladder1@aol.com

**Aims:** Chronic pelvic pain (CPP) is defined as a noncyclical pain that has duration of at least 6 months and can lead to decreased quality of life and physical performance. The pain can be attributed to problems in the pelvic organs and/or problems in related systems, and possible psycho-social attributes may contribute to the manifestation. Due to the complex nature, CPP syndromes are multifactorial and the terminology needs to reflect the setting.

**Methods:** The current review is a synthesis of key aspects of the recent International Continence Society Standardization for Terminology in CPP Syndromes.

**Results:** Nine domains can be used for a detailed description of CPP. They include four domains specific to the pelvic organs (lower urinary tract, female genital, male genital, gastrointestinal), two related to other sources of pain which may be perceived in the pelvis (musculoskeletal, neurological) and three which may influence the response to the pain or its impact on the individual (psychological, sexual, and comorbidities). For an individual patient with CPP, each domain should be reviewed in terms of symptoms and signs, noting that positive findings could reflect either a primary cause or a secondary consequence. The findings will guide further evaluations and subsequent treatment.

**Conclusion:** We present a synthesis of the standard for terminology in CPP syndromes in women and men, which serves as a systematic framework to consider possible sources of pain (pelvic organs or other sources) and the individual responses and impact.

## KEYWORDS

chronic pelvic pain, lower urinary tract dysfunction, LUTS, pelvic floor muscle pain, standardization

## 1 | INTRODUCTION

CPP is defined as a noncyclical pain that has duration of at least 6 months, and it can lead to decreased quality of

life and physical performance.<sup>1</sup> The presentation can be a challenge to assess and treat. This is because the pain can potentially be attributed to several contributory factors, in the context of the varied nature of pain responses manifested by individuals. Healthcare professionals (HCPs) need to consider gynecological, urological, gastrointestinal, musculoskeletal, neurological, or

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

rheumatological factors, with possible psycho-social attributes. Due to its complex nature, CPP syndromes are multifactorial and the current terminology aims to standardize descriptions, regardless of which type of specialist is performing the evaluation.

## 2 | METHODS

A standard for terminology in CPP syndromes was developed in accordance with the International Continence Society (ICS) Standardization Steering Committee methodology.<sup>2</sup> The current review is a synthesis of the key aspects of the standard for practical use in everyday practice.

## 3 | OVERVIEW

For a patient presenting with pelvic pain, thorough history is crucial, including establishing that the pain has been present for at least 6 months, identification of any potential inciting event and/or triggers, character, radiation, and severity. An indication of the source of pain is vital, yet it can be obscured in individual cases by the range of possible primary sources and secondary consequences, and the varied responses. To ensure a systematic approach, the ICS sets out a series of “domains” which facilitate consideration of possible issues.

The domains of chronic pelvic pain (CPP) syndromes include four which consider the pelvic organs;

1. Lower urinary tract domain
2. Female genital domain
3. Male genital domain
4. Gastrointestinal domain

Two domains consider other sources of pain which may be perceived in the pelvis, even if the actual site of the problem may not be within the pelvis;

5. Musculoskeletal domain
6. Neurological domain

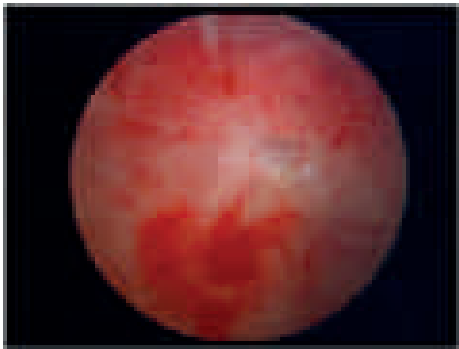
The final three domains relate to general factors that could influence the response to the pain or its impact on the individual;

7. Psychological domain
8. Sexual domain
9. Comorbidities

In any domain, features may be present as a result of a primary problem, or a secondary consequence. Each domain is evaluated with directed history-taking and a comprehensive physical examination done with a focus on the lower abdomen/pelvis to identify pain triggers and patterns of referred pain. The HCP can surmise the possible source of the

**TABLE 1** Lower urinary tract domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Bladder			
Increased daytime frequency	Suprapubic tenderness	Questionnaires	Hypersensitivity bladder
Increased night-time frequency	Tenderness of bladder	Voiding diary	Interstitial cystitis/bladder pain syndrome
Urgency	Tenderness of the pelvic floor muscles	Urine analysis	Interstitial cystitis/Hunner lesion
Hypersensitivity		Optional: urine culture/ cytology Intravesical anesthetic challenge	
Pain, pressure, discomfort with filling		Urodynamics Cystoscopy (biopsy)	
Hesitancy			
Intermittency			
Feeling of incomplete bladder emptying			
Urethra			
Frequency/urgency painful urination	Tenderness of the urethra	Urine analysis	Urethral pain



**FIGURE 1** The endoscopic appearances of bleeding and ulceration during general anesthetic cystoscopy indicate that the lower urinary tract domain is a contributory factor in CPP, especially if there are pain reactions such as tachycardia, tachypnoea, and hypertension

pain, relevant additional factors, and potential secondary consequences. Specific assessment and treatment requires access to multidisciplinary support, and awareness of the initiatives and guidance developed by a range of organizations and expert groups.<sup>3–5</sup> Imaging, endoscopy and special tests may be needed for evaluation of each domain considered influential for a patient. With the individual evaluation in mind, further investigation and initial therapy can be planned based on the multidisciplinary support and up-to-date awareness of clinical recommendations and guidelines.

As an example, chronic prostatitis will be associated with history and examination features in the male genital domain (the primary site of the problem), and the lower urinary tract and musculoskeletal domains (where secondary problems such as increased urinary frequency and muscle spasms may be experienced). The full scope of impact on the patient may be further driven by issues in the psychological and sexual domains.

3.1 | Domains related to the pelvic organs

The lower urinary tract domain (Table 1) incorporates the bladder and urethra. The global definitions for bladder pain syndrome (BPS) and interstitial cystitis (IC) are not fully standardized, as several professional organizations have an interest in the area. Society for Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction proposed the definition of IC/BPS as “an unpleasant sensation (pain pressure, discomfort) perceived to be related to the urinary bladder, associated with lower urinary tract symptoms of more than 6 weeks duration in the absence of other identifiable causes.”<sup>6</sup> For the bladder, patients may complain of increased urinary frequency (day and night), urgency, hypersensitivity, pain, pressure, discomfort, hesitancy, pain with filling, and sensation of incomplete emptying. The situation may be associated with relevant findings on general anesthetic cystoscopy (Figure 1). If the urethra is a significant contributor, pain is perceived usually when voiding and can be combined with a dull pressure that may radiate towards the groin or perineum.

The genital domains comprise the female genital domain (Table 2) and the Male Genital Domain (Table 3). Female patients may report pain with menstruation, abnormal bleeding, dyspareunia, vaginal discharge or itching, voiding/defecatory pain, and/or abdominal/pelvic pain. Pain mapping with a Q-tip is done to elicit localized areas of tenderness, which may be identified in the vagina or external genitalia. Generalized vulvar pain syndrome refers to pain/burning that cannot be localized by pain mapping. It is important to identify any ulcers, fissures, or cysts of the vulva. In addition, intra-abdominal signs related to the uterus and adnexa may indicate other pathology, such as fibroids, cysts, pelvic masses, endometriosis, or adhesive disease. These can present with uterine tenderness, cervical discharge or tenderness, or adnexal tenderness

Male patients may reports symptoms related to the lower urinary tract and sexual dysfunction. There may be complaints of dysuria, sensation of incomplete emptying,

**TABLE 2** Female genital domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Vagina			
Dyspareunia Sharp burning and/or stabbing Provocation of pain with touch	Tenderness Erythema	Pain mapping Q-tip touch sensitivity	Vaginal/vulvar/perineal pain
Intraabdominal female genital			
Dysmenorrhea Abnormal uterine bleeding Dyspareunia Itching, stabbing, burning pain Cyclic (episodic or persistent)	Tenderness: uterine/adnexal	Laboratory testing Pelvic ultrasound Laparoscopy/biopsy CT-scan	Ovarian Pelvic congestion Uterine Tubal

**TABLE 3** Male genital domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Pain	Tenderness on rectal/genital examination	Questionnaires	Prostate pain
LUTS	Urethral discharge	Culture	
Dyspareunia		PSA/biopsy	
Erectile dysfunction (Persistent) or episodic		Cystoscopy/biopsy	
		Ultrasound	
	Tenderness on physical examination	Questionnaires	Scrotal pain
	Scars	Ultrasound	Epididymal pain
			Testicular pain
			Penile pain

**TABLE 4** Gastrointestinal domain

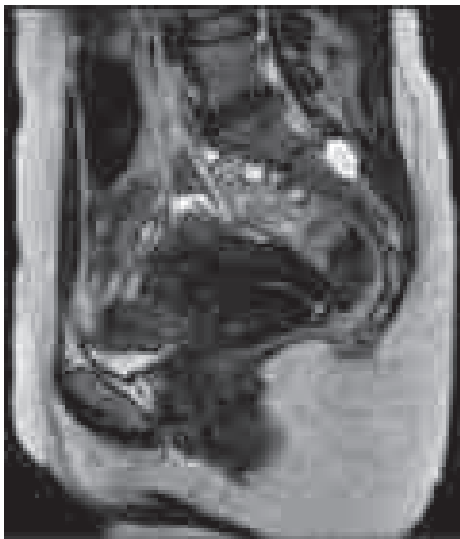
Symptoms	Signs	Evaluation	Syndrome/Disease
Pain with defecation	Tenderness on rectal exam	Questionnaires	Anorectal pain
Evacuation dysfunction		Culture	
Pain/pressure with sitting		Colonoscopy/biopsy	
Abdominal pain	Abdominal tenderness	Ultrasound CT/barium enema/MRI	Colorectal pain
Nausea	Bloating		
Constipation/diarrhea			
Persistent or episodic			

**TABLE 5** Musculoskeletal domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Abdominopelvic pain	Altered muscle tone	Questionnaires	Pelvic muscle pain syndrome
	Tension: spasms	Pain mapping	Coccyx pain syndrome
Pain at rest, with movement/sitting/sexual activity	Stiffness	Ultrasound	Pelvic joint, ligament, bony pain
Pain with voiding/defecation	Trigger point tenderness		
Unilateral/bilateral	Taut band		
Persistent or episodic	Twitch response, referred pain		

**TABLE 6** Neurological aspects domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Characteristic sensation of:	Tenderness (nerve distribution)	Questionnaires	Somatic neuropathic pain
Burning	Referred pain	Quantitative sensory testing	Complex regional pain syndrome
Throbbing	Possible skin change	Pain mapping	
Stabbing		Nerve block	
Shooting		imaging: Ultrasound MRI	
Electric shock-like Sensation			
paresthesia			
Atrophy			
Persistent or episodic			



**FIGURE 2** Observation of a sacral nerve root “Tarlov” cyst suggests the neurological domain may be a factor in a patient’s CPP

increased daytime frequency, change in urinary stream, urgency, and dyspareunia (assuming infection, surgical complications, or other pathology have been excluded). The assessment of CPP in males should prompt questioning to assess for onset, duration, inciting factors, laterality and any effect on urination and sexual function. A rectal examination is needed, and thorough evaluation of the genitalia, which may be performed in the supine and standing positions to identify any lesions, masses, and discharge.

Patients affected in the gastrointestinal domain (Table 4) commonly report constipation, diarrhea, defecatory pain, obstructive defecation, abdominal cramping, or rectal pain/pressure/burning. The main components are the anorectum or colorectum. Anorectal problems may result from hemorrhoids, abscesses, fissures, ulcers, levator ani syndrome, or chronic proctalgia. Colorectal problems may give rise to abdominal tenderness, watery/bloody diarrhea, or rectal bleeding and systemic features (weight loss and fever). Inflammatory bowel disease and malignancy must be excluded. Functional disorders should be ruled out, including irritable bowel syndrome.<sup>7</sup>

**TABLE 7** Psychological aspects domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Worry	Helplessness	Formal psychological assessment	Worry/anxiety/fear/depression
Anxiety	Hopelessness	Asking patient what is wrong and	
Fear	Avoidance of certain activities	what worries him/her about pain	
Catastrophizing		Questionnaires	
Persistent or episodic			

**TABLE 8** Sexual aspects domain

Symptoms	Signs	Evaluation	Syndrome/Disease
Lack of desire, arousal, orgasm	Depression	Questionnaires	Sexual dysfunction
Dyspareunia	Relationship issues	Laboratory	
Persistent or episodic		Doppler ultrasound	

**TABLE 9** Comorbidities

Symptoms	Signs	Evaluation	Syndrome/Disease
Allergies	Fatigue	General medical evaluation	Allergies
Fatigue	Skin lesions	Laboratory Imaging	Chronic pain and fatigue syndrome
Widespread muscular and joint pain	Dry eye		
Irritation of the eyes	Muscular skeletal tenderness		Systemic autoimmune diseases
Dryness			
Sleep disorder			

### 3.2 | Domains related to other causes of pain

Musculoskeletal problems are common, and sometimes are hard to localize for the patient. In CPP, they may be the principle cause of pain, or they may be consequential as the patient makes physical adaptations to deal with their primary problem (Table 5). Features that indicate a primary or secondary musculoskeletal problem include; tenderness, abnormal movement and alterations in the muscle (tone, stiffness, tension, spasms, cramping, fasciculation, and trigger points). Pain may originate from muscles, fascia, ligaments, joints, or bones, so familiarity with the anatomy and approaches to clinical examination is needed. Particularly key regions include;

- Muscular: the pelvic floor<sup>8</sup> (levator ani group/perineum), the lower abdominal wall, or posterior pelvic and gluteal regions.
- Joints, ligaments and bones: Coccyx pain syndrome, sacroiliac or pubic symphysis joints, sacrospinous or sacrotuberous ligaments, or the pubic ramus, ilium, and ischial spine

Where there is an issue in the neurological domain (Table 6), patients commonly use characteristic terms to describe pain (burning, stabbing, throbbing, tingling, stinging, electric shock-like) or they may report paresthesia. Somatic Neuropathic pain is secondary to a specific nerve injury, and is associated with symptoms related to the nerve distribution. In CPP, the relevant nerves could be sacral (Figure 2), pudendal, thoracolumbar, ilioinguinal, iliohypogastric, genitofemoral or obturator. A neuroma secondary to surgery or other trauma may give a localized tender point in the specific location, and if present should be identified and removed.

Complex regional pain syndrome (CRPS)<sup>9</sup> is a situation whose precise etiology is uncertain, but it can be categorized by burning pain and changes in the skin (increased sensitivity, and changes in skin temperature, color, and/or texture). CRPS type 1 is triggered by tissue injury without an underlying nerve injury and CRPS type 2 is attributed to a history of a nerve injury.

Pain in someone with a history of surgery which involved placement of synthetic is a specific issue. It can present as pain during physical activity, dyspareunia, vaginal discharge, and/or exposure of the mesh in the vagina or surrounding tissues.

### 3.3 | Domains affecting response or impact

Psychological aspects are an important element in the individual situation (Table 7). Patients may report symptoms of anxiety, worry, low mood, sleep disturbances, helplessness, hopelessness, difficulty concentrating, and pain impairing enjoyment. Alternatively, people close to the affected person may observe these features.

Sexual function may be affected by CPP in both men and women, and relationships may be affected (Table 8). Patients may report decreased libido, inability to become aroused, dyspareunia, and difficulty achieving an orgasm, and there may also be partner concerns. Several disorders can be identified;

- Sexual desire disorders; Hypoactive sexual disorder or Sexual aversion disorder
- Sexual arousal disorder
- Orgasmic disorder
- Sexual pain disorder

A comorbidities domain is also included (Table 9), as patients with CPP syndromes have a higher prevalence of problems such as allergies, chronic fatigue syndromes, fibromyalgia, and autoimmune diseases that may affect multiple systems.

## 4 | CONCLUSIONS


The current document extracts some of the pertinent elements that should be identified in order to understand fully the range of factors potentially present in CPP. The domain structure serves as a checklist to aid consideration of the several issues, and thereby ensure key relevant factors are not overlooked. The approach aids a logical sequence in considering the pelvic organs, other potential sources of pain, and factors that affect individual pain response and its impact.

## CONFLICTS OF INTEREST

Drs Neha Rana, Marcus J. Drake, Rebecca Rinko, and Melissa Dawson have nothing to disclose. Dr Kristene Whitmore reports grants from Allergan, grants from Astellas, and grants from Coloplast clinical research during the conduct of the study.

## ORCID

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

Kristene E. Whitmore  <http://orcid.org/0000-0002-0135-1158>

## REFERENCES

1. Ahangari A. Prevalence of chronic pelvic pain among women: an updated review. *Pain Physician*. 2014;17:E141–E147.
2. Doggweiler R, Whitmore KE, Meijlink JM, et al. A standard for terminology in chronic pelvic pain syndromes: a report from the chronic pelvic pain working group of the international continence society. *Neurourol Urodyn*. 2017;36:984–1008.



3. Bornstein J, Goldstein AT, Stockdale CK, et al. 2015 ISSVD, ISSWSH and IPPS consensus terminology and classification of persistent vulvar pain and vulvodynia. *Obstet Gynecol*. 2016;127: 745–751.
4. Engeler DS, Baranowski AP, Dinis-Oliveira P, et al. The 2013 EAU guidelines on chronic pelvic pain: is management of chronic pelvic pain a habit, a philosophy, or a science? 10 years of development. *Eur Urol*. 2013;64:431–439.
5. Jarrell JF, Vilos GA, Allaire C, et al. Consensus guidelines for the management of chronic pelvic pain. *J Obstet Gynaecol Can*. 2005;27: 781–826.
6. Hanno P, Dmochowski R. Status of international consensus on interstitial cystitis/bladder pain syndrome/painful bladder syndrome: 2008 snapshot. *Neurourol Urodyn*. 2009;28: 274–286.
7. Drossman DA. The functional gastrointestinal disorders and the Rome III process. *Gastroenterology*. 2006;130:1377–1390.
8. Montenegro ML, Mateus-Vasconcelos EC, Rosa e Silva JC, Nogueira AA, Dos Reis FJ, Poli Neto OB. Importance of pelvic muscle tenderness evaluation in women with chronic pelvic pain. *Pain Med*. 2010;11:224–228.
9. Harden RN, Oaklander AL, Burton AW, et al. Complex regional pain syndrome: practical diagnostic and treatment guidelines, 4th edition. *Pain Med*. 2013;14:180–229.

**How to cite this article:** Rana N, Drake MJ, Rinko R, Dawson M, Whitmore K. The fundamentals of chronic pelvic pain assessment, based on international continence society recommendations. *Neurourology and Urodynamics*. 2018;37:S32–S38.  
<https://doi.org/10.1002/nau.23776>

# How to use the Pelvic Organ Prolapse Quantification (POP-Q) system?

Chendrimada Madhu<sup>1</sup>  | Steven Swift<sup>2</sup> | Sophie Moloney-Geany<sup>3</sup> |  
Marcus J. Drake<sup>4</sup> 

<sup>1</sup> Department of Women's Health and Bristol Urological Institute, Southmead Hospital, Bristol, UK

<sup>2</sup> Department of Obstetrics and Gynaecology, Medical University of South Carolina, Charleston, South Carolina

<sup>3</sup> Department of Women's Health and Bristol Urological Institute, Southmead Hospital, Bristol, UK

<sup>4</sup> Bristol Urological Institute and Bristol Medical School, University of Bristol, Bristol, UK

## Correspondence

Chendrimada Madhu, Consultant Subspecialist Urogynaecologist, Department of Women's Health and Bristol Urological Institute, The Chilterns, Southmead Hospital, Bristol BS10 5NB.  
Email: cmadhu@nhs.net

**Aims:** To set out the basic description of pelvic organ prolapse (POP) using the International Continence Society/International Urogynecology Association Pelvic Organ Prolapse Quantification (POP-Q) system.

**Methods:** The basic approach to use of the POP-Q was identified and summarized.

**Results:** Six defined points in the vagina are identified; points Aa and Ba for the anterior vagina, Ap and Bp for the posterior vagina, and C and D for the cervix/vault. Point D is not used in women who previously had a hysterectomy. The patient is asked to strain, ideally when in the standing position, to elicit the POP to its maximum extent. The location of the defined points is then gauged relative to the hymenal ring and recorded on a grid. Three additional measurements are taken to achieve a full description; the genital hiatus length, perineal body length, and total vaginal length. Staging a POP relies on identifying the lowest extent of any part of the six defined points; if any point reaches close to the hymenal ring (at least stage 2), the prolapse is usually symptomatic.

**Conclusions:** The POP-Q system is readily cataloged and offers detailed description of considerable benefit in clinical practice and research.

## KEYWORDS

Pelvic organ prolapse quantification. POP-Q. Prolapse assessment

## 1 | INTRODUCTION

The International Continence Society (ICS), the American Urogynecologic Society, and the Society of Gynecologic Surgeons published a consensus document in 1996 to describing an objective system to describe female pelvic organ prolapse, which was called the Pelvic Organ Prolapse Quantification system (POP-Q).<sup>1</sup> This is the classification system that should be used to describe pelvic organ prolapse, as recommended by the ICS/International Urogynecology Association (IUGA) joint report on terminology for female

pelvic floor dysfunction.<sup>2,3</sup> The POP-Q has been used variably in both clinical practice and research.<sup>4,5</sup> The ICS/IUGA have recently made some suggestions to better define the disease of pelvic organ prolapse.<sup>3</sup> The aim of this article is to briefly summarize the key points in performing the POP-Q examination system to assist in its routine use.

## 2 | METHODOLOGY

The technique of performing the POP-Q has been described in detail in the ICS/IUGA documents.<sup>2,3</sup> We have summarized the key points that should be considered while performing the POP-Q examination.

Jan-Paul Roovers led the peer-review process as the Associate Editor responsible for the paper.

**TABLE 1** Showing the POPQ measurements (Adapted from Haylen et al<sup>2</sup>)

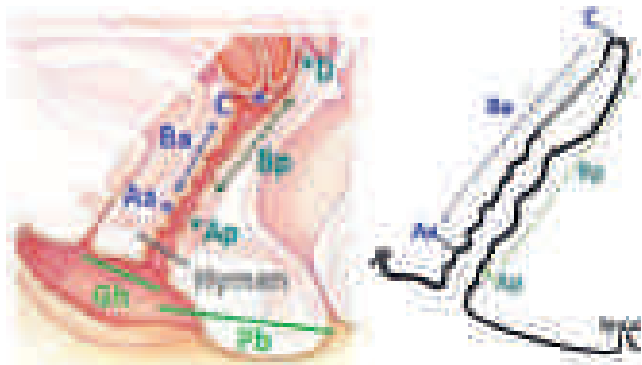
POPQ: Measurements
The locations of the six defined points when the prolapse is fully reduced.
Anterior vaginal wall:
1. <b>Point Aa:</b> A point located in the midline of the anterior vaginal wall three (3) cm proximal to the external urethral meatus. The potential range of position of Point Aa relative to the hymen is −3, indicating no anterior vaginal POP,to +3 cm which is full prolapse
2. <b>Point Ba:</b> A point that represents the most distal (ie, most dependent) position of any part of the upper anterior vaginal wall (between the vaginal cuff or anterior vaginal fornix and Point Aa). Point Ba coincides with Point Aa (−3 cm) in a woman who has no anterior POP. In a woman with severe POP, Ba coincides with Point C.
Upper vagina:
3. <b>Point C:</b> A point on either the most distal (ie, most dependent) edge of the cervix or the leading edge of the vaginal cuff (hysterectomy scar).
4. <b>Point D:</b> The posterior fornix in a woman who still has a cervix. <sup>a</sup>
Posterior vaginal wall:
5. <b>Point Ap:</b> A point located in the midline of the posterior vaginal wall three (3) cm proximal to the hymen. The potential range of position of Point Ap relative to the hymen is −3 to +3 cm
6. <b>Point Bp:</b> A point that represents the most distal position of any part of the upper posterior vaginal wall (between the vaginal cuff or posterior vaginal fornix and Point Ap).
Three further descriptive landmarks and measurements.
1. The <b>genital hiatus (GH)</b> is measured from the middle of the external urethral meatus to the posterior margin of the hymen.
2. The <b>total vaginal length (TVL)</b> is the length of the vagina (cm) from posterior fornix to hymen when Point C or D is reduced to its full normal position.
3. The <b>perineal body (PB)</b> is measured from the posterior margin of the hymen to the mid-anal opening.

<sup>a</sup>Point D is included as a point of measurement to differentiate suspensory failure of the uterosacral-cardinal ligament “complex” from cervical elongation. When the location of Point C is significantly more positive than the location of Point D, this is indicative of cervical elongation which may be symmetrical or eccentric. Point D is omitted in the absence of the cervix.

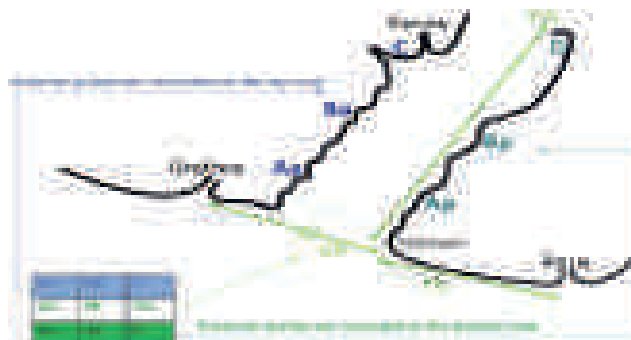
3 | RESULTS

POP-Q can be performed using the following four steps:  
Step1: Pre-procedure considerations

Examination should be performed with an empty bladder and if possible an empty rectum. A full bladder is potentially associated with underestimation of the POP-Q severity.<sup>6</sup> Any position that best demonstrates the maximum extent of the



**FIGURE 1** The six defined points used to quantify POP in women without (left) or with (right) a previous hysterectomy. Aa and Ap are 3 cm from the hymen when there is no POP, or any POP is fully reduced. POP-Q identifies where these points come to lie relative to the hymenal plane with the POP fully evident. Ba and Bp reflect the lowest point reached by a POP, relative to the hymenal plane. Any part of the vagina could potentially descend furthest, so Ba may lie anywhere from Aa-C. Bp may lie anywhere from Ap-D, or Ap-C in a woman post hysterectomy, from respectively reaching the locoincide with Aa and Ap in a woman who does not have POP. Three measurements complete the description; the genital hiatus (Gh), the perineal body (Pb), and the total vaginal length (not shown)



**FIGURE 2** How the six defined point and three measurements relate to a  $3 \times 3$  grid used for clinical documentation. Gh, genital hiatus; Pb, perineal body; TVL, total vaginal length

prolapse and which can be confirmed by the woman, by digital palpation or use of a mirror, should be used (left lateral, standing, lithotomy, or standing). Use a Sim's speculum if necessary to retract the anterior and posterior vaginal walls to assess for prolapse. The techniques and positions used should be recorded, as they may influence findings.<sup>7</sup>

Step 2: Measurements ("points to remember") (Table 1, Figure 1):

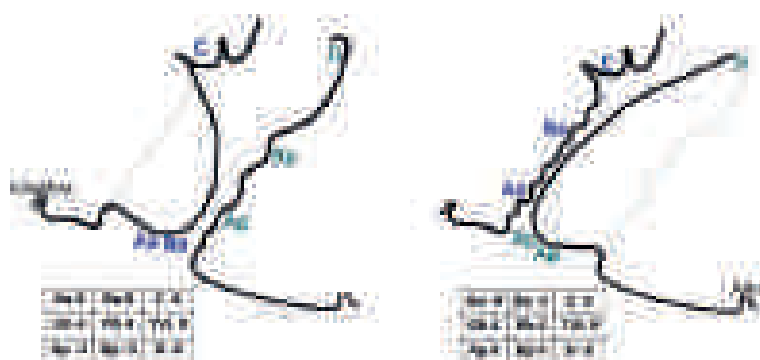
- There are six defined points (Aa, Ba, C, D, Ap, Bp) that are considered while recording the POP-Q, which are used to report the extent of descent or prolapse of the anterior vaginal wall, vaginal apex, and posterior wall.
- The positions of these six defined points are measured during maximal Valsalva or cough in relation to the hymen. If the point descends to the hymen it is measured as 0 cm, if it remains above the hymen it is measured in centimeters and described as negative integers and if it descends beyond the hymen it is

measured in centimeters and described as positive integers. For example, if point C remains 4 cm above the hymen during Valsalva/cough it is recorded as  $-4$  cm. If point C descends 4 cm beyond the hymen during Valsalva/cough it is recorded as  $+4$  cm.

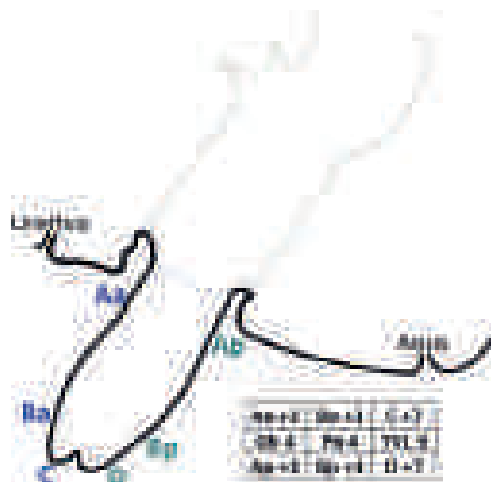
- There are three further descriptive measurements, which are also recorded independent of the hymen (genital hiatus-point GH, perineal body-point PB, and total vaginal length at rest-point TVL). Of note, all of the POP-Q points are recorded during maximal Valsalva or cough except for point TVL which is recorded at rest with the prolapse reduced.

Step 3: Recording the measurements (Figure 2):

The above measurements are recorded on a  $3 \times 3$  grid. The anterior vaginal wall and the cervix or vault are documented on the top row, the posterior vaginal wall, and the posterior fornix on the bottom row. The descriptive measurements of the genital hiatus, perineal



**FIGURE 3** POPQ staging of a second stage anterior (left) and second stage posterior (right) vaginal wall prolapse



**FIGURE 4** POPQ staging of a stage 4 pelvic organ prolapse (procidentia)

body, and total vaginal length at rest are recorded in the middle row.

#### Step 4: Staging of the prolapse

Depending on the measurements, prolapse of each of the compartments is staged based on its relationship to the hymen.

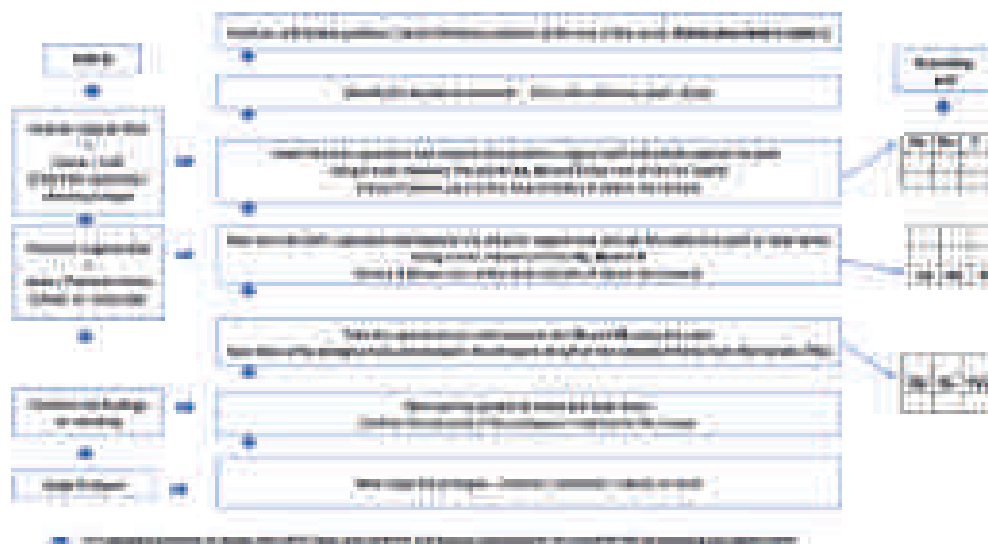
- Stage 0: No prolapse is demonstrated (points Aa, Ba, C, D, Ap, and Bp are all  $\leq -3$  cm).

- Stage I: The most distal portion of the prolapse is more than 1 cm above the level of the hymen (points Aa, Ba, C, D, Ap, and Bp are all  $\leq -1$  cm).
- Stage II (Figure 3): The most distal portion of the prolapse is situated between 1 cm above the hymen and 1 cm below the hymen (any of the points Aa, Ba, C, D, Ap, and Bp has a value between  $-1$  cm and  $+1$  cm).
- Stage III: The most distal portion of the prolapse is more than 1 cm beyond the plane of the hymen, but not completely everted meaning no value is  $\geq \text{TVL} - 2$  cm (any of the points Aa, Ba, C, D, Ap, Bp is  $\geq +2$  and  $\leq \text{TVL} - 3$  cm)
- Stage IV (Figure 4): Complete eversion or eversion to within 2 cm of the total vaginal length of the lower genital tract is demonstrated (any of the Points Ba, C, D, or Bp is  $\geq \text{TVL} - 2$  cm).

The steps of performing a POP-Q are summarized in Figure 5 and some examples of POPQ recording and staging of various prolapse are demonstrated in Figures 3 and 4.

## 4 | DISCUSSION

Since its introduction in 1996, POP-Q has been used variably in peer-reviewed publications.<sup>8</sup> It may be perceived as complex, but it has shown good inter-observer agreement and is the most common system used in peer-reviewed literature.<sup>9–11</sup> It has been criticized as being too complicated, difficult to use, teach, and communicate.<sup>12</sup> Various approaches and tools have been used to teach POP-Q and have all been shown to be effective.<sup>13,14</sup>



**FIGURE 5** Practical aspects of performing POP-Q

#### 4.1 | Clinical relevance of POP-Q

Women with POP generally present with several complaints of bladder, bowel, and pelvic dysfunction; however, the symptom of a vaginal bulge is considered specific to prolapse and correlates well with the severity for the prolapse.<sup>15,16</sup> POP is generally considered to be symptomatic when the leading edge of the prolapse is at or beyond the level of the hymen ( $\geq$ stage 2 POP-Q).<sup>17</sup> Another study suggested that the prolapse becomes symptomatic if it descends lower than a level 0.5 cm above the hymen ( $\geq$ Stage 2 POP-Q).<sup>18</sup> Genital hiatus size is associated with and predictive of apical vaginal support loss.<sup>19,20</sup> These factors need to be taken in to consideration when diagnosing and offering treatment options to women with prolapse.

#### 5 | CONCLUSION

POP-Q is a useful way of objectively assessing and recording pelvic organ prolapse and helps in better communication of findings. Stage 2 or above POP-Q seems to correlate well with a symptomatic prolapse.

#### ORCID

Chendrimada Madhu  <http://orcid.org/0000-0002-8571-6117>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

#### REFERENCES

1. Bump RC, Mattiasson A, Bø K, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol*. 1996;175:10–17.
2. Haylen BT, De Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J*. 2010;21:5–26.
3. Haylen BT, Maher CF, Barber MD, et al. Erratum to: An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic organ prolapse (POP). *Int Urogynecol J*. 2016;27:655–684.
4. Bump RC. The POP-Q system: two decades of progress and debate. *Int Urogynecol J*. 2014;25:441–443.
5. Riss P, Dwyer PL. The POP-Q classification system: looking back and looking forward. *Int Urogynecol J*. 2014;25:439–440.
6. Haya N, Segev E, Younes G, Goldschmidt E, Auslender R, Abramov Y. The effect of bladder fullness on evaluation of pelvic organ prolapse. *Int J Gynecol Obstet*. 2012;118:24–26.
7. Visco AG, Wei JT, McClure LA, Handa VL, Nygaard IE. Effects of examination technique modifications on pelvic organ prolapse quantification (POP-Q) results. *Int Urogynecol J*. 2003;14:136–140.
8. Oyama IA, Steinberg AC, Watai TK, Minaglia SM. Pelvic organ prolapse quantification use in the literature. *Female Pelvic Med Reconstr Surg*. 2012;18:35–36.
9. Parekh M, Swift S, Lemos N, et al. Multicenter inter-examiner agreement trial for the validation of simplified POPQ system. *Int Urogynecol J*. 2011;22:645–650.
10. Persu C, Chapple CR, Cauni V, Gutue S, Geavlete P. Pelvic organ prolapse quantification system (POP-Q) – a new era in pelvic prolapse staging. *J Med Life*. 2011;4:75–81.
11. Boyd SS, O'Sullivan D, Tulikangas P. Use of the Pelvic Organ Quantification System (POP-Q) in published articles of peer-reviewed journals. *Int Urogynecol J*. 2017;28:1719–1723.
12. Harmanli O. POP-Q 2.0: its time has come! *Int Urogynecol J*. 2014;25:447–449.
13. Parnell BA, Dunivan GC, Geller EJ, Connolly A. A novel approach to teaching the pelvic organ prolapse quantification (POP-Q) exam. *Int Urogynecol J*. 2011;22:367–370.
14. Geiss IM, Riss PA, Hanzal E, Dungal A. A simple teaching tool for training the pelvic organ prolapse quantification system. *Int Urogynecol J*. 2007;18:1003–1005.
15. Jelovsek JE, Maher C, Barber MD. Pelvic organ prolapse. *Lancet [Internet]*. 2007;369:1027–1038.
16. Ghatti C, Gregory WT, Edwards SR, Otto LN, Clark AL. Pelvic organ descent and symptoms of pelvic floor disorders. *Am J Obstet Gynecol*. 2005;193:53–57.
17. Swift SE, Tate SB, Nicholas J. Correlation of symptoms with degree of pelvic organ support in a general population of women: what is pelvic organ prolapse? *Am J Obstet Gynecol*. 2003;189:372–7–9.
18. Gutman RE, Ford DE, Quiroz LH, Shippey SH, Handa VL. Is there a pelvic organ prolapse threshold that predicts pelvic floor symptoms? *Am J Obstet Gynecol*. 2008;199:683.e1–683.e7.
19. Medina CA, Candiotti K, Takacs P. Wide genital hiatus is a risk factor for recurrence following anterior vaginal repair. *Int J Gynecol Obstet*. 2008;101:184–187.
20. Lowder JL, Oliphant SS, Shepherd JP, Ghatti C, Sutkin G. Genital hiatus size is associated with and predictive of apical vaginal support loss. *Am J Obstet Gynecol*. 2016;214:718.e1–718.e8.

**How to cite this article:** Madhu C, Swift S, Moloney-Geany S, Drake MJ. How to use the Pelvic Organ Prolapse Quantification (POP-Q) system? *Neurourology and Urodynamics*. 2018;37:S39–S43. <https://doi.org/10.1002/nau.23740>

# The fundamentals of uroflowmetry practice, based on International Continence Society good urodynamic practices recommendations

Andrew Gammie<sup>1</sup> | Marcus J. Drake<sup>2</sup>

Bristol Urological Institute, Southmead Hospital, Bristol, UK

## Correspondence

Andrew Gammie, Bristol Urological Institute, Southmead Hospital, Bristol BS10 5NB, UK.  
Email: andrew.gammie@bui.ac.uk

**Aims:** To review the recommendations on uroflowmetry in the International Continence Society (ICS) Standardization documents in order to identify a systematic approach to the delivery and interpretation of free flow rate testing in clinical practice.

**Methods:** Expectations of service and good practice in uroflowmetry described in the ICS standards on Urodynamic Practice, Urodynamic Equipment, and Terminology for Lower Urinary Tract Function were identified and summarized.

**Results:** Urodynamic centers should provide a suitable uroflowmetry testing environment. Equipment should be calibrated and maintained according to manufacturer requirements. Patients should be well-informed in advance of the test. They should be advised to avoid: knocking the machine; allowing the stream to move; squeezing the urethra; and body movements. It is generally appropriate to get more than one flow trace for each patient. Voided volume should be representative for the patient, for example by comparing with values recorded on a Bladder Diary. Post void residual (PVR) should be measured soon after testing. After the test, the urodynamicist should review the trace and ensure maximum flow rate and end of micturition are correctly identified in case the equipment has inappropriately taken the values from a trace artefact.

**Conclusions:** The summary provides a systematic approach to ensure a representative, high quality, non-invasive flow test is carried out for individual patients.

## KEYWORDS

free flows, standards

## 1 | INTRODUCTION

Urodynamics is the general term to describe the measurements that assess the function and dysfunction of the lower urinary tract (LUT) by any appropriate method. In

the clinical assessment of LUT symptoms (LUTS), evaluating the nature of an individual's voiding is a fundamental component of the diagnostic pathway, especially for men. Uroflowmetry is a non-invasive urodynamic test in which specific measurements are made of the rate of flow of urine and the volume voided. It is normally followed by an ultrasonically scanned measurement of post void residual (PVR) urine volume, and an interpretation of the flow pattern recorded by the machine over the duration of the void.

The work was undertaken at Bristol Urological Institute, Southmead Hospital, Bristol, UK.

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.



A recent think tank on uroflowmetry<sup>1</sup> recommended that specific, practical guidance be made available to increase the quality of uroflowmetry testing. Accordingly, the current article reviews the recommendations on uroflowmetry in the International Continence Society (ICS) Standardization documents in order to identify a systematic approach to the delivery and interpretation of free flow rate testing in clinical practice.

## 2 | METHODS

The ICS, through its Standardization Steering Committee (SSC), has an ongoing strategy to standardize LUT terminology and functional assessment, and link it to published evidence.<sup>2</sup> We reviewed key expectations of service and good practice in uroflowmetry described in the ICS standards on Urodynamic Practice,<sup>3,4</sup> Urodynamic Equipment,<sup>5</sup> and Terminology for LUT Function.<sup>6,7</sup> The current document is a synthesis of the key aspects applicable to uroflowmetry.

## 3 | GENERAL COMMENTS

A good urodynamic practice comprises: a clear indication for, and appropriate selection of, relevant test measurements and procedures; precise measurement with data quality control and complete documentation; accurate analysis and critical reporting of results. These general principles apply to all forms of urodynamic testing, including uroflowmetry.

Departments should develop uroflowmetry protocols on the basis of the ICS Urodynamic standards,<sup>3–5</sup> they should facilitate specific staff training and undertake regular evaluation of performance and adherence.<sup>3</sup> ICS Terminology Standards should be used when alluding to LUT symptoms, signs, and urodynamic observations.<sup>6,7</sup> Equipment should meet the requirements of the ICS guideline on equipment performance.<sup>5</sup>

Uroflowmetry is a test that measures the urinary stream as volume passed per unit time in milliliters per second (mL/s).<sup>4</sup> Maximum flow rate ( $Q_{\max}$ ) and total volume voided must be reported.<sup>4</sup> The PVR should also be reported. This is the remaining intravesical fluid volume determined immediately after completion of voiding. The technique (eg, ultrasound or catheter) used to measure the PVR should be specified.

## 4 | EQUIPMENT AND ENVIRONMENT

The basic set up for a flow test environment is illustrated in Figure 1. The requirement of a uroflowmeter is that it can continuously measure the flow rate of urine voided and the total volume voided. The method used to make this measurement is not clinically significant. Accuracy need only

be to  $\pm 1$  mL/s of true flow rate and to  $\pm 5\%$  of true volume voided (or  $\pm 2$  mL if that is greater than 5%).<sup>5</sup>

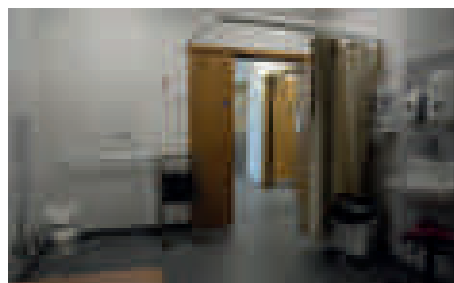
Units should regularly check the performance of their system and calibrate according to manufacturer recommendation.<sup>5</sup> Flowmeter calibration can be verified by pouring a precise volume into the flowmeter and checking the recorded volume. Calibration should be verified regularly, for example, at the start of every clinic or week of clinics, and documented. If frequent recalibration is necessary, the flow transducer might need to be replaced.

Uroflowmetry equipment should be placed in a private, quiet environment<sup>3</sup> that can be easily cleaned, with the machine ready for immediate use, as many LUTS patients having flow rate testing will experience urgency. PVR measurement is ideally done in the same room and immediately following the void. A sluice room with connecting door to the flow test room is preferable to an unconnected room.

## 5 | PREPARATIONS IN ADVANCE OF A UROFLOWMETRY TEST

An explanatory leaflet about uroflowmetry with sufficient information, which uses clear, unambiguous wording, will be appreciated by most patients. To reduce possible waiting time, patients can be asked to attend the clinic with a comfortably full bladder.

When sent the explanatory leaflet, the patient can also be asked to complete a frequency volume chart (FVC) or Bladder Diary. A FVC records the time of each micturition and the voided volumes, while a Bladder Diary also captures symptoms and events such as fluid intake, urgency, pain, incontinence episodes, and pad usage.<sup>6,8</sup> Average and maximum voided volumes, voiding frequency, and day/night urine production can be determined.

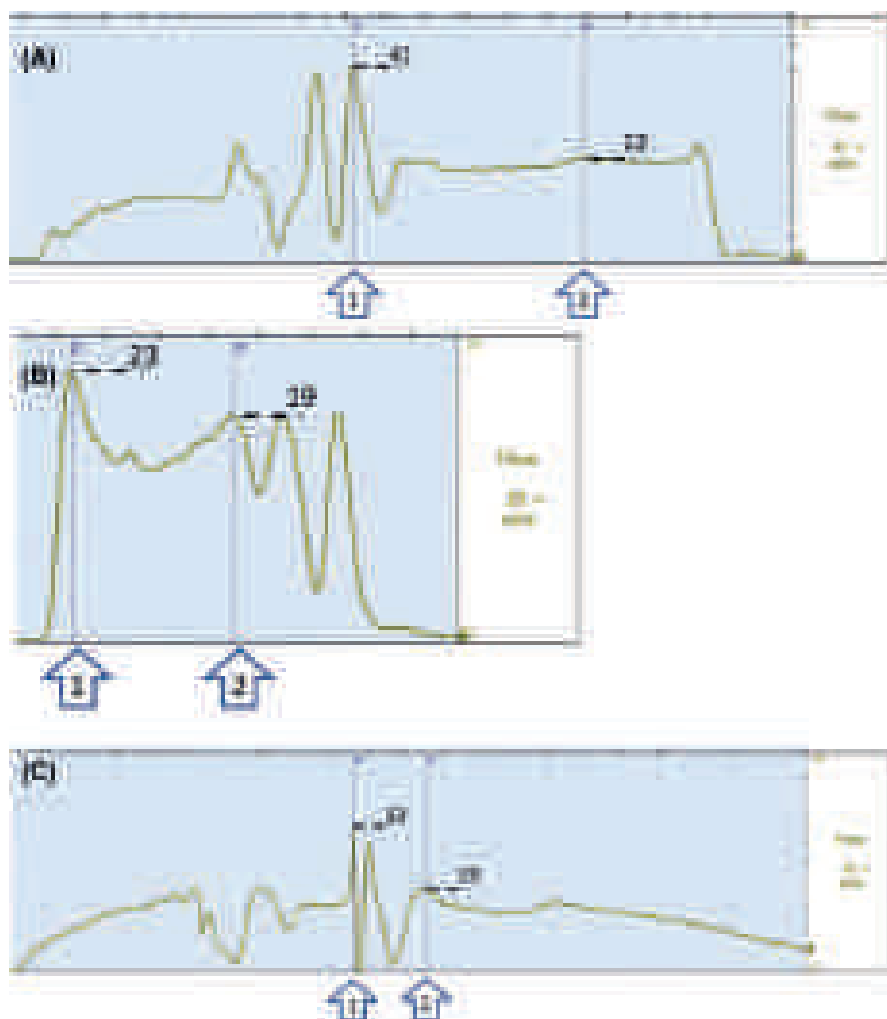


**FIGURE 1** A suitable environment for uroflowmetry. The flowmeter can be accessed quickly from the waiting area if the patient experience urgency, achieves privacy (here by having a curtain in addition to a locked doorway), is easy to clean, and has direct access to a sluice room (not in above picture). Female uroflowmetry would have a commode seat in addition to the funnel

## 6 | FLOW RATE TESTING

Patients should be asked to pass urine when they feel a “normal” desire to void,<sup>4</sup> and should undergo uroflowmetry in their preferred position. Intracorporeal modulations of the

flow rate should be minimized, for example, by asking the patient to relax and not to strain.<sup>4</sup> Men should be asked not to move the urine stream around the funnel, and not to squeeze the penis, both of which will affect the flow rate measurement (Figure 2).<sup>7</sup>



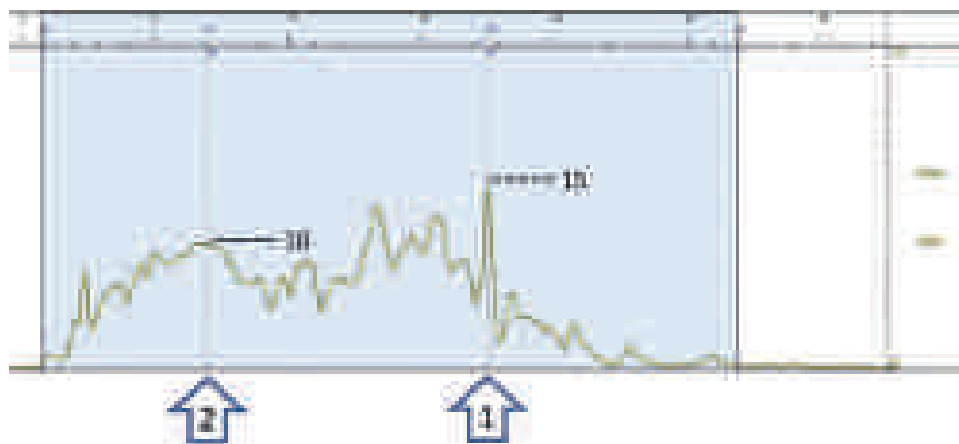
**FIGURE 2** Some artefacts encountered in uroflowmetry, and the importance of correcting for the error in  $Q_{\max}$  to establish the representative parameter. A, A male patient moving the urine stream back-and-forth across the funnel. B, A male squeezing and releasing the urethra at the start of flow, with straining toward the end of flow. C, A “knock artefact” (arrowed), resulting from a patient inadvertently kicking the uroflowmetry machine. In each case, the uroflowmetry machine has given a  $Q_{\max}$  value which is a result of the artefact, displayed on the right hand side, and taken from the point marked with arrow “1.” This is not representative of the patient’s own function, so the urodynamicist has scrutinized the trace after the test and selected the highest point in the trace that does appear to result from the patient’s own unimpeded bladder and outlet behavior, at the point marked with arrow “2.” This means the representative values change, for instance in A from 41 to 22 mL/s, which may well result in a clinically significant difference in interpretation. Before a flow test, the patient should be instructed to keep his stream in the same part of the funnel, not to squeeze his penis, and try to avoid knocking the machine

**TABLE 1** Task list to assist good practice in uroflowmetry

Task No.	Good practice question	If “No,” correction needed
1	Has equipment calibration been checked?	Check calibration
2	Is the patient aware of the reason for the test and what is required of them?	Explain to patient
3	Has the bladder diary been completed and examined?	Discuss with patient to gain estimates
4	Does the patient have a normal desire to void?	Wait until normal desire
5	Is the equipment set at the right height and position?	Adjust to suit patient
6	After the void, has urinalysis been carried out?	Perform urinalysis
7	Is the void known to be a representative normal void?	Repeat flow test after drinking
8	Is the trace clear of artefacts from movement of body, flowmeter or urine stream?	Adjust trace markers if possible, and instruct patient for improved next flow
9	Is $Q_{\max}$ marked at a point away from artefacts?	Move $Q_{\max}$ marker to smoothed maximum position
10	Are the markers for start and end of void away from artefacts or drops of urine?	Move markers away from artefacts
11	Does the scale of printing make the flow trace clearly visible?	Adjust scale of display/print
12	Has the residual urine volume been measured immediately after voiding?	Measure volume, including comment on any time delay
13	Does the report include: $Q_{\max}$ , voided volume, residual volume, Void%, flow and voiding times, flow trace shape description, whether flow is representative?  The report may also include if required: Clinical history summary, urinalysis, bladder diary summary and any lifestyle advice given.	Complete report

Practitioners should check if the voiding is representative, based on the patient's report, and comparing with other information, such as Bladder Diary volumes. Increasing bladder volume increases the potential bladder power,<sup>4</sup> notably in the

range from empty up to 150-250 mL. At volumes higher than 400-500 mL, the detrusor may become overstretched and contractile strength may decrease. Thus, interpretation should evaluate the bladder volume at time of testing (voided volume plus PVR).



**FIGURE 3** Example of a female patient who may have some pelvic floor contractions during voiding, leading to the uneven shape of the curve. This patient may also have moved about on the commode seat, giving rise to the particularly sharp spike. The computer-generated report reads  $Q_{\max} = 15$  mL/s, taking the value at arrow “1.” After the test, the urodynamicist identified this is not representative, and moved the cursor to the position of arrow “2,” where a portion of the flow unaffected by pelvic floor contraction and patient movement suggests an interpretable and representative flow.  $Q_{\max}$  value was accordingly corrected to 10 mL/s, and should be recorded as such, with comment on whether the flow was representative

Consider repeating the uroflowmetry if the result has not been representative for the patient or it indicates abnormality, with reasonable fluid intake and diuresis time before the flow is repeated.<sup>9</sup>

A list of tasks to aid good practice is contained in Table 1.

## 7 | QUALITY CONTROL

Several artefacts can occur which are readily identified: knocking of the flowmeter (Figure 2C), passing of feces or disposal of tissues result in high, sudden values of flow rate and/or volume. If such fast changes are observed and confirmed with the patient, instruction of the patient will improve the next flow test.

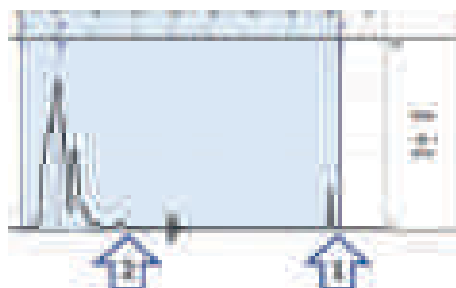
Moving the urine stream back and forth across the funnel results in phasic variations around the true flow rate (Figure 2A). Some men have developed the habit of squeezing the penis to build up pressure, in order to give a faster flow after release. This “squeeze and release” habit gives gaps in the flow followed by high flow rate spurts, illustrated in Figure 2B. In both cases, the patient should be instructed not to do so, in order to better evaluate the LUT itself. For some patients, pelvic floor muscle action or body movement can result in smaller, artefactual variations in flow rate, see Figure 3. Uroflowmetry machines will automatically, and perhaps wrongly, measure the highest peak of flow, rather than smooth out the flow rate to remove these artefacts. Accordingly, in each of these situations, the operator will need to move the  $Q_{\max}$  marker to a nearby point, or smooth the flow signal by eye, in order to establish the clinically representative value (Figures 2 and 3). A moving average using a 2 s window is advised.<sup>3</sup>

If the flow and voiding times are being reported, the operator will need to check that the end of flow is correctly marked by the machine. If drops due to coughs or other movement are included in the voiding time, the final marker will need to be moved back to the true end of micturition (Figure 4) and only then should the time values be recorded.

## 8 | REPORTING

All results and observations should be carefully reported. It is good clinical practice to integrate the uroflowmetry results with the history, examinations and Bladder Diary summary. A urinalysis should also be evaluated and reported with the flow results, since current urinary tract inflammation could alter the patient's flow characteristics.

The report after uroflowmetry should include; voiding position,  $Q_{\max}$  (corrected for any artefacts), voided volume and PVR. Flow time and voiding time may be reported if required. The ICS suggests a standard reporting format of “VOID: Maximum Flow Rate/Volume Voided/Post Void Residual



**FIGURE 4** Similar to correcting the  $Q_{\max}$  value after a test, the indicator identifying the end of micturition may need to be moved, from the point marked by arrow “1” to the point marked by arrow “2” arrow, if the patient experiences a post micturition dribble, or if the machine gets knocked as the patient moves away

Volume,” where flow rate is rounded to the nearest integer and volume rounded to the nearest 10 mL.<sup>3</sup> Scaling of the printout has been suggested as follows: 1 mm can equal 1 s on the x-axis and 1 mL/s and 10 mL voided volume on the y-axis,<sup>3</sup> but the trace must be clearly readable whatever scale is used.

Nomograms have been produced (summarized in Gammie et al<sup>1</sup>) that show the likelihood of the  $Q_{\max}$  and voided volume recorded resulting from a normal urinary tract. Clinicians must be aware that these nomograms are not diagnostic, but may be a useful screening tool for dysfunction.

Comment may also be made when reporting on the voided percentage (Void%) and the flow curve shape. Void% is the numerical description of the voiding efficiency, which is the proportion of bladder content emptied. Calculation: volume voided/(volume voided + PVR) \*100%.

The shape or pattern of the flow curve may suggest specific types of abnormality, but reliable and specific information about the cause cannot be derived from a flow curve alone.<sup>1,3</sup> The shape of the flow curve can be described as continuous or intermittent, and smooth or fluctuating.<sup>6</sup>

## 9 | CONCLUSIONS

This summary provides a systematic approach to ensure a representative, high quality, non-invasive flow test is carried out for individual patients. Adherence to the fundamentals of the ICS Standards, as synthesized in this review and summarized in Table 1, will enable urodynamic units to deliver high quality of uroflowmetry studies.

## CONFLICTS OF INTEREST

Dr Andrew Gammie reports grants from Andromeda, Digitimer, and Laborie, other from Astellas and Ipsen, outside the submitted work. Dr Marcus J. Drake reports

grants, personal fees, and non-financial support from Allergan, Astellas, and Ferring, personal fees from Pfizer, outside the submitted work.

## ORCID

Andrew Gammie  <http://orcid.org/0000-0001-5546-357X>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

## REFERENCES

1. Gammie A, Rosier P, Li R, Harding C. How can we maximize the diagnostic utility of uroflow?: ICI-RS 2017. *Neurourol Urodyn*. 2018. <https://doi.org/10.1002/nau.23472>
2. Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31:621–624.
3. Rosier P, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
4. Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
5. Gammie A, Clarkson B, Constantinou C, et al. International Continence Society guidelines on urodynamic equipment performance. *Neurourol Urodyn*. 2014;33:370–379.
6. Abrams P, Cardozo L, Fall M, et al. The standardization of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
7. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
8. Bright E, Cotterill N, Drake M, Abrams P. Developing and validating the International Consultation on Incontinence Questionnaire bladder diary. *Eur Urol*. 2014;66:294–300.
9. Reynard JM, Peters TJ, Lim C, Abrams P. The value of multiple free-flow studies in men with lower urinary tract symptoms. *Br J Urol*. 1996;77:813–818.

**How to cite this article:** Gammie A, Drake MJ. The fundamentals of uroflowmetry practice, based on International Continence Society good urodynamic practices recommendations. *Neurourology and Urodynamics*. 2018;37:S44–S49. <https://doi.org/10.1002/nau.23777>

## Fundamentals of urodynamic practice, based on International Continence Society good urodynamic practices recommendations

Marcus J. Drake<sup>1,2</sup>  | Stergios K. Doumouchtsis<sup>3</sup> | Hashim Hashim<sup>2</sup>  |  
 Andrew Gammie<sup>2</sup> 

<sup>1</sup> Translational Health Sciences, Bristol Medical School, Bristol, UK

<sup>2</sup> Bristol Urological Institute, Southmead Hospital, Bristol, UK

<sup>3</sup> Gynaecology Department, Epsom and St Helier University Hospitals NHS Trust, Epsom, UK

### Correspondence

Marcus J. Drake, Bristol Urological Institute, 3rd Floor L&R Building, Southmead Hospital, Bristol BS10 5NB, UK.

Email: marcus.drake@bristol.ac.uk

**Aims:** To review the recommendations on basic urodynamic testing in the International Continence Society (ICS) standardization documents, specifying key recommendations for delivery and interpretation in clinical practice.

**Methods:** Fundamental expectations described in the ICS standards on good urodynamic practices, urodynamic equipment, and terminology for lower urinary tract (LUT) function were identified and summarized.

**Results:** The ICS standard urodynamic protocol includes clinical history, including symptom and bother score(s), examination, 3-day voiding chart/diary, representative uroflowmetry with post-void residual, and cystometry with pressure-flow study (PFS). Liquid filled catheters are connected to pressure transducers at the same vertical pressure as the patient's pubic symphysis, taking atmospheric pressure as the zero value. Urodynamic testing is done to answer specific therapy-driven questions for treatment selection; provocations are applied to give the best chance of reproducing the problem during the test. Quality of recording is monitored throughout, and remedial steps taken for any technical issues occurring during testing. Labels are applied during the test to document events, such as patient-reported sensation, provocation tests, and permission to void. After the test, the pressure and flow traces are scrutinized to ensure artefacts do not confound the findings. An ICS standard urodynamic report details the key aspects, reporting clinical observations, technical, and quality issues. Urodynamic services must maintain and calibrate equipment according to manufacturer stipulations.

**Conclusions:** The review provides a succinct summary of practice expectations for a urodynamic unit offering cystometry and pressure flow studies (PFS) to an appropriate standard.

### KEYWORDS

LUTS, overactive bladder, standardization, urodynamics

Alan Wein led the peer-review process as the Associate Editor responsible for the paper.

## 1 | INTRODUCTION

Urodynamics is the general term to describe the measurements that assess the function and dysfunction of the lower urinary tract (LUT) by any appropriate method. The aim of urodynamics is to make clinical observations while taking these measurements, in order to surmise the underlying causes for the symptoms, and to quantify the related pathophysiological processes. This should establish objectively the presence of a dysfunction and understand its clinical implications. This may either confirm a clinical diagnosis or give a new, specifically urodynamic, diagnosis.

The International Continence Society (ICS), through its Standardization Steering Committee (SSC), has an ongoing strategy to standardize LUT terminology and functional assessment, and link it to published evidence.<sup>1</sup> Several ICS publications underpin the professional standard in Urodynamic testing, and describe in detail the underlying thinking and the evidence base. The current document is a synthesis of the key aspects applicable for the more common Urodynamic tests used in clinical pathways.

## 2 | METHODS

We reviewed recommendations in the ICS standards on urodynamic practice,<sup>2,3</sup> pressure flow studies (PFS),<sup>4</sup> urodynamic equipment,<sup>5</sup> terminology for LUT function,<sup>6,7</sup> and a publication on artefacts.<sup>8</sup> The review focusses on cystometry and PFS in adults without relevant neurological abnormalities and with intact “normal” anatomy of the LUT. Flow rate testing<sup>9</sup> and video-urodynamics<sup>10</sup> are described in separate documents.

### 2.1 | General comments

A good urodynamic practice comprises: a clear indication for and appropriate selection of relevant test measurements and procedures; precise measurement with data quality control and complete documentation; accurate analysis; reporting of results which evaluates urodynamic observations and places them into the patient's clinical context.

Departments should develop urodynamic practice protocols on the basis of the ICS urodynamic standards,<sup>2,3,5</sup> they should facilitate specific staff training and undertake regular evaluation of performance and adherence.<sup>2</sup> ICS terminology standards should be used when alluding to LUT symptoms, signs, and urodynamic observations.<sup>6,7</sup> Equipment, including the catheters and transducers, should meet the requirements of the ICS guideline on equipment performance.<sup>5</sup>

### 2.2 | Equipment

The basic requirement of a standard urodynamic system is that it can measure at least two pressures and calculate

detrusor pressure ( $p_{\text{det}}$ ) in real time, defined as the simultaneous difference between intravesical ( $p_{\text{ves}}$ ) and abdominal ( $p_{\text{abd}}$ ) pressures. It can measure the flow rate of the voided volume and regulate the rate of fluid infusion. It has an on-line display of pressures and flow, with adequate scale and resolution; no information should be lost electronically when tracings go off-scale on display. It is possible to record standard information about sensation and additional comments (event recording).<sup>5</sup>

Systems using liquid-filled catheters and external transducers are recommended by the ICS.<sup>2,3</sup> The transducer is levelled to the pubic symphysis, an anatomical landmark for the bladder, and the zero-point set to atmospheric pressure. Equipment should have the facility to move the transducers vertically in order to bring the transducers back to the level of the symphysis pubis, since patients may change position during a test. Micro-tip or air-filled catheters are not interchangeable with liquid-filled systems<sup>2</sup>; centers that utilize them should provide reference values for their data.

Using ICS standard pressures based on liquid-filled systems allows comparison of data between patients and centres. New technologies need to prove their usefulness and accuracy compared to existing ICS standard urodynamic tests before clinical application.<sup>11</sup> To date, there are no standardized pressure measurements for air-charged catheters.

### 2.2.1 | Calibration

Pressure transducer calibration is achieved by exposing the catheter tip to two different well-defined pressures (a pressure difference of  $\geq 50$  cmH<sub>2</sub>O is recommended).<sup>5</sup> The calibration should be verified regularly (eg, every 10 urodynamic measurements for non-disposable transducers) and documented.

Flowmeter calibration can be achieved by pouring a precise volume at a constant flow into the flowmeter and checking the recorded volume. Calibration should be verified regularly (eg, every 10 urodynamic measurements). If frequent recalibration is necessary, the flow transducer might need to be replaced.

Infusion pumps are tested by measuring the time to deliver a known volume. The filling catheter should be connected, as peristaltic type pumps (where a series of rollers compress a flexible tube) may show errors due to downstream resistance. Load cell measurement of infused volume is advised, as peristaltic pumps may turn even when the downstream tube is blocked.

### 2.3 | Preparations in advance of a urodynamic test

A leaflet clearly explaining urodynamic investigation in adequate detail will be appreciated by most patients. A table suggesting content to include in an information leaflet is



available.<sup>2</sup> Instructions must be given to the patient regarding continuation of usual LUT management (eg, medication).

A urinalysis to screen for infection or haematuria should be evaluated.

Patients should attend with a completed frequency volume chart (FVC) or bladder diary.<sup>6,12</sup> They can be used to determine fluid intake, maximum and average voided volume, voiding frequency, and day/night urine production. This information supports the patient's symptom reporting, and aids plausibility control of subsequent urodynamic studies (eg, to prevent over-filling of the patient's bladder).

Urodynamic tests should be requested with the goal of answering a specific question.<sup>3</sup> "Formulating the urodynamic question" is a process of reviewing the clinical assessment already available and what potential therapy options may subsequently be appropriate, so the test can identify appropriate treatment options and potential adverse effects.

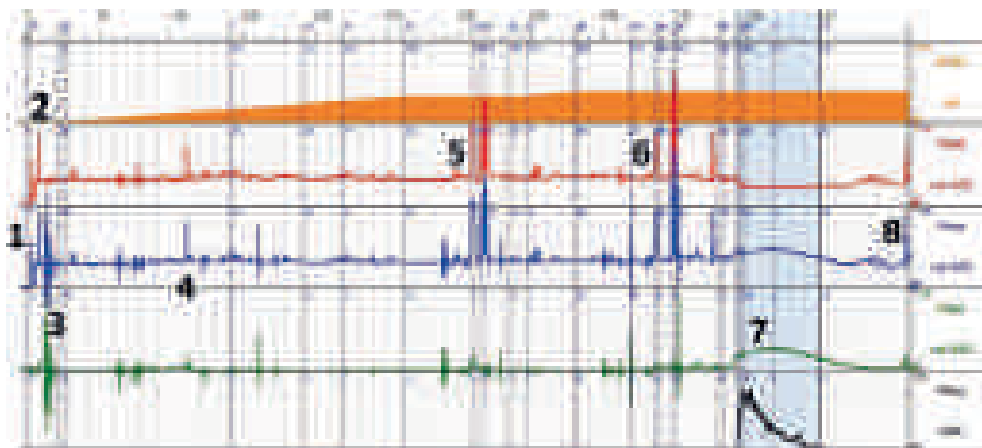
## 2.4 | ICS standard urodynamics protocol

- Clinical history, including valid symptom and bother score (s) and medication list.

- Relevant clinical examination (abdominal/pelvic/genital examination, and checking for possible neurological disease or oedema).
- Three day FVC or bladder diary.<sup>13</sup>
- Representative uroflowmetry with post-void residual (PVR).<sup>9</sup>
- A complete ICS standard urodynamic test<sup>2</sup>: Uroflowmetry and PVR plus cystometry and pressure-flow study (PFS).

Cystometry<sup>2</sup>: Continuous liquid filling of the bladder via a transurethral (or other route eg, suprapubic) catheter, at least with intravesical and abdominal pressure measurement and display of detrusor pressure, including quality checks and provocations to aid eliciting symptoms. Cystometry ends with "permission to void" or with severe incontinence. The fluid type and temperature, filling method and rate, catheter sizes, pressure recording technique, and patient position should all be specified.

Pressure-Flow study<sup>2</sup>: The intravesical and abdominal pressures are measured, from "permission to void," while uroflowmetry is performed with a transurethral (or suprapubic) catheter in place. The position of the patient, the catheter sizes and the pressure and flow recording technique should be specified.



**FIGURE 1** A specimen urodynamic test for a female patient. Transducers are zeroed to atmosphere at the start, as the  $p_{abd}$  and  $p_{ves}$  are at zero (1), before patient pressures are exposed to the transducers. When the transducers are connected to the patient (2), the clear rises in  $p_{abd}$  and  $p_{ves}$  are termed the "resting pressures"; the resting pressures of  $p_{abd}$  and  $p_{ves}$  are never zero (unless the urodynamic practitioner makes the technical mistake of zeroing the displayed pressures while recording from the patient, or the transducers are not placed in the required plane level with the pubic symphysis). In this case,  $p_{abd}$  and  $p_{ves}$  are both within normal limits, and similar magnitude, so  $p_{det}$  is zero. A cough test shows equal response on  $p_{abd}$  and  $p_{ves}$  (2). Some artefactual noise is recorded when the  $p_{ves}$  line is knocked (3). Cough tests are carried out and live signal is present throughout the test (4). At (5), filling is paused and a Valsalva manoeuvre and a stress cough test is carried out, but no leak occurs. Further filling is done, and these two tests repeated at (6) where leakage occurs on both (markers confirm this, and small changes in the flow trace have occurred but are not visible at this scale). After "permission to void" is given, the patient voids (7) and care is taken with the placement of the  $Q_{max}$  marker, and with the slight fall in  $p_{abd}$  at this point. Finally, a cough test (8) verifies that pressure transmission has remained good throughout the voiding phase

## 2.5 | Practice of cystometry and pressure flow studies

A good urodynamic investigation is performed interactively with the patient.<sup>3</sup> It should be established how the patient's symptoms relate to what they experienced during the test. There should be continuous observation of the signals as they are collected, and assessment of the plausibility of all signals. Direct inspection of the raw pressure and flow data before, during, and at the end of micturition is essential, because it allows artefacts and untrustworthy data to be recognized and eliminated.<sup>4</sup> The flow pattern in a PFS should be representative of free flow studies in the same patient. An overall study trace is illustrated in Figure 1.

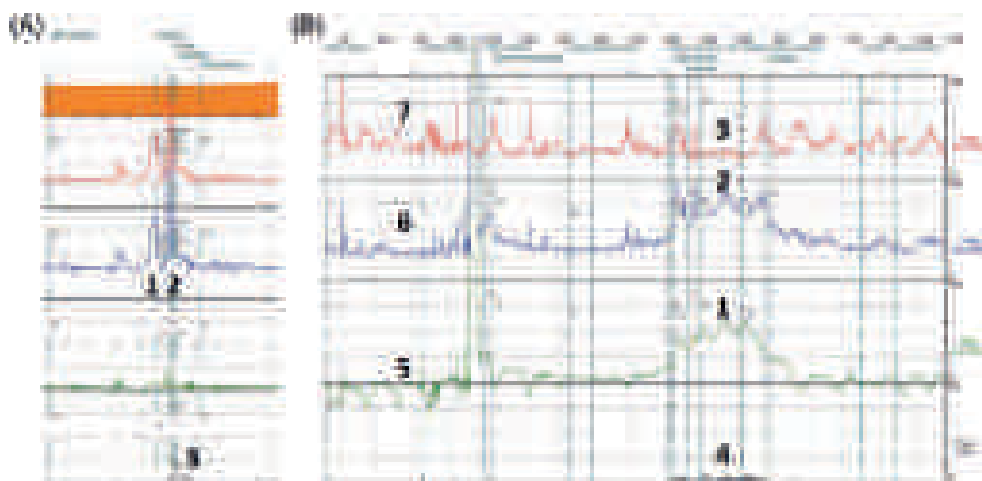
Electronic marking of events is important for subsequent analysis; the position of event markers should be adjustable after the test has finished, and the meaning of any abbreviations used for labels should be clear.<sup>5</sup>

### 2.5.1 | Pressure recording

Zero pressure is the value recorded when a liquid-filled transducer is open to the environment (either disconnected

from any tubes, or when the open end of a connected liquid-filled tube is at the same vertical level as the transducer). "Set zero" or "balance" can then be undertaken, making atmospheric pressure the zero baseline for the test. Intravesical pressure ( $p_{ves}$ ) or abdominal pressure ( $p_{abd}$ ) is thus the excess pressure above atmosphere at the hydrostatic level of the symphysis pubis. "Set zero" is not done when catheters are already recording from the patient; this is a common mistake in many urodynamic units.

- ICS standard cystometry is performed using liquid filled catheters, with external transducers at the reference level of the top of the symphysis pubis.<sup>2,3,6</sup> To achieve this, most urodynamic machines have a movable platform for the transducers, so they can easily be placed at the same height from the ground as the patient's symphysis.
- Use the thinnest possible transurethral double or triple lumen catheter or a suprapubic catheter. Two-catheter techniques (separate filling and pressure recording catheters) are an acceptable alternative.<sup>2</sup>
- Fix the catheters as close as possible to the anus and urethral meatus with tape, without blocking the urinary meatus.



**FIGURE 2** Urodynamic observations during filling cystometry. A, USI; the filling pump is stopped, and the patient is asked to do a Valsalva manoeuvre (1) and to do a sequence of 2 or 3 good coughs (2). This patient leaked with the coughs (3), and no DO was present, so the urodynamic observation of USI was documented. B, DO is the presence of a bladder contraction during filling (1), which may be spontaneous or provoked. It is essential to review all the lines in the trace before reporting DO, to confirm there is a bladder contraction (2) and minimal abdominal activity (3; though a small abdominal contraction might be seen if the patient tries to prevent leakage by contracting their pelvic floor). In this case, there is also incontinence (4), so the urodynamic observation here is DO incontinence (DOI). In the same trace, there are also fluctuations in the calculated detrusor pressure (5) which might be misinterpreted as DO. However, these are below the baseline, and there is no change in bladder pressure associated with them (6). Instead, there are phasic pressure changes visible in the abdominal pressure trace (7), indicating the presence of rectal contractions. Practitioners need to recognise that a true change in abdominal pressure shows up in both  $p_{ves}$  and  $p_{abd}$ ; a phasic change in one line which is absent in the other indicates a contraction of the organ containing the catheter tip (bladder or rectum, respectively)

- Rectal placement of a fully liquid filled open catheter, or punctured balloon catheter, to measure  $p_{abd}$  is ICS standard. Vaginal or stoma placement is used only if rectal placement is impossible.

Prevention of liquid leaks and air bubbles in the pressure tubing system is needed throughout testing, and should be corrected when identified.<sup>3</sup> Coughs or other abdominal pressure rises are used to ensure that the abdominal and intravesical pressure signals respond equally (see Figure 3).

## 2.5.2 | Cystometry

Filling cystometry is done in the upright/vertical position (standing or normally seated) whenever physically possible. Detection of detrusor overactivity (DO) and urodynamic stress incontinence (USI) are influenced by the position of the patient; sitting or standing has a higher sensitivity.<sup>2</sup>

## 2.5.3 | Filling rate

Maximum physiological filling rate is estimated by body weight in kg divided by four,<sup>6</sup> thus typically in the range of 20-30 mL/min. More rapid filling is referred to as non-physiological filling rate.<sup>3</sup>

For a balance between a filling rate that is slow enough to be representative and fast enough to complete the cystometry efficiently, consider a filling rate in mL/min of roughly 10% of the largest voided volume (reported on a FVC; and allowing for PVR).<sup>2</sup>

Diuresis adds bladder volume that is not recorded by the urodynamics system, but that is relevant for interpretation of the results. Cystometric capacity is most reliably determined by calculation of voided volume plus PVR immediately after PFS.<sup>3</sup>

## 2.5.4 | Sensations

Three sensation parameters are recorded<sup>6</sup>: first sensation of filling (FSF), first desire to void (FDV), and strong desire to void (SDV). The patient also may report sensation(s) suggesting “urgency,” which can be marked specifically. When indicating the volumes at which these sensations occurred, the report should make allowance for the fact that the volume instilled into the bladder by the machine is not necessarily the actual liquid volume in the bladder (eg, if the bladder was not empty at the start of the filling cystometry, or if the patient is experiencing diuresis).

1. FSF: “Tell me the moment when you perceive that your bladder is not empty anymore.”<sup>2</sup>

2. FDV: “Tell me when you have the sensation that normally tells you to go to the toilet, without any hurry, at the next convenient moment.”<sup>6</sup>
3. SDV: “The moment that you would definitely visit the nearest toilet to pass urine.” There should be no pain or any fear of losing urine.

The end of filling should relate to a “strong but not uncomfortable need to void,” indicated by SDV on the urodynamic graph. A specific marker to indicate permission to void must be used if there is a delay between halting the pump and permission to void. If another reason is chosen for concluding filling, this should be indicated.

Incontinence, fear of leakage, pain, or other signs or symptoms during the test should be specifically marked on the urodynamic graph.

## 2.5.5 | Provocation

Urodynamic stress test<sup>2</sup> (Figure 2) is used for any physical effort of the person tested, to elevate abdominal pressure during cystometry, with the aim of examining USI. The exact approach to stress testing during urodynamics has not been standardized. Thus, the provocation method, pressure measuring catheter (size) and method, the leak detection method, and the intravesical volume(s) may be reported.

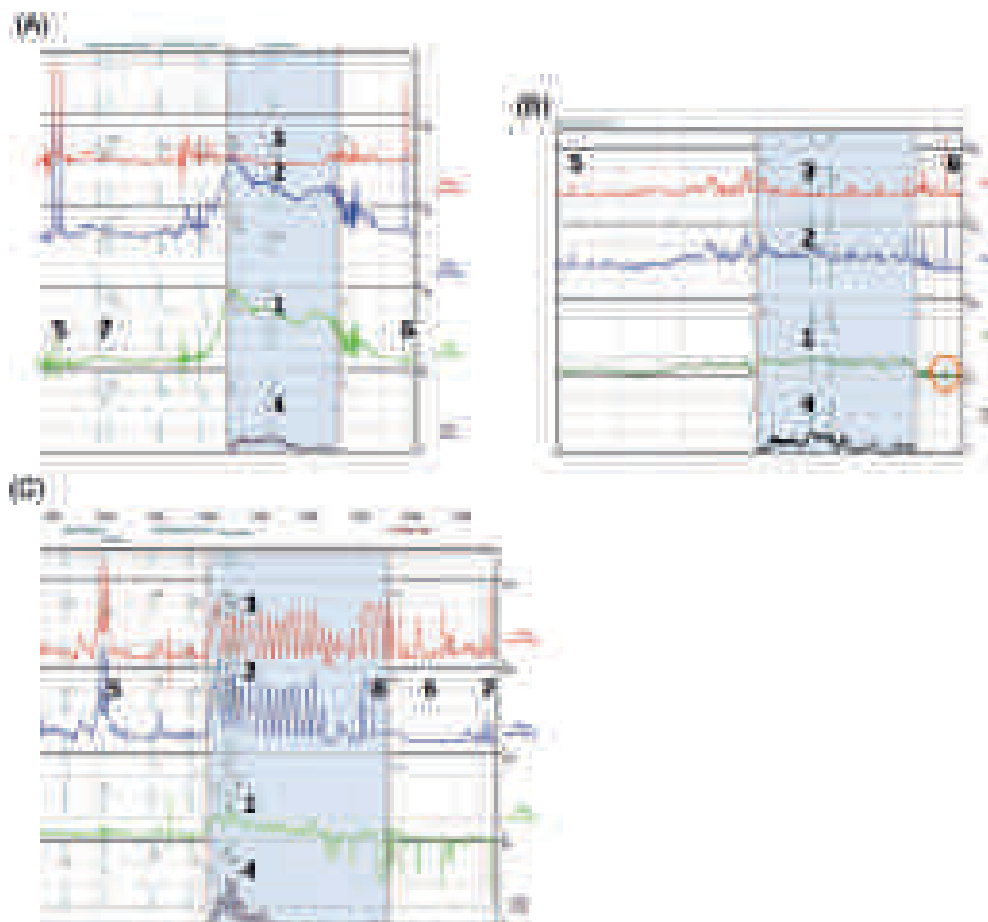
Leak point pressure (LPP)<sup>2</sup> is the pressure (spontaneous or provoked) that has caused fluid to be expelled from the bladder at the moment that it is visible outside the urethra. No ICS (or commonly agreed) standard technique or protocol is available and a variety of terms and techniques are used.

DO (Figure 2) is characterised by involuntary detrusor contractions during the filling phase which may be spontaneous or provoked.<sup>6</sup> Cough-associated DO<sup>2</sup>: Reported when the onset of the DO (with or without leakage) occurs immediately following the cough pressure peak. Cough-associated DO incontinence is a form of DO and must not be confused with USI.

## 2.5.6 | Pressure-flow studies

The relevance of instruction, position, and privacy while undertaking PFS is equal to uroflowmetry. PFS is done comfortably seated (women, some men) or standing if that is the preferred position (men). Pressure-flow analysis is only validated for voluntarily initiated micturitions and not for incontinence.

- PFS begins immediately after permission to void and ends when the detrusor pressure has returned to the baseline

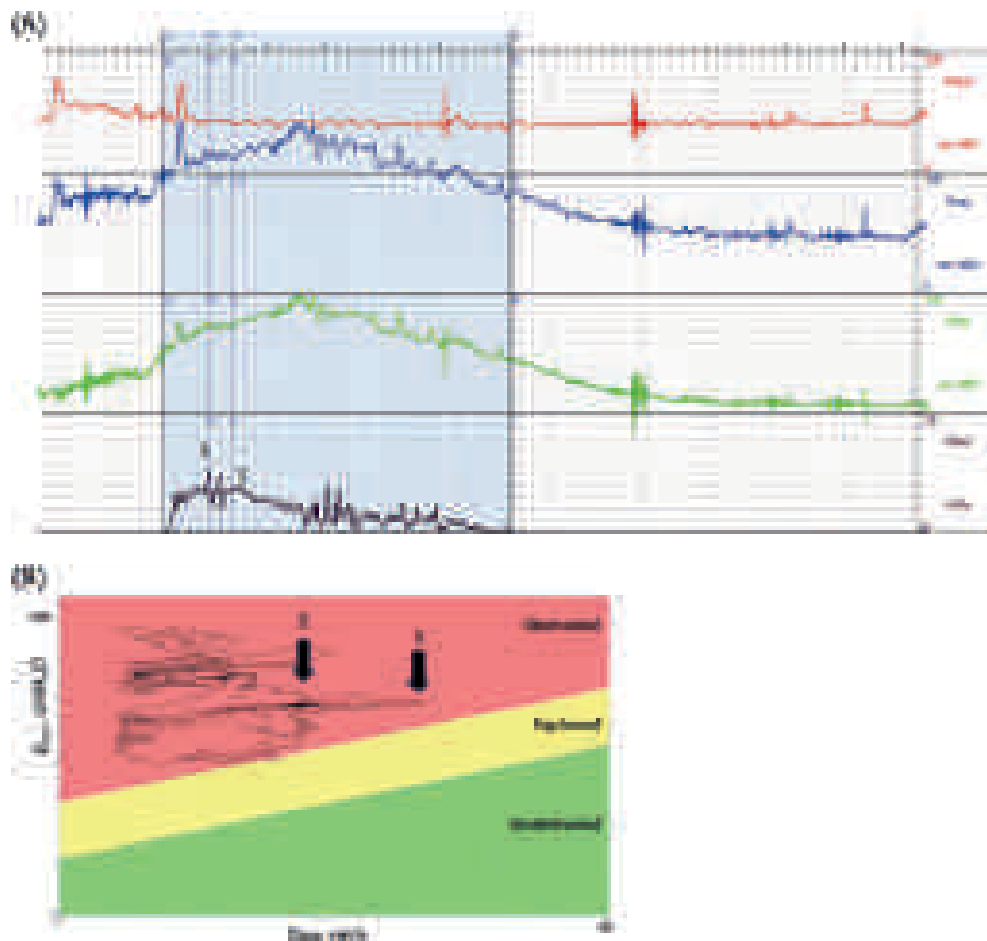


**FIGURE 3** Urodynamic observations during PFS.<sup>4</sup> A, Bladder outlet obstruction (BOO) is indicated by a high pressure generated yet only a slow stream. It is ascertained by evaluating the detrusor pressure ( $P_{\text{det}Q_{\text{max}}}$ ; 1) at the time of maximum flow rate ( $Q_{\text{max}}$ ; 4). It is important to check that the detrusor pressure reflects the bladder pressure (2), rather than a drop in the abdominal pressure (3). In this male case,  $Q_{\text{max}}$  was 8,  $P_{\text{det}Q_{\text{max}}}$  was 72, and there was no drop in abdominal pressure, so the bladder outlet obstruction index ( $P_{\text{det}Q_{\text{max}}} - 2Q_{\text{max}}$ ) was 56, that is, BOO was present. Fidelity of pressure recording must always be checked by asking patient to cough before (5) and after (6) voiding to be sure both  $P_{\text{ves}}$  and  $P_{\text{abd}}$  detect the pressure spike equally. This patient also had DO (7). B, Detrusor underactivity (DUA); Detrusor underactivity is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.<sup>6</sup> In this case, detrusor pressure is low (1) and  $Q_{\text{max}}$  (4) is slow, with a weak bladder contraction (2) and no change in  $p_{\text{abd}}$  (3). There is a marked delay between permission to void (5) and start of flow. Cough subtraction before (5) and after (6) the void are good. At 6, the cough subtraction (orange circle) shows a biphasic artefact, meaning a slight deflection upwards and an equal deflection downwards: this is acceptable, and is a consequence of the slight discrepancy in the exact moment the impulse reaches the respective transducer for the two measured pressures ( $p_{\text{ves}}$  and  $p_{\text{abd}}$ ). C, Straining is sometimes done by a patient to try and help initiate or sustain voiding, or to speed it up. In this case, there is a small detrusor contraction during voiding (1), but at the same time there are marked strains indicated by the intermittent peaks in vesical (2) and abdominal (3) pressure. Caution is needed to decide the corrected value of  $Q_{\text{max}}$  (4), as it should not be taken during a strain. The cough subtraction before voiding is fine (5), but not so after voiding (6), where this is a spike elicited by coughing only in the  $p_{\text{abd}}$  trace. A reduced signal is seen in the  $p_{\text{ves}}$  at (7), explaining the poor post void cough subtraction. The last moment of proper vesical pressure recording is at (8), and since this is after the completion of flow, the PFS can be considered meaningful

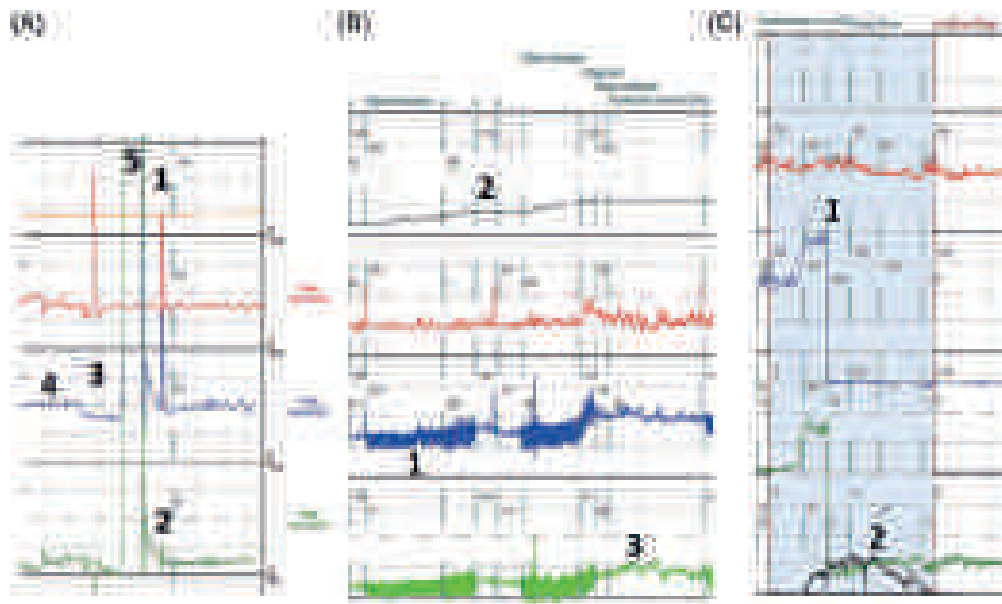
- value and/or the flowrate to zero and/or the patient considers the micturition completed.
- Use the shortest possible meatus-to-flowmeter distance, raising the flowmeter to suit the individual patient.

Correction for delay between pressure and flow recording may be needed.

- Cough checking of catheter response is always required after pressure-flow.



**FIGURE 4** Calculating the bladder outlet obstruction index (BOOI) and bladder contractility index (BCI), for describing PFS in men (no equivalent parameters have been identified as yet for women). A, Pressure flow study for a man with voiding LUTS. The machine placed the maximum flow rate at point 1. However, this was on the tip of an unnatural spike, so the urodynamicist checked the shape of the flow trace, and considered that point 2 reflected the flow of the patient's urine most faithfully. Thus, this was considered the corrected maximum flow rate ( $Q_{\max}$ ), with a value of 9 mL/s.  $p_{\det}$  at this point ( $p_{\det Q_{\max}}$ ) was 74. From the equation  $BOOI = p_{\det Q_{\max}} - 2 \cdot Q_{\max}$ , the value for this patient was  $74 - 18 = 56$ . Any value of BOOI above 40 in a man (with a prostate) indicates obstruction. From the equation  $BCI = p_{\det Q_{\max}} + 5 \cdot Q_{\max}$ , the value of BCI for this patient was  $74 + 45 = 119$ . Any value of BCI above 100 in a man (also with a prostate) indicates normal contractility. B, The ICS recommends that the PFS is plotted graphically on a PQ plot. On the P/Q plot, "1" shows the artefactual peak due to the flow spike. The P/Q plot allows the investigator to see how the artefact almost changes the diagnosis, by nearly crossing one of the lines on the nomogram. "2" shows the corrected position, away from the flow spike and clearly in the obstructed region. Failure of machine software using current technology to identify artefacts, like that shown at 1, means that traces must be checked for plausibility, since otherwise obstruction and contractility may be wrongly derived from the pressure flow study, leading to inappropriate treatment decisions for the patient



**FIGURE 5** Artefacts that can cause difficulty with identifying representative information and misinterpretation of urodynamic findings. A, A cough pressure peak (1) is recognizable during post-test evaluation as a phasic positive pressure change observed in  $p_{ves}$  and in  $p_{abd}$ . With liquid-filled catheters, it is usual that the bladder line is of smaller diameter than the abdominal line, so complete cancellation of a cough in the detrusor trace is unlikely. Thus, a symmetric biphasic wave on the detrusor trace (2) is acceptable. Poor pressure transmission is suggested when the cough pressure peak signals on  $p_{ves}$  and  $p_{abd}$  are not nearly equal, or one of them is absent, as illustrated at 3. This follows a phase of “dead signal,” meaning that it is not showing small pressure fluctuations and is not adequately responding on straining, patient movements, or coughing (4). Flushing the vesical pressure line (5) is a common approach to solving a dead signal or poor pressure transmission, and should be verified with a subsequent cough test, as illustrated. B, Pump vibrations: visible as stable frequency oscillations of small but constant amplitude if a dual-lumen is used, or if the filling tube touches the pressure connecting tube and the pump is switched on (1), clearly identified as they stop when the pump is off (2). This patient was observed to have DO (3; pump turned off at this time). C, Expelled catheter: this is observed as a sudden drop in either  $p_{ves}$  or  $p_{abd}$ , usually below zero (1). In this case, the vesical catheter was expelled before  $Q_{max}$  (2) in a pressure flow study, which means it is not possible to interpret the pressure-flow relationship at this key point during voiding. If this hinders answering the urodynamic question, the test will have to be repeated

Normal voiding function: Flow rate (and pressure rise) are within normal limits; flow begins more or less directly after permission to void, and ends with an empty bladder.

“Situational inability to void” or “Situational inability to void as usual”<sup>2</sup>; when the person performing the test, communicating with the patient, feels the attempted voiding has not been representative.

Bladder outflow obstruction (BOO) (Figure 3) is defined as a (specified) cut-off of bladder outflow resistance based on the pressure/flow relation (ratio) that is considered clinically relevant.<sup>2</sup>

A slow stream may be caused by BOO or detrusor underactivity (Figure 3). Presentation of pressure-flow studies should be with a plot of the flow rate (delay corrected) rate on the X-axis and the synchronous detrusor pressure on the Y-axis, in addition to the time-based graphs.<sup>2</sup> The ICS pressure flow

nomogram can be used to present this data for male patients, for whom BOO can be quantified with the BOO Index, and underactivity with the bladder contractility index<sup>14</sup> (Figure 4). While these indices are often stated by the urodynamic software, the urodynamicist is duty-bound to check the plausibility of the results, as the machine may wrongly identify an artefact as the  $Q_{max}$ , and give entirely wrong results with potentially disastrous consequences for the patient.

## 2.5.7 | Repeat testing

- When an error or artefact is observed, the person performing the test should act accordingly, and prevent continuation in case of an error.
- Do not routinely undertake immediate repetition of invasive urodynamics “for confirmation” if the test was

technically adequate and representative, and has answered the clinical question.

- Immediate repetition of the test is appropriate when doubt exists as to whether the test has answered the clinical question.
- Repetition of a urodynamic test subsequently is needed when technical errors and artefacts have been observed at post-test analysis.

Artefacts such as a signal which is non-responding (dead), has stepwise changes in pressure, or has negative pressures, often can be corrected only with speculation about the underlying causes. Studies with such artefacts should be repeated. A few common artefacts can be accepted, for example, rectal activity, biphasic spikes at cough tests (Figure 3B), or insufficient  $p_{abd}$  response during straining.

The urodynamic findings and the interpretation of the results should be documented immediately, that is, before the patient has left the urodynamic laboratory. Doing so allows for a second test if required.

## 2.6 | Technical and clinical quality control

The following three criteria form the minimum recommendations for ensuring quality control of pressure recordings:

1. Resting values for abdominal, intravesical, and detrusor pressure are in a typical range (see below);
2. The abdominal and intravesical pressure signals are “live,” with minor variations caused by breathing or talking being similar for both signals; these variations should not appear in  $p_{det}$ ;
3. Coughs or other abdominal pressure rises are used throughout, including before and after voiding, to ensure that the abdominal and intravesical pressure signals respond equally. This is because pressure recording quality can deteriorate quickly during a test, and wrong conclusions might be drawn if not identified quickly. Since the test is used to recommend treatment options, possibly including surgery, the consequence of a wrong conclusion can be detrimental for the patient.

Initial resting pressure<sup>2</sup> is the  $p_{ves}$  and the  $p_{abd}$  pressure at the beginning of the cystometry. Typical ranges for  $p_{ves}$  and  $p_{abd}$  are: supine 5–20 cmH<sub>2</sub>O; sitting 15–40 cmH<sub>2</sub>O; standing 30–50 cmH<sub>2</sub>O.<sup>3</sup> Usually both recorded pressures are almost identical (and they must not be zero: see Figure 1), so that the initial  $p_{det}$  is between –5 and +5 cmH<sub>2</sub>O in the majority.<sup>15</sup> Gentle flushing of both catheter channels and/or filling 20–30 mL into the bladder may be needed before the initial resting pressures are registered.

The use of rectal transducers assumes they measure resting abdominal pressure, but they can also measure rectal

contractions,<sup>5</sup> seen as positive waves on  $p_{abd}$  and reflected as negative  $p_{det}$  waves. If either detrusor or rectal contractions occur, the recorded pressures in  $p_{ves}$  and in  $p_{abd}$  will differ. The relation between signal changes and patient sensation/activity are checked for plausibility and documented during the test.

### 2.6.1 | Features, artefacts, and errors

Patient movement, external manipulation of the catheter and other influences cause signal patterns that should be recognized during the test and at (re-) evaluation of graphs.

- Position change<sup>2</sup>: A change in patient position, either active or passive (eg, tilting), is visible on the cystometry trace by a lasting change of equal magnitude in both  $p_{ves}$  and  $p_{abd}$ .

A position change should be followed by adjustment of the external pressure sensors height to the new level of the pubic symphysis, so that the physiological  $p_{ves}$  and  $p_{abd}$  are observed again;  $p_{det}$  should be unaffected.

- Rectal contractions: temporary phasic increases visible in the  $p_{abd}$  trace, without synchronous change in  $p_{ves}$ , resulting in negative deflections of  $p_{det}$  (Figure 2B).
- Dropped  $p_{abd}$  at void: during the voiding time,  $p_{abd}$  decreases below the previous resting pressure (as a consequence of pelvic [and abdominal] muscle relaxation). This will artefactually increase  $p_{det}$ , and so affect the pressure-flow analysis result.
- Straining: observable as a temporary increase in both  $p_{ves}$  and  $p_{abd}$  pressure.
- After-contraction: a continued or new detrusor pressure rise immediately after flow ends. It is important to note if this occurs with the complete emptying of the bladder. This may be the reason why some patients feel they have an urgency sensation at the end of voiding.

Artefacts affect interpretation of urodynamic findings (Figure 5), and could lead to mis-diagnosis in severe examples. Step-wise or prolonged constant slope pressure changes imply a non-physiological cause (eg, movement, blockage or disconnection, or leakage of a catheter), which should be resolved.<sup>3</sup> A detailed review of urodynamic artefacts has been published.<sup>8</sup>

### 2.6.2 | Post-test analysis

Once a test is completed, it should be scrutinized to confirm technical quality and exclude the possibility that artefacts have influenced key observations. Liquid leaks and air



**TABLE 1** Checklist for fundamentals of urodynamic practices

Question	What is the urodynamic question? Will patient management change as a result? Does the bladder diary/symptom score affect these? Does the patient's report match the above?
Setup	
Calibrate	Check that the equipment is registering pressure and volume accurately
Prepare	Fill the domes and tubes with water, and mount them on the transducers  Catheterise the patient, connect tubes and flush with water  Level transducers with symphysis pubis bone
Quality	
Zero to atmosphere	Ensure taps are closed to patient, and open to air when zero is pressed.
Check resting pressures are normal	Supine: $p_{abd}$ and $p_{ves}$ 5-20 cmH <sub>2</sub> O Seated: $p_{abq}$ and $p_{ves}$ 15-40 cmH <sub>2</sub> O Standing: $p_{abq}$ and $p_{ves}$ 30-50 cmH <sub>2</sub> O for all positions, $p_{det}$ -5-+5 cmH <sub>2</sub> O
Continuous monitoring	Check regularly that pressure transmission is equal on both lines, for example, coughs, blowing  Check that live patient signal is present throughout  Check that baseline pressures do not drift  Troubleshoot above during the test, temporarily stopping recording/filling if necessary  Stop or reduce fill rate if urgency is excessive, or compliance poor  Change patent position as required (eg, discomfort, stress testing)  Consider repeating test if urodynamic question not answered
Interpretation	Place markers on the trace frequently, for example, sensation, patient position, stress tests, permission to void  Adjust positions of markers after completion of test if needed  Take a when interpreting, for example, rectal contractions, knocking of flowmeter
Report	Bladder during filling Urethra during filling Bladder during voiding Urethra during voiding Reproduction of symptoms Management plan

bubbles in the pressure tubing system should be recognized and reported during post-test analysis, if not identified during the procedure, to prevent mis-diagnosis.<sup>8</sup>

Post-processing automated analysis is an optional extra in urodynamic equipment, and established nomograms and calculated parameters may also be provided. Such analysis could be affected by artefacts (eg,  $Q_{max}$  caused by knocking the flow meter,  $p_{max}$  from cough),<sup>5</sup> and the urodynamicist must check the trace to be certain that misinterpretation does not result. The user should have the ability to check the values for feasibility and change the relevant ones if necessary. Software should not filter or remove artefacts, but should be able to ignore them for analysis.

## 2.7 | The urodynamics report

Bladder storage function should be described according to bladder sensation, detrusor activity, bladder compliance, and bladder capacity.<sup>6</sup> The urethral closure mechanism during storage may be competent or incompetent. Voiding is described in terms of detrusor and urethral function and assessed by measuring urine flow rate and voiding pressures. An "ICS standard urodynamic (time based) graph" and an "ICS standard pressure-flow plot" are required elements in the ICS standard urodynamics report.

- Reporting includes the following elements (summarized from GUP2016<sup>2</sup>):

- a Overall judgement of the technical quality, clinical reliability, representativeness, and methods of assessment.
- b Uroflowmetry: voiding position,  $Q_{max}$ , voided volume, PVR.
- c Introduction of catheters: sensation, muscular defence, obstruction(s).
- d Patient position(s) during cystometry and PFS.
- e Patient's ability to report filling sensations and/or urgency and/or urine loss.
- f Method of urodynamic stress test and accessory tests (if applicable).
- g Diagnoses: filling sensation (with volumes); cystometry; PFS (bladder outflow function, detrusor contraction).

All results and observations should be carefully reported. It is good clinical practice to integrate the urodynamic test results with the history, examinations, and other tests.

Table 1 gives a proposed checklist for Fundamentals of Urodynamic Practice.

## 3 | CONCLUSIONS

A good study is one that is easy to read and one from which any experienced urodynamicist will abstract the same

results and come to the same conclusions (GUP2002). Adherence to the fundamentals of the ICS standards, as synthesized in this review, will enable urodynamic units to ensure the quality of urodynamic studies and compare findings with other units.

## CONFLICT OF INTEREST

Dr. Drake reports grants, personal fees, and non-financial support from Astellas, Allergan, and Ferring, outside the submitted work. Dr. Doumouchtsis has nothing to disclose. Dr. Hashim reports personal fees and non-financial support from Ferring and Allergan, personal fees from Astellas, Medtronic, and Boston, outside the submitted work. Dr. Gammie reports other from Astellas and Ipsen, grants from Andromeda, Digitimer, and Laborie, outside the submitted work.

## ORCID

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

Hashim Hashim  <http://orcid.org/0000-0003-2467-407X>

Andrew Gammie  <http://orcid.org/0000-0001-5546-357X>

## REFERENCES

- Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31:621–624.
- Rosier P, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
- Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
- Griffiths D, Hofner K, van Mastrigt R, Rollema HJ, Spangberg A, Gleason D. Standardization of terminology of lower urinary tract function: pressure-flow studies of voiding, urethral resistance, and urethral obstruction. International Continence Society Subcommittee on Standardization of Terminology of Pressure-Flow Studies. *Neurourol Urodyn*. 1997;16:1–18.
- Gammie A, Clarkson B, Constantinou C, et al. International Continence Society guidelines on urodynamic equipment performance. *Neurourol Urodyn*. 2014;33:370–379.
- Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
- Hogan S, Gammie A, Abrams P. Urodynamic features and artefacts. *Neurourol Urodyn*. 2012;31:1104–1117.
- Gammie A, Drake MJ. The fundamentals of uroflowmetry practice, based on international continence society good urodynamic practices recommendations. *Neurourol Urodyn*. 2018;37:S44–S49.
- Wyndaele M, PFWM Rosier. Basics of videourodynamics for adult patients with lower urinary tract dysfunction. *Neurourol Urodyn*. 2018;37:S61–S66.
- Harding C, Rosier PFWM, Drake MJ, et al. What research is needed to validate new urodynamic methods? ICI-RS2017. *Neurourol Urodyn*. 2018;37:S32–S37.
- Bright E, Drake MJ, Abrams P. Urinary diaries: evidence for the development and validation of diary content, format, and duration. *Neurourol Urodyn*. 2011;30:348–352.
- Bright E, Cotterill N, Drake M, Abrams P. Developing and validating the International Consultation on Incontinence Questionnaire bladder diary. *Eur Urol*. 2014;66:294–300.
- Abrams P. Bladder outlet obstruction index, bladder contractility index and bladder voiding efficiency: three simple indices to define bladder voiding function. *BJU Int*. 1999;84:14–15.
- Sullivan JG, Swithinbank L, Abrams P. Defining achievable standards in urodynamics—a prospective study of initial resting pressures. *Neurourol Urodyn*. 2012;31:535–540.

**How to cite this article:** Drake MJ, Doumouchtsis SK, Hashim H, Gammie A. Fundamentals of urodynamic practice, based on International Continence Society good urodynamic practices recommendations. *Neurourology and Urodynamics*. 2018;37:S50–S60. <https://doi.org/10.1002/nau.23773>

# Basics of videourodynamics for adult patients with lower urinary tract dysfunction

Michel Wyndaele | Peter F. W. M. Rosier 

Department of Urology, University Medical Center Utrecht, Utrecht, The Netherlands

## Correspondence

Michel Wyndaele, MD, PhD, FEBU (Fellow of the European Board of Urology), Functional Reconstructive Urology and Neurourology, Department of Urology C04.236; University Medical Center Utrecht, Utrecht, The Netherlands.  
Email: m.i.a.wyndaele@umcutrecht.nl

**Aims:** Videourodynamics is the addition of imaging to invasive urodynamics and one of the methods to ensure objective diagnosis in persons with signs or symptoms of lower urinary tract dysfunction. This manuscript has the aim to outline the basics of the practice of videourodynamics and to elementary explain interpretation of the results.

**Methods:** Literature sources and expert opinion were arranged to provide the reader with an introductory overview of current knowledge.

**Results:** Videourodynamics was—like most diagnostics in health care—introduced on the basis of plausibility and expert conviction but has stood the test of time. Videourodynamics has, especially in patients with congenital or acquired neurogenic dysfunction of the lower urinary tract, undisputedly although not precisely quantifiable, added to (lower urinary tract) health care quality.

**Conclusion:** The manuscript summarizes the basic elements of indication, practice, and interpretation of videourodynamics.

## KEYWORDS

meningomyelocele, neurogenic lower urinary tract dysfunction, practice recommendations, spinal cord injury, videourodynamics

## 1 | DEFINITION

The ICS good urodynamic practice<sup>1</sup> states that standard invasive urodynamics may be combined with imaging. Invasive urodynamics performed with contrast fluid as the filling medium is termed videourodynamics: X-ray (image amplifier) pictures or cine-loops are made at relevant moments.<sup>1</sup> This report states that the contrast medium should be specified and the total patient radiation dose should be reported. Videourodynamics is not further discussed in the good urodynamic practices document and we provide the basic principles of this technique in this manuscript, with the goal to briefly introduce the practice

and technique as well as the clinical purpose and application of the test to the not-expert.

## 2 | REQUIREMENTS

In addition to the standard urodynamic (UDS) set-up,<sup>1</sup> videourodynamics (VUDS) requires that the bladder is filled with (iodine) contrast fluid. The technique of VUDS has been introduced in the early seventies of last century<sup>2,3</sup> and the technique as was introduced in those early days has remained throughout the years.<sup>4,5</sup> All publications that explain the principles are expert opinion driven and all clinical studies, describing the application of the technique are single center retrospective reviews. We have extracted practical elements from a few reviews and instructional manuscripts.<sup>6,7</sup>

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

Diverse brands and types of contrast fluid are available. In general it is reasonable to use the contrast that is used on the radiology department to perform cysto-urethrography. As an example, the American College of Radiology provides a detailed description of the technique<sup>8</sup> and links, to documents that list available contrast agents. Recent studies about the type of contrast media and the quality of imaging are rare but earlier fundamental research demonstrates that very dense medium may obscure details.<sup>9</sup> Contrast agents have a different density compared to that of urine and or saline, which are usually applied for urodynamic measurements. The difference in weight requires specific calibration of the UDS equipment; the infusion pump and the flow meter, to ensure the machine does not overestimate volumes, because of the larger relative weight of the fluid.

A fixed X-ray unit that can move from 90° to 180° (allowing an antero-posterior, lateral as well as an oblique view), or a C-arm can provide for imaging in a fluoroscopy-proof room. Modern image intensifier, flat-panel and digital radiology equipped systems significantly reduce radiation dose when compared to the “old” x-ray film. Fluoroscopy rooms (also for VUDS) require shielded walls, shielded door(s) and usually have an x-ray glass control window. Shielding must be calculated by a physicist or radiation expert and is based on the specific imaging equipment utilized. The shielding typically will involve several different lead thicknesses depending upon primary beam and secondary scatter radiation fields, surrounding occupancy factors and other considerations. The patient and the medical team involved should be adequately protected and wear dosimeters.

VUDS should be performed in the patient's natural position, if possible. This will require a radiolucent toilet seat to allow fluoroscopy of voiding in a sitting position. A standing position should also be available to enable (stress) evaluation of urinary incontinence in men and women and or voiding in the standing position. Many patients, however, especially those with neurogenic dysfunction of the lower urinary tract (LUT) never void and or are unable to sit or stand. For those patients it should be considered, or preferred, to perform UDS in supine position. Both in seated as well as in supine position the relevant elements of the system should be upholstered adequately to prevent skin damage, especially again, for the patients with loss of sensation and LUT dysfunction.

VUDS software combining the X-ray images with the UDS trace, and presenting the data either on a split screen or by superposition, is widely commercially available although the precise association of the images with synchronous pressures is rarely reported.

Radiation exposure should be As Low As Reasonably Achievable (ALARA) without sacrificing diagnostic

accuracy, and the radiation time and dose should always be reported, making patient dose monitoring essential.<sup>1</sup> Urodynamicists that wish to perform VUDS, as well as physicians should be well-trained to ensure that video-monitoring is performed adequately. Snapshots at clinically relevant moments (eg, during provocative measures or bladder pressure rises) are usually sufficient and long cine-loops are rarely relevant. The radiation field should be limited to the anatomical region of interest (sparing the gonads if possible). Pulsed digitally enhanced or low-dose setting continuous fluoroscopy with spectral beam filtration, optimal selection of the tube current and high voltage by an automatic brightness control system should be used to reduce radiation exposure. Certainly regular servicing as per local maintenance plan is important. A relatively low effective dose is achievable, as was demonstrated in a cohort with historical controls. A mean fluoroscopic time of around 60 s for VUDS including filling, stress testing, and voiding observations has been possible.<sup>10</sup> Plausibly, observations done do not often need reconfirmation (with repeated images), and a few snapshots at critical moments are conceivably sensitive to observe anatomical abnormalities in combination with the (dys) function of the LUT. Regrettably not much scientific evidence is published, regarding this.

### 3 | VIDEO-URODYNAMIC FINDINGS

The possible findings during VUDS are listed in Table 1. The key to VUDS is to adequately relate the anatomical findings (see Figures 1-4) to the urodynamic observations.

For example, a critical part in the follow-up and management of patients with neurogenic dysfunction (NLUTD) is to ensure low-pressure urine storage, thereby protecting the upper urinary tract (UUT). An unsafe bladder, prone to cause UUT damage, was defined in adult patients with spinal dysraphism as a bladder with a high end filling pressure ( $>40$  cmH<sub>2</sub>O), poor compliance ( $<10$  mL/cmH<sub>2</sub>O) and high detrusor leak point pressure ( $>40$  cmH<sub>2</sub>O)<sup>11</sup> criteria that can be deducted from conventional UDS.<sup>12</sup> High bladder pressures during the storage phase can, however, cause vesico-ureteral reflux (VUR) (eg, Figure 4). Secondary, this VUR can create a pop-off of bladder pressure as (one of) the UUT(s) now absorbs the pressure. This may lead to overestimation of bladder compliance. Therefore, VUDS have a clear advantage over conventional UDS when hydronephrosis was documented in the patient or when VUR is suspected or known by other means. VUR can be related to bladder function; passive VUR at low intravesical pressures, for example, due to an insufficient ureteric orifice as is frequently existing in congenital ureteral anomalies, for example, doubling versus active VUR occurring during

**TABLE 1** Video-urodynamic observations in relation during anatomical site and urodynamic phase

Anatomical site	Video-urodynamic finding
Ureters and renal pelvis	Vesico-ureteral reflux + grade
Bladder	Trabeculation Diverticula Christmas tree appearance Postvoid residual (+ quantification) Vesico-vaginal fistula Filling “defect” (eg, prostate median lobe, bladder tumor, bladder stone)
Bladder base	Cystocele + grade (at rest, during stress testing, and during voiding)
Bladder neck	Filling: Bladder neck incompetence (during stress testing) Filling: Bladder neck opening during detrusor overactivity contractions Voiding: Bladder neck dysfunction or dyssynergia Voiding: Bladder neck fibrosis
Urethra	Urinary incontinence Urethral stricture Urethral diverticula Urethrovaginal fistula (Neurogenic) detrusor—(external urethral) sphincter dyssynergia

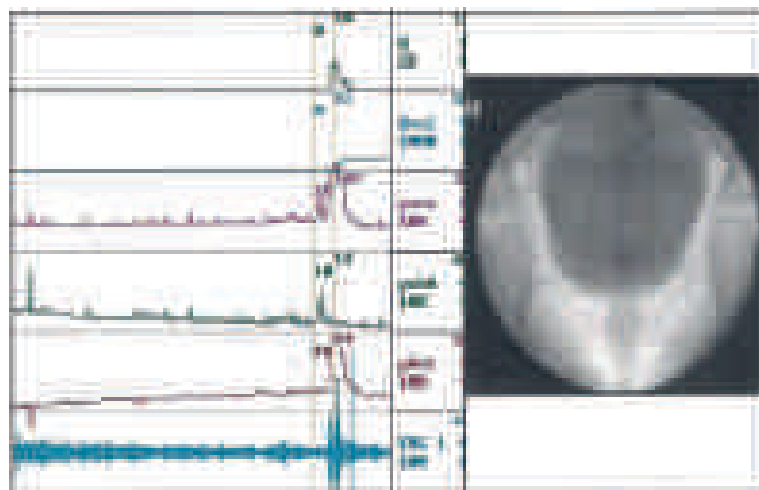
elevated pressure as a consequence of reduced compliance or synchronous with a detrusor contraction during filling or during—high pressure—dyssynergic voiding. It is important to note that in patients with spinal dysraphism, anatomical

abnormalities of the LUT are more prevalent than in patients with acquired NLUTD due to the abnormal muscle functional as well as anatomical development of the LUT and pelvic floor even before birth, as a consequence of the lack of (early) normal innervation.

Abnormalities in the shape or outline of the bladder should be related to the functional and the cystometric capacity. Bladder diverticula, for example, can serve as a pressure sink or can be responsible for postvoid residual (eg, Figure 3).

VUDS can also aid in the diagnosis of urinary incontinence. Male (post-prostatectomy) PRP-UI has been suggested as an indication for VUDS on the basis of expert conviction.<sup>13,14</sup> Whether VUDS is of advantage in uncomplicated PRP-UI; men without any other urological history or (neuro-) urological co-morbidity, than UDS has not been assessed yet. In women with recurrent signs and symptoms of UI on the other hand, VUDS can aid in the evaluation and may guide the management, but this also has not been evaluated prospectively with regard to improvement in management selection and or outcome. Therefore, the added value of fluoroscopy to UDS in women with recurrent UI after initial (surgical) intervention has yet to be determined. In NLUTD, VUDS can also be used to determine detrusor leak point pressure; it is possible to observe contrast fluid entering the urethra via the X-ray; however, all leak points are designed or calibrated with externally visible leakage.

In young men with non-neurogenic LUTS, a single center report suggests that VUDS can offer guidance in diagnosing

**FIGURE 1** Voids phase of VUDS bladder contour has normal appearance and bladder neck and prostatic urethra are clearly visible. Pressure flow analysis demonstrate that this patient has a normal contraction (BCI 144) and a bladder outflow obstruction grade 4 (or ICS-BOOI: 74)



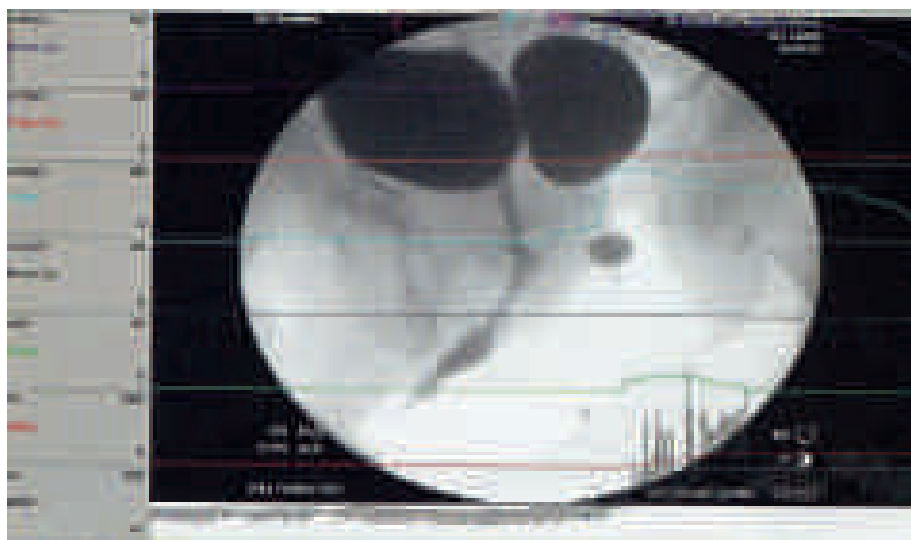
**FIGURE 2** Cystogram showing trabeculation over the entire bladder

the location or cause of bladder outflow obstruction (BOO): bladder neck dysfunction versus bladder neck fibrosis<sup>15</sup> versus urethral stricture. Some reports also suggest that VUDS can be useful for women with voiding difficulties to distinguish the effect of pelvic organ prolapse or dyssynergia in women with consistent intermittent or fluctuating flow,<sup>16,17</sup> however, the precise predictive value of observations with the video-part of the study are poorly described and difficult to reproduce.

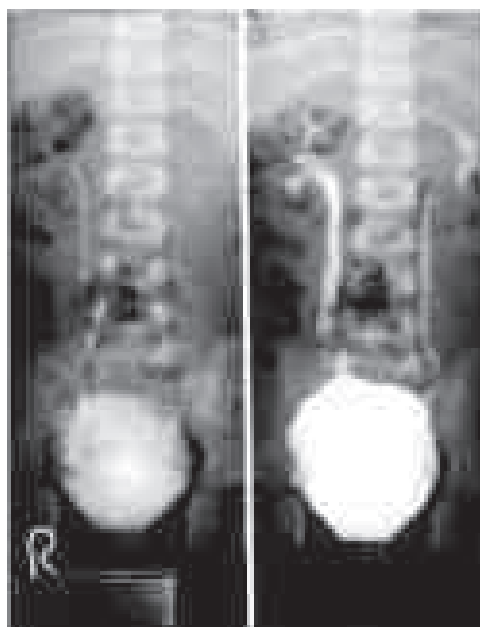
Other indications for VUDS are listed in Table 2. In general, fluoroscopy can be added to the urodynamic evaluation if there is suspicion of an anatomical anomaly contributing to the patient's LUTD or when a relevant neurological disease is causing the dysfunction and an anatomical cause or consequences are expected.

#### 4 | GUIDELINES

The evidence supporting VUDS in non-neurogenic LUTS is low grade; sparse, incomplete, and almost exclusively based on expert opinion and single center uncontrolled studies.<sup>18</sup> Data on the effect of VUDS with or without comparison with UDS on management selection and outcomes are also lacking. Nevertheless, the aim of VUDS is to achieve a more accurate diagnosis in these patients and hence improve the therapeutic decision-making, however, usually at the cost



**FIGURE 3** A relatively large diverticulum, filled during voiding; normal appearance of urethra, but pressure flow parameters (over-projected: not zeroed to atmosphere as per ICS standard; low flow and relatively high detrusor pressure) indicate bladder outflow obstruction (should be graded on [ICS] pressure flow plot)



**FIGURE 4** Vesico-ureteral reflux initially at the right hand side and subsequently on both sides

**TABLE 2** Indications for considering fluoroscopy during the urodynamic evaluation

Neurological findings or history of relevant neurologic disease
(History of) congenital genitourinary anomaly (eg, ectopic ureter, posterior urethral valves, prune-belly syndrome, vesico-ureteral reflux)
Bladder outflow obstruction or urinary retention associated with complex history
History of pelvic radiotherapy or intrapelvic surgery
History of pelvic reconstructive surgery, SUI surgery, urethral stricture repair, POP reconstruction, urethral diverticulectomy
Suspicion of vesico-vaginal or urethro-vaginal fistula
Suspicion of urethral diverticulum
Pre- and post-renal transplant

of patient comfort, making the chance of not representative outcome of studies more likely, especially in patients without neurological disease.

The European Association of Urology (EAU) recommends, based on level 4 evidence, VUDS as the optimum procedure for invasive UDS in neuro-urological patients.<sup>19,20</sup> In male LUTS VUDS are considered applicable if this is needed for the clinician to understand the pathophysiological mechanism of a patient's LUTS although this is also based on experts impressions.<sup>21</sup> The British National Institute for "Health" and Care Excellence (NICE) recommends to offer VUDS to people who are known to have a high risk of renal complications from their LUT function (eg, people with spina bifida, spinal cord injury, or anorectal abnormalities).<sup>22</sup>

The American Urological Association (AUA) and Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction (SUFU) states that, when available, clinicians may perform VUDS in patients with relevant neurologic disease at risk for neurogenic bladder dysfunction, in patients with other neurologic disease and elevated PVR.<sup>23</sup> Clinicians may also perform VUDS in properly selected patients to urodynamically grade and to anatomically localize bladder outflow obstruction, based on this association statement.<sup>23</sup>

## 5 | CONCLUSION

Medical imaging has developed in a century.<sup>24</sup> Imaging finds its application in healthcare via the evolution of technical



possibilities in combination with plausibility, and expert opinion. Randomized prospective studies that demonstrate the effect of diagnosis with and without imaging, on outcome of management have not been published. The development of videourodynamic evaluation is no exception. It is difficult to precisely delineate the indications for the study, as well as to assess its precise surplus for predictive value of the diagnostic strategy, however, it is undoubtedly plausible and useful to combine reliable objective functional physiological measurements (UDS) with anatomical information of synchronous imaging in a proportion of patients with lower urinary tract dysfunction.

## ORCID

Peter F. W. M. Rosier  <http://orcid.org/0000-0003-0445-4563>

## REFERENCES

- Rosier PFWM, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
- Bates CP, Corney CE. Synchronous cine-pressure-flow cystography: a method of routine urodynamic investigation. *Br J Radiol*. 1971;44:44–50.
- Arnold EP, Brown AD, Webster JR. Videocystography with synchronous detrusor pressure and flow rate recordings. *Ann R Coll Surg Engl*. 1974;55:90–98.
- Marks BK, Goldman HB. Videourodynamics: indications and technique. *Urol Clin North Am*. 2014;41:383–391, vii–viii.
- McGuire EJ, Cespedes RD, Cross CA, O'Connell HE. Videourodynamic studies. *Urol Clin North Am*. 1996;23:309–321.
- Gray M. Traces: making sense of urodynamics testing—part 12: videourodynamics testing. *Urol Nurs*. 2012;32:193–202.
- Cardozo L, Shafir F, Araklitis G, Rantell A, Robinson D. Narrated video demonstrating the procedure of videourodynamics. *Neurourol Urodyn*. 2018;37:1176–1177. <https://www.acr.org/-/media/ACR/Files/Practice-Parameters/cysto-urethro.pdf>
- McAlister WH, Griffith RC. Cystographic contrast media: clinical and experimental studies. *AJR Am J Roentgenol*. 1983;141:997–1001.
- Giarenis I, Phillips J, Mastoroudes H, et al. Radiation exposure during videourodynamics in women. *Int Urogynecol J*. 2013;24:1547–1551.
- Galloway NT, Mekras JA, Helms M, et al. An objective score to predict upper tract deterioration in myelodysplasia. *J Urol*. 1991;145:535.
- Veenboer PW, Bosch JL, Rosier PF, et al. Cross-sectional study of determinants of upper and lower urinary tract outcomes in adults with spinal dysraphism—new recommendations for urodynamic followup guidelines? *J Urol*. 2014;192:477–482.
- Groutz A, Blaivas JG, Chaikin DC, Weiss JP, Verhaaren M. The pathophysiology of post-radical prostatectomy incontinence: a clinical and video urodynamic study. *J Urol*. 2000;163:1767–1770.
- Jura YH, Comiter CV. Urodynamics for postprostatectomy incontinence: when are they helpful and how do we use them? *Urol Clin North Am*. 2014;41:419–427, viii.
- Nitti VW, Lefkowitz G, Ficazzola M, Dixon CM. Lower urinary tract symptoms in young men: videourodynamic findings and correlation with noninvasive measures. *J Urol*. 2002;168:135–138.
- Nitti VW, Tu LM, Gitlin J. Diagnosing bladder outlet obstruction in women. *J Urol*. 1999;161:1535–1540.
- Brucker BM, Fong E, Shah S, Kelly C, Rosenblum N, Nitti VW. Urodynamic differences between dysfunctional voiding and primary bladder neck obstruction in women. *Urology*. 2012;80:55–60.
- Anding R, Rosier P, Smith P, et al. When should video be added to conventional urodynamics in adults and is it justified by the evidence? ICI-RS 2014. *Neurourol Urodyn*. 2016;35:324–329.
- Drake MJ, Apostolidis A, Cocci A, et al. Neurogenic lower urinary tract dysfunction: clinical management recommendations of the Neurologic Incontinence committee of the fifth International Consultation on Incontinence 2013. *Neurourol Urodyn*. 2016;35:657–665.
- Stöhrer M, Blok B, Castro-Diaz D, et al. EAU guidelines on neurogenic lower urinary tract dysfunction. *Eur Urol*. 2009;56:81–88.
- Nosseir M, Hinkel A, Pannek J. Clinical usefulness of urodynamic assessment for maintenance of bladder function in patients with spinal cord injury. *Neurourol Urodyn*. 2007;26:228–233.
- Gratzke C, Bachmann A, Descazeaud A, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. *Eur Urol*. 2015;67:1099–1109.
- <https://www.nice.org.uk/guidance/cg148/evidence/full-guideline-188123437>
- Winters JC, Dmochowski RR, Goldman HB, et al. Urodynamic studies in adults: AUA/SUFU guideline. *J Urol*. 2012;188:2464–2472.
- Scatliff JH, Morris PJ. From Roentgen to magnetic resonance imaging: the history of medical imaging. *N C Med J*. 2014;75:111–113.

**How to cite this article:** Wyndaele M, Rosier PFWM. Basics of videourodynamics for adult patients with lower urinary tract dysfunction. *Neurourology and Urodynamics*. 2018;37:S61–S66. <https://doi.org/10.1002/nau.23778>

## Why ICS standardization of lower urinary tract symptoms matters

Why does a red traffic light mean “STOP” everywhere? Or why are you able to browse the Internet from anywhere over the world? These are just a few examples from our daily life that illustrate the need for standardization and the use of a common and correct terminology.

Standards make the world a safer place. Our health is dependent on standards, going from the definition of safe drinking water, over the quality of medical equipment to the creation of terminology, standards, and guidelines in healthcare.

Standards and terminology define what is being talked about. This is especially necessary in critical communication, but also to ensure the safe diagnosis and treatment of patients. It is important that the term for a symptom, condition or disease has the same meaning for every healthcare professional on this planet. If you hear of a new development at a congress or in publication, you need to understand it fully in order to adopt it properly into your practice. When talking with patients, both of you need to understand what the other is saying. Achieving this is the aspiration of the International Continence Society (ICS) standardizations.<sup>1</sup> They are a series of evidence based pragmatic documents, some of them developed in partnership with other professional bodies, covering the field of lower urinary tract function and dysfunction, and urodynamic assessment.<sup>2–4</sup>

Similar words can have different meanings in different languages, or translation. Notably an English term in another language can change the linguistic meaning or can have different connotations than in the original language. For example many languages do not make a distinction between urinary urge and urinary urgency. The ICS has clearly defined this difference to make it clear that urgency is pathological, as in overactive bladder, and urge is the normal sensation associated with a strong desire to pass urine. So as to be consistent for inclusion of patients in clinical trials on Overactive Bladder Syndrome potentially being run in several countries, correct interpretation of the inclusion and exclusion criteria is essential. For these trials it is of paramount importance to recruit only patients with urgency, and not those describing the normal sensation of urge. Standards help in managing cultural and linguistic diversity and differences. Such terminology efforts are crucial for the advancement of research and clinical practice.

Standards allow sharing of technology and innovation and information. If we would not use a standardized terminology and a set of standards in urodynamics, results from one center would not be interchangeable with those from another center. This would lead to an unnecessary duplication of examinations, when a patient would be referred to another center. Technology is highly dependent on terminology and standardization.<sup>5</sup> Standards also make information retrievable and speed up research. Every book or published article can be found with internet search engines or through library systems, thanks to unique identifiers that have been attributed according to international standards. Just imagine to have go back in time and to be dependent on an old-fashioned librarian and his reference system on little cards, before you could read an interesting article or book. Standards help tremendously in speeding-up research and interaction between researchers.

We strongly encourage all healthcare professionals to engage with the ICS standardizations, so as to push forward the progress in this field. Once it is in universal use, the ICS terminology offers a backbone for communications between professionals and also with patients.

### CONFLICTS OF INTEREST

Dr. De Ridder reports grants from Astellas, grants from Janssen-cilag, grants from Medtronic, other from Coloplast, outside the submitted work.

Dirk De Ridder MD, PhD, FEBU <sup>1</sup>

Marcus Drake BM, BCh, MA(Cantab.),

DM (Oxon.), FRCS(Urol)<sup>2</sup>

<sup>1</sup>Dept. of Urology, University Hospitals KU Leuven, Herestraat 49, 3000 Leuven, Belgium

<sup>2</sup>Office C39b, Bristol Urological Institute, University of Bristol, Level 3 Learning and Research Building, BS10 5NB, Bristol, United Kingdom

### \*Correspondence

Dirk De Ridder, MD, PhD, FEBU, Department of Urology, University Hospitals KU Leuven, Herestraat 49, 3000 Leuven, Belgium.  
Email: dirk.deridder@uzleuven.be

## REFERENCES

1. Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31:621–624.
2. Haylen B, Freeman R, de Ridder D, et al. An international urogynecological association (iuga) – international continence society (ics) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2009;28:787.
3. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
4. Toozs-Hobson P, Freeman R, Barber M, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for reporting outcomes of surgical procedures for pelvic organ prolapse. *Int Urogynecol J*. 2012;23:527–535.
5. Seth JH, Sahai A, Khan MS, et al. Nerve growth factor (NGF): a potential urinary biomarker for overactive bladder syndrome (OAB)? *BJU Int*. 2013;111:372–380.

**How to cite this article:** De Ridder D, Drake M. Why ICS standardization of lower urinary tract symptoms matters. *Neurourology and Urodynamics*. 2018;37:S67–S68. <https://doi.org/10.1002/nau.23736>

# Critical steps in developing professional standards for the International Continence Society

Peter F. W. M. Rosier 

Functional Urology, Department of Urology  
C04.236, University Medical Center  
Utrecht, Utrecht, The Netherlands

## Correspondence

Peter F.W.M. Rosier, MD, PhD, Functional  
Urology, Department of Urology C04.236,  
University Medical Center Utrecht, The  
Netherlands.  
Email: P.F.W.M.Rosier@umcutrecht.nl

**Aims:** Standardization on the basis of systematic assessment of evidence has become an indispensable element of modern healthcare. International Continence Society (ICS) has initiated and produced extremely well cited standardization documents. The process of standardization is recently depicted in a published manuscript, to keep up with modern society healthcare demands.

**Methods:** A narrative review of the ICS history and current state of standardizations for the terms, assessment and the management of patients with lower urinary tract dysfunction.

**Results:** This article highlights the philosophy and the historical context of standardization and explains the core elements of modern day standardization. The article also demonstrates the scientific relevance of the ICS standards, on the basis of reference-counts.

**Conclusion:** The history and the relevance of ICS standards are summarized.

## KEYWORDS

health care quality, lower urinary tract dysfunction, systematic assessment and diagnosis

## 1 | INTRODUCTION

The Mars Climate Orbiter was a space probe launched by NASA on December 11, 1998 to study the Martian climate. However, on September 23, 1999, communication with the spacecraft was lost as the spacecraft went into orbital insertion, due to ground-based computer software which produced output in non-SI units of pound (force)-seconds (lbf/s) instead of the SI units of newton-seconds (N/s) specified in the contract between NASA and Lockheed. The spacecraft encountered Mars on a trajectory that brought it too close to the planet, causing it to pass through the upper atmosphere and disintegrate.<sup>1</sup> SI units are standard units of technical measurement, allowing communication about

technical issues. Standardization is relevant, in technical science as well as in medical science. Standard terms, classifications and disease and management patterns were sought, in fact since the early days of healthcare, for example, by Hippocrates. Maybe in the more modern society further standardization began in the 16th century, where parish clerks were asked to classify mortality and standard terms were developed with this aim. This can be seen as the later basis for health epidemiological observations. In the beginning of 20th century a standard nomenclature for diseases was developed that progressed into the nowadays International Classification of Diseases (ICD) and Systematized Nomenclature of Medicine (SNOMED, now SNOMED-CT).<sup>2</sup>

Medical societies are established around (clinical-medical) specialisms to improve knowledge and accountability. The Continence Club was established in Exeter (UK) in 1971, renamed to International Continence Society that same year and had the purpose to "... provide a link for the interchange of ideas and results for clinicians and physicists interested in

Clinical trial: No.

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

**TABLE 1** “General” (not specific) ICS standardization documents with publication year and between brackets, a double or triple publication are showed

<b>Scopus EXPORT DATE: 15 May 2018 searched quote: “standard* lower urinary tract function”</b>		
Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, Van Kerrebroeck P, Victor A, Wein A. The standardization of terminology of lower urinary tract function: Report from the standardization sub-committee of the international continence society (2002) <i>Neurourology and Urodynamics</i> , 21 (2), pp. 167–178.	2002 (1)	Cited 4360 times.
Bump, RC, Mattiasson, A, Bo, K, Brubaker, LP, DeLancey, JOL, Klarskov, P, Shull, BL, Smith, ARB. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction (1996) <i>American Journal of Obstetrics and Gynecology</i> , 175 (1), pp. 10–17.	“ICS approved”	Cited 2616 times.
Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, Van Kerrebroeck P, Victor A, Wein A. The standardization of terminology in lower urinary tract function: Report from the standardization sub-committee of the International Continence Society (2003) <i>Urology</i> , 61 (1), pp. 37–49.	2002 (2)	Cited 1583 times.
Good Urodynamic Practices: Uroflowmetry, filling cystometry, and pressure-flow studies (2002) <i>Neurourology and Urodynamics</i> , 21 (3), pp. 261–274.		Cited 1006 times.
Abrams P, Blaivas JG, Stanton SL, Andersen JT. The standardization of terminology of lower urinary tract function. The International Continence Society Committee on Standardization of Terminology. (1988) <i>Scandinavian Journal of Urology and Nephrology, Supplement</i> , 114, pp. 5–19.	1988 (1)	Cited 951 times.
Haylen, BT, De Ridder D, Freeman RM, Swift SE, Berghmans B, Lee J, Monga A, Petri E, Rizk DE, Sand PK, Schaer GN. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction (2010) <i>International Urogynecology Journal</i> , 21 (1), pp. 5–26.		Cited 771 times.
Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, Van Kerrebroeck P, Victor A, Wein A. The standardization of terminology of lower urinary tract function: Report from the Standardization Sub-committee of the International Continence Society (2002) <i>American journal of obstetrics and gynecology</i> , 187 (1), pp. 116–126.	2002 (3)	Cited 607 times.
Griffiths D, Hofner K, Van Mastrigt R, Rollema HJ, Spangberg A, Gleason D. Standardization of terminology of lower urinary tract function: Pressure-flow studies of voiding, urethral resistance, and urethral obstruction (1997) <i>Neurourology and Urodynamics</i> , 16 (1), pp. 1–18.		Cited 324 times.
Abrams P, Blaivas JG, Stanton SL, Andersen JT. The standardization of terminology of lower urinary tract function recommended by the international continence society (1990) <i>International Urogynecology Journal</i> , 1 (1), pp. 45–58.	1988 (1)	Cited 305 times.
Bates P, Bradley WE, Glen E, Griffiths D, Melchior H, Rowan D, Sterling A, Zinner N, Hald T. The standardization of terminology of lower urinary tract function (1979) <i>Journal of Urology</i> , 121 (5), pp. 551–554.		Cited 233 times.
First Report on the Standardization of Terminology of Lower Urinary Tract Function: PRODUCED BY THE INTERNATIONAL CONTINENCE SOCIETY, FEBRUARY, 1975 (1976) <i>British Journal of Urology</i> , 48 (1), pp. 39–42.		Cited 215 times.
Austin PF, Bauer SB, Bower W, Chase J, Franco I, Hoebeke P, Rittig S, Vande Walle J, Von Gontard A, Wright A, Yang SS, Nevéus T. The standardization of terminology of lower urinary tract function in children and adolescents: Update report from the standardization committee of the international children's continence society (2014) <i>Journal of Urology</i> , 191 (6), pp. 1863–1865.		Cited 193 times.
The standardization of terminology of lower urinary tract function (1990) <i>BJOG: An International Journal of Obstetrics &amp; Gynecology</i> , 97, pp. 1–16.		Cited 118 times.
Glen ES, Bradley WE, Melchior H, Rowan D, Sterling AM, Sundin T, Thomas D, Torrens M, Warwick RT, Zinner NR, Chairman TH. Fourth Report on the Standardization of Terminology of Lower Urinary Tract Function: Terminology related to neuromuscular dysfunction of the lower urinary tract: PRODUCED BY THE INTERNATIONAL CONTINENCE SOCIETY (1981) <i>British Journal of Urology</i> , 53 (4), pp. 333–335.		Cited 90 times.
Abrams P, Blaivas JG, Stanton SL, Andersen JT. The standardization of terminology of lower urinary tract function – Produced by the international continence society committee on standardization of terminology (1989) <i>World Journal of Urology</i> , 6 (4), pp. 233–245.	1998-9 (3)	Cited 52 times.
Austin PF, Bauer SB, Bower W, Chase J, Franco I, Hoebeke P, Rittig S, Walle J.V, Von Gontard A, Wright A, Yang SS, Nevéus T. The standardization of terminology of lower urinary tract function in children and adolescents: Update report from the standardization committee of the International Children's Continence Society (2016) <i>Neurourology and Urodynamics</i> , 35 (4), pp. 471–481.		Cited 47 times.

(Continues)

TABLE 1 (Continued)

Scopus EXPORT DATE: 15 May 2018 searched quote: “standard* lower urinary tract function”		
Bates CP, Bradley WE, Glen ES, Griffiths D, Melchior H, Rowan D, Sterling A, Hald T. Third Report on the Standardization of Terminology of Lower Urinary Tract Function: Procedures related to the evaluation of micturition: Pressure-flow relationships. Residual urine: PRODUCED BY THE INTERNATIONAL CONTINENCE SOCIETY, FEBRUARY 1977* (1980) <i>British Journal of Urology</i> , 52 (5), pp. 348–350.	1977 (3)	Cited 43 times.
Bates P, Bradley WE, Glen E, Griffiths D, Melchior H, Rowan D, Sterling AM, Zinner N, Hald T. Standardization of terminology of lower urinary tract function First and second reports: International Continence Society (1977) <i>Urology</i> , 9 (2), pp. 237–241.	1977 (4)	Cited 34 times.
Abrams P, Blaivas JG, Stanton SL, Andersen JT, Fowler CJ, Gerstenberg T, Murray K. Sixth report on the standardization of terminology of lower urinary tract function. Procedures related to neurophysiological investigations: electromyography, nerve conduction studies, reflex latencies, evoked potentials and sensory testing. The International Continence Society Committee on Standardization of Terminology, New York, May 1985. (1986) <i>Scandinavian Journal of Urology and Nephrology</i> , 20 (3), pp. 161–164.	1985 (1)	Cited 26 times.
Névéus T, Von Gontard A, Hoebeke P, Hjalmas K, Bauer S, Bower W, Jørgensen TM, Rittig S, Van De Walle J, Yeung, C-K, Djurhuus JC. The standardization of terminology of lower urinary tract function in children and adolescents: Report from the Standardization Committee of the International Children's Continence Society (ICCS) (2007) <i>Neurourology and Urodynamics</i> , 26 (1), pp. 90–102.		Cited 20 times.
Bates P, Bradley WE, Glen E, Melchior H, Rowan D, Sterling A, Hald T. The standardization of terminology of lower urinary tract function (1976) <i>European Urology</i> , 2 (6), pp. 274–276.		Cited 15 times.
Andersen JT, Blaivas JG, Cardozo L, Thuroff J. Seventh report on the standardization of terminology of lower urinary tract function: Lower urinary tract rehabilitation techniques (1992) <i>Scandinavian Journal of Urology and Nephrology</i> , 26 (2), pp. 99–106.		Cited 14 times.
Abrams P, Blaivas JG, Stanton SL, Andersen JT, Fowler CJ, Gerstenberg T, Murray K. Sixth report on the standardization of terminology of lower urinary tract function – Procedures related to neurophysiological investigations: Electromyography, nerve conduction studies, reflex latencies, evoked potentials and sensory testing (1986) <i>World Journal of Urology</i> , 4 (1), pp. 2–5.	1985-6 (2)	Cited 9 times.
Bates P, Rowan D, Glen E. Second report on the standardization of terminology of lower urinary tract function. Produced by the International Continence Society committee on standardization of terminology Copenhagen, August 1976 (1977) <i>European Urology</i> , 3 (3), pp. 168–170.	1977 (2)	Cited 8 times.
Bates P, Bradley WE, Glen E, Melchior H, Rowan D, Sterling A Hald T. First report on the standardization of terminology of lower urinary tract function: Incontinence, cystometry, urethral closure pressure profile and units of measurement (1977) <i>Urologia Internationalis</i> , 32 (2–3), pp. 81–87.	1977 (1)	Cited 7 times.

The third column shows the number of citations to the specific document as obtained from Scopus.com (May 2018).

urodynamic studies . . . treating related disorders.”<sup>3</sup> To this aim, as a logical consequence, “. . . to set it [the new society (ICS)] on the way to becoming a professional body”<sup>3</sup> a “standardization of terminology of lower urinary tract function” was developed and published simultaneously in diverse journals.<sup>4</sup> Terms for urodynamic observations were developed since then and refined, together with improvements in the techniques used to objectively measure lower urinary tract functions, independent from the patients expression of symptoms. New ICS standardization documents have been published in the years that followed.

## 2 | MATERIAL AND METHODS

A narrative review of the evolution of the process of standardization in healthcare, in general and specific for ICS is presented. Scopus—website counts are used to demonstrate

the scientific relevance of the published manuscripts of ICS standards.

## 3 | RESULTS

### 2.1 | Standard for standards

Early standards in health care have been eloquence based. A group of renowned experts sat together and developed the text of the standard, on the basis of their knowledge. That actual knowledge failed against big data was demonstrated in the late 1960s. A clinical epidemiological book discussed the complexity of medical decision making, and was the starting point for nowadays clinical epidemiology. Clinical epidemiology became a tool to be the more reliable basis for (more) systematic diagnosis and management.<sup>5</sup> This clinical epidemiology, and systematic reviewing of research data were deployed into evidence based medicine later.<sup>6</sup>

Also early ICS standards have been developed in the “good old boys sat around the table” (GOBSAT)—manner. In 2012, however, the ICS standardization committee has published a standard to deviate from GOBSAT and to introduce—evidence based-(healthcare and) ICS standards.<sup>7</sup> This manuscript highlights also that the ICS standardization committee had modernized itself and became a standardizing steering committee, with the aim to oversee and guide (ad hoc) working groups to deliver new ICS standards. The renewed process and structure of standards production were defined, to ensure careful inclusion of evidence in the standard and to explicitly grade evidence and also indicate expert opinion where evidence is lacking. In summary of the earlier published document, the process consists of a proposal stage, a preparatory stage, a committee stage and an approval stage

and has also defined an implementation stage.<sup>7</sup> An idea for a new standard should be proposed to the ICS standardization steering committee who will establish an opinion- and background-balanced working group with a chairperson. The “balance,” referred to in the standard<sup>7</sup> includes that the background should as diverse as possible, around the topic of the standardization, not only in opinion and profession but also including partnership of other organizations (outside ICS) when that is deemed potentially rewarding. The working group, when established, searches for relevant evidence and makes summaries of answers for clinical questions associated with the topic of the standard. Terms may also be searched for existence in scientific databases or in the, here above mentioned, international nomenclature—sets, or medical dictionaries, before introduction in the (new) standard.

**TABLE 2** The top ranking documents with (clinical OR practice) standard\* in the title with the number of citations to the specific document (may 2018) are showed

<b>Scopus EXPORT DATE: 15 May 2018 Search quote: “Standard*”- in Title.</b>		
Standardization of spirometry (2005) European Respiratory Journal, 26 (2), pp. 319–338.		Cited 6495 times.
Standardization of spirometry: 1994 Update (1995) American Journal of Respiratory and Critical Care Medicine, 152 (3), pp. 1107–1136.		Cited 5248 times.
Bone histomorphometry: Standardization of nomenclature, symbols, and units: Report of the asbmr histomorphometry nomenclature committee (1987) Journal of Bone and Mineral Research, 2 (6), pp. 595–610.		Cited 4397 times.
<b>The standardization of terminology of lower urinary tract function: Report from the standardization sub-committee of the international continence society (2002) Neurourology and Urodynamics, 21 (2), pp. 167–178.</b>		<b>Cited 4360 times.</b>
The consortium to establish a registry for Alzheimer's disease (CERAD). Part II. Standardization of the neuropathologic assessment of Alzheimer's disease(1991) Neurology, 41 (4), pp. 479–486.		Cited 3495 times.
The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction (1996) American Journal of Obstetrics and Gynecology, 175 (1), pp. 10-17		Cited 2616 times.
Lung volumes and forced ventilatory flows. Report Working Party Standardization of Lung Function Tests, European Community for Steel and Coal. Official Statement of the European Respiratory Society. (1993) The European respiratory journal. Supplement, 16, pp. 5-40		Cited 2523 times.
Standard of spirometry- 1987 update. Statement of the American Thoracic Society. (1987) The American review of respiratory disease, 136 (5), pp. 1285–1298.		Cited 2070 times.
Design and standardization of PCR primers and protocols for detection of clonal immunoglobulin and T cell receptor gene recombinations in suspect lymphoproliferations: Report of the BIOMED 2 concerted action BMH4- CT98-3936 (2003) Leukemia, 17 (12), pp. 2257–2317.		Cited 1834 times.
<b>The standardization of terminology in lower urinary tract function: Report from the standardization sub- committee of the International Continence Society (2003) Urology, 61 (1), pp. 37–49.</b>		<b>Cited 1583 times.</b>
A Specific Laboratory Test for the Diagnosis of Melancholia: Standardization, Validation, and Clinical Utility (1981) Archives of General Psychiatry, 38 (1), pp. 15-22		Cited 1579 times.
Revised Recommendations of the International Working Group for diagnosis, standardization of response criteria, treatment outcomes, and reporting standards for therapeutic trials in acute myeloid leukemia (2003) Journal of Clinical Oncology, 21 (24), pp. 4642–4649.		Cited 1471 times.
Standardization of uveitis nomenclature for reporting clinical data. Results of the first international workshop (2005) American Journal of Ophthalmology, 140 (3), pp. 509-516		Cited 1435 times.
A working formulation for the standardization of nomenclature in the diagnosis of heart and lung rejection: Heart rejection study group (1990) Journal of Heart Transplantation, 9 (6), pp. 587-592		Cited 1301 times.

When the number of citations to the three versions of the 2002 document are added (4360 + 1583 + 607), 3th not shown, see Table 1), the total of 6650 would rank this document number 1 clinical standard in healthcare. Note also that the number 6 document is an “ICS-collaboration-endorsed” standard.



Objective evidence for management in new standard should be systematically gathered with structured searches of literature and Oxford grading. Theoretically a Delphi process would be applicable for sub-topics where evidence is lacking, however, this procedure is not without pitfalls, for example, has the danger of devaluating to the “old GOBSAT” manner,<sup>8,9</sup> by overestimation of the experts knowledge<sup>8</sup> and underestimation of the existence of evidence. Potential other pitfalls are, for example, imposing preconceptions of a problem and not allowing for the contribution of other related perspectives; poor techniques of summarizing and presenting the group responses; not exploring disagreements and; underestimating the demanding nature of a Delphi.<sup>8</sup> A recent systematic review of reports based on the Delphi method found substantial variation in quality as consequence of lack of rigorousness of the application of the process.<sup>9</sup> Ultimately the (new) standard terms are selected on the basis of arguments made transparent. Sensitive and systematic searching for existing evidence prevents reinvention of knowledge and has to provide the evidence base for the practice recommendations or for the terms. Finally the members and board of the ICS will see the draft standard and control, for process and structure, but also for missed evidence that may change the recommendations. Details of this process are given in the original publication but essentially the draft document is made available for all ICS members via the ICS website, and is also submitted to internal invited peer review and or discussed during an annual society meeting. The finally approved standard is published and, for example, relevant committees can take out relevant elements and make these into educational modules to be published as presentation on the ICS website to enhance implementation of standard good practice and terms by education.

### 3.2 | Scientific relevance

The International Continence Society has produced one of the most cited standards in healthcare.<sup>10</sup> Table 1 shows the number of citations for the most “general” ICS standards on the basis of the counts given in Scopus.com website on May 15, 2018. Table 2 shows that the number of citations to the 2002 standardization document exceeds all documents with “practice guideline” or “practice standard” in the title when the three versions of the 2002 document (see Table 1) are grouped. (source: scopus.com). The references total of 6650 contains that the document is referred to every single day since its publication.

## 4 | DISCUSSION

The modern era standards should aim at that level and be the basis for good practice. ICS is still leading in the development of careful objective assessment of lower urinary tract

dysfunction as has been aimed in 1971. Objective assessment of dysfunction meets patients expectations also (or especially?) to date.<sup>11</sup> Modern era healthcare, however, also demands, more than in the early days of ICS, that patients quality of life and well-being are taken into account and that minimal or not invasive management is recommended to them, where possible. Not only terms and techniques for objective assessment and diagnosis should be renewed, in an evidence based fashion, also the assessment of the patients well-being deserves evidence based standardization. Furthermore standards for management may lead the way to improvements. The ICS standard for standardization may become the basis for systematic evidence based documents to enforce the International Consultation on Incontinence management recommendations<sup>12</sup> and may also expand to management of lower urinary tract dysfunctions without urinary incontinence.

## 5 | CONCLUSION

Standardization prevents miscommunication and therefore mismanagement, also in healthcare. ICS started with standardization, based on scientific progress and development and has continued this, in the lead, for almost 50 years. ICS Standardization is now standardized within the framework of Evidence Based Medicine and apart from further standardization of urodynamic assessment and evidence based objective pelvic floor muscle function evaluation standardization of quality of life assessment as well as standards for management may be future goals.

### CONFLICT OF INTEREST

No.

### ORCID

Peter F. W. M. Rosier  <http://orcid.org/0000-0003-0445-4563>

### REFERENCES

1. <https://mars.jpl.nasa.gov/msp98/news/mco990930.html>.
2. Chute CG. Clinical classification and terminology: some history and current observations. *J Am Med Inform Assoc*. 2000;7:298–303.
3. Arnold T, Glenn E, Zinner N. *The First 40 Years, History of ICS*. Bristol, UK: Conticom Limited; 2011.
4. No authors listed. First report on the standardisation of terminology of lower urinary tract function. *Br J Urol*. 1976;48:39–42. Report published also in other journals: Bates et al.
5. Feinstein AR. *Clinical Judgement*. Baltimore: Williams & Wilkins; 1967.
6. Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence based medicine: what it is and what it isn't. *BMJ*. 1996;312:71–72.

7. Rosier PF, de Ridder D, Meijlink J, Webb R, Whitmore K, Drake MJ. Developing evidence-based standards for diagnosis and management of lower urinary tract or pelvic floor dysfunction. *Neurourol Urodyn*. 2012;31(5):621–624.
8. *The Delphi Method: Techniques and Applications*. In: Linstone HA, Turoff M, eds. Addison-Wesley Pub. Co., Advanced Book Program; 1975. University of Michigan, ISBN0201042940, 9780201042948 (digitalized august 27 2007). <https://web.njit.edu/~turoff/pubs/delphibook/delphibook.pdf>
9. Jünger S, Payne SA, Brine J, Radbruch L, Brearley SG. Guidance on Conducting and REporting DELphi Studies (CREDES) in palliative care: recommendations based on a methodological systematic review. *Palliat Med*. 2017;31:684–706.
10. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology in lower urinary tract function: report from the standardisation subcommittee of the International Continence Society. *Urology*. 2003;61:37–49. Review. PubMed PMID: 12559262.
11. Makanjee CR, Bergh AM, Hoffmann WA. Healthcare provider and patient perspectives on diagnostic imaging investigations. *Afr J Prim Health Care FamMed*. 2015;7:art#801.
12. Abrams P, Andersson KE, Birder L, et al. Fourth International Consultation on Incontinence Recommendations of the International Scientific Committee: evaluation and treatment of urinary incontinence, pelvic organ prolapse, and fecal incontinence. *Neurourol Urodyn*. 2010;29:213–240.

**How to cite this article:** Rosier PFWM. Critical steps in developing professional standards for the International Continence Society. *Neurourology and Urodynamics*. 2018;37:S69–S74.  
<https://doi.org/10.1002/nau.23779>

### 3. THE INTERNATIONAL CONSULTATION ON INCONTINENCE ALGORITHMS

Since its inception in 1998, the International Consultation on Incontinence, now in its 6th iteration, has brought together many of the world's leading experts to produce a unique scholarly knowledge synthesis of scientific work in the field of continence. Viewed by many senior and junior academics and clinicians as the "bible" of continence, the 6th edition is part of a productive partnership with the International Continence Society, seen by many as the "natural" home of the consultation. Its 23 or so chapters cover the range of scientific endeavour, from fundamental cellular mechanisms underlying incontinence and pelvic floor dysfunction to applied research in policy and health services research. In addition to providing an expert view of the state of the science, each committee rigorously examines the latest scientific evidence using the Oxford Grading system to produce recommendations for research and clinical practice in its areas of focus.

Each committee's findings were presented to a wide audience of ICS members at the 2016 ICS Annual Scientific Meeting in Tokyo where feedback was offered and considered prior to publication of the book "Incontinence". As part of its work, committees with a clinical focus produce an evidence informed algorithm for assessment and care for both initial and specialist assessment and management. The algorithms and their accompanying notes are published in *Neurourology and Urodynamics* as part of the Scientific Report from the Consultation<sup>1</sup> and are reproduced here as part of the programme of knowledge dissemination for the Consultation. Clearly production of such work is irrelevant without use, we therefore hope that you use these algorithms in practice and in presentation form in order to enhance to promote the highest quality of clinical care to patients.



**Adrian Wagg**  
ICI Editor

on behalf of the Editors of the ICS and the ICS-ICI Steering Committee

1. Abrams P, Andersson KE, Apostolidis A, Birder L, Bliss D, Brubaker L, et al. 6th International Consultation on Incontinence. Recommendations of the International Scientific Committee: EVALUATION AND TREATMENT OF URINARY INCONTINENCE, PELVIC ORGAN PROLAPSE AND FAECAL INCONTINENCE. *Neurourol Urodyn*. 2018 Sep;37(7):2271-2.

2017

# 6th International Consultation on Incontinence

## Co-sponsored by

International Consultation on Urological Diseases (ICUD)

International Continence Society (ICS)

## In collaboration with

major international associations of urology, gynaecology and urodynamics

and other medical associations

## Recommendations of the International scientific Committee:

# EVALUATION AND TREATMENT OF URINARY INCONTINENCE, PELVIC ORGAN PROLAPSE AND FAECAL INCONTINENCE

P. Abrams, K-E. Andersson, A. Apostolidis, L. Birder, D. Bliss, L. Brubaker, L. Cardozo, D. Castro, P.R. O'Connell, A. Cottenden, N. Cotterill, D. de Ridder, R. Dmochowski, C. Dumoulin, M. Fader, C. Fry, H. Goldman, P. Hanno, Y. Homma, V. Khullar, C. Maher, I. Milsom, D. Newman, J.M. Nijman, K. Rademakers, D. Robinson, P. Rosier, E. Rovner, S. Salvatore, M. Takeda, A. Wagg, T. Wagner, A. Wein

and the members of the committees

## INTRODUCTION

The 6th International Consultation on Incontinence met between September 13-15th 2016 in Tokyo and was organised by the International Consultation on Urological Diseases and the International Continence Society (ICS), in order to develop consensus statements and recommendations for the diagnosis, evaluation and treatment of urinary incontinence, faecal incontinence, pelvic organ prolapse and bladder pain syndrome.

The consensus statements are evidence based following a thorough review of the available literature and the global subjective opinion of recognised experts serving on focused committees. The individual committee reports were developed and peer reviewed by open presentation and comment. The Scientific Committee, consisting of the Chairs of all the committees then refined the final consensus statements. These consensus statements published in 2017 will be periodically reevaluated in the light of clinical experience, technological progress and research.

## CONTENTS

<b>1. DEFINITIONS</b>	<b>2551</b>
<b>2. EVALUATION</b>	<b>2552</b>
<b>3. MANAGEMENT CONSENSUS STATEMENTS</b>	<b>2557</b>
<b>I. URINARY INCONTINENCE IN CHILDREN</b>	<b>2559</b>
<b>II. URINARY INCONTINENCE IN MEN</b>	<b>2564</b>
<b>III. URINARY INCONTINENCE IN WOMEN</b>	<b>2568</b>
<b>IV. FISTULAE</b>	<b>2572</b>
<b>V. PELVIC ORGAN PROLAPSE</b>	<b>2577</b>
<b>VI. URINARY INCONTINENCE IN NEUROLOGICAL PATIENTS</b>	<b>2582</b>
<b>VII. BLADDER PAIN SYNDROME</b>	<b>2587</b>
<b>VIII. FAECAL INCONTINENCE IN ADULT PATIENTS</b>	<b>2592</b>
<b>IX. FAECAL INCONTINENCE IN NEUROLOGICAL PATIENTS</b>	<b>2597</b>
<b>X. URINARY AND FAECAL INCONTINENCE IN FRAIL OLDER MEN AND WOMEN</b>	<b>2601</b>
<b>4. RECOMMENDATIONS FOR FURTHER RESEARCH IN EPIDEMIOLOGY</b>	<b>2606</b>
<b>5. RECOMMENDATIONS FOR FURTHER BASIC SCIENCE RESEARCH</b>	<b>2607</b>
<b>6. RECOMMENDATIONS FOR PRIMARY PREVENTION, CONTINENCE PROMOTION, MODELS OF CARE AND EDUCATION</b>	<b>2608</b>
<b>7. RECOMMENDATIONS FOR TRANSLATIONAL AND CLINICAL RESEARCH</b>	<b>2610</b>
<b>8. INTERNATIONAL CONSULTATION ON INCONTINENCE MODULAR QUESTIONNAIRE (ICIQ): QUESTIONNAIRES AND BLADDER DIARY</b>	<b>2613</b>

# 1. DEFINITIONS

The consultation agreed to use the current International Continence Society definitions (ICS) for lower urinary tract dysfunction (LUTD) including incontinence, except where stated. These definitions were published in the journal *Neurourology and Urodynamics* (2002; 21:167-178 and 2006; 25: and can be viewed on the ICS website: [www.ics.org](http://www.ics.org)

The following ICS definitions are relevant:

## 1. LOWER URINARY TRACT SYMPTOMS (LUTS)

LUTS are divided into storage and voiding symptoms.

Urinary incontinence is a storage symptom and defined as the complaint of any involuntary loss of urine. This definition is suitable for epidemiological studies, but when the prevalence of bothersome incontinence is sought, the previous ICS definition of an “Involuntary loss of urine that is a social or hygienic problem”, can be useful.

Urinary incontinence may be further defined according to the patient's symptoms

- **Urgency Urinary Incontinence** is the complaint of involuntary leakage accompanied by or immediately preceded by urgency.
- **Stress Urinary Incontinence** is the complaint of involuntary leakage on effort or exertion, or on sneezing or coughing.
- **Mixed Urinary Incontinence** is the complaint of involuntary leakage associated with urgency, and also with effort, exertion, sneezing and coughing.
- **Nocturnal Enuresis** is any involuntary loss of urine occurring during sleep.
- **Post-micturition dribble** and **continuous urinary leakage** denotes other symptomatic forms of incontinence.

**Overactive bladder** is characterised by the storage symptoms of urgency with or without urgency incontinence, usually with frequency and nocturia.

## 2. URODYNAMIC DIAGNOSIS

- **Detrusor Overactivity** is a urodynamic observation characterised by involuntary detrusor contractions during the filling phase, which may be spontaneous or provoked.

Detrusor overactivity is divided into:

- **Idiopathic Detrusor Overactivity**, defined as overactivity when there is no clear cause
- **Neurogenic Detrusor Overactivity** is defined as overactivity due to a relevant neurological condition.
- **Urodynamic stress incontinence** is noted during filling cystometry, and is defined as the involuntary leakage of urine during increased abdominal pressure, in the absence of a detrusor contraction.

## 3. BLADDER PAIN SYNDROME

Bladder pain syndrome is defined by ESSIC as chronic pelvic pain, pressure or discomfort of greater than 6 months duration perceived to be related to the urinary bladder accompanied by at least one other urinary symptom like persistent desire to void or urinary frequency. Confusable diseases as the cause of the symptoms must be excluded.

## 4. PELVIC ORGAN PROLAPSE

- **Urogenital prolapse** is defined as the symptomatic descent of one or more of: the anterior vaginal wall, the posterior vaginal wall, and the apex of the vagina (cervix/uterus) or vault (cuff) after hysterectomy. Urogenital prolapse is measured using the POP-Q system.
- **Rectal prolapse** is defined as circumferential full thickness rectal protrusion beyond the anal margin.

## 5. ANAL INCONTINENCE

**Anal incontinence** defined as “any involuntary loss of faecal material and/or flatus and/or mucus” and may be divided into:

- **Faecal incontinence**, any involuntary loss of faecal material
- **Flatus incontinence**, any involuntary loss of gas (flatus)
- **Mucus incontinence**, any involuntary loss of mucus only (not faeces)

\* At the time of this consultation, these definitions are not included in the current ICS terminology.

## 2. EVALUATION

The following phrases are used to classify diagnostic tests and studies:

- **A highly recommended test** is a test that should be done on every patient.
- **A recommended test** is a test of proven value in the evaluation of most patients and its use is strongly encouraged during evaluation.
- **An optional test** is a test of proven value in the evaluation of selected patients; its use is left to the clinical judgement of the physician
- **A not recommended test** is a test of no proven value.

This section primarily discusses the Evaluation of Urinary Incontinence with or without Pelvic Organ Prolapse (POP) and Faecal Incontinence.

The recommendations are intended to apply to children and adults, including healthy persons over the age of 65.

These conditions are highly prevalent but often not reported by patients. Therefore, the Consultation strongly recommends case finding, particularly in high risk groups.

### A. HIGHLY RECOMMENDED TESTS DURING INITIAL EVALUATION

The **main recommendations** for this consultation have been abstracted from the extensive work of the 23 committees of the 6th International Consultation on Incontinence (ICI, 2016).

Each committee has written a report that reviews and evaluates the published scientific work in each field of interest in order to give Evidence Based recommendations. Each report ends with detailed recommendations and suggestions for a programme of research.

The main recommendations should be read in conjunction with the management algorithms for children, men, women, the frail older person, neurogenic patients, bladder pain, pelvic organ prolapse, and anal incontinence

The initial evaluation should be undertaken, by a clinician, in patients presenting with symptoms/ signs suggestive of these conditions.

### 1. HISTORY AND GENERAL ASSESSMENT

Management of a disease such as incontinence requires caregivers to assess the sufferer in a holistic manner. Many factors may influence a particular individual's symptoms, some may cause incontinence, and may influence the choice and the success of treatment. The following components of the medical history are particularly emphasised:

#### 1.1. Review of Systems:

- Presence, severity, duration and bother of any urinary, bowel or prolapse symptoms. Identifying symptoms in the related organ systems is critical to effective treatment planning. The use of validated questionnaires to assess symptoms are recommended.
- Effect of any symptoms on sexual function: validated questionnaires including impact on quality of life are a useful part of a full assessment.
- Presence and severity of symptoms suggesting neurological disease

#### 1.2. Past Medical History:

- Previous conservative, medical and surgical treatment, in particular, as they affect the genitourinary tract and lower bowel. The effectiveness and side effects of treatments should be noted.
- Coexisting diseases may have a profound effect on incontinence and prolapse sufferers, for example asthma patients with stress incontinence will suffer greatly during attacks. Diseases may also precipitate incontinence, particularly in frail older persons.
- Patient medication: it is always important to review every patient's medication and to make an assessment as to whether current treatment may be contributing to the patient's condition.
- Obstetric and menstrual history.
- Physical impairment: individuals who have compromised mobility, dexterity, or visual acuity may need to be managed differently

#### 1.3. Social History:

- Environmental issues: these may include the social, cultural and physical environment.



- Lifestyle: including exercise, smoking and the amount and type of fluid and food intake.

#### 1.4. Other Treatment Planning Issues:

- **Desire for treatment** and the extent of treatment that is acceptable
- **Patient goals** and expectations of treatment
- **Patient support** systems (including caregivers).
- **Cognitive function:** all individuals need to be assessed for their ability to fully describe their symptoms, symptom bother and quality of life impact, and their preferences and goals for care. They must be able to understand proposed management plans and to discuss, where appropriate, alternative treatment options. In some groups of patients, formal testing is essential e.g. cognitive function testing for individuals for whom the clinician has concerns regarding memory deficits and/or inattention or confusion, and depression screening for individuals for whom the clinician has concerns about abnormal affect. Proxy respondents, such as family and caregivers, may be used to discuss the patient's history, goals of care, and treatment for individuals with dementia, but only if the individual is incapable of accurate reporting or weighing treatment decisions.

## 2. PHYSICAL EXAMINATION

The more complicated the history and the more extensive and/or invasive the proposed therapy, the more complete the examination needs to be. Depending on the patient's symptoms and their severity, there are a number of components in the examination of patients with incontinence and/or pelvic organ prolapse.

Physical examination should be performed regardless of whether the patient is a child, a woman, a man, someone with neurological disease or a frail elderly person.

#### 2.1. General status:

- Mental status
- Obesity (BMI)
- Physical dexterity and mobility

#### 2.2. Abdominal/flank examination: for masses, bladder distention, relevant surgical scars

#### 2.3. Pelvic examination:

- Examination of the perineum and external genitalia including tissue quality and sensation.
- Vaginal (half-speculum/Sims) examination for pelvic organ prolapse (POP), which should be done in the vertical position

- Bimanual pelvic and anorectal examination for pelvic mass,
- Digital rectal examination to assess pelvic floor muscle function and the function of internal and external anal sphincter as well as puborectalis muscle.
- Stress test for urinary incontinence.

#### 2.4. Neurological testing (see chapter on assessment)

## 3. URINALYSIS

In patients with LUTS, the possibility of a urinary tract infection should be evaluated, with appropriate testing (ranging from dipstick to urine microscopy and culture when indicated as UTI is a readily detected, and easily treatable cause of LUTS,

### Conclusion

For simple treatments, particularly non-invasive and inexpensive therapies, management may start without the need for the further investigations listed below.

## B. RECOMMENDED FURTHER ASSESSMENT PRIOR TO, OR DURING, SPECIALIST ASSESSMENT

The tests below are recommended when the **appropriate indication(s) is present**. Some recommended tests become highly recommended in specific situations.

This section should also be read in conjunction with the relevant committee reports.

## 1. FURTHER SYMPTOM AND HEALTH-RELATED QOL ASSESSMENT

### 1.1. Bladder Diary

In patients with **urinary symptoms** the use of a **bladder diary** (examples in Annex 1) is highly recommended to document the frequency of micturition, the volumes of urine voided, incontinence episodes and the use of incontinence pads.

### 1.2. Questionnaires

The use of the **highest quality questionnaires** (GoR A, where available) is recommended for the assessment of the patient's perspective of symptoms of incontinence and their impact on quality of life.

The ICIQ is highly recommended (GoR A) for the basic evaluation of the patient's perspective of urinary incontinence, with other GoR A questionnaires recommended for more detailed assessment. **Further development is required in the areas** of pelvic organ prolapse, bladder pain syndrome, and for specific patient groups, as only GoR B questionnaires are currently available (see Assessment Chapter).

## 2. RENAL FUNCTION ASSESSMENT

Standard biochemical tests for renal function are recommended in patients with urinary incontinence when there is the possibility of renal impairment.

## 3. UROFLOWMETRY

Uroflowmetry with the measurement of post void residual urine is recommended as a screening test for symptoms suggestive of urinary voiding dysfunction or physical signs of POP or bladder distension. Uroflowmetry should be part of the initial assessment if the result is likely to influence management eg in older men with possible prostatic obstruction.

## 4. ESTIMATION OF POST VOID RESIDUAL URINE (PVR)

In patients with suspected voiding dysfunction, PVR should be part of the initial assessment if the result is likely to influence management, for example, in neurological patients.

## 5. IMAGING

Although routine imaging is not recommended, imaging of the lower urinary tract and pelvis is highly recommended in those with urinary symptoms whose initial evaluation indicates a possible co-existing lower tract or pelvic pathology. Initial imaging may be by ultrasound, or plain X-ray.

Imaging of the upper urinary tract is highly recommended in specific situations. These include:

- Haematuria,
- Neurogenic urinary incontinence e.g. myelodysplasia, spinal cord trauma,
- Incontinence associated with significant post-void residual,
- Co-existing renal disease such as pyelonephritis or reflux, or loin/kidney pain,
- Severe pelvic organ prolapse, not being treated
- Suspected extra-urethral urinary incontinence,
- Children with incontinence and UTIs, where indicated

- Urodynamic studies which show evidence of poor bladder compliance or high pressure detrusor overactivity.

## 6. INVESTIGATIONS IN FAECAL INCONTINENCE AND RECTAL PROLAPSE

- Endoanal US or MRI prior to anal sphincter surgery is highly recommended, even when obvious anatomic defects are not evident.
- Defaecating proctography or dynamic MRI is recommended in suspected rectal prolapse which cannot be adequately confirmed by physical examination.
- Anorectal manometry is useful to assess resting and squeeze anal pressures. The resting and squeeze pressures represent the function of the internal and external anal sphincter, respectively.

## 7. ENDOSCOPY

Although routine cysto-urethroscopy is not recommended, LUT endoscopy is **highly recommended**:

- When initial testing is abnormal, e.g. haematuria and suggests other pathologies,
- When pain or discomfort feature in the patient's LUTS, these may suggest an intravesical lesion
- When appropriate in the evaluation of vesicovaginal fistula and extra-urethral urinary incontinence (in childbirth fistulae, endoscopy is often unnecessary).

**In anorectal conditions**, proctoscopy or flexible sigmoidoscopy should routinely be performed in the evaluation of patients with faecal incontinence. Colonoscopy, air contrast barium enema or CT colography is highly recommended in the presence of unexplained change in bowel habit, rectal bleeding or other alarm symptoms or signs (see Basic Assessment chapter).

## 8. URODYNAMIC TESTING

### 8.1. Urodynamic (multi channel pressure subtracted cystometry) evaluation is recommended

- When the results may change management, such as prior to most invasive treatments for UI and POP,
- After treatment failure, if more information is needed in order to plan further therapy,

- As part of both initial and long-term surveillance programmes in some types of neurogenic lower urinary tract dysfunction,
- In “complicated incontinence” (for details please see relevant subcommittee reports).

**8.2. The aims of urodynamic evaluation are often diagnostic, but may also relate to prognostic factors, direct management or assess response to prior therapy, and also:**

- To reproduce the patient’s symptoms and correlate these with urodynamic findings
- To assess bladder sensation
- To detect detrusor overactivity
- To assess urethral competence during filling
- To determine detrusor function during voiding
- To assess outlet function during voiding
- To assess residual urine

## 9. SMALL BOWEL FOLLOW-THROUGH, CT ENTOGRAPHY OR CAPSULE ENDOSCOPY

These tests are recommended in those with faecal incontinence and the presence of unexplained diarrhoea or when Crohn’s disease is suspected.

## C. FURTHER DIAGNOSTIC TESTS TO BE USED AS APPROPRIATE

### 1. ADDITIONAL URODYNAMIC TESTING

**Video-urodynamics** may be useful in the management of UI in children, in patients who fail surgery and in some neurogenic patients, to obtain additional anatomical information. Either X-ray or US imaging can be used depending on the needs of the individual patient.

If a more **detailed estimate of urethral function** is required, then the following optional tests may give useful information:

- Urethral pressure profilometry
- Abdominal leak point pressures
- Video-urodynamics
- Electromyography of pelvic floor or urethral sphincter

**If initial urodynamics have failed** to demonstrate the cause for the patient’s incontinence then the following tests are optional:

- Repeated routine urodynamics or video-urodynamics
- Ambulatory urodynamics

## 2. PAD TESTING

Pad testing is an optional test for the routine evaluation of urinary incontinence and, if carried out, a 24 hr test is suggested.

## 3. NEUROPHYSIOLOGICAL TESTING AND IMAGING

The information gained by clinical examination and urodynamic testing may be **enhanced by neurophysiological testing** of striated muscle and nervous pathways.

Appropriately trained personnel should perform these tests. The following neuro-physiological tests can be considered in patients with peripheral lesions prior to treatment for lower urinary tract or anorectal dysfunction.

- Concentric needle EMG
- Sacral reflex responses to electrical stimulation of penile or clitoral nerves.

Imaging of the nervous system (and neighbouring structures, including spine, the abdominal cavity and pelvis) by MRI or CT, may confirm suspected involvement of the nervous system, and the nature of the cause.

## 4. FURTHER IMAGING

Cysto-urethrography, US, CT and MRI may have an indication:

- Suspected pelvic floor dysfunction
- Failed surgery, such as recurrent posterior vaginal wall prolapse or failed sling surgery
- Suspected fixed urethra

## 5. CYSTO-URETHROSCOPY

This is an optional test in patients with complicated, persistent or recurrent UI (e.g. after failed SUI surgery)

## 6. ANORECTAL PHYSIOLOGY TESTING

**Endocoil MRI** has high accuracy for detecting anal sphincter injury but is second line after endoanal ultrasound. Patients with faecal incontinence may benefit from assessment with MRI, particularly those with

anorectal malformations and/or previous anal sphincter surgery.

**Defaecography** may be useful and is recommended in patients with faecal incontinence, who have failed conservative therapies, and are possible candidates for laparoscopic ventral rectopexy.

### 3. MANAGEMENT CONSENSUS STATEMENTS

The consensus statements are derived from the **detailed work in the committee reports** on the management of incontinence in children, men, women, the frail elderly and neurological patients, as well as those with obstetric fistula, pelvic organ prolapse, bladder pain syndrome, and faecal incontinence. The management of incontinence is presented in **algorithm form with accompanying notes**.

The chapters analyze the evidence and give it a level of evidence (LoE) and this generates a GoR of recommendation (GoR)

**The Consultation recognises that no algorithm can be applied to every patient and each patient's management must be individualised.**

There are algorithms for

- I. Urinary Incontinence in Children
- II. Urinary Incontinence in Men
- III. Urinary Incontinence in Women
- IV. Fistulae
- V. Pelvic Organ Prolapse
- VI. Urinary Incontinence in Neurological Patients
- VII. Bladder Pain Syndrome
- VIII. Faecal Incontinence in Adults
- IX. Urinary and faecal Incontinence in frail Older Men and Women

These algorithms are divided into two for groups I to III, VII and X. The two parts, initial **management** and **specialised management** require a little further explanation.

Although the management algorithms are designed for patients whose predominant problem is incontinence, there are many other patients in whom the algorithms may be useful such as those patients with urgency and frequency, so-called “OAB dry

Management definitions

Management may be divided into

- Conservative, all methods that are non-medical and non-surgical, some of which do not target the disease process
- Medical (pharmacological) therapy

- Surgical therapy
- Conservative therapy includes
  - Lifestyle interventions e.g. weight loss
  - Bladder training
  - Pelvic floor muscle training (PFMT)
  - Containment products e.g. pads
  - Dependent continence strategies eg regular toileting

Consensus does not exist as to the use of the term “behavioural therapy” as some state that this term only includes bladder training and PFMT, whilst others consider that all conservative management contains a behavioural element, for example wearing and changing pads constitutes a change in behaviour. Hence the consultations recommendations list the elements of conservative management as relevant are intended for use by all clinicians including health care assistants/aides, nurses, physiotherapists, generalist doctors and family doctors as well as by specialists such as urologists, geriatricians and gynaecologists. The consultation has attempted to phrase the recommendations in the basic algorithms in such a way that they may be readily used by clinicians in all countries of the world, both in the developing and the developed world.

#### The algorithms for initial management

are intended for use by all **clinicians** including health care assistants/aides, nurses, physiotherapists, generalist doctors and family doctors as well as by specialists such as urologists, geriatricians and gynaecologists. The consultation has attempted to phrase the recommendations in the basic algorithms in such a way that they may be readily used by clinicians in all countries of the world, both in the developing and the developed world.

#### The specialised algorithms

The specialised algorithms are intended for use by **specialists**. The specialised algorithms, as well as the initial management algorithms are **based on evidence where possible**, and on the **expert opinion** of the 400 healthcare professionals who took part in the Consultation. In this consultation, committees ascribed levels of evidence to the published work on the

subject and devised GoRs of recommendation to inform patient management.

It should be noted that these algorithms, dated **April 2017**, represent the Consultation **consensus at that time**. Our knowledge, developing from both a research base and because of evolving expert opinion, will inevitably **change with time and relate to the unique context of individual patients seeking care**. The Consultation does not wish those using the algorithms to believe they are “carved in tablets of stone”: there will be changes both in the relatively short term and in the long term.

## 1. ESSENTIAL COMPONENTS OF BASIC ASSESSMENT

Each algorithm contains a core of recommendations in addition to a number of essential components of basic assessment listed in sections I to III.

- General assessment
- Symptom assessment
- Assessment of quality of life impact
- Assessment of the desire for treatment
- Physical examination
- Urinalysis

## 2. JOINT DECISION MAKING

**The patient's desires and goals for treatment:** Treatment is a matter for discussion and joint decision making between the patient and his or her health care advisors. This process of consultation includes the specific need to assess whether or not the patient wishes to receive treatment and, if so, what treatments he or she would favour. Implicit in this statement is the assumption that the health care provider will give an **appropriate explanation of the patient's problem** and the **alternative lines of management**, and the potential **benefits** and **risks of treatment**. The assumption that patients almost always wish to have treatment is flawed, and the need to incorporate patient values and preferences is paramount.

**In each algorithm**, treatments are listed in **order of simplicity**, the least invasive being listed first. This order does not imply a scale of efficacy or cost, two factors which need to be considered in choosing the sequence of therapy. The order is likewise not meant to imply a suggested sequence of therapy, which should be determined jointly by the treating health care provider and the patient, considering all the relevant factors listed above.

In the **initial management algorithms**, treatment is **empirically based**, whilst the **specialised management algorithms** usually rely on precise diagnosis from urodynamics and other testing.

The assumption is made that patients will be reassessed at an appropriate time to evaluate their progress.

## 3. USE OF CONTINENCE PRODUCTS

The possible role of **continence products** to prevent, contain and/or manage bladder and/or bowel leakage should be considered at each stage of patient assessment and treatment, to maintain dignity and social functioning, and/or to support self-management or care by others.

Consider **temporary** use of continence products:

- While treatment is awaited.
- **In addition** to treatment; for example using pads and/or urinals when taking anti-muscarinics or carrying out pelvic floor exercises, until sufficient improvement is achieved.

Consider **permanent** use of continence products:

- When treatment is not chosen or not suitable for the individual
- When treatment does not achieve (complete) cure
- For **intermittent use**; for example when the patient has a cough, or needs to travel without reliable toilet access
- For **continuous use** if incontinence is unpredictable and/or frequent or if complications related to incontinence (e.g. skin breakdown) are imminent or present

Consider offering a **mixture** of continence products (disposable/washable; absorbent/non-absorbent) to optimise effectiveness and to reduce costs; e.g. different products for day and night; or for staying at home and for going out/travel/specific activities.

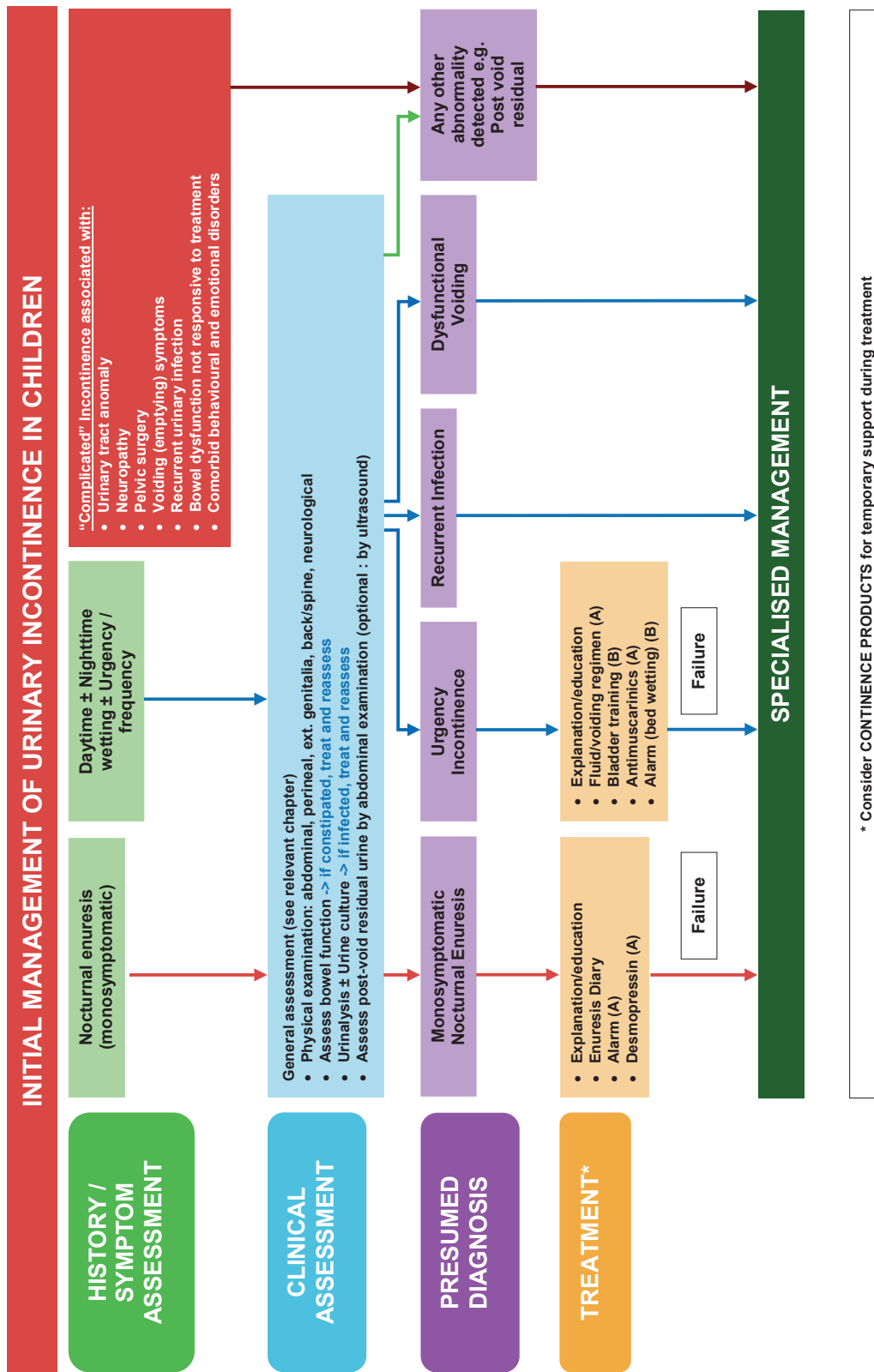
Further guidance on management with continence products is given in Chapter 20 and at the ICI/ICS supported website:

[www.continenceproductadvisor.org](http://www.continenceproductadvisor.org)

At the foot of each of the treatment algorithms below, the phrase “Consider CONTINENCE PRODUCTS for temporary support during treatment”, emphasizes the importance of continence products for many sufferers of incontinence

I. URINARY INCONTINENCE IN CHILDREN	
A. INITIAL MANAGEMENT	
<p>Children present specific management problems for a variety of reasons: assessment requires help from their parents and caregivers; consent to treatment may be problematic; and cooperation in both assessment and treatment may be difficult.</p> <p><b>1. INITIAL ASSESSMENT SHOULD INVOLVE A DETAILED INVESTIGATION OF VOIDING AND BOWEL HABITS USING BLADDER/BOWEL DIARIES AND STRUCTURED AND VALIDATED QUESTIONNAIRES.</b></p> <p>The child's social environment and general and behavioural development should also be formally assessed and recorded. Physical examination should be done to detect a palpable bladder, faecal loading and exclude anatomic and neurological causes. Urine analysis and culture is sufficient to exclude the presence of infection. If possible, the child should be observed voiding.</p>	<ul style="list-style-type: none"><li>• Comorbid behavioural (e.g. ADHD and ODD) and emotional disorders.</li><li>➢ <b>Initial treatment is recommended for the remaining patients who have:</b></li><li>• Nocturnal enuresis without other symptoms (monosymptomatic enuresis).</li><li>• Daytime symptoms of frequency, urgency, voiding postponement, straining, interrupted voiding, urgency incontinence with or without nighttime wetting.</li></ul>
2. TREATMENT	
<p>➢ <b>Referrals for specialist treatment are recommended for children who have complicated incontinence associated with:</b></p> <ul style="list-style-type: none"><li>• Recurrent and febrile urinary infection</li><li>• Voiding symptoms or evidence of poor bladder emptying</li><li>• Urinary tract anomalies</li><li>• Previous pelvic surgery</li><li>• Neuropathy or neuropathic origin</li><li>• Bowel dysfunction not responsive to treatment</li></ul>	<ul style="list-style-type: none"><li>➢ Initial treatment for <b>mono-symptomatic nocturnal</b> enuresis should include:<ul style="list-style-type: none"><li>• Parental and child counselling and motivation</li><li>• Review of bladder diary with attention to night-time polyuria</li><li>• Age appropriate education and demystification or explanation</li></ul></li><li>➢ A choice between either bed wetting alarm (GoR A) or anti-diuretic hormone analogues of desmopressin (GoR A). It may be a parental and child choice if advantages and disadvantages are well explained.</li><li>➢ Daytime incontinence should be managed holistically including:<ul style="list-style-type: none"><li>• Counselling, timed voiding, behaviour modification and bowel management when necessary (GoR B);</li><li>• Antimuscarinics may be used if the child has OAB symptoms (GoR A)</li></ul></li></ul>





I. URINARY INCONTINENCE IN CHILDREN

B. SPECIALISED MANAGEMENT

- **Two groups of children with “complicated” incontinence** should have specialist management from the outset (Fig. 2).
  - Children whose incontinence is due to, or associated with, **urinary tract anomalies and neuropathy**.
  - **Children** without urinary tract anomalies, but with **recurrent febrile infection** and, proven or suspected, **lower urinary tract dysfunction**.
  - Children who **fail the basic treatment**, but who have neither neurogenic nor anatomical problems, should also receive specialist management.
- Children with comorbid behavioural and emotional disorders require referral to mental health services, as compliance and treatment outcomes are lower.
- Assessment and treatment should follow evidence-based practice guidelines

1. ASSESSMENT

- As part of further assessment, the measurement of **urine flow** (in children old enough), together with the **ultrasound estimate of residual urine** and appearance of the bladder wall and rectum are highly recommended. An evaluation of the **upper urinary tracts with ultrasound is also highly recommended**.
- Those who do not improve **with treatment** and have neither neurogenic nor anatomical problems **should be reassessed** using bladder diaries, symptom questionnaires, urinalysis, uroflowmetry and residual urine determination.
- If there are recurrent and febrile infections**, upper tract imaging and possibly a VCUG should be considered. However, endoscopy is rarely indicated.
- **Urodynamics should be considered:**
  - If the type and severity of lower tract dysfunction **cannot be explained by clinical findings** or in the presence of possible relevant neuropathy or urinary tract anomalies. (GoR B)

- If **invasive treatment** is under consideration, for example, stress incontinence surgery if there is sphincteric incompetence, or bladder augmentation if there is detrusor overactivity. (GoR B)
- If **upper tract dilation exists** and is thought to be due to bladder dysfunction. (GoR A)
- **Invasive urodynamic studies are generally not recommended** if the child has normal upper tract imaging and is to be treated by noninvasive means. (GoR B)
- **Spinal Imaging** (US/X-ray/MRI) may be needed if a bony abnormality or neuro-logical condition is suspected. (GoR A)

2. TREATMENT

The treatment of incontinence associated with **urinary tract anomalies** is complex and cannot easily be dealt with in an algorithm. In many children **more than one pathology** demands treatment. If there are **complex congenital abnormalities present**, the treatment is mostly surgical and it should be individualised according to the type and severity of the problem (please see Children’s Committee Report).

Care should be given by specialist children’s nurses and therapists.

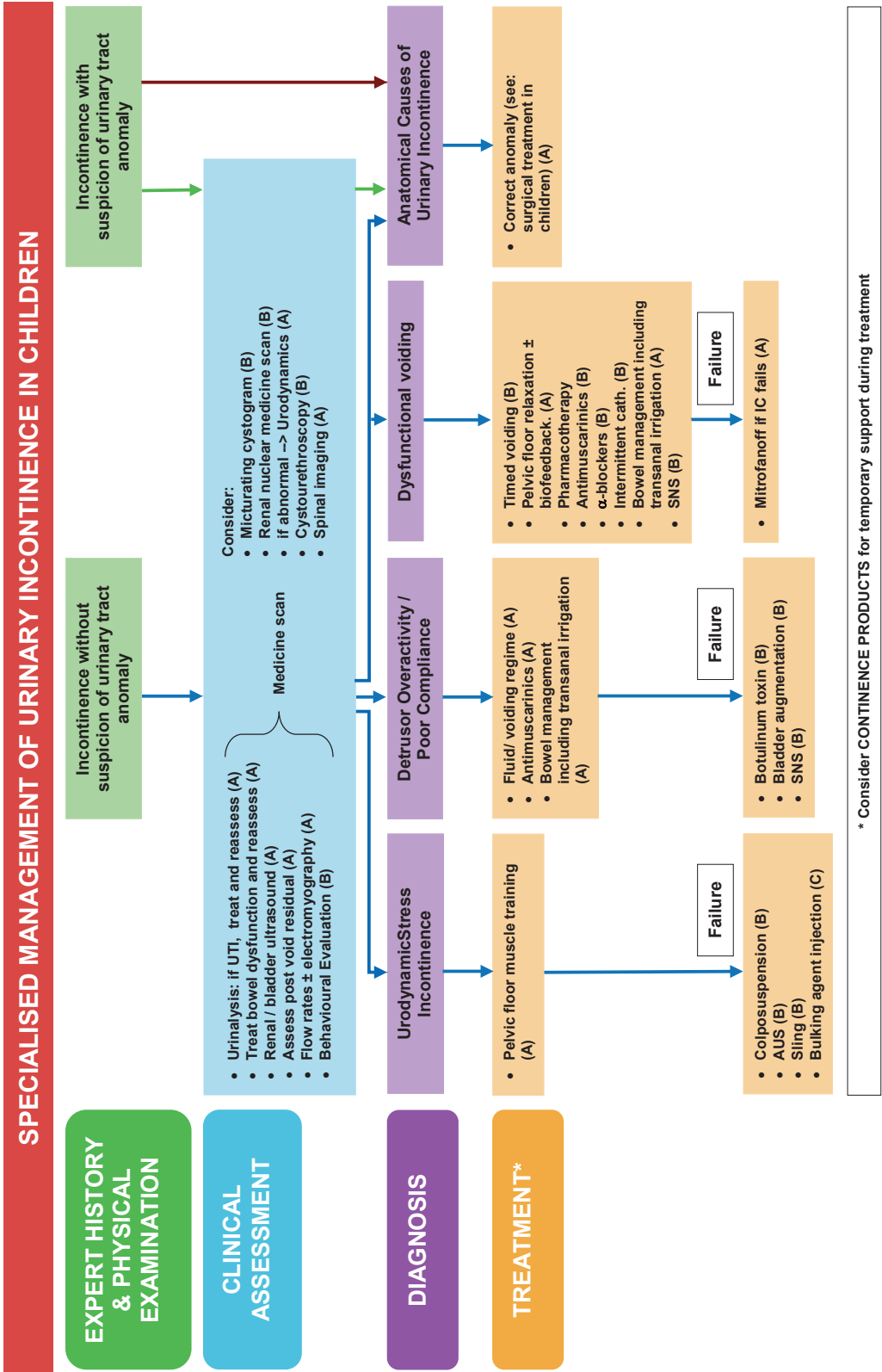
- **Initial treatment should be non-surgical.**
- **For stress urinary incontinence** (SU): pelvic floor muscle training (GoR C).
- **For OAB** symptoms: fluid/voiding regimens and antimuscarinics (GoR A).
- **For voiding dysfunction:** timed voiding, voiding re-education, pelvic floor muscle relaxation (+/- biofeedback), alpha-blocker therapy, and intermittent catheterisation (when PVR >30% of bladder capacity) (GoR A/B).
- **For bowel dysfunction:** high fibre diet and laxatives as appropriate, and, transanal irrigation in severe cases (GoR A).

2562

The child's progress should be assessed and, if quality of life is still significantly impaired, or if the upper urinary tracts are at risk, **surgical treatment** is likely to be necessary.

- **If surgical treatment is required**, then urodynamic studies are recommended to confirm the diagnosis.
- **For USI**, colposuspension, sling surgery, bulking agent injection and AUS may be considered (GoR B).

- **For DO/poor compliance**, botulinum toxin (for DO, and off-label) and bladder augmentation may be performed (GoR B).
- **If the child cannot do IC** then a Mitrofanoff channel may be needed (GoR A).



## II. URINARY INCONTINENCE IN MEN

2564

### A. INITIAL MANAGEMENT

#### 1. INITIAL ASSESSEMENT SHOULD IDENTIFY:

##### ➤ “Complicated” incontinence group

Those with pain or with haematuria, recurrent infection, suspected or proven poor bladder emptying (for example due to bladder outlet obstruction), or incontinence following pelvic irradiation or radical surgery, are recommended for **specialised management**.

**Poor bladder emptying** may be suspected from symptoms, physical examination or if imaging has been performed by X-ray or ultrasound after voiding.

##### ➤ **Four other main groups** of men should be identified by initial assessment as being suitable for **initial management**.

- Those with post-micturition dribble alone,
- Those with overactive bladder (OAB) symptoms: urgency with or without urgency incontinence, together with frequency and nocturia
- Those with stress urinary incontinence (most often post-prostatectomy),
- Those with mixed urinary urgency and stress incontinence (most often post-prostatectomy)

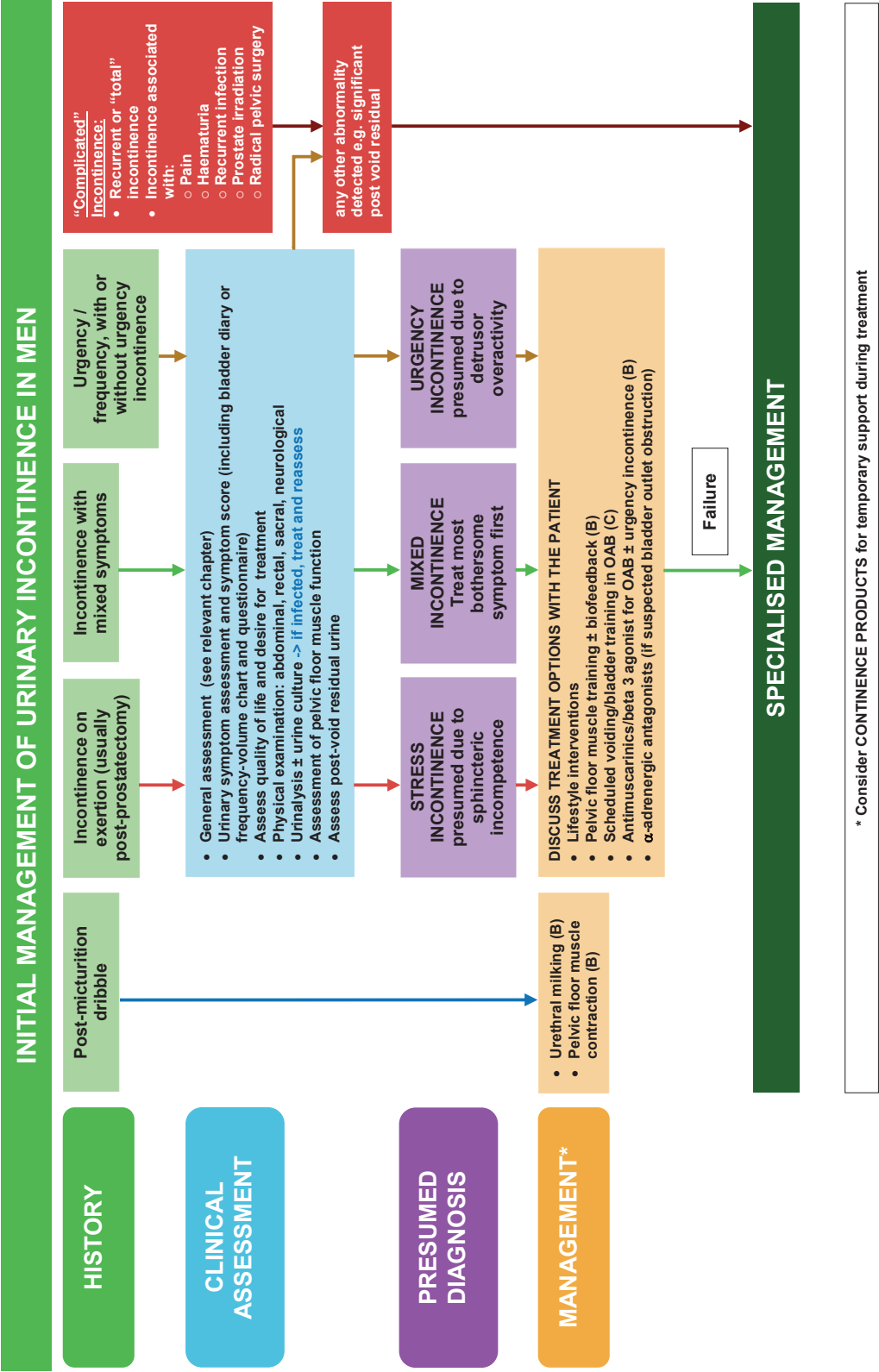
### 2. MANAGEMENT

- For men with **post-micturition dribble**, this requires no assessment and can usually be treated by teaching the man how to do a strong pelvic floor muscle contraction after voiding, or manual compression of the bulbous urethra directly after micturition. (GoR B)

- For men with **stress, urgency or mixed urgency** / stress incontinence, initial treatment should include appropriate lifestyle advice, pelvic floor muscle training, scheduled voiding regimens, behavioural therapies and medication. In particular:

- Lifestyle interventions (eg weight loss GoR B)
- Supervised pelvic floor muscle training for men with post radical prostatectomy SU1 accelerates recovery time(GoR B)
- Scheduled voiding regimen for OAB (GoR C)
- Antimuscarinic/beta 3 agonist drugs for OAB symptoms with or without urgency incontinence (GoR B) if the patient has no evidence of significant post-void residual urine
- $\alpha$ -adrenergic antagonists (a-blockers) can be added if it is thought that there may also be bladder outlet obstruction. (GoR C)
- **Should initial treatment be unsuccessful** after a reasonable time (for example, 8-12 weeks), **specialist advice** is highly recommended.

Clinicians are likely to wish to treat the **most bothersome symptom** first in men with symptoms of **mixed** incontinence.



II. URINARY INCONTINENCE IN MEN

B. SPECIALISED MANAGEMENT

The specialist may first **reinstitute initial management** if it is felt that previous therapy had been inadequate.

1. ASSESSMENT

- Patients with “**complicated**” **incontinence** referred directly to specialised management, are likely to require **additional testing**, such as cytology, cystourethroscopy and urinary tract imaging.

If **additional testing is normal** then those individuals can be treated for incontinence by the initial or specialised management options as appropriate.

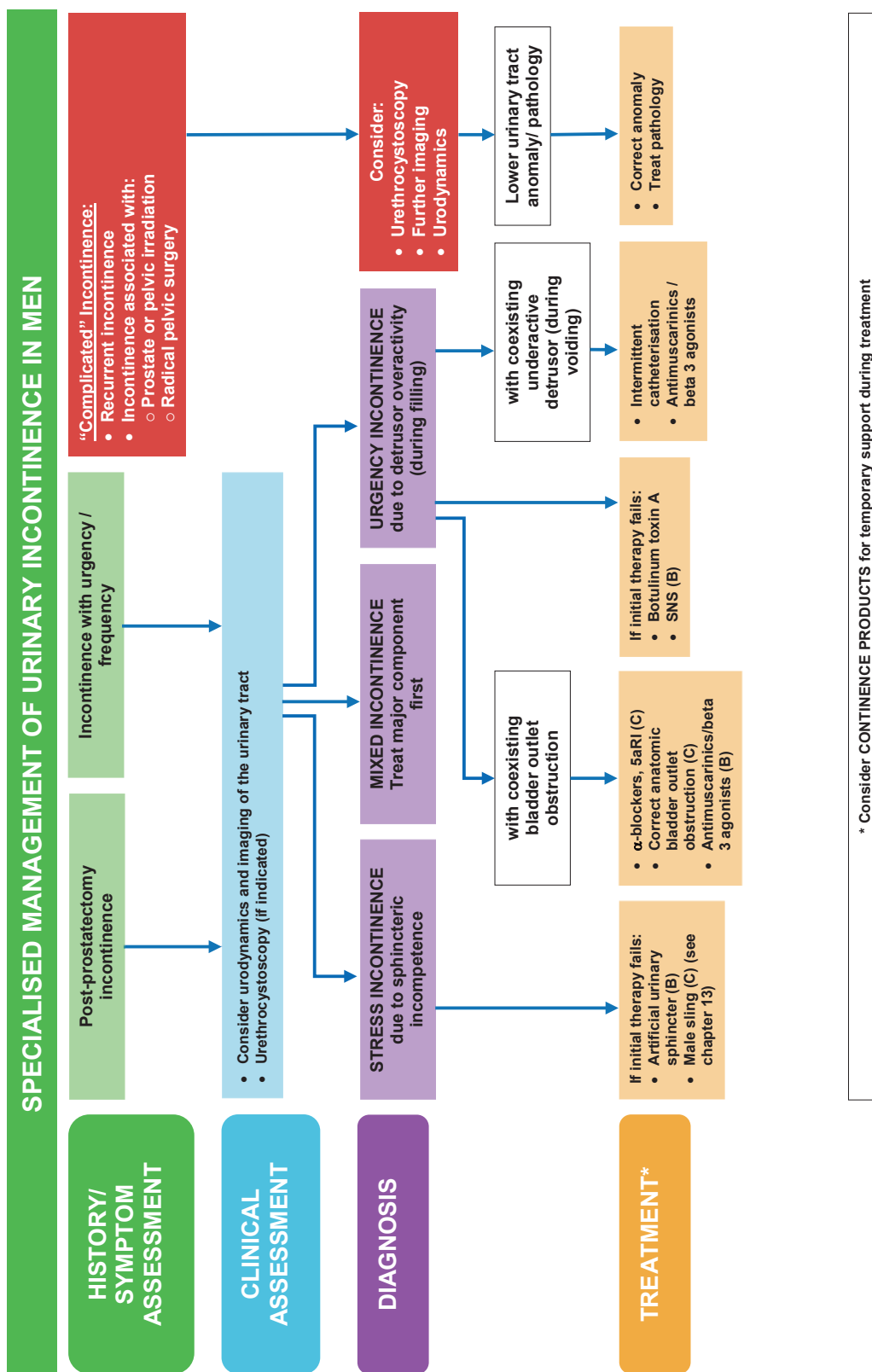
If **symptoms** suggestive of detrusor overactivity, or of sphincter incompetence **persist**, then **urodynamic** studies are advisable in order to arrive at a precise diagnosis, prior to invasive treatment.

2. TREATMENT

When basic management has been unsuccessful and if the patient’s incontinence markedly disrupts his quality of life then **invasive therapies** should be considered.

- For **sphincter incompetence** the recommended option is the artificial urinary sphincter (GoR B). Other options, such as a male sling, may be considered (GoR C).
- For **refractory idiopathic detrusor overactivity**, (with intractable overactive bladder symptoms) the recommended therapies are: Botulinum toxin A (GoR B), and SNS (GoR C).
- When incontinence has been shown to be associated with **poor bladder emptying** due to **detrusor underactivity**, it is recommended that effective means are used to ensure bladder emptying, for example, intermittent catheterisation (GoR B/C).
- If incontinence is associated with bladder outlet obstruction, then consideration should be given to surgical treatment to relieve obstruction (GoR B).  $\alpha$ -blockers and/or 5 $\alpha$ - reductase inhibitors would be an optional treatment (GoR C).
- There is increased evidence for the safety of antimuscarinics for overactive bladder symptoms in men, chiefly in combination with an  $\alpha$ -blocker (GoR B).





### III. URINARY INCONTINENCE IN WOMEN

2568

#### A. INITIAL MANAGEMENT

#### 1. INITIAL ASSESSMENT SHOULD IDENTIFY:

##### ➤ “Complicated” incontinence group.

Those with pain or haematuria, recurrent infections, suspected or proven voiding problems, significant pelvic organ prolapse or who have persistent incontinence or recurrent incontinence after pelvic irradiation, radical pelvic surgery, previous incontinence surgery, or who have a suspected fistula, should be referred to a specialist.

##### ➤ Three other main groups of patients should be identified by initial assessment.

- Women with **stress incontinence** on physical activity
- Women with **urgency, frequency** with or without urgency incontinence: overactive bladder (OAB)
- Those women with **mixed** urgency and stress incontinence

Abdominal, pelvic and perineal examinations should be a routine part of physical examination. Women should be asked to perform a “stress test” (cough and strain to detect leakage likely to be due to sphincter incompetence). Any pelvic organ prolapse or urogenital atrophy should be assessed. Vaginal or rectal examination allows the assessment of voluntary pelvic floor muscle function, an important step prior to the teaching of pelvic floor muscle training.

#### 2. TREATMENT

- For women with **stress, urgency or mixed** urinary incontinence, initial treatment should include appropriate lifestyle advice, pelvic floor muscle training,

PFMT), scheduled voiding regimes, behavioural therapies and medication. In particular:

- **Advice** on caffeine reduction for OAB (GoR B) and weight reduction (GoR A).
- Supervised pelvic floor muscle training (GoR A), supervised vaginal cones training for women with stress incontinence (GoR B).
- Supervised bladder training (GoR A) for OAB.

- **If oestrogen deficiency** and/or **UTI** is found, the patient should be treated at initial assessment and then reassessed after using vaginal oestrogens for a suitable period (GoR B).

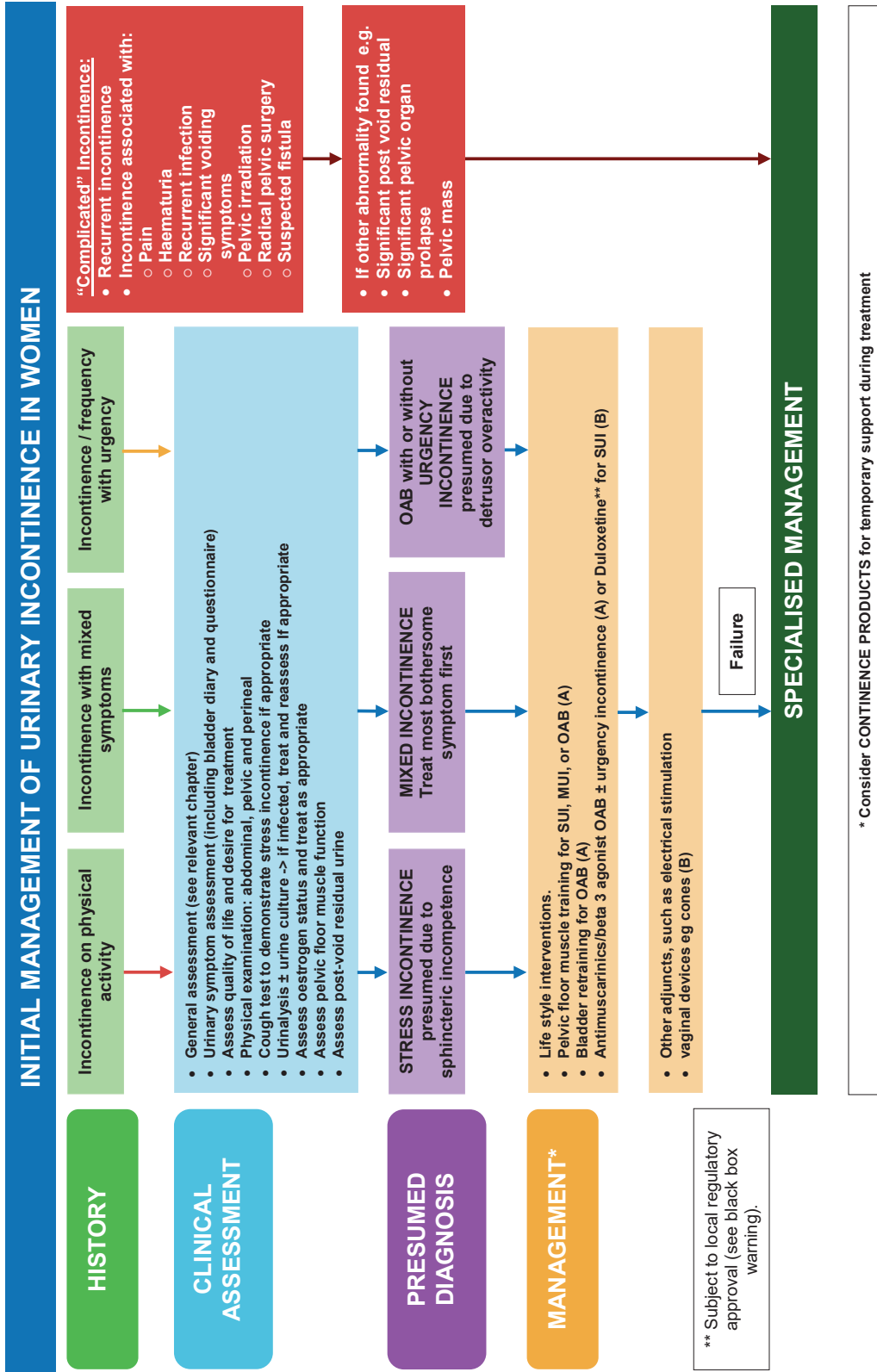
- **Antimuscarinics/beta 3 agonist** for OAB symptoms with or without urgency incontinence (GoR A); duloxetine\* may be considered for stress urinary incontinence (GoR B)

PFMT should be based on sound muscle training principles such as specificity, overload progression, correct contraction confirmed prior to training and use of “the Knack” for 12 weeks before reassessment and possible specialist referral.

Clinicians are likely to wish to treat the **most bothersome symptom first** in women with symptoms of mixed incontinence. (GoR C).

- Some women with significant pelvic organ prolapse can be treated by vaginal devices that treat both incontinence and prolapse (incontinence rings and dishes).

\*Duloxetine is not approved for use in United States. In Europe it is approved for use in severe stress incontinence (see committee report on pharmacological management for information regarding efficacy, adverse events, and ‘black box’ warning by the Food and Drug Administration of the United States).



III. URINARY INCONTINENCE IN WOMEN

2570

A. SPECIALISED MANAGEMENT

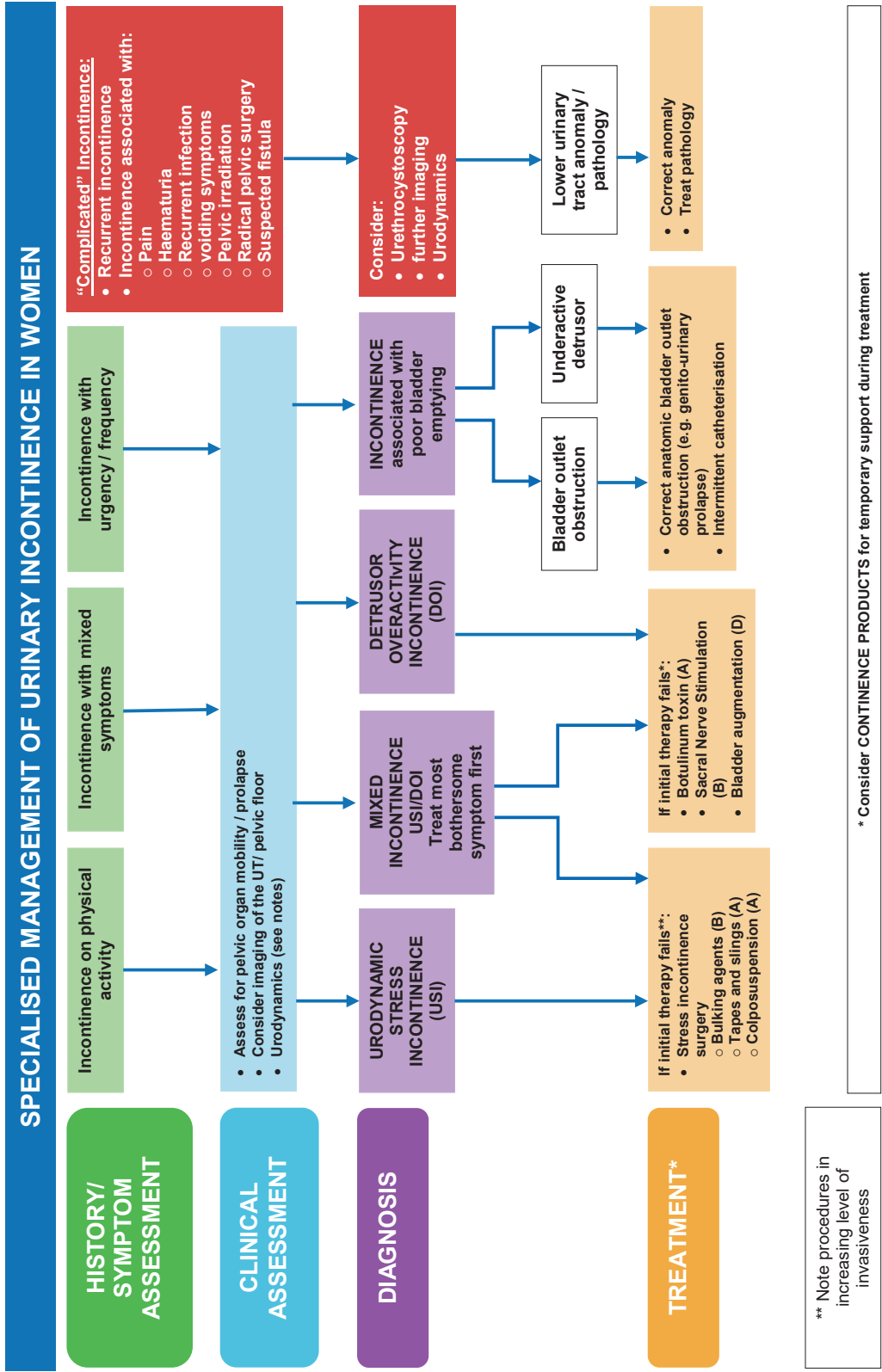
1. ASSESSMENT

Women who have “complicated” incontinence (see initial algorithm) may need to have additional tests such as cytology, urodynamics, cystourethroscopy or urinary tract imaging. If these tests are normal then they should be treated for incontinence by the initial or specialised management options as appropriate.

- Those women with persistent symptoms despite **initial management** and whose quality of life is impaired are likely to request further treatment. If initial management has been given an adequate trial then **interventional therapy may be desired**. When the results of urodynamic testing may change management, we highly recommend testing prior to intervention in order to diagnose the incontinence type and, therefore, inform the management plan. Urethral function testing by urethral pressure profile or leak point pressure is optional.
- Systematic assessment for **pelvic organ prolapse** is highly recommended and the POP-Q method should be used in research studies. Women with co-existing pelvic organ prolapse should have their prolapse treated as appropriate.

2. TREATMENT

- If **stress incontinence is confirmed** then the treatment options that are recommended for patients include the full range of non-surgical treatments, as well as colposuspension procedures, (GoR A) and bladder neck/sub-urethral sling operations (GoR A). All of these procedures have potential risks and associated complications which should be discussed with the individual. **The correction of symptomatic** pelvic organ prolapse may be desirable at the same time. For selected patients injectable bulking agents (GoR B) and the artificial urinary sphincter (GoR C) can be considered.
- **Refractory urgency incontinence** (overactive bladder) secondary to idiopathic detrusor overactivity may be treated by botulinum toxin A (GoR A), sacral nerve stimulation (GoR B) or bladder augmentation/intestinal cystoplasty (GoR D).
- Those patients with **voiding dysfunction** leading to significant post-void residual urine (for example, >30% of total bladder capacity) may have bladder outlet obstruction or detrusor underactivity. Prolapse is a common reversible cause, of voiding dysfunction.



## IV. FISTULAE

In the developing world fistulae occur as a consequence of poor perinatal care. Despite vast surgical experience in some centres, published research is of low quality.

In the developed world, iatrogenic urogenital fistulae are known complications of pelvic surgery and oncological treatments such as radiotherapy, chemotherapy or a combination of both. In the oncological context, fistulae may also occur as a result of primary or recurrent malignancy. The development of fistula following radiotherapy for primary treatment should trigger a search for evidence of tumour recurrence (GoR D). The use of neoadjuvant or adjuvant therapies is likely to be associated with a greater risk of fistula development than the primary treatment alone.

The most common non-obstetric causes of fistulae involving the gastro-intestinal tract are diverticular disease, Crohn's disease, malignancy and radiotherapy.

### 1. INITIAL ASSESSMENT

Early detection of fistulae could be improved by examining all women after their delivery, or prevented by Caesarian section for women who suffer prolonged labour and who are at risk of developing an obstetric fistula. Associated pathologies should be actively searched for and should be taken into account in the treatment plan: all components of the 'obstructed labour injury complex' should be examined. Prevention by better health education, and by avoiding harmful practices must be encouraged.

Classification of fistulae is recommended. Although many classification systems exist, the committee recommends the use of the Goh, WHO or Tefesse classification systems (GoR B)

The formal classification of the fistula should be done under anaesthesia when the patient is on the operation table, just before surgery.

- Leakage of stool, urine, or possibly both is the hallmark sign of a fistula. The leakage is usually painless, may be intermittent if it is position dependent, or may be constant.
- CT and cystoscopy appear more consistent in the confirmation and location of possible intestino-vesical fistulae, than other investigations (GoR C)

- Level 3 evidence indicates that the routine use of cystoscopy with dye testing at gynaecological surgery has high sensitivity, specificity and negative predictive value in the detection of ureteric injury, although false positive tests do occur. (GoR C)
- Ureteric injury or fistula may be suspected in patients following pelvic surgery if a fluid leak or pelvi-calyceal dilatation occurs postoperatively. (GoR D)
- Uretero-arterial fistula may be suspected in patients presenting with haematuria with a history of relevant pelvic surgery and indwelling ureteric stent. (GoR D)
- Elevated levels of creatinine in drainage fluid following pelvic surgery are suggestive of urine leaking due to a urinary tract injury. (GoR D)

### 2. MANAGEMENT OF NEW AND ESTABLISHED VVF

Management of VVF depends on whether the fistula is diagnosed within a few weeks of its occurrence or whether the woman presents late with an established fistula.

Early fistulae are those which are not re-epithelialised, and ischaemic and necrotic tissue can be present at the time of examination. There is evidence that early catheter care will result in the cure of a significant minority of VVFs. (GoR C)

Established fistulae are re-epithelialised and show no oedema, ischaemic changes or inflammation. These fistulae and those that fail catheter treatment should be treated surgically by an experienced surgeon. (GoR C)

### 3. TREATMENT

If catheter drainage fails, then fistula repair will be necessary. There are certain principles behind fistula repair:

- Necrotic tissue must be removed prior to fistula repair.
- Fistula repair must only be undertaken by a properly trained surgeon.
- Adequate post-operative care is essential.

- Proper follow-up should be arranged.

In principle, most fistulae can be dealt with by the vaginal approach, but an abdominal approach may be needed in some cases (e.g. concomitant reconstructive procedures e.g. ureteral reimplantation or bladder augmentation). (GoR C)

A tension-free single layer closure of the bladder wall and closure of the vaginal wall in a separate layer is advocated. A Martius flap in primary fistula repair is not recommended.

When reporting on outcome after fistula repair, authors should make a clear distinction between fistula closure rates and post-operative incontinence rates and the time at which the follow-up was organised.

Prevention of post-operative stress incontinence must be added to the surgical procedure if the urethral closing mechanism is involved. This can be done by a good repair of the pubocervical fascia and refixation or by adding a sling procedure.

Attention should be given as appropriate to skin care, nutrition, rehabilitation, counselling and support prior to and following fistula repair. (GoR D)

There is no proven benefit to delayed repair of vesicovaginal fistulae; the timing of repair should be tailored to the individual patient and surgeon requirements, but can be undertaken as soon as any oedema, inflammation, tissue necrosis, and infection have resolved. (GoR B)

There are no high quality data to indicate greater cure rates for any one technique as compared to others; level 3 evidence indicates similar success rates for vaginal and abdominal, and for transvesical and transperitoneal approaches. (GoR C)

A variety of interpositional grafts can be used in either abdominal or vaginal procedures, although there is little evidence to support their use in any specific setting. (GoR C)

Conventional and robotically-assisted laparoscopic approaches have both been shown to be feasible in selected cases; the indications for, or optimal patient for these techniques is not yet clear. (GoR C)

A period of continuous bladder drainage is crucial to successful fistula repair; there are no high level data to support any particular type, route, or duration of catheterisation. Current practice suggests, 10-14 days for simple and/or post-surgical fistulae; 14-21 days for complex and/or post-radiation fistulae. (GoR D)

Whilst diversion is used more widely in radiation-associated fistulae of all types as compared to non-radiated fistulae, there is low-level evidence that repair procedures can achieve successful fistula closure and continence in appropriately selected cases. (GoR C)

Where urinary and/or faecal diversions are required, attempts should be made to avoid using irradiated tissues wherever possible, and to minimise the potential for anastomotic complications. (GoR C)

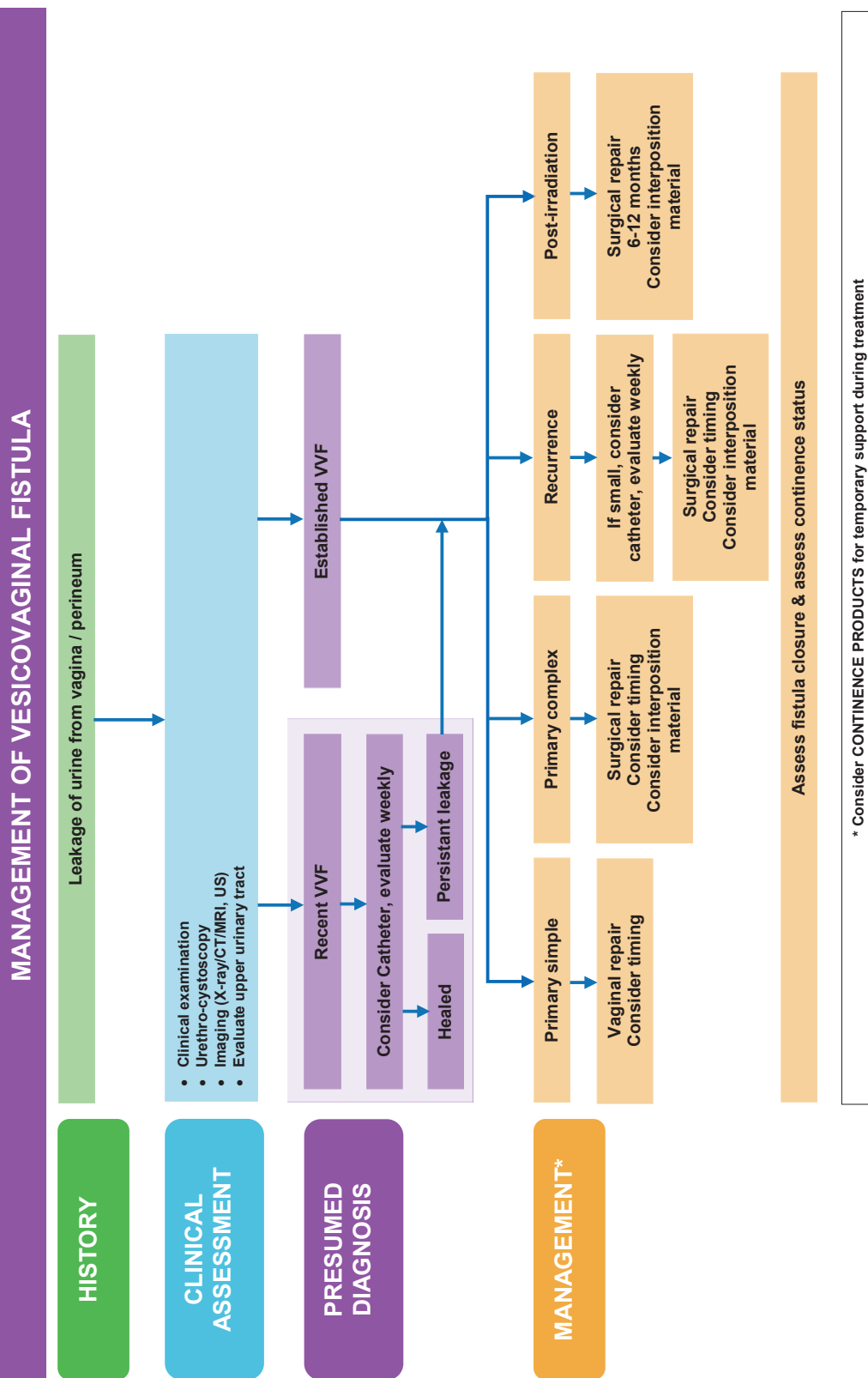
There is low-level evidence to support the use of interposition grafts when repair of radiation-associated fistulae is undertaken. (GoR C)

## 4. MANAGEMENT OF THE COMPLICATIONS OF VVF

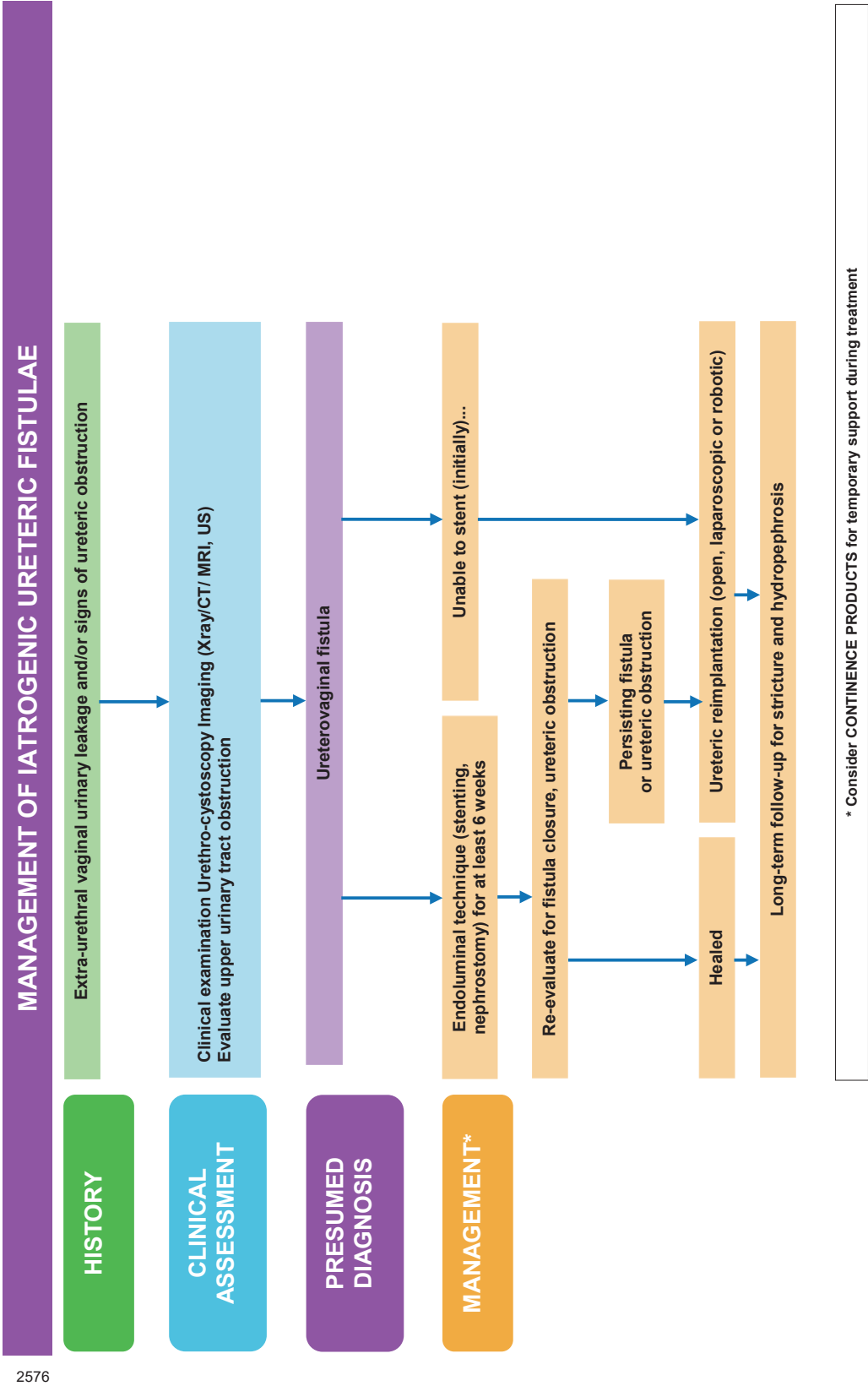
The complications of vesico-vaginal fistulae are many but include:

- Persistence or recurrence of urinary incontinence
- Persistence of lower urinary tract symptoms or occurrence of new lower urinary tract symptoms, including overactive bladder
- Urinary tract infections
- Upper urinary tract symptoms, including loin pain
- Dyspareunia and sexual dysfunction
- Infertility
- Neurological symptoms
- Psychological problems and mental illness





<div>1. MANAGEMENT OF FISTULAE INVOLVING BOWEL</div> <div><ul style="list-style-type: none"><li>There is limited evidence to support a non-surgical or conservative surgical approach in colo-vesical fistulae where there are minimal symptoms or evidence of limited bowel involvement. (GoR C)</li><li>A one-stage approach to surgery for intestino-vesical fistulae is appropriate in many cases, but should be limited to those patients whose nutritional state is good, and where there is no evidence of additional intra-abdominal pathology (e.g. severe inflammation, radiation injury, advanced malignancy, intestinal obstruction) or major co-morbidity. (GoR B)</li><li>A laparoscopic/robotic approach to one-stage management is feasible, although there is no high level evidence to allow comparison of outcomes with open surgery. (GoR D)</li></ul></div>	<div><ul style="list-style-type: none"><li>Most upper urinary tract fistulae should be initially managed by conservative or endoluminal techniques where such expertise and facilities exist. (GoR B)</li><li>Persistent ureterovaginal fistulae should be repaired by an abdominal approach using open, laparoscopic or robotic techniques according to availability and competence. (GoR D)</li><li>For patients with ureteric fistulae associated with advanced pelvic cancer and poor performance status, palliation by nephrostomy tube diversion and endoluminal distal ureteric occlusion is an option. (GoR C)</li></ul></div>
<div>2. MANAGEMENT OF URETERIC FISTULAE</div> <div><ul style="list-style-type: none"><li>Surgeons undertaking complex pelvic surgery should be competent at identifying, preserving and repairing the ureter. (GoR D)</li><li>Ureteric stents are not required as prophylaxis against injury during routine gynaecological surgery, while their role in more extensive surgery remains to be established. (GoR B)</li></ul></div>	<div>3. MANAGEMENT OF URETHRO-VAGINAL FISTULAE</div> <div><div>Recommendations</div><ul style="list-style-type: none"><li>Urethrovaginal fistulae are preferably treated by a vaginal approach. (GoR C)</li><li>A variety of autologous tissue interposition techniques have been described, but their value remains uncertain. (GoR C)</li><li>Urethrovaginal fistulae repair may be complicated by stress incontinence, urethral stricture and urethral shortening necessitating long-term follow-up. (GoR C)</li></ul></div>



V. PELVIC ORGAN PROLAPSE

1. INTRODUCTION

Pelvic organ prolapse includes vaginal and rectal prolapse. Treatment of pelvic organ prolapse is generally reserved for symptomatic prolapse. Clinicians should recognise that coexistent pelvic floor symptoms are frequently present and that these symptoms may or may not be related to the prolapse. Women with prolapse require a careful and detailed initial assessment not only of the prolapse but associated bladder, bowel and sexual function.

2. ASSESSMENT

Symptom assessment preferably with a validated pelvic floor questionnaire that assesses bladder, bowel, vaginal and sexual function and bothersomeness is required. (Grade C).

Physical examination should:

- Report the most distal site of vaginal descent in relation to a fixed point such as the hymen and include an assessment of the anterior posterior and apical vagina. While standardised reporting utilising tools such as the Pelvic Organ Prolapse Quantification (POP-Q) are encouraged. The system used to measure the extent of the prolapse should be documented.
- Be undertaken in the standing position to evaluate the full extent of the prolapse.
- Determine if coexistent pelvic pathology is present on careful bimanual examination. Cytological screening of the cervix should be undertaken if required.
- The prolapse should be reduced to document the presence of occult stress urinary incontinence (see chapter for prolapse and urinary incontinence pathway).
- Assess pelvic floor muscle function (see chapter for full review).
- Determine if epithelial/ mucosal ulceration is present.
- Evaluate anal sphincter tone and or the presence of rectal prolapse in those with bowel symptoms (refer to chapter for pelvic organ prolapse and bowel symptom pathway).

When examination findings of the extent of the prolapse are not consistent with the history the examination can be repeated in a few weeks' time. (GoR C).

Post void residual should be measured; while most elevated post-void residual urines (150mls) resolve with treatment of the prolapse, a specialist consultation is required.

3. MANAGEMENT

*Observation* is appropriate when medically safe (GoR C).

Lifestyle interventions include weight loss, treating constipation, avoiding straining at stool and heavy lifting (GoR C).

*Pelvic floor muscle training:*

- Reduces associated pelvic floor symptoms (GoR A).
- May reduce the symptom of vaginal bulge (GoR C).
- Does not reduce extent of prolapse on examination based on POP-Q stage (GoR B).

*Vaginal Pessary:* when successfully fitted

- May reduce prolapse symptoms (GoR B)
- Need to be regularly reviewed (GoR C)
- Have high rates of discontinuation (GoR C)
- Local Oestrogens* are recommended in those with hypo-oestrogenic symptoms and in those with urethral prolapse or vaginal ulceration (GoR B)

*Reconstructive surgery* is reserved for those with symptomatic prolapse and is aimed at correcting the vaginal topography and functional pathology. Please see text for full recommendations.

*Obilitative surgery* is an important and effective treatment option in those who are happy to sacrifice coital activity. (GoR C)



## PATHWAY FOR THE SURGICAL MANAGEMENT OF PELVIC ORGAN PROLAPSE

The pelvic organ prolapse (POP) surgery pathway was designed to provide an evidence based guide for both clinicians and women for the surgical management of pelvic organ prolapse. Within the pathway green lines highlight the preferred option and yellow lines indicate reasonable options.

An early option in the treatment pathway for women not wanting to preserve sexual function is obliterative surgery (colpocleisis) which is an efficacious intervention that has low morbidity (LoE 3).

The majority of women will enter the reconstructive pathway. Apical suspension procedures should be considered in all cases with 10-year re-operation rates for prolapse being significantly reduced if apical suspensions are performed concomitantly with both anterior and posterior colporrhaphy as compared to those performed without apical support.

In those undergoing anterior and posterior colporrhaphy the evidence is supportive of traditional native tissue suture plications (LoE 1). In the anterior compartment permanent mesh could be considered for recurrent cases when the patient understands the risk benefit profile for these interventions and that the data for their use is scant. Evidence is not supportive of biological grafts in the anterior compartment (LoE 2).

In the posterior compartment, fascial plication is superior to site specific native tissue repair (LoE 2) and levatorplasty should be avoided due to higher rates of dyspareunia (LoE3). Data are not supportive of biological or permanent mesh grafts. Posterior colporrhaphy is superior to transanal repair of rectocele (LoE 1) and there is no data to support ventral rectopexy with or without vaginal graft for rectocele.

With recognition of the importance of apical vaginal support in minimising the risk of subsequent recurrence, the pathway separates those with post-hysterectomy (vault) prolapse from those with uterine prolapse.

Data are supportive of sacral colpopexy as the preferred intervention for vault prolapse with superior anatomical and functional outcomes when compared to a variety of vaginal based interventions with and without transvaginal mesh (LoE1). This preference is highlighted by a green preferred option arrow in the management pathway. In recognition that not all patients are suitable for sacral colpopexy, a yellow reasonable option is included for vaginal based apical support (uterosacral or sacrospinous colpopexy). Both uterosacral and sacrospinous colpopexy are

equally effective vaginal options (LoE 1) and utilisation of transvaginal permanent mesh apical support is not supported by the data (LoE1).

When performing sacral colpopexy the laparoscopic approach is preferred with reduced peri-operative morbidity and cost when compared to both the open or robotic approach (LoE 2). The yellow reasonable option pathway exists for both open and robotic options in recognition of the longer learning curve associated with the laparoscopic approach (LoE3).

Apical support in those with uterine prolapse can be performed abdominally or vaginally and includes options for both uterine preservation (hysteropexy) and hysterectomy, with not insignificant relative contraindications for uterine preservation listed in Table 6. In post-menopausal women undergoing hysterectomy, bilateral salpingo-oophorectomy (BSO) significantly reduces the rate of ovarian cancer without increased morbidity. In those retaining ovaries at hysterectomy, bilateral salpingectomy also reduces rate of subsequent ovarian cancer.

Vaginal hysteropexy is equally effective as vaginal hysterectomy with apical suspension and is associated with reduced blood loss and operating time as compared to hysterectomy (LoE 1). Vaginal hysterectomy with apical support has a lower re-operation for prolapse than abdominal sacrohysteropexy (LoE1). Sacrohysteropexy has a higher re-operation for prolapse than sacral colpopexy with hysterectomy however sacral colpopexy with hysterectomy is not recommended due to the high rate of mesh exposure (LoE2). Supra-cervical hysterectomy at sacral colpopexy reduces the rate of mesh exposure associated with hysterectomy and sacral colpopexy however in a single retrospective study, recurrent prolapse was more common in the supracervical hysterectomy group. Although those data is not complete, vaginal based hysterectomy and hysteropexy with apical support should generally be considered as preferred options for uterine prolapse with sacral colpopexy reserved for vault prolapse.

Those undergoing prolapse surgery with stress urinary incontinence (SUI) and occult SUI should generally have continence surgery performed at the time of prolapse surgery (LoE1). Those with prolapse without SUI or occult SUI should not undergo continence surgery at time of prolapse surgery (LoE1).

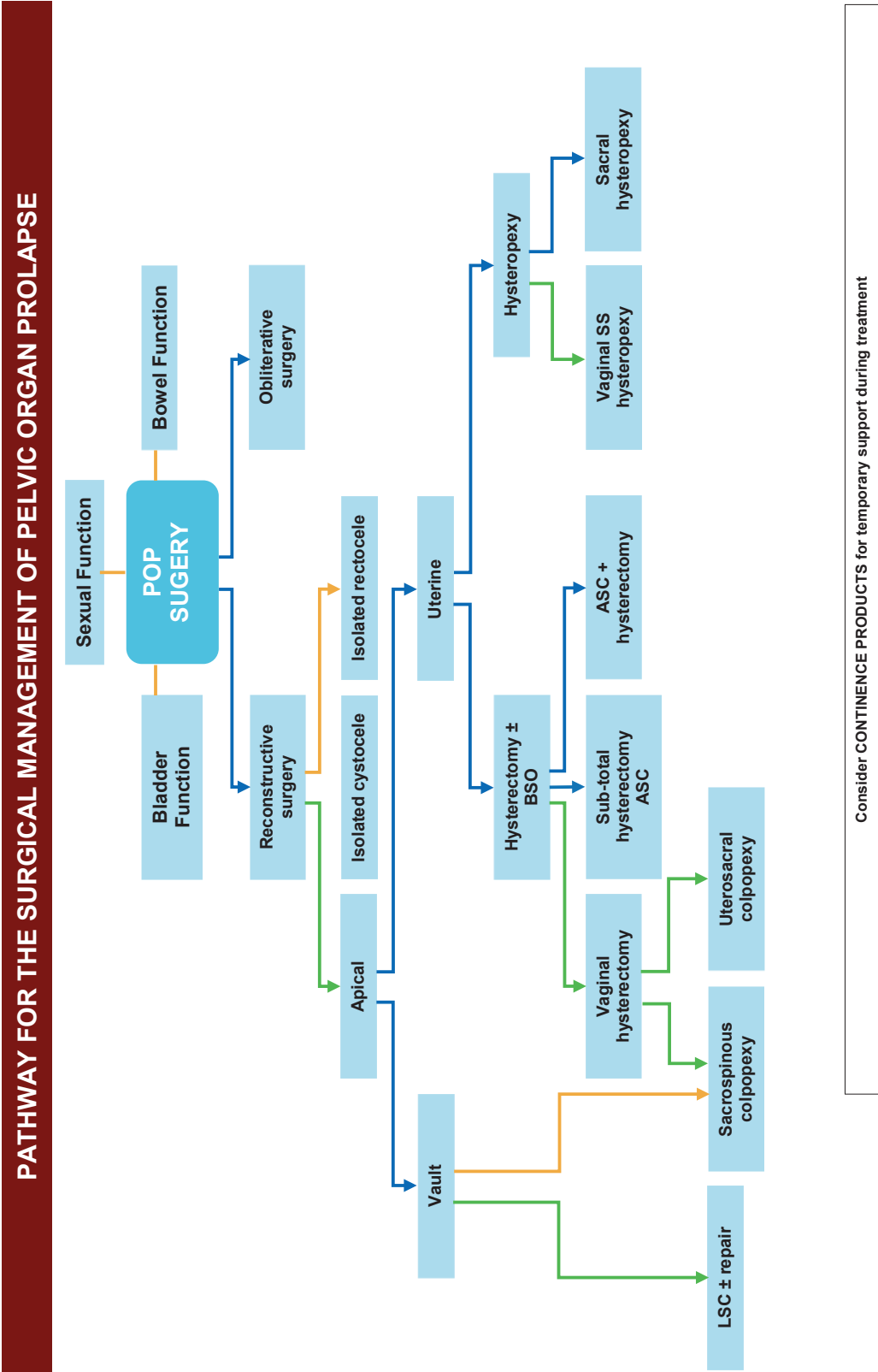
Based largely upon expert opinion (LoE3) those with prolapse without bowel symptoms and those with impaired defaecation with rectocele should undergo prolapse surgery as per the above pathway. Those with POP and impaired defaecation without rectocele, and those with faecal incontinence require colorectal assessment. If

rectal prolapse exists, these patients may benefit from combined colorectal and gynaecological interventions. Those with significant constipation and prolapse should be approached cautiously and may benefit from gastroenterology assessment prior to entering the POP surgery pathway.

Those undergoing POP surgery generally have improved sexual function post-operatively but a small number undergoing any POP surgery will experience painful intercourse post-operatively that may require subsequent intervention (LoE 1).

2580





## VI. URINARY INCONTINENCE IN NEUROLOGICAL PATIENTS

2582

### A. INITIAL MANAGEMENT

#### 1. STRONG GENERAL RECOMMENDATIONS

- Patients with known neurological disease often need evaluation to exclude bladder dysfunction, not only if symptoms occur, but as a standard assessment as neurogenic bladder has a high prevalence in the particular disease (for prevalence figures see chapter)
- A possible neurological cause of "idiopathic" incontinence should always be considered. Diagnostic steps to evaluate this include basic assessments, such as history and physical examination, urodynamics and specialised tests.
- Incontinence in neurological patients does not necessarily relate to the neurologic pathology. Other diseases such as prostate pathology, pelvic organ prolapse, might have an influence. These factors should be evaluated as potential primary or contributory causes.
- Extensive diagnostic evaluation is often useful and necessary to tailor an individual treatment based on complete neurofunctional data. This may not be needed in every patient e.g. patients with suprapontine lesions or in patients where treatment will consist merely of bladder drainage when the person is frail or has limited life expectancy.
- There is often a need to manage both bladder and bowel dysfunction simultaneously

#### 2. INITIAL ASSESSMENT

- The management of neurological urinary incontinence depends on an understanding of the likely mechanisms producing incontinence. This can in turn depend on the site and extent of the nervous system abnormality.
- Under current classifications, neurogenic incontinence patients can be divided into four groups. History and physical examination are important in helping distinguish these groups:

- peripheral lesions (as after major pelvic surgery) including those with lesions of the cauda equina (eg. lumbar disc prolapse);
- sacral spinal cord lesions involving the sacral micturition centre
- suprasacral spinal cord lesions (suprasacral infrapontine spinal cord lesions);
- central lesions of the brain or brain stem (stroke, Parkinson's disease).
- Assessment should be made using Questionnaires, urinalysis, bladder diary, uroflowmetry with assessment of PVR, and imaging of the urinary tract (ultrasoundography); all provide basic data for the initial assessment of the NLUTD.
- Invasive urodynamics should be used as part of the initial assessment in select patient populations (SCI, meningomyelocele)
- Due to increasing data on organ cross-sensitisation and the debilitating effect of faecal incontinence on QoL, a history of bowel function should be also included

#### 3. INITIAL TREATMENT

- Patients with peripheral nerve lesions (e.g. denervation after pelvic surgery) and patients with spinal cord lesions (e.g. traumatic spinal cord lesions) should receive specialised urological management (GoR A).
  - Initial treatment for patients with incontinence due to suprapontine pathology, like stroke: need to be assessed for degree of mobility and ability to cooperate. Initial recommended treatments are behavioural therapy (GoR C) and antimuscarinic drugs for presumed detrusor overactivity (GoR A). If incontinence persists and if operative procedures are not indicated then continence products (GoR B) or catheters (GoR C) may be necessary on a long-term basis. These can also be necessary in non-cooperative or less mobile patients.
- Pharmacological detrusor relaxation and/or antibiotics may be useful in cases of persistent bypass leakage and/or recurrent UTI (patients with continuous drainage)
- In all cases, bowel management should complement management of NLUTD



VI. URINARY INCONTINENCE IN NEUROLOGICAL PATIENTS

2584

B. SPECIALISED MANAGEMENT

1. ASSESSMENT

- Most patients with neurogenic urinary incontinence require specialised assessment: Invasive urodynamic studies should be used with videourodynamics if available when surgical interventions are planned or when the "bladder may be unsafe".
- Upper tract imaging is needed in some patients and more detailed renal function studies will be desirable if the upper tract is considered in danger: high bladder pressure, upper urinary tract dilation, recurrent or chronic upper tract infection, (major) stones, (major) reflux.
- In patients with peripheral lesions, clinical neurophysiological testing may be helpful for better definition of the lesion

2. TREATMENT

For specialised management, conservative treatment is the mainstay (GoR A). Management of neurogenic urinary incontinence has several options. The algorithm details the recommended options for different types of neurological dysfunction of the lower urinary tract. The dysfunction does not necessarily correspond to one type/level of neurological lesion and is defined best by urodynamic studies. One should always ascertain that the management ensures a safe lower urinary tract (storage at low pressure and complete emptying)

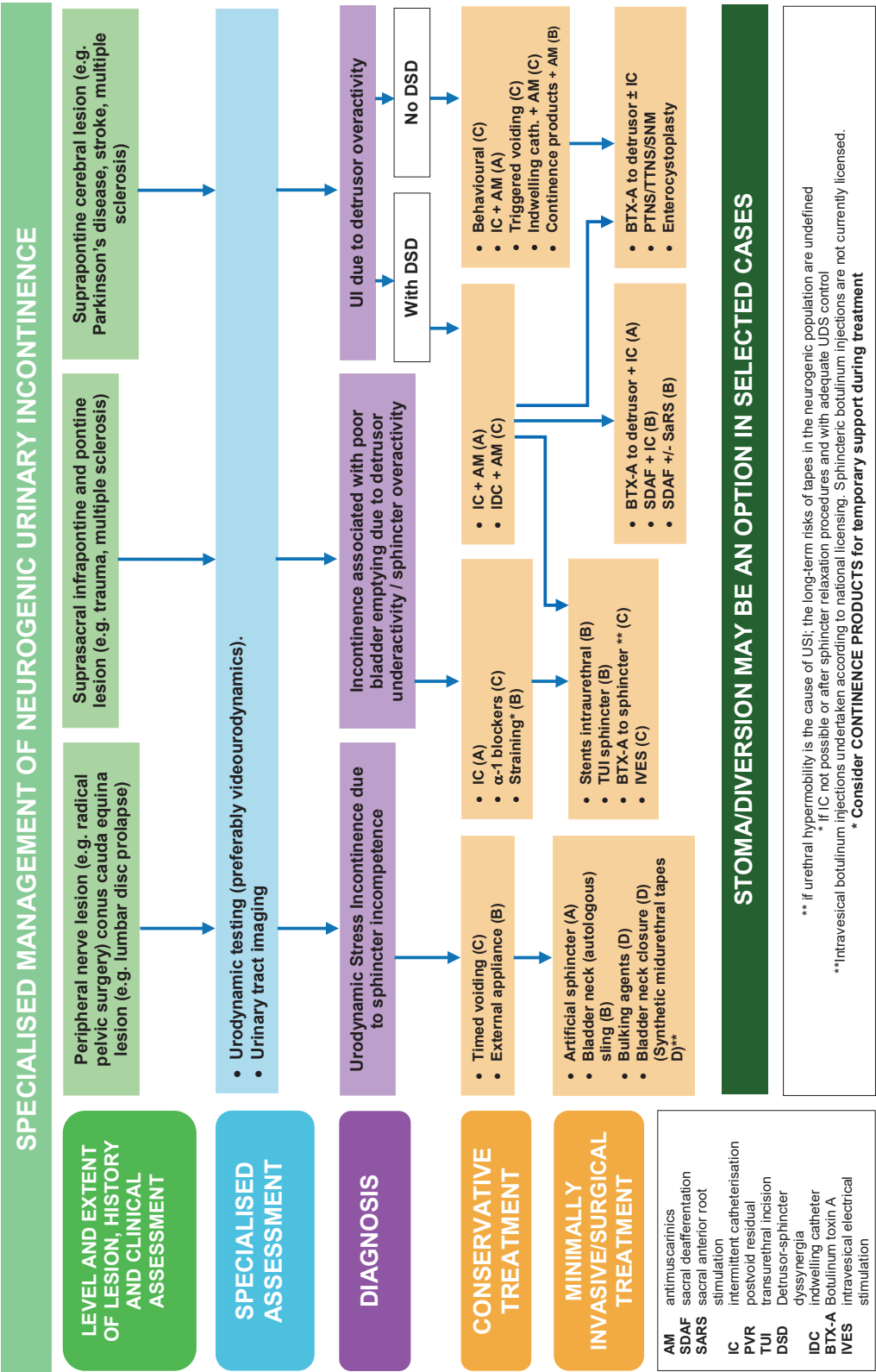
Both urinary and bowel function should be assessed together if both systems are affected, as symptoms and treatment of one system can influence the other, and *vice versa* (GoR A).

As therapeutic approaches can differ in various neurological diseases, the most prevalent diseases are discussed separately in the chapter

3. TREATMENT MODALITIES (OFTEN IN COMBINATION)

- Conservative
  - Intermittent catheterisation (GoR A)
  - Behavioural treatment (GoR C)
  - Timed voiding (GoR C)
  - Continence products (GoR B)
  - Antimuscarinics (GoR A)
  - Alpha-1-adrenergic blockers (GoR C)
  - Oral cannabinoid agonists (MS) (GoR C)
  - Beta-3-agonist alone or as an add-on to AM (GoR D)
  - Bladder expression (GoR B)
  - Triggered voiding (GoR C)
  - Indwelling catheter (GoR C)
- Minimally invasive treatments
  - Botulinum toxin for: sphincter (C) detrusor (A)
  - Intravesical electrical stimulation (C)
  - PTNS/TTNS (C)
  - SNM (stable disease only) (C)

➤	Surgical treatment		
•	Artificial sphincter (A)	•	Stents intraurethral (B)
•	Bladder neck sling (B)	•	TUI sphincter (B)
•	Sub-urethral tapes (D)	•	Sacral deafferentation (B)
•	Bulking agents (D)	•	Sacral anterior root stimulator (B)
•	Bladder neck closure (D)	•	Enterocystoplasty (B)



VII. BLADDER PAIN SYNDROME

Definition

Bladder Pain Syndrome (BPS): in the absence of a universally agreed definition, the International Society for the Study of Interstitial Cystitis – ESSIC definition is given (1).

ESSIC: Chronic pelvic pain, pressure or discomfort of greater than 6 months duration perceived to be related to the urinary bladder accompanied by at least one other urinary symptom like persistent desire to void or urinary frequency. Confusable diseases as the cause of the symptoms must be excluded.

There are no published data as to what duration of symptoms indicates that early spontaneous resolution of symptoms is unlikely. While ESSIC arbitrarily uses a 6 month duration, the American Urological Association Guideline suggests that a 6 week history is long enough to initiate diagnosis and treatment of BPS (2). Without further data, the Consultation cannot make a recommendation and believes that it is up to the discretion of the physician and patient as to the proper interval between symptom onset and evaluation and diagnosis of a chronic condition.

1. NOMENCLATURE

The scientific committee of the International Consultation voted to use the term “bladder pain syndrome” for the disorder that has been commonly referred to as interstitial cystitis (IC). The term painful bladder syndrome was dropped from the lexicon. The term IC implies an inflammation within the wall of the urinary bladder, involving gaps or spaces in the bladder tissue. This does not accurately describe the majority of patients with this syndrome. Painful Bladder Syndrome, as defined by the International Continence Society, is too restrictive for the clinical syndrome.

Properly defined, the term Bladder Pain Syndrome appears to fit in well with the taxonomy of the International Association for the Study of Pain (IASP) (see below), and focuses on the actual symptom complex rather than what appears to be long-held misconception of the underlying pathology.

Bladder Pain Syndrome (XXIII-2) (per IASP)

Bladder pain syndrome is the occurrence of persistent or recurrent pain perceived in the urinary bladder region, accompanied by at least one other symptom, such as

pain worsening with bladder filling and day-time and/or night-time urinary frequency. There is no proven infection or other obvious local pathology. Bladder pain syndrome is often associated with negative cognitive, and behavioural, sexual, or emotional consequences, as well as with symptoms suggestive of lower urinary tract and sexual dysfunction.

The Consultation believes that, based on the pathology and endoscopic finding characteristics of the Hunner lesion, the epidemiological pattern that distinguishes it from bladder pain syndrome, the clinical response to local treatment of the lesion by resection, fulguration, or steroid injection, the response to cyclosporine, and the



Figure 1



absence of reports in the literature that non-Hunner patients go on to develop Hunner lesions (ie, the finding of a Hunner lesion does not represent a continuum in the natural history of bladder pain syndrome), that the presence of a Hunner lesion should be considered a distinct disease. It therefore should drop out of the bladder pain syndrome construct, much like we do not consider other painful conditions like radiation cystitis, ketamine cystitis, or urinary tract infection a part of bladder pain syndrome.

The Consultation concludes that it would be reasonable to designate the Hunner lesion in symptomatic patients with the term "interstitial cystitis", thus indicating a true interstitial inflammation. It would be defined much as Hunner defined it 100 years ago, and harmonise the largely Asian, European, and North American concepts of interstitial cystitis. The Consultation will continue to refer to the symptom complex as "bladder pain syndrome". Hunner lesion will be considered a distinct phenotype, but in the future may be classified as a separate disorder entirely, albeit with local symptoms that are difficult to differentiate from bladder pain syndrome in the absence of endoscopy. In other words, we may be coming full circle in the historical perspective Figure 1.

## 2. HISTORY / INITIAL ASSESSMENT

Males or females whose symptoms meet the requirements of the definition of bladder pain syndrome should be evaluated. The presence of commonly associated disorders including irritable bowel syndrome, chronic fatigue syndrome, and fibromyalgia in the presence of the cardinal symptoms of bladder pain syndrome also suggests the diagnosis. Abnormal gynaecological findings in women and well-characterised, confusable diseases that may explain the symptoms must be ruled out.

The initial assessment consists of a bladder diary or frequency/volume chart, focused physical examination, urinalysis, and urine culture. In the absence of confusable disorders (uncomplicated disease), a diagnosis can be made and treatment instituted. Urine cytology, cystoscopy, and urodynamic evaluation are recommended if clinically indicated and/or the diagnosis is in doubt (complicated disease). Patients with urinary infection should be treated and reassessed. Those with recurrent urinary infection, abnormal urinary cytology, and microscopic or gross haematuria are evaluated with appropriate imaging and endoscopic procedures, and only if the findings are unable to explain the symptoms, are they diagnosed with BPS. GoR C

## 3. INITIAL TREATMENT

- Patient education, (GoR B)
- Dietary manipulation, (GoR B)
- Nonprescription analgesics,
- Stress reduction,
- Pelvic floor relaxation techniques comprise the initial treatment of BPS. In the patient with findings suggesting pelvic floor dysfunction, pelvic floor physical therapy with myofascial trigger point release and intravaginal Thiele massage is often an effective therapeutic intervention. The treatment of pain needs to be addressed directly, and in some instances referral to an anesthesiologist/pain centre can be an appropriate early step in conjunction with ongoing treatment of the syndrome. (GoR A)

When conservative therapy fails or symptoms are severe and conservative management is unlikely to succeed,

- Oral medication (GoR B) or
- Intravesical treatment can be prescribed. It is recommended to initiate a single form of therapy and observe results, adding other modalities or substituting other modalities as indicated by the degree of response or lack of response to treatment. (GoR B)

## 4. SECONDARY ASSESSMENT

If initial oral or intravesical therapy fails, or before beginning such therapy based on clinician judgment, it is reasonable to consider further evaluation which can include urodynamics, pelvic imaging, and cystoscopy with bladder distention and possible bladder biopsy under anaesthesia.

- Findings of detrusor overactivity suggest a trial of antimuscarinic or beta-3-agonist therapy.
- The presence of a Hunner lesion suggests therapy with transurethral resection, fulguration of the lesion, or direct steroid injection into the lesion. (GoR B)

- Bladder distention itself can have therapeutic benefit in 30-50% of patients, though benefits rarely persist for longer than a few months. (GoR C)

5. REFRACTORY BPS

Those patients with persistent, unacceptable symptoms despite oral and/or intravesical therapy are candidates for more aggressive treatment modalities. Many of these are best administered within the context of a clinical trial if possible. These may include

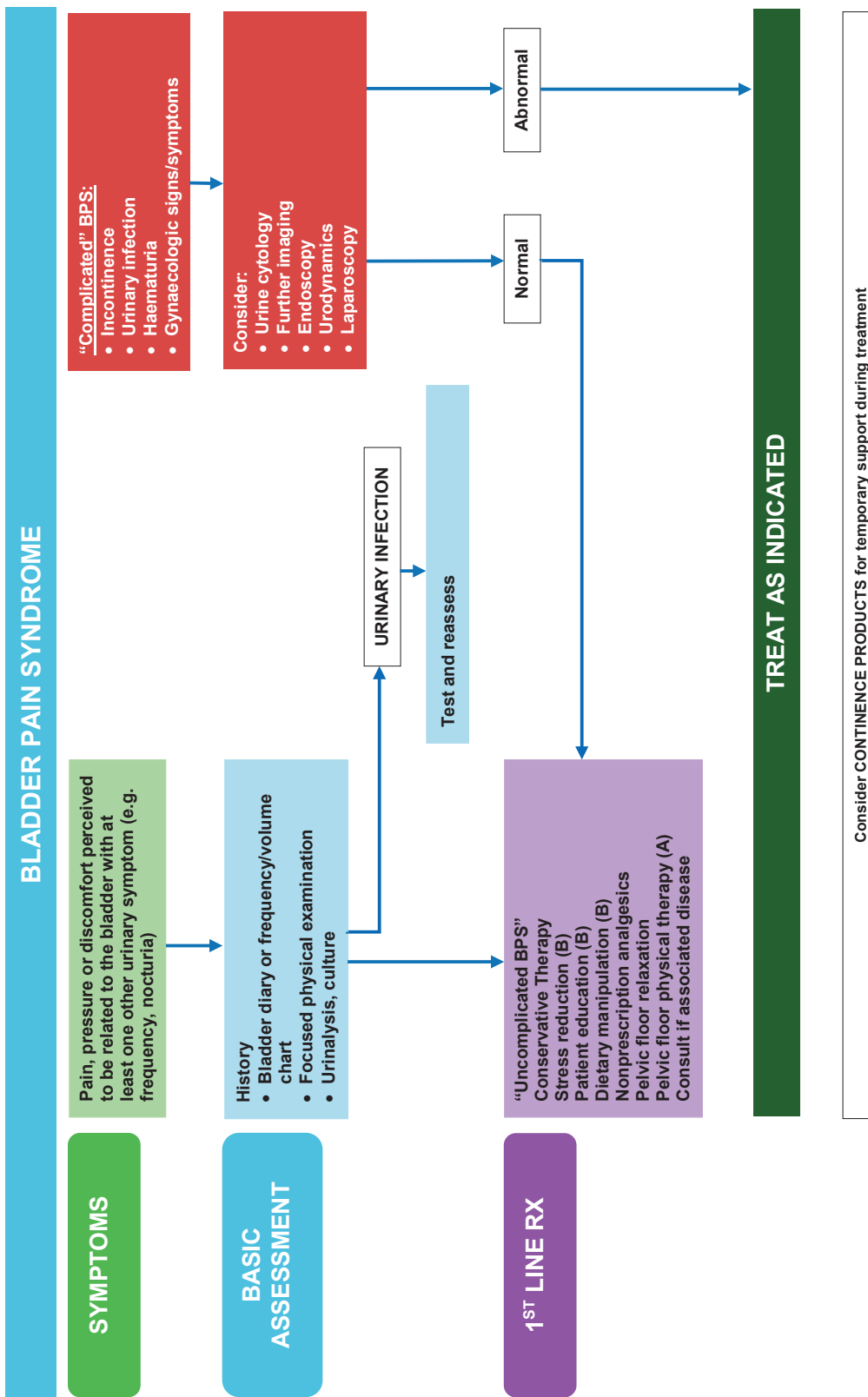
- Sacral nerve stimulation, (GoR B)
- Intradetrusor botulinum toxin, (GoR B)

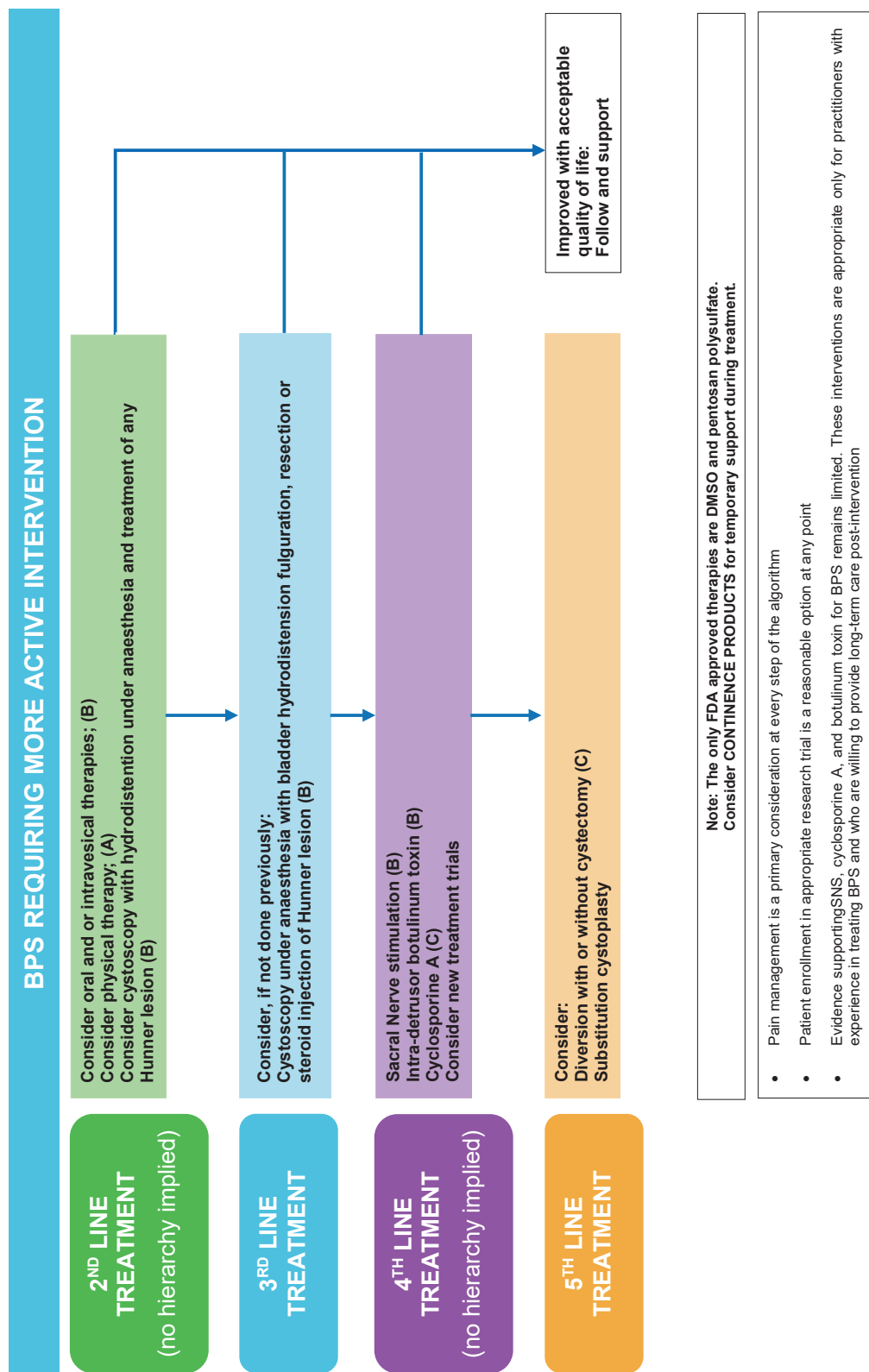
- Oral cyclosporine A (GoR C), or
- Clinical trials of newly described pharmacological management techniques. At this point, most patients will benefit from the expertise of an anaesthesia pain clinic.

The last step in treatment is usually some type of surgical intervention aimed at increasing the functional capacity of the bladder or diverting the urinary stream.

- Urinary diversion with or without cystectomy has been used as a last resort with good results in selected patients. Cystectomy and urethrectomy do not appear to add any additional efficacy to diversion alone.

Augmentation or substitution cystoplasty seems less effective and more prone to recurrence of chronic pain in small reported series (GoR C)





## VIII. FAECAL INCONTINENCE IN ADULT PATIENTS

2592

### ASSESSMENT AND MANAGEMENT

#### 1. INITIAL CLINICAL ASSESSMENT

Adult patients with faecal incontinence present with a variety of symptom complexes. As many people are reluctant to admit to having faecal incontinence, it is important to proactively enquire about it, especially in known high risk groups (such as older community-living individuals, post partum women who might have had an obstetric injury and patients with loose stools).

History will include symptoms such as loose stools and urgency, the type and severity of bowel incontinence, systemic disorders, neurological disorders, and anorectal surgeries (e.g., haemorrhoidectomy), obstetric history for women, medications, diet, chronic straining, cognitive status, and effects of symptoms on quality of life.

#### 2. INITIAL INTERVENTIONS

- Assessing the type of bowel incontinence may help identify an aetiology. Types of bowel incontinence: Anal incontinence is the involuntary loss of faeces and/or flatus and/or mucus). Faecal incontinence is the involuntary loss of faeces. Flatus incontinence is the involuntary loss of rectal gas, which may indicate rectal sensory impairment and/or anal sphincter dysfunction. Mucus incontinence is the involuntary loss of mucus only (See Figure 1).
  - Some subtypes of faecal incontinence are urgency faecal incontinence, which is the involuntary loss of faeces due to an inability to defer defaecation, once the desire is perceived, for long enough to reach a toilet. Urgency faecal incontinence is often a symptom of external anal sphincter dysfunction. The symptom of urgency does not necessarily result in urgency faecal incontinence. Functional faecal incontinence is due to limitations in mobility or toileting ability or delayed assistance. Passive faecal incontinence, incontinence without forewarning, is typically related to internal anal sphincter dysfunction or poor closure of the external sphincter due to rectal prolapse or stage III/IV haemorrhoids.

- Physical examination will include anal inspection, abdominal palpitation, a brief neurological examination, digital rectal examination and usually procto-sigmoidoscopy or colonoscopy.
  - Further diagnostic testing needs to be considered if the patient has symptoms such as an unexplained change in bowel habit, weight loss, anaemia, rectal bleeding, severe or nocturnal diarrhoea, or an abdominal or pelvic mass and bowel pathology when organic conditions such as cancer, inflammatory bowel disease (IBD), a recto-vaginal fistula, full thickness rectal prolapse, or cloacal deformity are suspected. Condition specific management is indicated for these patients.
  - Reversible factors (such as inadequate access to toilets and side effects of medications resulting in loose stools) should be assessed and addressed at the outset.
- Some initial management can often be performed in primary care. After environmental factors and local or systemic pathology have been excluded, initial interventions include:
- Discussion of options and goals of management with the patient
  - Provision of patient or caregiver information and education (GoR A)
  - Adjustment of diet and fluid advice, fibre intake (GoR A)
  - Establishing a regular bowel habit (GoR C) or urgency training if relevant (GoR C)
  - Anti-diarrhoeal medication can help if stools are loose (GoR B)
  - Use of continence products including various types and sizes of absorbent pads, briefs, etc., to contain leaked faeces and prevent skin damage
  - Provide advice on practical coping skills when incontinence occurs (GoR C)

3. SECONDARY INTERVENTIONS	4. SECONDARY ASSESSMENT
<ul style="list-style-type: none"><li>• If initial interventions fail to improve symptoms after 8-12 weeks, consideration should be given to referral to an incontinence specialist (e.g., gastroenterologist, continence nurse, advisor physiotherapist, or colorectal surgeon) for other interventions or further assessment.</li><li>• Pelvic floor muscle training (PFMT) – contraction of pelvic floor muscles, multiple times per day to improve strength of contraction and increase awareness of anorectal muscle function. (GoR C)</li><li>• Biofeedback therapy – behavioural treatment designed to enhance the strength of sphincter contraction and improve rectal sensation using specialised equipment. Biofeedback therapy can be combined with PFMT to improve strength. (GoR B)</li><li>• Transanal Irrigation to maximise bowel emptying and minimise faecal incontinence primarily in patients with incomplete elimination, passive faecal incontinence, or faecal incontinence with defaecation difficulty. (GoR C)</li></ul>	<ul style="list-style-type: none"><li>• A variety of anorectal investigations, including manometry, anal ultrasound, and possibly MRI, defaecography, and neurophysiological testing can help to define structural or functional abnormalities of anorectal function and guide management if initial and/or secondary interventions are ineffective</li></ul>
	5. TERTIARY REFERRAL, SURGICAL OR MULTI-DISCIPLINARY CONSULTATION
	<ul style="list-style-type: none"><li>• Faecal incontinence that fails to respond to initial and secondary management requires specialised consultation by a gastroenterologist, colorectal surgeon, urogynaecologist, and/or a multi-disciplinary team</li></ul>

# ASSESSMENT AND CONSERVATIVE MANAGEMENT OF FAECAL INCONTINENCE

**Identification**  
Active case finding or patient presents with faecal incontinence (C)

**Initial Clinical Assessment**

- History (C)
- Physical exam (C)
- Medication and diet review (C)
- Assessment of impact on quality of life (C)
- Proctosigmoid-oscscopy and/or colonoscopy as needed (C)

**Condition Specific Assessment and Management**  
For cancer, IBD, impaction, full thickness rectal prolapse, recto-vaginal fistula, cloacal deformity (C)

**Address Reversible Factors**  
Toilet access, medication side effects, loose stools, etc. (C)

**Initial Interventions**

- Discussion of options and patient's goals of management (B/C)
- Education of patient and/or caregiver (B/C)
- Diet and eating pattern modifications (B), and dietary fibre supplements (A)
- Medications (loperamide) (B)
- Bowel habit training (C)
- Transanal irrigation (C)
- Incontinence products such as pads for containment (B)
- Practical advice for coping (locating toilets, carrying cleansing kits, etc.) (C)

**Incontinence Specialist (C)**

**Secondary Interventions**

- PFMT +/- (B)
- Biofeedback (A)
- Incontinence products such as an anal plug or insert (B)

**Secondary Assessment**

- Manometry and/or Ultrasound (B/C)
- Possible additional test
- MRI (C)
- Defaecography (B/C)
- Neuro-physiology testing (C/D)

**Tertiary**  
Referral, surgical and/or multi-discipline consult (C)

\* Consider CONTINENCE PRODUCTS for temporary support during treatment



# VIII. FAECAL INCONTINENCE IN ADULT PATIENTS

## SURGERY FOR FAECAL INCONTINENCE

### 1. PATIENT ASSESSMENT

- The reader is referred to the relevant chapter sections in “Dynamic Testing” and “Conservative Treatment for Faecal Incontinence.” In general, patients referred for surgical management of faecal incontinence must either have failed conservative therapy or not be candidates for conservative therapy due to severe anatomic or neurological dysfunction.
- Prior to surgical management of faecal incontinence, the integrity of the anal sphincter complex should be assessed. This assessment is best performed with endoanal ultrasound, though pelvic MRI may also be useful. Ancillary tests include anal manometry, electromyography, and defaecography.
- If the patient has persisting faecal incontinence, he or she should undergo repeat assessment, including endoanal ultrasound.

### 2. SPECIALISED MANAGEMENT

- The surgical approach is influenced by the presence and magnitude of an anatomical anal sphincter defect. If no defect is present, or if the sphincter defect is minimal, options include SNS and biomaterial injection therapy.
- Acute anal sphincter repair is usually required following obstetric or direct trauma. End to end or overlapping repair may be performed. When possible the internal anal sphincter should be separately repaired. (GoR C)
- Patients with rectal prolapse, rectovaginal fistula or cloacal deformity often have associated faecal incontinence. Initial therapy should be directed at correction of the anatomical abnormality. (GoR C)
- For patients with moderate sphincter defects, sphincteroplasty, SNS or biomaterial injection therapy can each be considered. For patients with large sphincter defects (>120 degrees), sphincteroplasty is likely to be the best option, though a PNE trial for SNS can be considered. (GoR C)

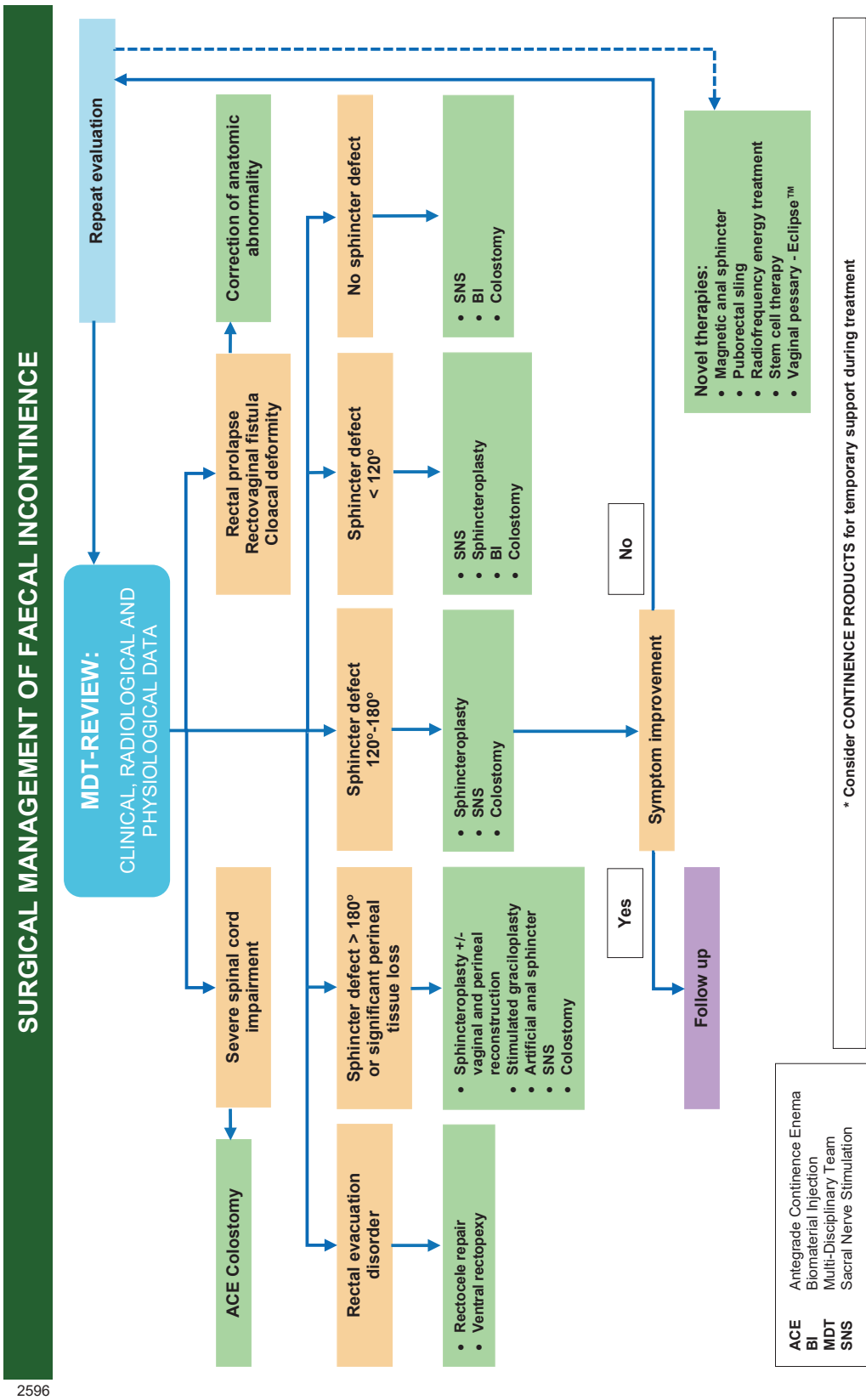
- Patients with sphincter defects of greater than 180° or major perineal tissue loss require individualised treatment. In some cases, initial reconstruction can be performed. Should incontinence persist, alternatives include stimulated muscle transposition (usually graciloplasty) artificial anal sphincter implantation, or SNS. (GoR C)

### 3. SALVAGE MANAGEMENT

- For patients who remain incontinent following sphincteroplasty, repeat endoanal ultrasound should be undertaken to reassess the status of the repair. If no defect is present, or if the sphincter defect is minimal, options include SNS and biomaterial injection therapy. If there is a large persisting sphincter defect, repeat sphincteroplasty can be considered. (GoR C)
- Patients who have failed SNS can be considered for biomaterial injection therapy or sphincteroplasty if a sphincter defect is present. Other alternatives include stimulated graciloplasty and implantation of an artificial anal sphincter. (GoR C)
- Patients who fail surgical therapy for faecal incontinence, or who do not wish to undergo extensive pelvic reconstruction, should consider placement of an end sigmoid colectomy. (GoR C) While this procedure does not restore continence, it does restore substantial bowel control and appears to improve social function and quality of life. Novel therapies can also be considered under protocol: PTNS, the magnetic anal sphincter, SECCATM, vaginal pessary (EclipseTM) and sling procedures. (GoR D)

### 4. SPECIAL SITUATIONS

- Individuals with congenital abnormalities may be amenable to surgical repair. Often this will involve both laparoscopic abdominal and perineal approaches. Poor functional outcomes may be treated by an Antegrade Continence Enema (ACE) procedure or colectomy. Patients with cauda equina type neurological disorders, either congenital or acquired, should be considered for an ACE procedure or colectomy. (GoR C)



2596

IX. FAECAL INCONTINENCE IN NEUROLOGICAL PATIENTS

A. INITIAL MANAGEMENT

- Patients with known neurological disease may present with symptoms related to neurological bowel dysfunction, such as; difficulty in defaecation, constipation and faecal incontinence which disturb their activities of daily living and impair quality of life. Many have permanent impairments and functional limitations and disabilities, which are due to neurological deficits and complications
- Functional assessment:
  - Hand and arm use, fine hand use, mobility – maintaining body position, transfer and walking ability.
  - Environmental factors assessment:
    - toilet accessibility; devices for bowel care and mobility; caregiver support and attitude;

1. INITIAL ASSESSMENT

- The history should include:
  - Neurological diagnosis and functional level
  - Previous and present lower gastrointestinal (LGIT) function and disorders
  - Severity of neurogenic bowel dysfunction
  - Current bowel care and management including diet, fluid intake, medications affecting bowel functions
  - Co-morbidity / complication e.g., urinary incontinence, autonomic dysreflexia, pressure ulcers, sexual dysfunction
  - Patient's satisfaction, needs, restrictions and quality of life
  - Environmental factors and barriers and facilitators to independent bowel management.
- Physical examination:
  - Cognitive function; motor, sensory and sacral reflexes – voluntary anal sphincter contraction, deep perineal sensation, anal tone, anal and bulbo-cavernosus reflexes
  - Spasticity of the lower limbs
  - Abdominal palpation for faecal loading and rectal examination

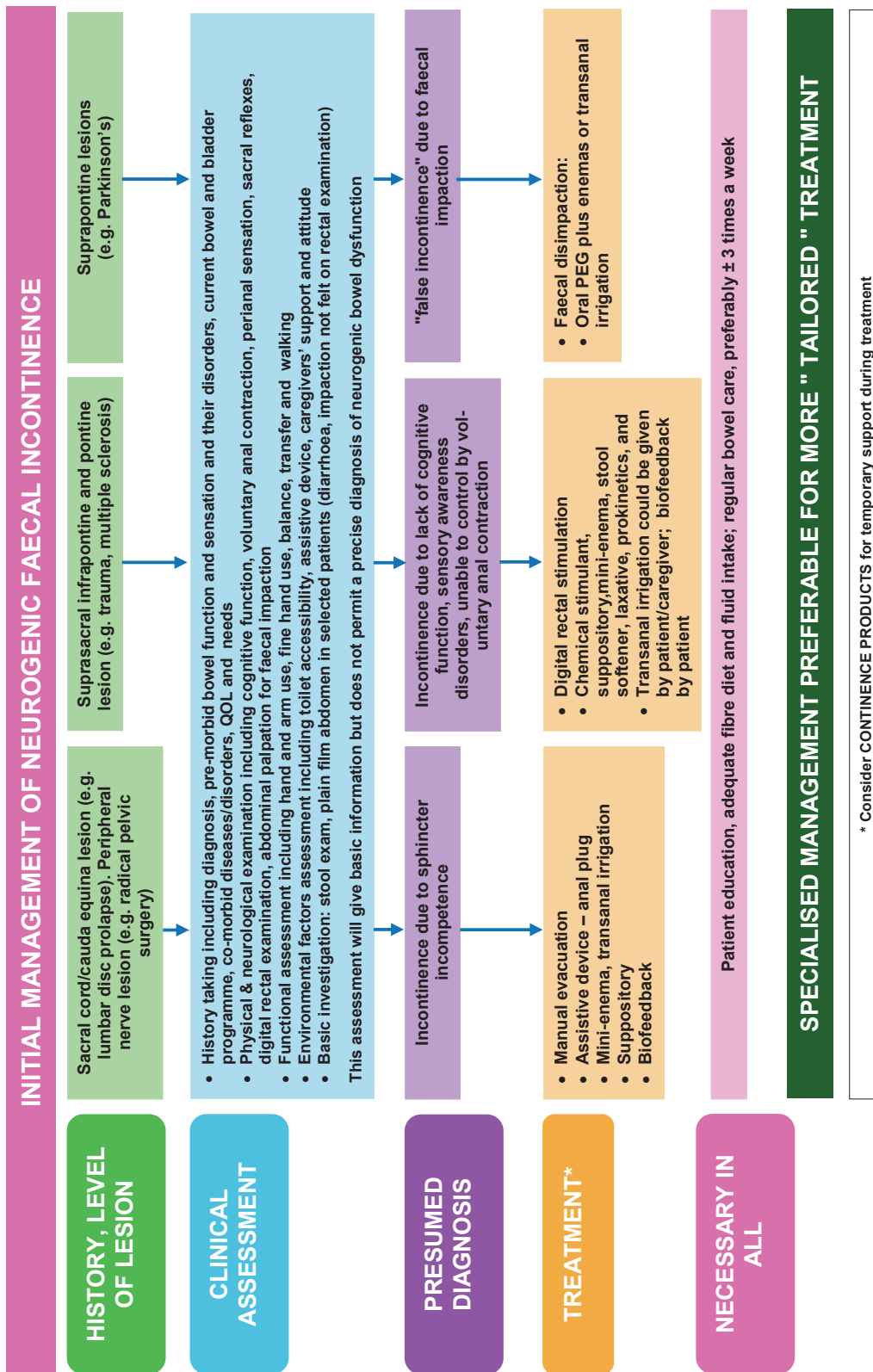
2. BASIC INVESTIGATIONS

Stool examination, plain abdominal X-Ray

3. INITIAL TREATMENTS

- Patient education and goals-setting to achieve complete defaecation on a regular basis and faecal continence based on right time, right place, right trigger and right consistency
- Adequate fibre diet and fluid intake; appropriate trigger according to preservation of sacral (anorectal) reflex – digital rectal stimulation (GoR C); suppository and enema (GoR B); if no anorectal reflex, manual evacuation (GoR B); abdominal massage (GoR C) can also be helpful
- Prescribe medications – stool softener, laxative, prokinetic agents, anti-diarrhoeal drugs as necessary
- Assistive techniques may be necessary for
  - Defaecation – transanal irrigation (GoR A)
  - For incontinence – anal plug (GoR C)

The algorithm does not apply to management in acute neurological patients that need regular bowel emptying.



IX. FAECAL INCONTINENCE IN NEUROLOGICAL PATIENTS

B. SPECIALISED MANAGEMENT

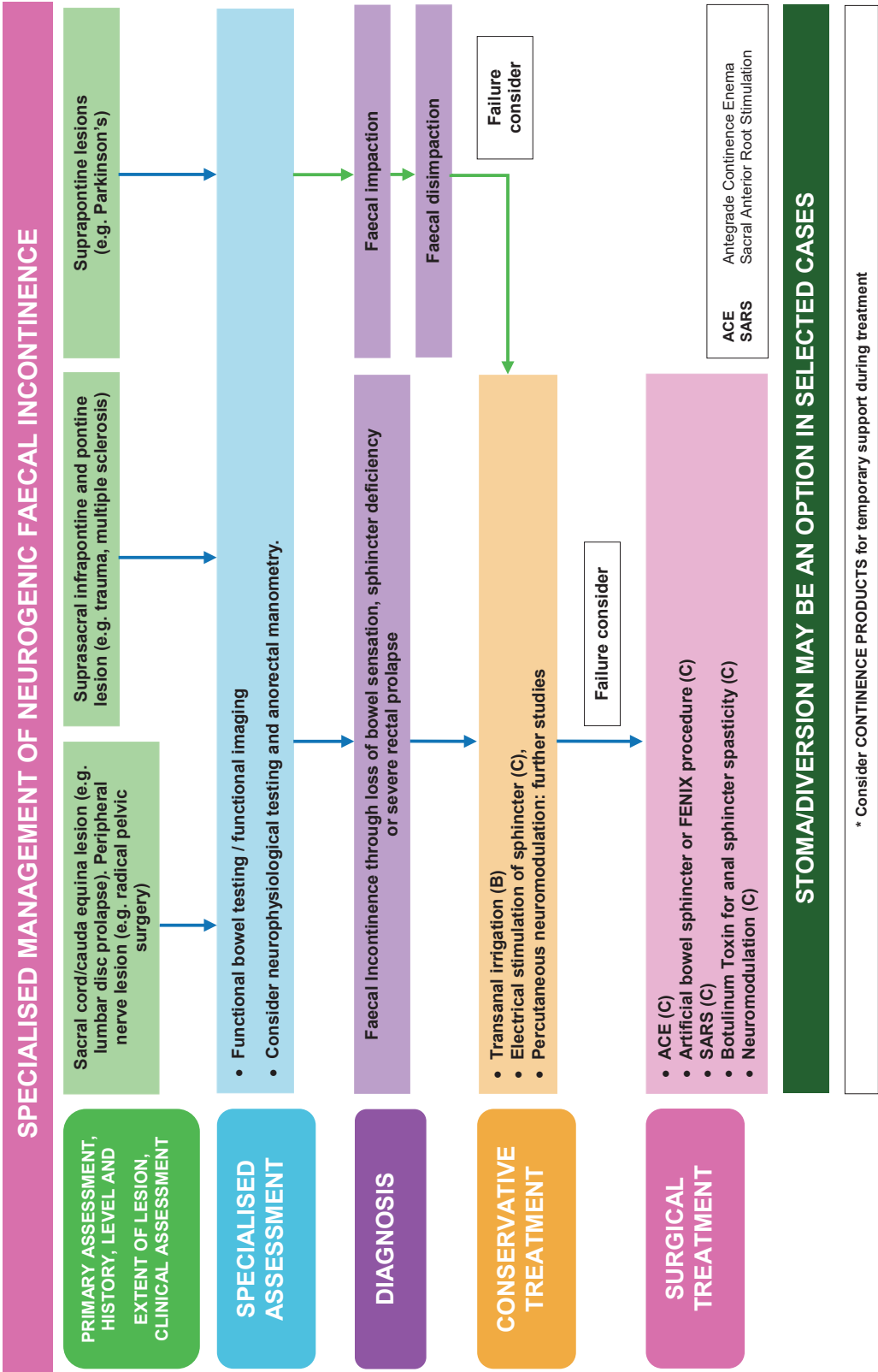
1. ASSESSMENT

- Some patients with neurogenic faecal incontinence will need specialised assessment, especially if initial management is unsuccessful to look for comorbidity and certainly before performing invasive treatment
- Do not assume that all symptoms are due to neuropathy, e.g. women with neurological pathology might have had childbirth injury to the sphincter
- Special investigations: manometry, endoanal ultrasound, (dynamic) MRI, (needle) EMG. These specific bowel functional tests and electro-diagnostic tests must be considered optional, as their value in neurological pathology is not sufficiently demonstrated so far.

2. TREATMENTS

- Conservative treatment for neurological faecal incontinence is also the mainstay for specialised management, (GoR C).
- Management of neurological incontinence does not include very extensive treatment modalities and many conservative interventions are still empirical.
- Transanal irrigation (GoR B).

- Electrical stimulation sphincter, (GoR C).
- Percutaneous neuromodulation and sacral nerve stimulation : further research is required (GoR D).
- Surgical management of neurogenic faecal incontinence has different options which need a very strict patient selection
  - Antegrade Continence Enema ACE (GoR C).
  - Artificial bowel sphincter or FENIX procedure (GoR C).
  - Sacral Anterior Root Stimulation SARS (GoR C).
  - Botulinum Toxin (GoR C).
  - Neuromodulation (GoR C).
- It is recommended that urinary and bowel function are assessed simultaneously if both systems are affected, as symptoms and treatment of one system can influence the other and vice versa (GoR A).
- As the therapeutic approach can differ in different neurological diseases, the most prevalent diseases are discussed separately in the chapter.



## X. URINARY AND FAECAL INCONTINENCE IN FRAIL OLDER MEN AND WOMEN

- There is no reason to suspect why interventions which have proven efficacy in the community dwelling elderly should not also be effective in frail older people. Clinicians should, however, take due regard of the practicality, potential benefits and dangers of employing any single intervention in this population.
- Frail older people do require a different approach addressing the potential role of co-morbid disease, current medications (prescribed, over the counter and/or naturopathic), and functional and cognitive impairment in urinary and faecal incontinence.
- The extent of the investigation and management should take into account the degree of bother to the older person and/or caregiver, the goals for care, the degree that the older person is able to undertake any intervention and the overall prognosis and life expectancy.
- Effective management to meet the goals of care should be possible for most frail older people.

### 1. HISTORY AND SYMPTOM ASSESSMENT

- Active case finding for urinary and faecal incontinence should be done in all frail older people (GoR A).
- History should include comorbid conditions and medications that could cause or worsen incontinence.
- Physical examination should include a rectal examination for faecal loading or impaction (GoR C), functional assessment (mobility, transfers, manual dexterity, dressing and undressing ability, ability to toilet) (GoR A), a screening test for depression (GoR B), and cognitive assessment (to assist in planning and management, (GoR C)).
- The mnemonic DIPPERS (see urinary and faecal incontinence algorithms) covers some of these comorbid conditions. Note that urogenital atrophy does not, in itself, cause urinary incontinence and should not be treated for this purpose (GoR B).
- The patient and / or caregiver should be asked about the degree of bother of urinary incontinence and/or faecal incontinence (GoR B); goals for urinary and

faecal incontinence care (dryness, decrease in specific symptoms, quality of life, reduction of comorbidity, lesser care burden) (GoR B); and likely cooperation with management (GoR C).

- Evaluation for bowel "alarm" symptoms (rectal bleeding, positive blood screening from stool studies, obstructive symptoms, recent onset of constipation, weight loss, and a change in stool calibre) will need more extensive evaluation (GoR A)
- Urinalysis is recommended for all patients, primarily to screen for haematuria (GoR C).
- Treatment of otherwise asymptomatic bacteriuria/pyuria is not beneficial (GoR C), and it may cause harm by increasing the risk of antibiotic resistance and severe adverse effects. e.g., *Clostridium difficile* colitis (GoR C).
- Stool studies may not be needed in all patients with faecal incontinence. Patients with diarrhoea, especially those with more acute onset diarrhoea, may need to be tested for infectious causes of their diarrhoea. Other stool studies could involve testing for malabsorption syndromes.
- The utility of the Clinical Stress test in this population is uncertain (GoR D).
- Wet checks can assess urinary incontinence frequency in long-term care residents (GoR C).
- A post voiding residual volume (PVR) test is impractical in many care settings and there is no consensus for the definition of what constitutes a "high" PVR in any population. A PVR measurement is not recommended in the routine initial assessment of frail older people with urinary incontinence.
- However, there is compelling clinical experiential evidence for PVR testing in selected frail older people with: diabetes mellitus (especially long standing); prior urinary retention or high PVR; recurrent UTIs; medications that impair bladder emptying (e.g., opiates); severe constipation; persistent or worsening urgency urinary incontinence despite antimuscarinic/beta-3-agonist treatment; or prior urodynamics showing detrusor underactivity and/or bladder outlet obstruction (GoR C). Treatment of contributing comorbidity may reduce PVR. Trial with catheter may be considered for PVR > 200-500 ml if the PVR is felt to contribute to UI or urinary frequency (GoR C).



- Nocturia Assessment of frail elders with bothersome nocturia should identify potential underlying causes including nocturnal polyuria (by bladder diary/frequency- volume chart or wet checks; oedema on examination) (GoR C), primary sleep problems (e.g., sleep apnoea); and low voided volumes (e.g., from high PVR).
- Stool impaction/loading. If suspected on digital rectal examination, an abdominal x-ray may be necessary to further evaluate the degree and location of impaction/loading in frail older adults.

## 2. CLINICAL DIAGNOSIS

The most common types of Urinary Incontinence in frail older people are urgency, stress, and mixed urinary incontinence. Frail older people with urgency urinary incontinence also may have detrusor underactivity during voiding with a high PVR but without outlet obstruction. There is no evidence that antimuscarinics are less effective or cause retention in this situation (GoR D).

The most common types of faecal incontinence in frail older people are related to urgency and passive leakage. Passive leakage can refer to leakage, seepage and staining following bowel movements that are not associated with faecal urgency and may also occur with faecal impaction. Because constipation and impaction often contribute to faecal incontinence in older adults, these are considered separately in the algorithm.

## 3. INITIAL MANAGEMENT

- Initial treatment should be individualised and influenced by goals of care, treatment preferences and estimated remaining life expectancy, as well as the most likely clinical diagnosis (GoR C). In some frail older persons the only possible outcome may be containment; management with continence products, especially for people with minimal mobility (require assistance of > 2 people to transfer), advanced dementia (unable to state their name), and/or nocturnal urinary and faecal incontinence.
- Conservative and behavioural therapy for UI includes lifestyle changes (GoR C), bladder training for more fit alert persons (GoR B), and prompted voiding for frailer, more impaired older people (GoR A).
- For the select cognitively intact older person with UI or FI, pelvic floor muscle therapy can be considered, but there are few studies (GoR C). Antimuscarinics

may be added to conservative therapy of urgency UI (GoR A-C, depending on agent).

- For the select cognitively intact older with FI, biofeedback may be considered, but few studies exist among frail older adults.
- Alpha-blockers may be cautiously considered in frail men with suspected prostatic obstruction (GoR C). All drugs should be started at the lowest dose and titrated with regular review until either care goals are met or adverse effects are intolerable.
- DDAVP (vasopressin) has a high risk of severe hyponatraemia in frail older persons and should not be used outside specialist centres or without very careful monitoring and long term followup (GoR A).
- Improving stool consistency can be done with dietary fibre and supplemental fibre in older adults (GoR C). In older adults with diarrhoea, loperamide may be considered at low doses to improve stool consistency. However, close monitoring for constipation and impaction is needed.

## 4. ONGOING MANAGEMENT AND REASSESSMENT

Optimal urinary and faecal incontinence management is usually possible with the above approaches. If initial management fails to achieve the desired goals, the next steps are reassessment and treatment of contributing comorbidity and/or functional impairment.

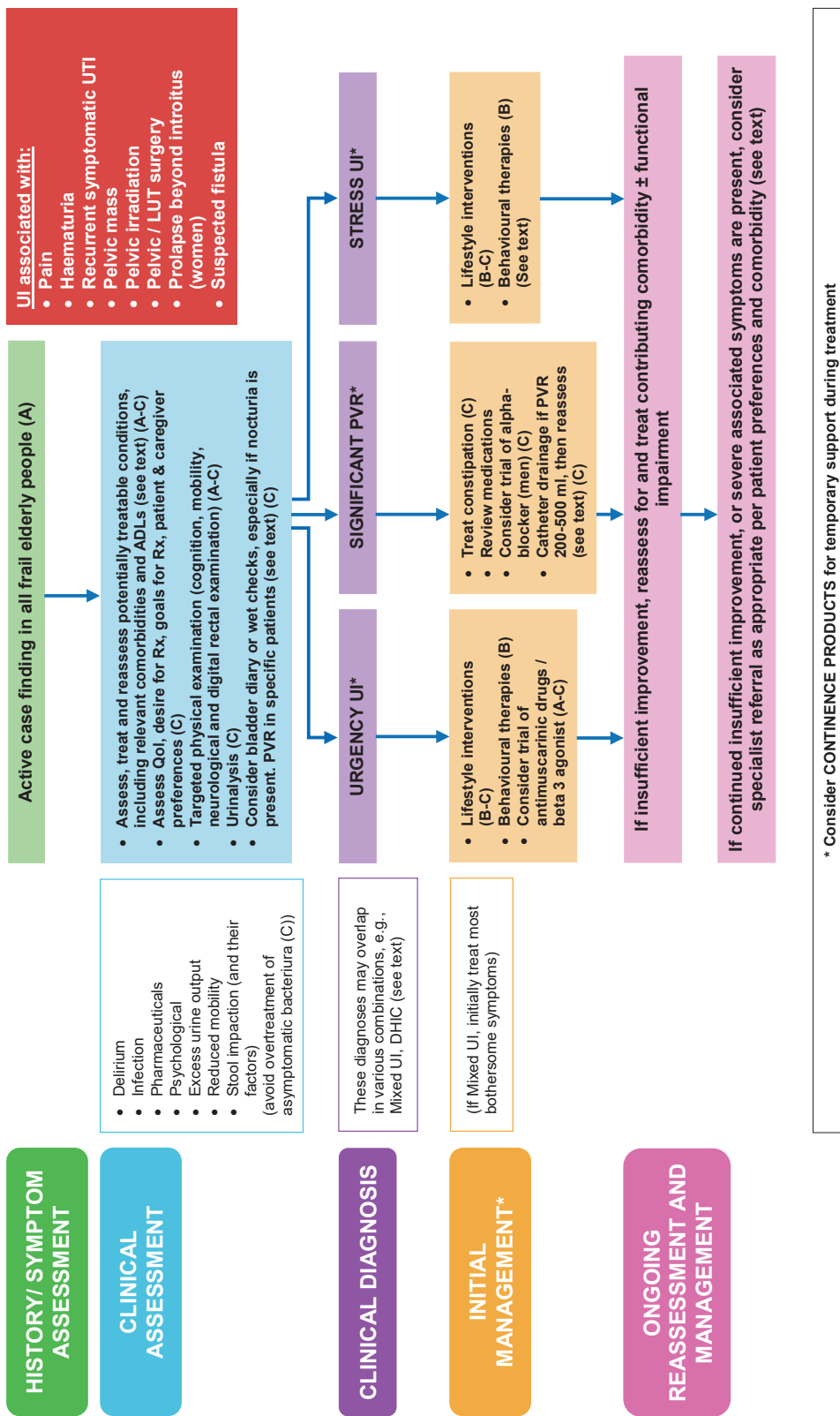
## 5. SPECIALISED MANAGEMENT

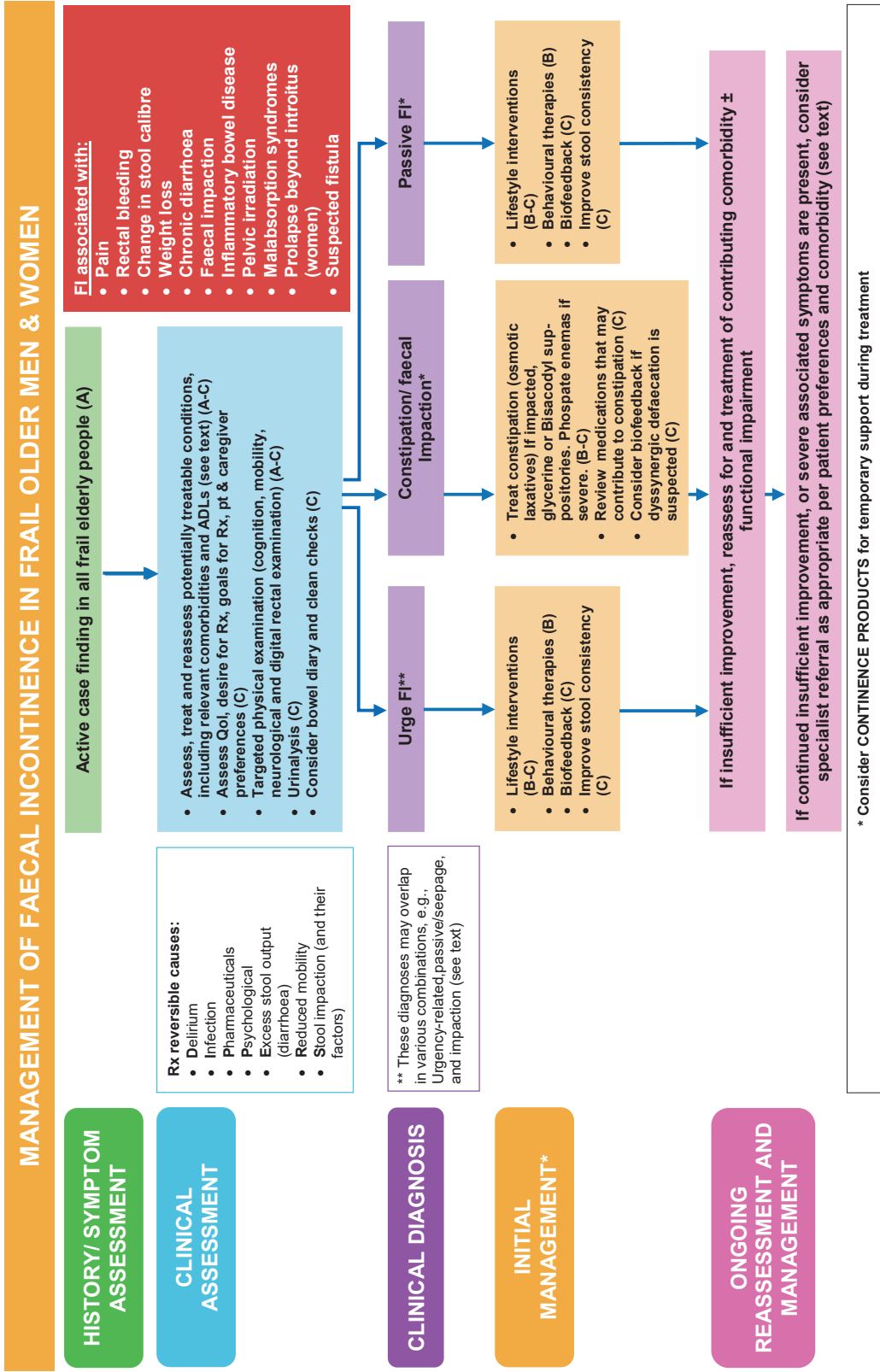
If frail older people have either other significant factors (e.g., pain, haematuria, bowel "alarm" symptoms), UI or FI symptoms that cannot be classified as urgency, stress, or mixed or overflow or other complicated comorbidity which the primary clinician cannot address (e.g. dementia, functional impairment), then specialist referral should be considered. Referral may also be appropriate when there is been insufficient response to initial management. The type of specialist will depend on local resources and the reason for referral: surgical specialists (urologists, gynecologists, colorectal surgeons), gastroenterologists, geriatricians or physical therapist (functional and cognitive impairment); or continence nurse specialists (homebound patients). Referral decisions should consider goals of care, patient/caregiver desire for invasive therapy and estimated remaining life expectancy.

- Age *per se* is not a contraindication to UI or FI surgery (GoR C), but before surgery is considered, all patients should have:
  - Evaluation and treatment for any comorbidity, medications, and cognitive or functional impairments contributing to UI that could compromise surgical outcome (e.g., dementia that precludes patient ability to use artificial sphincter) (GoR C).
  - Adequate trial of conservative therapy, including pharmacological therapies where relevant (GoR C).
- Discussion (including the caregiver) to ensure that the anticipated surgical outcome is consistent with goals of care in the context of the patient's remaining life expectancy (GoR C).
- Urodynamic testing or anorectal manometry, because clinical diagnosis may be inaccurate (GoR B).
- Preoperative assessment and perioperative care to establish risk of, and to minimise the risk of common geriatric post-operative complications such as delirium and infection (GoR A), dehydration and falls (GoR C).

# MANAGEMENT OF URINARY INCONTINENCE IN FRAIL OLDER MEN & WOMEN

2604





## 4. RECOMMENDATIONS FOR FURTHER RESEARCH IN EPIDEMIOLOGY

1. Longitudinal study designs are needed to: (i) estimate the incidence and remission rates of urinary incontinence (UI) anal incontinence (AI) and pelvic organ prolapse (POP) and to (ii) describe the natural course of these conditions and (iii) to investigate risk factors and possible protective factors. In addition, similar studies regarding other lower urinary tract symptoms (LUTS) should be initiated.
2. Although there is now more information regarding prevalence, incidence, and other epidemiological data in developing countries, further information is still needed. It is recommended that fundamental research regarding prevalence, incidence and other epidemiological data in developing countries should be encouraged, and tailored to the cultural, economic and social environment of the population under study.
3. Some potential risk and protective factors deserve more attention. For example, the role of pregnancy and childbirth in the development of UI, AI and POP must be studied in a fashion that links population-based methods to clinical assessment of pregnancy, delivery and birth trauma and follows women over many years. Such a design is necessary because the effect of pregnancy and childbirth may become clear only years later when the woman is older and because the woman will not then be able to report the exact nature of the tear, episiotomy, etc.
4. There should be more emphasis on the associations between UI, AI and POP and specific diseases like stroke, diabetes, and psychiatric diseases.
5. The variation of disease occurrence in groups of different racial origin yet similar environmental exposures, lend support to the presumed genetic influence on the causation of UI, AI and POP. This again provides circumstantial evidence for a genetic contribution to pelvic floor muscle disorders since most of these studies have been unable to control for heritability in relation to the complex interaction of environmental factors.

The aetiology of UI, AI and POP is widely recognised to be multifactorial, yet the complex interaction between genetic predisposition and environmental influences is poorly understood. Genetic components require further investigation. Twin studies provide a possible means of studying the relative importance of genetic predisposition and environmental factors. By comparing monozygotic female twins with identical genotype, and dizygotic female twins who, on average, share 50 percent of their segregating genes, the relative proportions of phenotypic variance resulting from genetic and environmental factors can be estimated. A genetic influence is suggested if monzygotic twins are more concordant for the disease than dizygotic twins whereas evidence for environmental effects comes from monozygotic twins who are discordant for the disease.

## 5. RECOMMENDATIONS FOR FURTHER BASIC SCIENCE RESEARCH

The following proposals for research come from the Committees' work in reviewing the current literature on Basic Science:

1. Integrate data from reductionist experiments to inform the formulation of better systems-based approaches in the investigation of the pathology of the lower urinary tract (LUT), the genital tract (GT) and the lower gastro-intestinal tract (LGIT).
2. Encourage greater emphasis on basic research to characterise tissues receiving relatively little attention: ie the lower gastrointestinal tract; the bladder neck and urethra; the ureter, pelvic floor musculature.
3. Generate research programmes for fetal and neonatal research in LUT and LGIT function.
4. Use genome-wide bioinformatic and population health surveys to generate testable hypotheses regarding the physiological and pathophysiological functions of the LUT, GT and LGIT.
5. Generate improved experimental approaches to investigate the pathophysiology of the LUT and LGIT by:
  - The development of animal models that accurately describe human pathological conditions, including the greater use of large-animal models
  - The better use of reverse translational approaches for linking animal models to the human disease.
  - The use of human tissue from well-characterised patient groups.
  - The development of emerging areas such as: tissue engineering; proteomics and metabolomics
  - Increased collaborations between biological, physical and mathematical sciences.
6. Develop centres of excellence or consortia of excellence in LUT, GT and GIT research
  - Integrate expertise from university departments, academic medical units and industry
  - Encourage translational approaches to research.
  - Develop inter-institutional research-training programmes to allow new researchers the opportunity to better interact and exchange ideas.
7. Bring about a greater emphasis on the importance of research to medical trainees and science graduates through:
  - Establishing research training as a core component of postgraduate clinical development
  - Increased access to support funds, especially scholarships and personal awards
  - Organisation of focused multidisciplinary research meetings, either stand-alone or as dedicated sessions during national and international conferences
  - Greater interaction between medical centres and Higher Education Institutions (HEIs).
  - Allowing researchers-in-training better access to international meetings through reduced registration charges and improved travel grants.
  - Inclusion in clinical meetings of point-counterpoint session(s) with both basic science and clinical viewpoints.
  - Development of research forums for exchange of ideas between active researchers and industry.
  - Lobbying research-funding organisations about the medical and social importance of LUT and LGIT disorders.
8. Increase emphasis on research into LUT and LGIT in HEIs through:
  - Greater representation on grant-funding agencies
  - Encouragement of submission to high impact factor journals and recognition of research published in specialty journals
  - More integrated teaching and training opportunities

## 6. RECOMMENDATIONS FOR PRIMARY PREVENTION, CONTINENCE PROMOTION, MODELS OF CARE AND EDUCATION

Primary prevention, continence promotion and advocacy, models of care and education involves informing and educating the public and health care professionals that UI and FI are not inevitable, but are treatable or at least manageable. Other bladder disorders such as BPS/IC and POP can also be treated successfully. The committee found information about recent practice and research initiatives in all of these areas but evidence-based research only on primary prevention of UI. Continence promotion and advocacy, and professional and non-professional education, require prioritisation by public health professionals, educationalists, clinicians and researchers to reduce the burden that UI, FI, BPS/IC and POP places on society, healthcare systems, caregivers, and above all, affected adults. As to models of care, the evidence supports nurse-led community services as leading to higher health-related QoL and in some instances, higher cure rates. The multidisciplinary referral settings are also reporting favourable outcomes.

### 1. PRIMARY PREVENTION

- Pelvic floor muscle exercises can prevent UI in pregnant and postpartum women. (Level of Evidence: 1)
- Education designed for community-dwelling older women can prevent UI. (Level of Evidence: 1)
- No recent RCTs or case-control studies were located for prevention of FI. (Level of Evidence: 4)
- Pelvic floor muscle exercises should be provided for pregnant women. (GoR A)
- Education of older women to prevent UI should be provided. (GoR A)
- Continence promotion is required to address broad gaps in knowledge about incontinence (GoR C)
- Strategies to promote awareness about incontinence and its treatment can be strengthened by the use of evidence based theories and methods from the field of health promotion, including the social determinants of health (GoR D)
- The Internet represents an important source of information about incontinence, however the quality of information is variable (GoR C)
- For help-seeking behaviour, no RCTs or case-control studies were located (Level of Evidence 4)
- Continence promotion programmes need to accommodate varying levels of health literacy and access to health information in different populations (Level of Evidence: 4)
- Public health campaigns about incontinence and other pelvic floor disorders need to use terminology targeted to consumers' understandings (Level of Evidence: 4)
- Satisfaction surveys about continence care could yield relevant and detailed information by using open-ended, rather than closed-ended questions (Level of Evidence: 1)
- Evidence for the use of leaflets or brochures in raising awareness about UI and different treatment options is inconclusive (Level of Evidence: 1).
- Evidence for the impact of continence advocacy worldwide was based on opinion (Level of Evidence: 1)
- Recommendation for help-seeking behaviour: No recommendation was possible based on the level of evidence provided by the available research.
- Worldwide Advocacy (GoR D)



2. MODELS OF CARE

- Effectiveness of service delivery models. (Level of Evidence: 4)
- A care delivery model should be based on the principles as described in the Optimum Continence Service Specification. (GoR C)
- Increased emphasis is needed on non-physician models of care. (GoR C)
- Despite the proliferation of guidelines, there is increasing evidence that practicing clinicians and nurses are not consistently following them. Implementation models should be developed on how to translate guidelines into practice. (GoR C)

3. EDUCATION

- Professional education of UI, FI, BPS/IC, and POP is not evident as determined by materials reviewed. (Levels of Evidence: 3-4)

- Effectiveness of guidelines in clinical practice has not been determined. (Levels of evidence: 3 to 4).
- There is a continued need for evaluation research to explore impact of guidelines on clinical care both at individual and population levels. This evaluation strategy needs to include impact on a wide range of outcomes, including incidence and prevalence of disease, treatment outcomes, prevention efforts, costs, and health care policy. (GoR: C)
- Effectiveness of public education efforts through various channels including education, public media and mass communications (Levels of Evidence 3-4)
- There is a need for additional focused research on methods to enhance patient and public about pelvic disorders, both at an individual and broader public level. (GoR C)
- The role of technology in public education for continence promotion should be examined in more depth. (GoR C)

# 7. RECOMMENDATIONS FOR TRANSLATIONAL AND CLINICAL RESEARCH

## A. RECOMMENDATIONS ON STUDY CONDUCT AND STATISTICAL METHODS

The role of quality RCTs as providing the strongest level of evidence in incontinence research should be fully acknowledged by researchers, journal reviewers, and editors. (GoR A)

Careful attention to the planning and design of all research, especially RCTs, is of the utmost importance. (GoR A)

Appropriate expertise in biostatistics and clinical trial design should be employed at the design phase of a RCT and thereafter on an ongoing basis. For Phase 4, phase 5, and implementation trials, health economists should be included in trial design to support questions of value (cost-effectiveness). (GoR A)

The design, conduct, analysis and presentation of RCTs must be fully in accordance with the CONSORT Statement. (GoR A)

The design, conduct, analysis and presentation of observational studies should follow STROBE guidelines. (GoR A)

The design, conduct, analysis and presentation of meta-analyses should follow QUORUM guidelines. (GoR A)

Reporting studies of diagnostic tests, including urodynamics, should follow the STARD statement guidelines. (GoR A)

## B. RECOMMENDATIONS ON RESEARCH CONDUCT

### 1. RECOMMENDATIONS FOR CONSERVATIVE TREATMENT TRIALS

Use correct terminology to describe the intervention. (GoR A)

Report details of ability to perform correct contraction, dose-response issues and adherence. (GoR A)

Use recommended outcome measures with high responsiveness, reliability and validity. (GoR A)

Compare new methods with the best available intervention. (GoR A)

Use power calculation in planning of the study. Avoid large sample sizes and weak (ineffective dosages) interventions. (GoR A)

For long-term follow-up studies report cross-over, co-interventions, recurrent and competing events, adherence in the follow-up period and loss to follow-up. (GoR A)

### 2. RECOMMENDATIONS FOR SURGICAL AND DEVICE TRIALS

- The safety and serious side effects of new operations must be completely defined with adequate follow-up so that risks can be weighed against efficacy. At a minimum, this requires more use of large scale, independent, prospective, multicentre cohort studies when RCTs are not practical. (GoR A)
- Safety and serious side effects of incontinence devices must be completely defined with adequate follow-up, especially for use of implantable devices and biological materials, so that risks can be weighed against efficacy. (GoR A)
- Valid informed research consent is required in all trials of surgical interventions, which is separate from the consent for surgery. (GoR A)
- We recommend ongoing research into the usefulness of pre- and post-operative predictive testing (such as urodynamics, ultrasound, MRI, etc) in surgical trials. (GoR A)
- Reports of successful treatment should be limited to subjects with a minimum (not mean) of one-year follow-up and should include a patient perspective measure. Specific assumptions about subjects lost to follow-up should be stated. (GoR A)

- Randomisation for surgical trials should occur at the time of surgery to minimise drop-outs and switch of procedure (GoR A)
- Long-term follow-up of RCT cohorts in an observational cohort is recommended (GoR A)

### 3. RECOMMENDATIONS ON COST ANALYSIS IN INCONTINENCE

- Cost analysis should be incorporated into clinical studies whenever possible (137). (GoR A)
- Cost analysis should describe the perspective of the analysis and analyses using the societal perspective and the payer perspective are useful. (GoR A)

## C. RECOMMENDATIONS FOR SPECIFIC PATIENT GROUPS

### 1. MEN AND WOMEN WITH LUTS

#### 1.1. Men with LUTS

- Measurement of prostate size should be performed before and after treatment (at the same time as continence outcome measures where possible) whenever prostate size is considered to be a variable, or to change during the intervention and follow up. (GoR A)
- Maximum free flow rate and measurement of post-void residual urine should be recorded pre-treatment and the effect of therapy on these parameters should be documented simultaneously with assessment of the primary outcome variables. (GoR A)
- Participants should be stratified by prostate size at randomisation when size is considered to be a potentially important determinant of treatment outcome. (GoR C)

#### 1.2. Women with LUTS

- Specific information about menopausal status, hysterectomy, parity/obstetric history, and hormonal status should be included in baseline clinical trial data and controlled for in specified analyses in the research protocol. (GoR A)
- High quality, symptom and bother scores (e.g., ICIQ-FLUTS, ICIQ-SF, ICIQ-QoL(KHQ), PISQ, ICIQ-FLUTSsex) validated in women should be employed when assessing outcomes. (GoR A)
- Standardised assessment of pelvic organ prolapse should be performed before treatment and at the time of other outcome assessments in all

research where prolapse and continence outcomes are being assessed. (GoR A)

- Criteria for cure/improvement/failure from incontinence treatment should be defined in the protocol based on patient perception as well as objective and semi-objective instruments such as validated questionnaires, diaries and pad tests. (GoR A)
- Assessment of the impact of treatment on sexual function should be performed with other outcome assessment when appropriate. (GoR B)

### 2. CHILDREN

- Long-term follow-up is of critical importance in the paediatric population in order to ascertain the effect of a treatment on normal growth and development. (GoR A)
- Research is needed to develop standardised outcome measures including validated, age-specific symptom and disease-specific quality of life outcome measures. (GoR B)

### 3. NEUROGENIC POPULATIONS

- Detailed urodynamic studies are recommended for classification of neurogenic lower urinary tract disorders in research studies because the nature of the lower tract dysfunction cannot be accurately predicted from clinical data. Videourodynamic studies are preferred but are not mandatory. (GoR C)
- An area of high priority for research is the development of a classification system to define neurogenic disorders. Relevant features could include the underlying diagnosis, the symptoms, a precise documentation of the neuromuscular lesion by clinical neurophysiologic testing, and the nature of the urodynamic abnormality. (GoR C)

### 4. POPULATIONS AFFECTED BY BLADDER PAIN SYNDROME (INCLUDING INTERSTITIAL CYSTITIS)

- Broader entry criteria should be used to reflect the full spectrum of the BPS/IC patient population. (GoR B)
- The primary endpoint of BPS/IC trials should be patient driven and the Global Response Assessment is recommended. A wide spectrum of secondary endpoints will be useful in defining the effect of treatments. (GoR B)

## 5. POPULATIONS AFFECTED BY PELVIC ORGAN PROLAPSE

- A validated standardised assessment of prolapse (eg POP-Q) should be used for baseline and outcome assessments. (GoR A)
- Complete reporting of outcomes including a validated assessment of anatomy, functional status, and complications is essential. (GoR A)
- Complications/adverse events (especially for mesh) must be explicitly and completely reported in any research. (GoR A)
- Long term outcomes (> 2 years) of intervention studies are needed. (GoR A)

## D. RECOMMENDATIONS FOR ETHICS IN RESEARCH

The GoR for this section is A.

Continuity in clinical direction from design through authorship is mandatory. Investigators should be involved in the planning stage and a publications committee should be named at the beginning of the clinical trial. The Uniform Requirements for Manuscripts

Submitted to Biomedical Journals, from the International Committee of Medical Journal Editors should be followed. Authorship requires:

- Substantial contributions to conception and design or acquisition of data or analysis and interpretation of data,
  - Drafting the article or revising it critically for important intellectual content,
  - Final approval of the version to be published
- Authors should provide a description of what each contributed and editors should publish that information.
- Authors should have access to all raw data from clinical trials, not simply selected tables

Clinical trial results should be published regardless of outcome. The sponsor should have the right to review manuscripts for a limited period of time prior to publication but the manuscript is the intellectual property of its authors, not the sponsor.

- All authors should be able to accept responsibility for the published work and all potential conflicts of interest should be fully disclosed

# 8. INTERNATIONAL CONSULTATION ON INCONTINENCE MODULAR QUESTIONNAIRE (ICIQ): QUESTIONNAIRES AND BLADDER DIARY

## A. INTERNATIONAL CONSULTATION ON INCONTINENCE MODULAR QUESTIONNAIRE (ICIQ)

The scientific committee which met at the end of the 1st ICI in 1998 supported the idea that a universally applicable questionnaire should be developed, that could be widely applied both in clinical practice and research and should reflect the patients' perspective of their situation.

The hope was expressed that such a questionnaire would be used in different settings and studies and would allow cross-comparisons, for example, between a drug and an operation used for the same condition, in the same way that the IPSS (International Prostate Symptoms Score) has been used.

An ICIQ Advisory Board was formed to steer the development of the ICIQ and met for the first time in 1999. The project's early progress was discussed with the Board and a decision made to extend the concept further and to develop the ICIQ Modular Questionnaire to include assessment of urinary, bowel and vaginal symptoms(1). The first module to be developed was the ICIQ Short Form Questionnaire for urinary incontinence: the ICIQ-UI Short Form (2) (Fig 1). The ICIQ-UI Short Form is now widely used globally and since 2004 its use or further development has been reported in almost 100 publications.

Given the intention to produce an internationally applicable questionnaire, requests were made for translations of the ICIQ-UI Short Form at an early stage, for which the Advisory Board developed a protocol for the production of translations of its modules. The ICIQ modules have been translated into over 40 languages to date across the various modules.

Since the fifth consultation a further two modules have been published and are available for use: the ICIQ Bladder Diary (3,4) and ICIQ-LTCqol(5). The bladder diary is the first fully validated bladder diary, which notably incorporated patient and clinician input during its development. The ICIQ-LTCqol questionnaire provides an assessment of symptoms, impact and bother associated with indwelling catheter use. This brings the total number of available modules to sixteen.

With increasing demand for electronic versions of questionnaires, a study has been conducted by the ICIQ group to evaluate the equivalence of the ICIQ's psychometric properties in alternative formats (6). With equivalence demonstrated, app development for the eICIQ is underway.

www.ICIQ.net provides details of the validation status of the modules under development for urinary symptoms, bowel symptoms and vaginal symptoms and provides information regarding the content of existing modules. Information regarding production of translations and the ICIQ development protocol is also available for those interested in potential collaborations to continue development of the project.

<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Initial number	ICIQ-UI Short Form <b>CONFIDENTIAL</b>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> DAY MONTH YEAR <b>Today's date</b>
---	---	--

Many people leak urine some of the time. We are trying to find out how many people leak urine, and how much this bothers them. We would be grateful if you could answer the following questions, thinking about how you have been, on average, over the PAST FOUR WEEKS.

**1 Please write in your date of birth:**        
 DAY MONTH YEAR

**2 Are you (tick one):** Female ☐ Male ☐

**3 How often do you leak urine? (Tick one box)**

never	<input type="checkbox"/>	0
about once a week or less often	<input type="checkbox"/>	1
two or three times a week	<input type="checkbox"/>	2
about once a day	<input type="checkbox"/>	3
several times a day	<input type="checkbox"/>	4
all the time	<input type="checkbox"/>	5

**4 We would like to know how much urine you think leaks.**  
**How much urine do you usually leak (whether you wear protection or not)?**  
*(Tick one box)*

none	<input type="checkbox"/>	0
a small amount	<input type="checkbox"/>	2
a moderate amount	<input type="checkbox"/>	4
a large amount	<input type="checkbox"/>	6

**5 Overall, how much does leaking urine interfere with your everyday life?**  
*Please ring a number between 0 (not at all) and 10 (a great deal)*

0	1	2	3	4	5	6	7	8	9	10
not at all										a great deal

ICIQ score: sum scores 3+4+5

**6 When does urine leak? (Please tick all that apply to you)**

never – urine does not leak	<input type="checkbox"/>
leaks before you can get to the toilet	<input type="checkbox"/>
leaks when you cough or sneeze	<input type="checkbox"/>
leaks when you are asleep	<input type="checkbox"/>
leaks when you are physically active/exercising	<input type="checkbox"/>
leaks when you have finished urinating and are dressed	<input type="checkbox"/>
leaks for no obvious reason	<input type="checkbox"/>
leaks all the time	<input type="checkbox"/>

**Thank you very much for answering these questions.**

Copyright © "ICIQ Group"

**Figure 1: ICIQ-UI Short Form**

**Table 1: Fully validated ICIQ modules and derivation**

MODULES AVAILABLE FOR USE	
<b>ICIQ-MLUTS(7)</b> (ICS <sub>male</sub> Short Form)	Urinary symptoms (male)
<b>ICIQ-FLUTS(8)</b> (BFLUTS Short Form)	Urinary symptoms (female)
<b>ICIQ-VS(9)</b>	Vaginal symptoms and quality of life
<b>ICIQ-B(10,11)</b>	Bowel symptoms and quality of life
<b>ICIQ-UI Short Form(2)</b>	Urinary incontinence short form
<b>ICIQ Bladder diary(3,4)</b>	Bladder events and fluid intake
<b>ICIQ-N(12,13)</b> (ICS <sub>male</sub> /BFLUTS)	Nocturia symptoms
<b>ICIQ-OAB(12,13)</b> (ICS <sub>male</sub> /BFLUTS)	Overactive bladder symptoms
<b>ICIQ-MLUTS Long Form(12)</b> (ICS <sub>male</sub> )	Urinary symptoms long form (male)
<b>ICIQ-FLUTS Long Form(13)</b> (BFLUTS)	Urinary symptoms long form (female)
<b>ICIQ-LUTSqol(14)</b> (KHQ)	Urinary symptoms quality of life
<b>ICIQ-Nqol(15)</b> (N-QoL)	Nocturia quality of life
<b>ICIQ-OABqol(16)</b> (OABq)	Overactive bladder quality of life
<b>ICIQ-LTCqol(5)</b>	Long term catheter symptoms and quality of life
<b>ICIQ-MLUTSsex(12)</b> (ICS <sub>male</sub> )	Sexual matters related to urinary symptoms (male)
<b>ICIQ-FLUTSsex(13)</b> (BFLUTS)	Sexual matters related to urinary symptoms (female)

## B. ANNEX 1 BLADDER CHARTS AND DIARIES

The ICS defines three types of Bladder Charts and Diaries which can be used to collect data:

### MICTURITION TIME CHART

- times of voiding and
- incontinence episodes

### FREQUENCY VOLUME CHART

- times of voiding with voided volumes measured,
- incontinence episodes and number of changes of incontinence pads or clothing

### BLADDER DIARIES

- the information above, but also
- assessments of urgency,
- degree of leakage (slight, moderate or large) and descriptions of factors leading to symptoms such as stress leakage, eg. running to catch a bus. It is important to assess the individual's fluid intake, remembering that fluid intake includes fluids drunk plus the water content of foods eaten. It is often necessary to explain to a patient with LUTS that it may be important to change the timing of a meal and the type of food eaten, particularly in the evenings, in order to avoid troublesome nocturia.

The recent development and publication of the ICIQ Bladder Diary provides the first fully validated bladder diary that incorporated patient, clinician and statistical



input during its development (3,4). This rigorous development methodology has ensured the provision of a psychometrically robust tool that reflects the key issues from a patient's and clinical perspective to enable the gathering of required information to treat patients with LUTS (Fig 1). The diary is intended to be a standalone tool that provides instructions and an example to guide completion. The diary is intended for completion over three days and fits onto two sides of A4 to optimise administration and completion. Data collected are:

- Fluid intake
- Urine output
- Leakage episodes
- Time of sleep and waking
- Pads used
- Optional bladder sensation scale

The bladder sensation scale is intended to be an interchangeable variable that can be replaced with a more pertinent measure for an intended use, for example, a pain scale. It is advised that any scale used in this manner should be validated.

#### INSTRUCTIONS FOR USING THE BLADDER DIARY

This diary helps you and us to understand why you get trouble with your bladder. The diary is a very important part of the tests we do, so that we can try to improve your symptoms. On the chart you need to record:

9. When you get out of bed in the morning, show this on the diary by writing 'GOT OUT OF BED'.
10. During the day please enter at the correct time the drinks you have during the day, eg. 8.00am – two cups of coffee (total 400 ml).

11. The time you pass your urine, eg. 7.30am. Do this every time you pass urine throughout the day and night.
12. Each time you pass urine, collect the urine in a measuring jug and record the amount (in mls or fluid ozs) next to the time you passed the urine, eg. 1.30pm/320ml.
13. Each time you pass your urine, please write down how urgent was the need to pass urine:  
 'O' means it was not urgent.  
 + means I had to go within 10 minutes.  
 ++ means I had to stop what I was doing and go to the toilet.
14. If you leak urine, show this by writing an 'W' on the diary at the time you leaked.
15. If you have a leak, please add 'P' if you have to change a pad and 'C' if you have to change your underclothes or even outer clothes. So if you leak and need to change a pad, please write 'WP' at the time you leaked.
16. If you have a leakage please write in the column called 'Comments' whether you leaked a small amount or a large amount and what you were doing when you leaked, eg. 'leaked small amount when I sneezed three times'.
17. Each time you change a pad or change clothes, please write in the 'Comments' column.
18. When you go to bed at the end of the day show it on the diary - write 'Went to Bed'.

**ICIQ-BLADDER DIARY** (12/13)**YOUR NAME:** \_\_\_\_\_

Please complete this **3 day** bladder diary. Enter the following in each column against the time. You can change the specified times if you need to. In the time column, please write **BED** when you went to bed and **WOKE** when you woke up.

**Drinks** Write the amount you had to drink and the type of drink.

**Urine output** Enter the amount of urine you passed in millilitres (mls) in the urine output column, day and night. Any measuring jug will do. If you passed urine but couldn't measure it, put a tick in this column. If you leaked urine at any time write **LEAK** here.

**Bladder sensation** Write a description of how your bladder felt when you went to the toilet using these codes

**0** - If you had no sensation of needing to pass urine, but passed urine for "social reasons", for example, just before going out, or unsure where the next toilet is.

**1** - If you had a normal desire to pass urine and no urgency. "Urgency" is different from normal bladder feelings and is the sudden compelling desire to pass urine which is difficult to defer, or a sudden feeling that you need to pass urine and if you don't you will have an accident.

**2** - If you had urgency but it had passed away before you went to the toilet.

**3** - If you had urgency but managed to get to the toilet, still with urgency, but did not leak urine.

**4** - If you had urgency and could not get to the toilet in time so you leaked urine.

**Pads** If you put on or change a pad put a tick in the pads column.

Here is an example of how to complete the diary:

Time	Drinks		Urine output	Bladder sensation	Pads
	Amount	Type			
6am WOKE			350ml	2	
7am	300ml	tea		2	
8am			✓		
9am					
10am	cup	water	Leak	3	✓

**DAY 1** **DATE:** \_\_\_\_/\_\_\_\_/\_\_\_\_

Time	Drinks		Urine output (mls)	Bladder sensation	Pads
	Amount	Type			
6am					
7am					
8am					
9am					
10am					
11am					
Midday					
1pm					
2pm					
3pm					
4pm					
5pm					
6pm					
7pm					
8pm					
9pm					
10pm					
11pm					
Midnight					
1am					
2am					
3am					
4am					
5am					

**Figure 2: ICIQ-Bladder Diary (page 1)**

**ICIQ-BLADDER DIARY** (12/13)

YOUR NAME: \_\_\_\_\_

DAY 2 DATE: ____/____/____						DAY 3 DATE: ____/____/____					
Time	Drinks		Urine output (mls)	Bladder sensation	Pads	Time	Drinks		Urine output (mls)	Bladder sensation	Pads
	Amount	Type					Amount	Type			
6am						6am					
7am						7am					
8am						8am					
9am						9am					
10am						10am					
11am						11am					
Midday						Midday					
1pm						1pm					
2pm						2pm					
3pm						3pm					
4pm						4pm					
5pm						5pm					
6pm						6pm					
7pm						7pm					
8pm						8pm					
9pm						9pm					
10pm						10pm					
11pm						11pm					
Midnight						Midnight					
1am						1am					
2am						2am					
3am						3am					
4am						4am					
5am						5am					

**Bladder sensation codes**

- 0** - No sensation of needing to pass urine, but passed urine for "social reasons"
- 1** - Normal desire to pass urine and no urgency
- 2** - Urgency but it had passed away before you went to the toilet
- 3** - Urgency but managed to get to the toilet, still with urgency, but did not leak urine
- 4** - Urgency and could not get to the toilet in time so you leaked urine

**Figure 3: ICIQ-Bladder Diary (page 2)**

## REFERENCES

1. Abrams P, Avery K, Gardener N, Donovan J, ICIQ Advisory Board. The International Consultation on Incontinence Modular Questionnaire: www.iciq.net. *J Urol.* 2006 Mar;175(3 Pt 1):1063–6; discussion 1066.
2. Avery K, Donovan J, Peters TJ, Shaw C, Gotoh M, Abrams P. ICIQ: a brief and robust measure for evaluating the symptoms and impact of urinary incontinence. *Neurourol Urodyn.* 2004;23(4):322–30.
3. Bright E, Cotterill N, Drake M, Abrams P. Developing and validating the International Consultation on Incontinence Questionnaire bladder diary. *Eur Urol.* 2014 Aug;66(2):294–300.
4. Bright E, Cotterill N, Drake M, Abrams P. Developing a validated urinary diary: phase 1. *Neurourol Urodyn.* 2012 Jun;31(5):625–33.
5. Cotterill N, Fowler S, Avery M, Cottenden AM, Wilde M, Long A, et al. Development and psychometric evaluation of the ICIQ-LTCqol: A self-report quality of life questionnaire for long-term indwelling catheter users. *Neurourol Urodyn.* 2016 Mar;35(3):423–8.
6. Uren AD, Cotterill N, Parke SE, Abrams P. Psychometric equivalence of electronic and telephone completion of the ICIQ modules. *Neurourol Urodyn.* 2016 Aug 11;
7. Donovan JL, Peters TJ, Abrams P, Brookes ST, de aa Rosette JJ, Schäfer W. Scoring the short form ICSmaleSF questionnaire. *International Continence Society. J Urol.* 2000 Dec;164(6):1948–55.
8. Brookes ST, Donovan JL, Wright M, Jackson S, Abrams P. A scored form of the Bristol Female Lower Urinary Tract Symptoms questionnaire: data from a randomized controlled trial of surgery for women with stress incontinence. *Am J Obstet Gynecol.* 2004 Jul;191(1):73–82.
9. Price N, Jackson SR, Avery K, Brookes ST, Abrams P. Development and psychometric evaluation of the ICIQ Vaginal Symptoms Questionnaire: the ICIQ-VS. *BJOG Int J Obstet Gynaecol.* 2006 Jun;113(6):700–12.
10. Cotterill N, Norton C, Avery KNL, Abrams P, Donovan JL. A patient-centered approach to developing a comprehensive symptom and quality of life assessment of anal incontinence. *Dis Colon Rectum.* 2008 Jan;51(1):82–7.
11. Cotterill N, Norton C, Avery KNL, Abrams P, Donovan JL. Psychometric evaluation of a new patient-completed questionnaire for evaluating anal incontinence symptoms and impact on quality of life: the ICIQ-B. *Dis Colon Rectum.* 2011 Oct;54(10):1235–50.
12. Donovan JL, Abrams P, Peters TJ, Kay HE, Reynard J, Chapple C, et al. The ICS-'BPH' Study: the psychometric validity and reliability of the ICSmale questionnaire. *Br J Urol.* 1996 Apr;77(4):554–62.
13. Jackson S, Donovan J, Brookes S, Eckford S, Swithinbank L, Abrams P. The Bristol Female Lower Urinary Tract Symptoms questionnaire: development and psychometric testing. *Br J Urol.* 1996 Jun;77(6):805–12.
14. Kelleher CJ, Cardozo LD, Khullar V, Salvatore S. A new questionnaire to assess the quality of life of urinary incontinent women. *Br J Obstet Gynaecol.* 1997 Dec;104(12):1374–9.
15. Abraham L, Hareendran A, Mills IW, Martin ML, Abrams P, Drake MJ, et al. Development and validation of a quality-of-life measure for men with nocturia. *Urology.* 2004 Mar;63(3):481–6.
16. Coyne K, Revicki D, Hunt T, Corey R, Stewart W, Bentkover J, et al. Psychometric validation of an overactive bladder symptom and health-related quality of life questionnaire: the OAB-q. *Qual Life Res Int J Qual Life Asp Treat Care Rehabil.* 2002 Sep;11(6):563–74.

## 4. ICS CONSENSUS DOCUMENTS

A 'medical consensus' is defined by the Council of Europe as "a public statement on a particular aspect of medical knowledge that is generally agreed upon as an evidence-based, state-of-the-art knowledge by a representative group of experts in that area".

The document is usually developed by a multidisciplinary independent panel of experts convened either by a medical association or by a governmental authority to review and summarise the scientific literature in order to:

1. Advance the understanding of an issue, procedure, or method;
2. Outline standards of care and good practice;
3. Provide guidance to health care professionals, especially on controversial or poorly understood aspects of care;
4. Support and promote good clinical practice in the best interest of the patient;
5. Improve the quality and effectiveness of health care.

The consensus documents by summarising the published literature on a specific topic should be considered as a comprehensive summary of the opinions and the expression of the general opinion of the panel of experts that does not necessarily imply unanimity. Since they provide a "snapshot in time" they must be re-evaluated periodically.

There are different ways of producing a consensus document. The Delphi method is a useful process that involves sending out questionnaires of statements; collating and anonymizing feedback; sharing them in a number of cycles within the experts who can adjust their answers in subsequent rounds. It allows to avoid bringing experts together for a physical meeting, to facilitate interaction between experts and to reduce individual bias. However, consensus documents do not provide algorithms or guidelines for practice that are usually issued by any organization for healthcare providers and commissioners to promote best care for patients.

In this e-book we will describe how the International Continence Society consensus documents are developed. These are usually commissioned by the Board of Trustees or by ICS committees and aim to set out the organisation's position or philosophy about a specific topic.

We will also describe the criteria that Working /Committee groups which wish to produce a consensus document for the ICS should adhere to.

Finally, we will discuss the Standard Operating Procedure that has been compiled by the International Continence Society. This includes a Proposal Stage, a Preparatory Stage, a Review Stage, a Publication Stage and a Implementation Stage. A set of step-by-step instructions for the creation of the consensus documents will be described in detail including: creation of a working group and appointment of a chair; submission of the proposal sent to ICS Office; review and approval of the proposal by Board of Trustees and Editor of NeuroUrology & Urodynamics Journals (NUUJ); preparation of the consensus document; review of the content by relevant committees and Board of Trustees; submission of the consensus document NUUJ; publication of the consensus document on the ICS website and advertised."



**Alex Digesu**  
ICS Trustee



## Artificial Urinary Sphincter: Executive Summary of the 2015 Consensus Conference

X. Biardeau, S. Aharony, the AUS Consensus Group,\* L. Campeau, and J. Corcos\*\*  
*Department of Urology, Jewish General Hospital, McGill University, Montreal, Québec, Canada*

### INTRODUCTION

The AMS800™ device, by far the most frequently implanted artificial urinary sphincter (AUS) worldwide, is considered to be the “gold-standard” when male incontinence surgical treatment is contemplated. Despite 40 years of experience, it is still a specialized procedure with a number of challenges. Here, we present the recommendations issued from the 2015 ICS AUS Consensus Group, regarding indications, management, and follow-up AMS800™ implantation or revision.

### MATERIALS AND METHODS

Under ICS auspices, an expert panel met on July 10, 2015 in Chicago, IL, in an attempt to reach a consensus on diverse issues related to the AMS800™ device. Participants have been selected on the basis of their practice in a University hospital and their number of implanted AUSs according to AMS (American Medical System Holdings Inc., Minnetonka, MN) records and/or major published articles. Listed topics were selected by a pre-meeting email brainstorming by all

participants. The co-chairs distributed topics randomly (except for one) to all participants. Each participant had to propose a statement on their topic(s) for approval by the conference after a short evidence-based presentation, when possible.

### RESULTS

A total of 25 urologists were invited to participate, 19 able to attend the conference. The present recommendations, based on the most recent and relevant data available in the literature as well as expert opinions, successively address multiple specific and problematic issues associated with the AMS800™ through a eight-chapter structure: pre-operative assessment, pre-operative challenges, implantation technique, post-operative care, trouble-shooting, outcomes, special populations, and the future of AUSs.

### Preoperative Assessment

The AUS should be offered to individuals with stress urinary incontinence (SUI) due to intrinsic sphincter deficiency (ISD),

Conflict of Interest: Dr. Morey has received honoraria from Coloplast and American Medical Systems outside the submitted work. Dr. Mourtzinou has served as a consultant for Boston Scientific, Medtronic, Allergan, and Astellas outside of the submitted work. Dr. Peterson has received grants from American Medical Systems and Coloplast during the conduct of the study, as well as grants from American Medical Systems outside of the submitted work. Dr. Chartier-Kastler reports personal fees from American Medical Systems and personal fees from Uromedica outside of the submitted work. Dr. Sandhu reports personal fees from Boston Scientific outside the submitted work. Dr. Corcos reports grants from Pfizer, Astellas, and Allergan outside the submitted work. Dr. Angermeier reports grants and personal fees from American Medical Systems (now Boston Scientific) outside the submitted work. Dr. McCammon has received honoraria from American Medical Systems and has been a consultant for American Medical Systems outside the submitted work. Dr. Drake reports grants, personal fees and non-financial support from Allergan, grants and personal fees from Ferring, grants, personal fees and non-financial support from Astellas, outside the submitted work. Dr. Westney reports grants from American Medical Systems, outside the submitted work. Dr. Herschorn reports personal fees from Boston Scientific, during the conduct of the study; grants and personal fees from Astellas, grants and personal fees from Allergan, personal fees from Pfizer, personal fees from Merus, personal fees from Lilly, personal fees from Promedon, outside the submitted work. Dr. Boone has served on advisory boards and acted as a speaker for Astellas and Allergan outside of the submitted work. Dr. Nitti has served as an investigator for Allergan, Astellas, and Cook MyoSite outside of the submitted work. Dr. Brant reports grants and personal fees from Boston Scientific, during the conduct of the study. Dr. Hellstrom reports personal fees from American Medical Systems, during the conduct of the study; personal fees from Abbvie, Allergan, Antares, Astellas, Coloplast, Endo, Pfizer, Repros, Lipocine, other from Coloplast, Endo, NERI, personal fees from Endo, Menarini, other from NIH, Theralogix, outside the submitted work. The other authors have no conflicts to disclose.

\*The AUS Consensus Group: KW Angermeier<sup>1</sup>, TB Boone<sup>2</sup>, WO Brant<sup>3</sup>, E Chartier-Kastler<sup>4</sup>, DS Elliott<sup>5</sup>, M Drake<sup>6</sup>, WJ Hellstrom<sup>7</sup>, S Herschorn<sup>8</sup>, JS Sandhu<sup>9</sup>, KA McCammon<sup>10</sup>, AF Morey<sup>11</sup>, A Mourtzinou<sup>12</sup>, VW Nitti<sup>13</sup>, AC Peterson<sup>14</sup>, OL Westney<sup>15</sup>, FA Yafi<sup>7</sup>

<sup>1</sup>Glickman Urologic and Kidney Institute, Cleveland Clinic Foundation, Cleveland, OH, USA

<sup>2</sup>Department of Urology, Houston Methodist Hospital, Houston, TX, USA

<sup>3</sup>Division of Urology, Center for Reconstructive Urology and Men's Health, University of Utah, Salt Lake City, UT, USA

<sup>4</sup>Pitié-Salpêtrière Academic Hospital, Department of Urology, Assistance Publique-Hôpitaux de Paris, Pierre and Marie Curie Medical School, Paris, France

<sup>5</sup>Department of Urology, Section of Pelvic and Reconstructive Surgery, Mayo Clinic, Rochester, MN, USA

<sup>6</sup>Bristol Urological Institute, University of Bristol, Bristol, UK

<sup>7</sup>Department of Urology, Tulane University Health Sciences Center, New Orleans, LA 70112, USA

<sup>8</sup>Division of Urology, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, ON, Canada

<sup>9</sup>Division of Urology, Department of Surgery, Memorial Sloan Kettering Cancer Center, New York, New York, USA

<sup>10</sup>Department of Urology, Eastern Virginia Medical School, Norfolk, VA, USA

<sup>11</sup>Department of Urology, University of Texas Southwestern, Dallas, TX, USA

<sup>12</sup>Institute of Urology, Lahey Clinic Medical Center, Tufts University School of Medicine, Burlington, MA 01805, USA

<sup>13</sup>Department of Urology, New York University Langone Medical Center, New York, New York, USA

<sup>14</sup>Division of Urologic Surgery, Department of Surgery, Duke University Medical Center, Durham, NC, USA

<sup>15</sup>Division of Urology, Department of Surgery, University of Texas-Houston Medical School, Houston, TX 77030, USA

\*\*Correspondence to: Jacques Corcos, M.D., Department of Urology, Jewish General Hospital, 3755 chemin de la Côte Sainte-Catherine, Montreal, Quebec, Canada H3T 1E2.

E-mail: jcorcos@uro.jgh.mcgill.ca

Published online in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.23001

© 2016 Wiley Periodicals, Inc.



having failed conservative management. It should be considered no earlier than 6 months after prostatectomy in patients presenting with sufficient dexterity and cognitive function to operate the device.

SUI should be evaluated and verified by careful history and physical examination. UDS should be carried out at the discretion of clinicians in cases where it will help with diagnosis or counseling and follow-up, while pre-operative endoscopic evaluation of the lower urinary tract is highly recommended prior to AUS placement.

Pre-operative teaching must deliver a full explanation of device function. Furthermore, patients must be fully informed about expected rates of mechanical failure, erosion, and infection.

#### Preoperative Challenge

Clinicians must manage bladder neck or vesico-urethral anastomotic stricture prior to AUS placement. Surgeon must treat clinically relevant bladder neck or vesico-urethral anastomotic stricture either prior to or during AUS implantation.

Radiated patients should be informed that they constitute a high-risk population with increased adverse outcomes and associated complications, including cuff erosion as well as reoperation. When AUS implantation is considered in males presenting with post-prostatectomy incontinence, the potential indication for adjuvant radiation therapy should be taken into account, and risks and benefits of cancer control versus urinary outcome need to be weighed.

Detrusor overactivity should be treated before surgery, but does not constitute a contraindication for AUS implantation.

#### Implantation Technique

Surgery for AUS implantation may be performed either in lithotomy or supine position. Surgeons should be permitted their choice of razors or clippers for pre-operative preparation of the male genitalia. A 5-min pre-operative topical antimicrobial scrub is recommended and Chlorhexidine-alcohol skin preparation should be performed.

Pre-operative prophylactic antibiotics should be administered for all AUS procedures within 60 min of the incision and all efforts should be made to ensure low bacterial counts at the time of AUS placement.

The perineal approach should be preferred for AUS cuff placement while trans-scrotal approach may represent a useful alternative in some select instances. The peri-urethral cuff placement should be favored while the trans-corporal implantation may be considered under certain circumstances.

Prosthesis may be filled with either sterile saline or contrast filling solution, at the surgeon's discretion. A 61–70 cmH<sub>2</sub>O pressure-regulating balloon should be used for most patients implanted with bulbar urethral cuff and filling volume range with empty cuff should be 22–27 cc, depending on cuff size and number of cuffs. It must be placed under the abdominal wall fascia and may be inserted into the retro-pubic space or into a space created between the abdominal musculature and the transversalis fascia. The pump should be placed in the dependent portion of the scrotum, anterior to the testicle, to ensure that patients can access it post-operatively.

At the end of the procedure, urethral injury should systematically be ruled out and proper functioning should be confirmed by device cycling. Closure should finally be done multi-layered with absorbable sutures after copious irrigation.

*Neurourology and Urodynamics* DOI 10.1002/nau

#### Post-Operative Care

A14 French urethral catheter should be left in place and removed after a brief period (usually overnight). Post-operative prescriptions should consist of oral analgesia and stool softener, if indicated by patient history, while no evidence currently supports the standard administration of post-operative antibiotics. Patients should be advised to limit physical activity during the 6-week post-operative period.

Although a virgin AUS should be activated at 4–6 weeks post-implantation, activation times after device replacement or revision may be adjusted on the basis of clinical situation and patient comfort.

Patients must be informed to forewarn healthcare professionals in the event of catheterization. They should avoid perineal pressure and be instructed to wear a *MedicAlert* type of bracelet.

Physical long-term follow-up should be ensured between 3 and 6 months post-operatively. Subsequently, yearly follow-up may be undertaken in person or by mailed questionnaire.

#### Trouble Shooting

Patients who complain of leakage problems after AUS placement may have technical issues with the device, another urodynamic factor or a combination of the two. Therefore, assessment of men with unsatisfactory outcomes after AUS requires a systematic evaluation to determine if AUS malfunction, urodynamic changes, or other influences occur.

Sub-cuff urethral atrophy is defined as progressive loss of initial continence after AUS implantation in the absence of erosion, mechanical malfunction or leak, and/or bladder-related causes of worsening urinary continence. In AUS patients presenting with recurrent or gradual worsening of incontinence, sub-cuff urethral atrophy should be considered as diagnosis of exclusion, after dismissing erosion on cysto-urethroscopy and mechanical failure by other modalities. Treatment should first take the most conservative revision approach, followed by procedures for cuff revision requiring complex surgery or additional hardware.

If AUS infection is suspected, cysto-urethroscopy should be undertaken to evaluate the urethra for cuff erosion. In gross or persistent infections, the entire device should be explanted as soon as it is clinically safe, and reimplantation should be delayed.

In case of urethral cuff exposure or erosion, the decision to remove the cuff exclusively or the device entirely will mainly depend on time since AUS implantation. The decision to perform concomitant urethroplasty should be based on the extent of urethral loss at the time of cuff explantation. Eroded cuffs should be replaced at different urethral locations or even through a trans-corporal approach, depending on local conditions.

Definitive diagnosis of mechanical AUS failure is demonstrated by decreased fluid in the system, either by intra-operative aspiration or pre-operative radiologic evidence of diminished fluid in the pressure-regulating balloon. In case of mechanical failure, whole system replacement is generally preferred at the time of AUS revision.

#### Special Populations

Inflated penile prosthesis placement after trans-corporal AUS cuff insertion should be considered a high risk and the procedure should be done in specialized, high-volume centers.



It should be noted that trans-corporal AUS could have a potentially negative impact on erectile dysfunction.

AUSs can successfully manage urinary incontinence in neurogenic bladder patients. However, it is associated with a higher numerical complication rate versus post-prostatectomy patients. Erosion is frequent in this specific population and all effort should be made to prevent its occurrence. Furthermore, long-term follow-up with bladder and upper urinary tract monitoring is essential.

Placement of indwelling urethral catheters in patients with AUSs is the most common cause of erosion and should be avoided at all costs. When catheters are absolutely required the device must be inactivated in the open position, and the smallest size urethral catheter should be used for the shortest time period (less than 48 hr). When fluid monitoring in obtunded patients is required, the device should be deactivated and an externally secured collection method, such as a condom catheter, should be attempted. In cases that require prolonged drainage (>48 hr), a supra-pubic tube should be considered, with imaging guidance.

In females, AUSs are indicated in cases of pure SUI or mixed UI in female patients if ISD is present and is the main reason for SUI. They have never been compared in this population with any technique, especially slings, and they should, therefore, be

considered as a salvage technique in bothered patients after mid-urethral sling failure in the absence of urethral mobility. AUSs in women should be contra-indicated after pelvic radiotherapy.

The retro-pubic approach is recommended over the vaginal approach because of a lower infection rate.





#### Future of AUS

The “ideal” AUS should be easily manipulated and inactivated, modify cuff pressure after implantation, be able to adapt occlusive cuff pressure in a real-time manner, have a simple and robust design, be safely implanted via a minimally invasive procedure, and be as cost effective as possible.

#### CONCLUSION

The present guidelines are issued from brainstorming by 19 urological surgeons, all considered expert in the use of the AMS800<sup>TM</sup>. The most recent and relevant data available in the literature as well as expert opinions were taken into account to reach a consensus on each of the presented statements. These recommendations will undoubtedly help urologists in their daily practice with the AMS800<sup>TM</sup>.

# International Continence Society consensus on the diagnosis and treatment of nocturia

Karel Everaert<sup>1</sup> | Francois Hervé<sup>1</sup>  | Ruud Bosch<sup>2</sup> | Roger Dmochowski<sup>3</sup> |  
Marcus Drake<sup>4</sup>  | Hashim Hashim<sup>4</sup>  | Christopher Chapple<sup>5</sup>  |  
Philip Van Kerrebroeck<sup>6</sup> | Sherif Mourad<sup>7</sup> | Paul Abrams<sup>4</sup> | Alan Wein<sup>8</sup>

<sup>1</sup>Urology Department, Ghent University Hospital, Ghent, Belgium

<sup>2</sup>Urology Department, UMC Utrecht, Utrecht, The Netherlands

<sup>3</sup>Urology Department, Vanderbilt University Medical Center, Nashville, Tennessee

<sup>4</sup>Bristol Urological Institute, University of Bristol, Bristol, United Kingdom

<sup>5</sup>Department of Urology, Sheffield Teaching Hospitals NHS Foundation Trust, University of Sheffield, Sheffield, United Kingdom

<sup>6</sup>Urology Department, Maastricht University Medical Center, Maastricht, The Netherlands

<sup>7</sup>Urology Department, Ain Shams University, Cairo, Egypt

<sup>8</sup>Urology Department, University of Philadelphia, Philadelphia, Pennsylvania

## Correspondence

Karel Everaert, Department of Urology, Ghent University, Ghent, Belgium.  
Email: karel.everaert@uzgent.be

## Abstract

**Introduction:** Patients with nocturia have to face many hurdles before being diagnosed and treated properly. The aim of this paper is to: summarize the nocturia patient pathway, explore how nocturia is diagnosed and treated in the real world and use the Delphi method to develop a practical algorithm with a focus on what steps need to be taken before prescribing desmopressin.

**Methods:** Evidence comes from existing guidelines (Google, PubMed), International Consultation on Incontinence-Research Society (ICI-RS) 2017, prescribing information and a Delphi panel (3 rounds). The International Continence Society initiated this study, the authors represent the ICI-RS, European Association of Urology, and Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction (SUFU).

**Results:** Diagnostic packages: there is a consensus on history taking for all causalities, intake diary (fluid, food) and bladder diary, not for its duration. Pelvic (women) or rectal (men) examination, prostate-specific antigen, serum sodium check (SSC), renal function, endocrine screening: when judged necessary. Timing or empty stomach when SSC is not important. Therapeutic packages: the safe candidates for desmopressin can be phenotyped as no polydipsia, heart/kidney failure, severe leg edema or obstructive sleep apnea syndrome. Lifestyle interventions may be useful. Initiating desmopressin: risk management consensus on three clinical pictures.

Follow-up of desmopressin therapy: there was consensus on SSC day 3 to 7, and at 1 month. Stop therapy if SSC is <130 mmol/L regardless of symptoms. Stop if SSC is 130 to 135 mmol/L with symptoms of hyponatremia.

**Conclusion:** A summary of the nocturia patient pathway across different medical specialists is useful in the visualization and phenotyping of patients for diagnosis and therapy. By summarizing basic knowledge of desmopressin, we aim to ease its initiation and shorten the patient journey for nocturia.

Karel Everaert and Francois Hervé contributed equally to this study.

Editorial assistance was provided by Caroline Loat, PhD.

**KEYWORDS**

Delphi technique, desmopressin, expert opinion, guideline, interdisciplinary research, nocturia, nocturnal polyuria

## 1 | INTRODUCTION

Nocturia was defined in 2002 as a complaint that the individual has to wake at night one or more times to void.<sup>\*1</sup> It affects a high proportion of adults.<sup>2</sup> Nevertheless, for a long time, the symptom received very little specific research attention as it was considered just one of a number of lower urinary tract symptoms (LUTS) indicating overactive bladder (OAB) or benign prostatic obstruction (BPO). In recent years, however, there has been growing recognition that it is a specific symptom in its own right, with wide-ranging pathophysiology (including blood pressure changes, cardiac dysfunction, fluid shift into the lower limbs, polyuria, sleep apnea, insomnia, pharmacotherapy, and polypharmacy). Furthermore, it is associated with significant negative outcomes in terms of patient health, sleep, and quality of life. Yet there is no consensus on how to identify and manage nocturia patients for the best possible outcomes.

During the 2017 meeting of the International Consultation on Incontinence-Research Society (ICI-RS) in Bristol, a nocturia think-tank discussed how to study the gaps in our knowledge to develop a practical patient-oriented diagnostic and therapeutic algorithm for nocturia.<sup>3</sup> It was obvious that the many and varied causes of the condition are underdiagnosed and that many clinicians of different disciplines see patients with nocturia without paying specific attention to diagnosing and treating their excessive nocturnal voiding.

Nocturia guidelines are mainly hidden within broader LUTS guidelines because nocturia has historically been linked primarily to OAB and BPO, even though its main cause is nocturnal polyuria (NP).<sup>5</sup> A one-year delay between onset of LUTS symptoms and consultation of a medical professional has been reported.<sup>6</sup> Patients with nocturia are treated by healthcare providers from numerous different disciplines because nocturia is prevalent in many other conditions, such as cardiovascular disease, diabetes, and OAB. However, the specific condition of nocturia is ignored by most specialities, and only rarely does it improve with treatment of other underlying conditions. Different medical disciplines diagnose and treat nocturia or its underlying diseases

using their own guidelines and recommendations based on levels of evidence available from prior research and literature. Diagnostic and therapeutic “packages” from each discipline are helpful to visualize the approach to nocturia that is taken in clinical practice.

No single treatment can effectively treat nocturia in all contexts. However, desmopressin is the only evidence-based pharmaceutical therapy for nocturia.<sup>7</sup> Despite this, the breadth of its use in clinical practice is limited.<sup>6,8</sup> Patients with nocturia have to face many hurdles before being diagnosed properly and treated with desmopressin, instead of OAB/BPO medication.<sup>6</sup> Potential reasons for this, besides side effects, are the limited knowledge of clinicians regarding the drug and how to use it, and anxiety about safety, regardless of the evidence that with the available low-dose formulations, hyponatremia is extremely rare, even in older patients.<sup>9,10</sup> There is a clear need for a summary of the available information and a simple algorithm on how desmopressin should be used in adults with nocturia.

The aim of this paper, based on the International Continence Society's (ICS) 2002 document,<sup>1</sup> is to:

- 1) Summarize the nocturia patient pathway.
- 2) Explore how nocturia is diagnosed and treated in the real world.
- 3) Use the Delphi method to develop a practical algorithm based on the ICS's 2002 standardization of terminology in nocturia,<sup>1</sup> with a focus on what steps need to be taken before prescribing desmopressin.

## 2 | METHODS

An initial consultation between 12 urologists was held during the ICS 2017 meeting in Florence, with participants representing the ICS, ICI-RS, European Association of Urology (EAU), and Society of Urodynamics, Female Pelvic Medicine and Urogenital Reconstruction (SUFU). Following the meeting, a nonsystematic keyword-based literature search was performed using Google (search on “guidelines 2010-2017” + symptom/sign/disease terms [edema, hypertension, heart failure, diet, menopause, male LUTS, OAB, prolapse, renal failure, diabetes insipidus, and diabetes mellitus]). All expert panel members were also invited to add any additional important guidelines from the different

\*The nocturia definition was recently updated by the International Continence Society (see the article by Hashim et al<sup>4</sup>) as: The number of times urine is passed during the main sleep period. Having woken to pass urine for the first time, each urination must be followed by sleep or the intention to sleep. This should be quantified using a bladder diary.

medical disciplines relevant to the diagnosis and treatment of nocturia and its underlying causes. Some of these guidelines specifically target nocturia, and others aspire to target the underlying cause.

In areas where there was an absence of evidence and consistency between guidelines, the Delphi method was used to obtain an expert consensus—see Figure 1 for details. After the ICS 2017 meeting, a survey to gain views regarding the format, content, and additional panel members needed for the consensus report was distributed among nine of the urologists who agreed to participate as authors of the report, using the [www.surveymonkey.com](http://www.surveymonkey.com) platform (round 1); 75% agreement was needed to reach a consensus. As part of this round, it was decided that a broader range of experts should be included in the panel for round 2 to provide a multidisciplinary perspective. The initial Delphi panel for round 2 comprised of 20 clinicians, but 1 invitee did not respond to any of the rounds, and so the consensus was reached based on the views of the remaining 19 who participated. These 19 included 11 urologists (9 from the original group), 1 gynecologist, 1 epidemiologist/physiotherapist, 1 sleep specialist, 1 nephrologist, 1 geriatrician, 1 general practitioner, 1 neurologist, and 1 pharmacist. The Delphi panel members were asked to indicate whether they agree or disagree with statements about the diagnosis and treatment of nocturia patients. Again, 75% of the panel had to agree to achieve a consensus. If there was a criticism of the statement/question, it was reformulated for an additional subround, of which there were 2 in round 2 (Figure 1). In round 3, a different set of statements were presented to the multidisciplinary Delphi panel, and the same level of agreement was needed (ie,  $\geq 75\%$ ) for a consensus, but panel members were also asked to rate appropriateness of the statement on a scale of 1 to 9 (1-3 inappropriate; 4-6 uncertain; 7-9 appropriate). From the panel responses, a median appropriateness score was derived. As in round 2, if there was a criticism of the statement/question proposed, it was reformulated for an additional subround.

This consensus report on the diagnosis and treatment of nocturia is therefore based on real-life clinical practice, guideline/literature reviews, and where needed, an expert consensus obtained using the Delphi method.

### 3 | RESULTS

The real-life diagnostic and therapeutic pathways for nocturia patients, based on the underlying causes of nocturia,<sup>6</sup> are summarized in Figure 2. There was a consensus that we should treat bothersome nocturia but there was no consensus on whether this should be

confined to two or more voids per night, or include any level of nocturia. There was a consensus that nonbothersome nocturia, or convenient voids, should not be treated with desmopressin.

#### 3.1 | Diagnostic packages

The diagnostic packages in each subdiscipline dealing with nocturia patients are summarized below with reference to guidelines, prescribing information and the Delphi consensus—see Table 1 for an overview. History-taking, physical examination, and clinical assessment including disease-specific questionnaires (DSQ) are recommended diagnostic tools. The EAU 2018 guidelines suggest the severity and bother of individual LUTS (nocturia) should be identified with a symptom score, supplemented by directed questioning if needed. Examples of nocturia-specific questionnaires are the international consultation on incontinence questionnaire—nocturia; nocturia quality of life questionnaire, and the nocturia impact diary. In line with the diagnostic considerations from each of the relevant therapeutic areas, a questionnaire has recently been developed to help to unify approaches to nocturia diagnosis.<sup>11</sup> The TANGO questionnaire is a short patient-administered screening metric designed to help the clinician assess nocturia and diagnose these different contributory mechanisms. Although some further validation is needed, the tool is available for clinical use in English and Dutch, and validation in French and Spanish is ongoing.

##### 3.1.1 | The lower urinary tract package

History-taking with or without the use of validated questionnaires is structured based on symptoms of the filling phase and the emptying phase of the bladder.<sup>4,12</sup> Physical examination focusses mainly on assessment of the prostate, vaginal examination for pelvic organ prolapse, and any urethral pathology, according to the relevant guidelines.

The 2018 EAU male LUTS guidelines<sup>4</sup> recommend to add urine analysis, serum prostate-specific antigen (PSA) test (if a diagnosis of prostate cancer will change the management), and to measure postvoid residual urine volumes.

Three-day bladder diaries, including sleep and wake up time, as well as the next morning's first void, have been recommended as giving the optimal balance between compliance and reliability.<sup>13</sup> The Delphi panel agreed (15/19) that it is necessary to demonstrate the presence of NP using a bladder diary before prescribing desmopressin. There was no consensus on the duration of



**FIGURE 1** Summary of the Delphi process [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

bladder diary required, including on whether patients with cognitive impairment or impaired executive function warrant the use of a shorter duration of bladder diary. Approximately half of the panel (9/17) believe that all patients need to complete a 3-day diary; while the remainder (8/17) believe that the diary period can be shortened if the patient had his/her symptoms during the observation day. In the latter case, it would be necessary to include a question in the bladder diary regarding whether this was a typical night for LUTS, or if it was better or worse than usual, for example, to give an indication of whether the case night was indicative of the patient's condition. Even if there was an accurate questionnaire (>95% accuracy) that could predict NP, 13/18 (no consensus, 72%) would still ask patients to complete a bladder diary. This perseverance with the use of a bladder diary may reflect an underlying lack of conviction amongst the panel that such a questionnaire could feasibly be developed.

The maximum voided volume, void frequency, and the ratio of nocturnal to 24-hour urine production are the most used diary parameters to study and assess nocturia.<sup>14</sup> A maximum voided volume of 350 mL is generally considered as reduced without real evidence to support this criterion. When the nocturnal urine production exceeds the maximum voided volume, then

nocturia is predictable, with some safety margin (nocturia index of >1.3 is generally accepted as a reliable cut-off).<sup>15</sup> The frequent causes of reduced voided volumes include an OAB and residual urine (secondary to obstruction or detrusor underactivity). A residual urine measurement is, therefore, part of the initial assessment of nocturia.<sup>4</sup> When reduced voided volumes are seen, imaging, urodynamics, and occasionally cystoscopy are performed, as appropriate.

Excessive nocturnal or 24-hour urine output is diagnosed using a bladder diary. According to the ICS definition, NP is diagnosed if more than one-third (>33%) of the 24-hour urine volume is produced during the night in patients over 65 years, and after excluding patients with 24-hour polyuria (>40 mL/kg/d). In the United States, the FDA's regulatory decision-making regarding desmopressin use has been based on these definitions. In younger people (21-35 years) the cut-off for NP is >20% of 24-hour urine.<sup>1</sup> No definition of NP between these age categories has been established. The "one-third" definition in older people is the most widely used definition and has a high sensitivity but low specificity. Other definitions are available,<sup>16</sup> but the most appropriate definition of NP is still the subject of much discussion.<sup>17,18</sup> However, the definition of NP is not the scope of this document.



**FIGURE 2** Summary of the nocturia patient diagnosis and treatment pathways. Note that obesity can be indicative of excess caloric intake but is also associated with metabolic syndrome and is therefore also relevant to the cardiovascular pathway. Clinical specialities that deal with specific conditions may vary by country—for example, OSAS patients may be treated by a variety of specialists (including sleep, ear nose, and throat). BOO, bladder outlet obstruction; OAB, overactive bladder; OSAS, obstructive sleep apnea syndrome; RLS, restless legs syndrome [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

The Delphi panel considered that, in women, a pelvic examination is necessary before starting desmopressin either in all cases (7/19) or in those women with daytime symptoms (8/19)—an overall consensus of 15/19 in favor of pelvic examination.

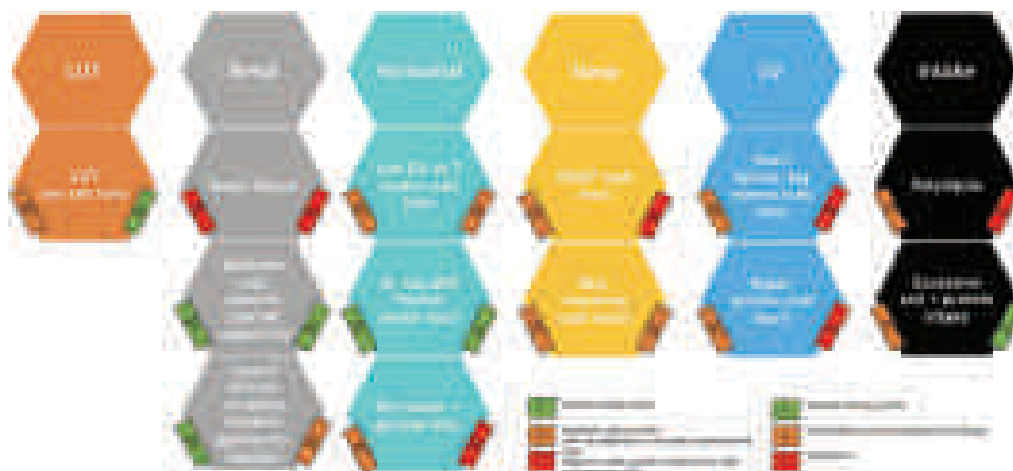
There was a consensus from the panel that a PSA check need not be standard in all older men before starting desmopressin (0/18); 7/18 answered that there is no need to check PSA and 11/18 agreed that PSA measurement is only appropriate when considered necessary for other reasons. LUTS have no relation to PSA except in advanced prostate cancer (owing to the associated bladder outlet obstruction), and NP specifically is not associated with prostate cancer.

There was a consensus that older men with nocturia should complete a DSQ (13/17, median 7.4), post-void residual (14/17, median 7.4), bladder diary is mandatory (14/17, median 8.7), and there was no consensus on the need for a digital rectal examination (10/17, median 7).

### 3.1.2 | Nephrological causes of nocturia and their diagnosis

Renal causes of polyuria include renal diseases such as nephrogenic diabetes insipidus and loss of different circadian rhythms of the kidney, for example through aging of the kidney.<sup>19,20</sup> Nephrogenic diabetes insipidus can also be caused by some medications, including lithium. Renal failure can also lead to leg edema with NP as a consequence.

When (nocturnal) polyuria is found, it is possible to diagnose the cause of the excess in urine output using renal function profiles.<sup>19</sup> These renal function profiles help in distinguishing whether the excess in urine production is due to an increase in free water clearance (vasopressin-related), osmotic diuresis (mainly salt, but can be urea [protein], glucose [diabetes], calcium [hypercalciuria], or lithium), or a combination. However, renal function profiles are only advised after the failure of desmopressin therapy, and for research purposes. In clinical practice, elevated free water clearance is the most



**FIGURE 3** Phenotyping nocturia for uncontrolled causalities when prescribing desmopressin, based on guidelines, prescribing information or Delphi panel. \*Based on evidence and guidelines to use CPAP for sleep apnea and the high levels of ANP and nocturnal salt loss. Conc, concentration; CV, cardiovascular; DI diabetes insipidus; DM, diabetes mellitus; Est, estrogen; E, efficacy; LUT, lower urinary tract; OSAS, obstructive sleep apnea syndrome; RLS, restless legs; S, safety; T, testosterone [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

frequent cause of NP throughout the lifespan and increases with age. The second most frequent etiology is an increased sodium clearance (eg, due to excess intake, leg edema, heart failure, hypertension, obstructive sleep apnea syndrome [OSAS], and medication), and this also increases with age. In summary, at first assessment, phenotyping (Figures 2 and 3) based on history taking, concomitant medication and a general physical examination help the clinician to implement lifestyle interventions and therapies such as desmopressin (assuming minimum glomerular filtration rate [GFR] of 50 mL/kg/min).

### 3.1.3 | Hormones and nocturia

Vasopressin is the main water-regulating hormone in our body. Vasopressin deficiency and vasopressin resistance of nephrogenic (receptor) origin are the main mechanisms leading to a lack of antidiuretic response within the body. The result is 24-hour polyuria and polydipsia, known as diabetes insipidus, which is a rare condition diagnosed via a bladder diary and a low morning (fasting) serum and urine osmolality. An abnormal circadian rhythm of vasopressin is the main mechanism for NP.<sup>21,22</sup> Asplund described a lack of circadian rhythm in patients with NP and nocturia in both men and women,<sup>23</sup> but plasma levels in adults without nocturia peak at around 8 pg/mL in men and 4 pg/mL in women—both with a circadian rhythm.<sup>24</sup> These levels fall and a gender difference becomes more obvious in adults, as described

by Graugaard et al,<sup>24</sup> and levels are even lower in the elderly, as described by Asplund. There is further evidence of an effect of the menstrual cycle in women,<sup>25</sup> which may also increase female sensitivity to desmopressin. If doses are given in identical strengths in men and women (not measuring the dynamic endpoint of NP), we would expect more safety concerns in women, especially elderly women. Vasopressin itself is difficult to measure as a routine test; copeptin is a by-product of vasopressin and is being explored as a biomarker of vasopressin levels.

The sex hormones are also involved in regulation of diuresis.<sup>26</sup> Deficiency in sex hormones (estrogen, testosterone) is diagnosed based on history taking and physical examination and can be confirmed with blood analysis. Some validated questionnaires are available for diagnosing menopause. Nocturia is not discussed in these guidelines.<sup>27</sup>

### 3.1.4 | Sleep and the central nervous system (CNS) as a cause of nocturia

Sleep pathology, insomnia, and sleep disruption are well-known causes of NP and nocturia,<sup>28,29</sup> and as such, they need to be diagnosed, especially as they are associated with morbidity and mortality.<sup>30–32</sup> In epidemiological studies, nocturia is associated with restless legs syndrome.<sup>33</sup> History taking and physical examination can be complemented with questionnaires including the Pittsburgh Sleep Quality Index,<sup>34</sup> which screens for both



**TABLE 1** Summary of diagnostic and therapeutic packages

Diagnostic			Therapeutic		
Guidelines (see the Supporting Information Materials for refs.)		Prescribing information for dDAVP	Delphi panel	Lifestyle	Pharmacological
Diagnostic test	Materials for refs.)	dDAVP			
Lower urinary tract					
Nocturia within other guidelines (OAB, LUTS)	Nocturia, nocturia due to nocturnal polyuria	Nocturia, nocturia due to nocturnal polyuria		Bladder training (level 2 evidence)	OAB/BOO medication
History and physical examination, DSQ	+	–	Consensus	Pelvic floor training (level 2 evidence)	dDAVP
Pelvic—digital rectal examination	+	–	If judged necessary		Consider combination therapy for refractory nocturia (Delphi consensus)
PSA	+	–	If judged necessary		Botulinum toxin, sacral neuromodulation
PVR	+	–	Consensus		Prostatic and urethral surgery, prolapse correction
Kidney					
Nocturia within other urological guidelines	Nocturia, nocturia due to nocturnal polyuria	Nocturia, nocturia due to nocturnal polyuria		Salt, protein and calorie restriction	No dDAVP if eGFR <50 (Delphi consensus)
History and physical examination, DSQ	+	–			Consider dDAVP in low/moderate renal failure
Need/use for/off questionnaire for screening NP	–	–	No consensus		Antihypertensive medication
Bladder diary	+ 3 d	+	1. Consensus on the use of a diary, no consensus on duration (50/50) 2. No consensus on the definition, NPI33 is widely used and practical but too sensitive. Use the right definition for the right population		Dialysis

(Continues)

TABLE 1 (Continued)

Diagnostic			Therapeutic		
Guidelines (see the Supporting Information Materials for refs.)		Prescribing information for dDAVP			
Diagnostic test	Materials for refs.)		Delphi panel	Lifestyle	Pharmacological
Baseline GFR estimation	+	+	1. No consensus, as by PI 2. Consensus no desmopressin below 50 mL/kg/min		Kidney transplantation
Baseline serum sodium	+	+	1. Age cutoff as by PI, consensus, but not stringent 2. Consensus <130 mmol/L is contraindication for desmopressin; majority (66%) prefers >135 3. Timing and having an empty stomach or not are of no importance to the timing of test, consensus		Nephrectomy
Hormones	Nocturia not mentioned	–		Sleep hygiene	Menopause-related nocturia should be treated with lifestyle interventions and HRT (Delphi consensus)
History and physical examination, DSQ	+	–		Limit drinking	dDAVP for patients with blunted AVP secretion at night
Serum LH, FSH, testosterone, estrogen	+	–		Bladder/pelvic floor training	
Sleep	Nocturia not mentioned	–		Sleep hygiene	CPAP in patients with OSAS (level 1a evidence)
	+	–		Weight loss	Sleep clinic/dDAVP in patients with insomnia, nocturia, and NP (consensus)
Polysomnography	+	–	RLS: no consensus to refer/diagnose	Physical activity	Pramipexol, sleep aids
Cardiovascular and edema	Nocturia not mentioned	–		Physical activity, weight loss	Antihypertensive medication, timed diuretics

(Continues)

TABLE 1 (Continued)

Diagnostic		Therapeutic	
Diagnostic test	Guidelines (see the Supporting Information Materials for refs.)	Prescribing information for dDAVP	
		Delphi panel	Pharmacological
History and physical examination and assess leg edema, DSQ	+	–	Salt restriction dDAVP with caution only in those with Class I mild congestive heart failure and no severe leg edema
BNP	+ (excludes heart failure if suspected)	–	Postural drainage stockings Varicose vein surgery
Intake	Nocturia not mentioned	+	Fluid restriction Consider dDAVP
History and physical examination, DSQ, Intake diary	+	+ (limited to fluid intake)	Salt, protein, and calorie restriction – balanced diet

Abbreviations: AVP, arginine vasopressin; BNP, brain natriuretic peptide; BOO, bladder outlet obstruction; CPAP, continuous positive airway pressure; dDAVP, desmopressin; DSQ, disease-specific questionnaire; FSH, follicle stimulating hormone; GFR, glomerular filtration rate; HRT, hormone replacement therapy; LH, luteinising hormone; LUTS, lower urinary tract symptoms; NP, nocturnal polyuria; NP133, nocturnal polyuria index >33%; OAB, overactive bladder syndrome; OSAS, obstructive sleep apnea syndrome; PI, prescribing information; PSA, prostate-specific antigen; PVR, post-void residual urine; RLS, restless legs syndrome.

nocturnal and diurnal symptoms related to sleep disorders. The Berlin questionnaire<sup>35</sup> and the STOP questionnaire<sup>36</sup> are screening tools for OSAS. Polysomnography is performed when a diagnosis of sleep disorders is suspected.

Parkinson's disease and restless legs syndrome are conditions characterized by a dopamine deficiency.<sup>37,38</sup> Sleep disruption and deprivation are associated with low dopamine levels in the central nervous system.<sup>39</sup> Both Parkinson's disease and restless legs syndrome are associated with NP and a reduced bladder capacity due to OAB and sphincter dysfunction.<sup>40–42</sup> However, a recent study suggested that the prevalence of NP in Parkinson's disease is no higher when compared with a control population, indicating some uncertainty in this regard.<sup>43</sup> The diagnosis of a brain- or sleep-related cause of nocturia is made clinically, and when suspected, patients need to be referred to neurologists or sleep specialists.

Evidence-based medicine<sup>6</sup> supports the need to refer and diagnose nocturia patients with suspected obstructive sleep apnea. Among the Delphi panel, there was no consensus whether suspected restless legs syndrome required a referral (9/17 [6 would treat NP simultaneously with referral]) or simply initiation of treatment for NP (8/17).

### 3.1.5 | Cardiovascular causes of nocturia

Hypertension is associated with nocturia and NP.<sup>22</sup> Nondipping hypertensive patients are a subgroup who do not exhibit a nocturnal reduction in blood pressure. There is an association between nondipping hypertension and nocturia,<sup>44</sup> and a specific association has been reported between NP and nondipping hypertension.<sup>45</sup> Children with enuresis have also been found to have higher nocturnal blood pressure than controls.<sup>46</sup> Nondipping hypertension is associated with increased morbidity.<sup>47</sup> In addition, postural hypotension with low blood pressures when standing results in higher blood pressures when supine. Diagnosis is simply made by measuring the blood pressure as part of the general clinical examination. Available guidelines in this area do not discuss nocturia.<sup>48–53</sup>

The metabolic syndrome is strongly associated with nocturia and many conditions predisposing to NP,<sup>54,55</sup> and it is an important burden for healthcare systems worldwide. The condition needs to be diagnosed when clinically suspected in patients with nocturia. Again, available guidelines in this area do not mention nocturia.<sup>56,57</sup>

Heart failure often coincides with renal failure (30%–40%) and correlates with increased mortality. This cardio-renal syndrome presents as elevated brain natriuretic peptide (BNP) with hypovolemia (normal serum

sodium) or as overfilling (hyponatremia). Both conditions coincide with an elevated creatinine, a bad estimator of GFR in these patients, and demand referral before initiation of desmopressin or timed diuretic therapy.<sup>58</sup>

Right-sided heart failure, in particular, is characterized by fluid retention and swelling of the abdomen, legs, and feet (<https://www.mayoclinic.org/diseases-conditions/heart-failure/symptoms-causes/syc-20373142>). Edema, and especially leg edema, causes NP and nocturia through resorption of fluid when supine,<sup>59,60</sup> resulting in an immediate excess in urine output and a delayed increase in ANP-related salt diuresis. Leg edema is seen with liver, heart or kidney disease or following varices of the legs, lack of physical activity or muscle paralysis. Concomitant medications that can cause edema are listed in the section below on concomitant medication. Diagnosis of edema is based on expert opinion rather than empirical evidence, and the available guideline documents for edema do not mention nocturia.<sup>48,49</sup>

As mentioned above, there was a consensus that older men with edema and nocturia should complete a DSQ (13/17), have a postvoid residual measurement (14/17), and a clinical evaluation of cardiovascular and leg edema (13/17); a bladder diary is mandatory (17/17). There was no consensus on a digital rectal examination (10/17). There was a consensus that older people with nocturia should have their blood pressure measured (13/17, median appropriateness 8). Older people with leg edema and nocturia were considered likely candidates for cardiovascular aetiological factors (13/17, median appropriateness 7), and it was agreed that clinical examination should focus on this pathophysiology (13/17, median 7).

### 3.1.6 | Fluid and food intake as a cause of nocturia

High intake of water, salt, or protein results in an increased excretion by the kidney and can result in NP and nocturia. An excess intake of osmoles leads to thirst, and increased fluid intake—a second reason for NP. An excess intake of calories results in obesity which may, even without the presence of the metabolic syndrome, result in NP due to the higher intra-abdominal pressure, mainly when supine, as a result of obstruction of the respiratory tract.<sup>61</sup> History taking, physical examination, recording of fluid and food intake on a bladder diary, and hypothetically renal function profiles can diagnose the excess of intake of sodium (salt) and ureum (protein).<sup>62,63</sup>

Dietary guidelines discuss the treatment of obesity<sup>56,64</sup> but nocturia-related recommendations are not available. The consensus panel agreed that it is appropriate (13/17, median appropriateness 7) to investigate caloric intake and physical activity through history taking and/or diaries.

### 3.1.7 | Concomitant medication leading to nocturia

Concomitant medication is often difficult to interrupt or change but might have an important impact on nocturia through increasing or decreasing diuresis, changing bladder function, or through interfering with sleep. Other factors that will influence the impact of concomitant medication are the timing of administration, mode of administration, formulation (long- vs short-acting), and so on. Most of these factors have not been well studied.<sup>3,14</sup>

For many medications, the net result on diuresis (water and osmotic diuresis) is unknown and insufficiently studied, and many medications have contradictory effects on water and osmotic diuresis. Even desmopressin, known to solely impact on free water excretion, can cause water retention resulting in renin-angiotensin-aldosterone system suppression, ANP, release and osmotic diuresis.

Another example of the contradictory effects of concomitant medication is calcium channel blockers—these increase salt excretion<sup>65</sup> to lower blood pressure, but side effects include leg edema, which can potentially worsen nocturia when the edema fluid is resorbed during the night.

Medications that typically increase diuresis are diuretics, all antihypertensive medication, progesterone, melatonin, lithium, and SECT-2-inhibitors (antidiabetic patients).<sup>6</sup> Other medications decrease diuresis, such as the older antidiabetic patients, antidepressants, antiepileptics, estrogens, testosterone, corticoids, and nonsteroidal anti-inflammatory drugs (NSAIDs).

Medications that typically cause leg edema are antidepressants (monoamine oxidase inhibitors, trazodone), antihypertensives (beta-blockers, clonidine, hydralazine, methyldopa, minoxidil and so on), antivirals (acyclovir), hormones (sex hormones), NSAIDs (celecoxib, ibuprofen), and some chemotherapeutics and cytokines.<sup>6</sup>

There is a consensus that the following conditions are a contraindication for desmopressin: congestive heart failure (16/19), polydipsia (15/19), and concomitant medication with a high risk of hyponatremia (16/19).<sup>66</sup> There was no consensus for peripheral edema (12/19), uncontrolled hypertension (13/19), uncontrolled diabetes (11/19), and oral steroids (6/19). For nasal/inhalation steroids there was a reversed consensus (0/19).

Diagnostic packages:

- Consensus on history taking or questionnaires for all causalities.
- Pelvic (women) or rectal (men) examination when judged necessary.
- Blood pressure and edema check is necessary.

- Consensus for bladder diary, but not for its duration (3 days suggested).
- Consensus for diaries on sleep, intake (fluid and food), and physical activity.
- Consensus for postvoid residual measurements.
- PSA, serum sodium check (SSC), renal/heart function, and endocrine screening when judged necessary.
- Timing or empty stomach when SSC performed is not important.

## 3.2 | Therapeutic packages

Lifestyle interventions targeted towards the aetiology of nocturia may be useful in some patients (Figure 4).

### 3.2.1 | Lower urinary tract therapy

There is level two evidence that treating dysfunctions of the bladder and the prostate (eg, OAB and BPO) with lifestyle interventions such as bladder training and pelvic floor training, or evening exercise (eg, walking the dog), as well as medication or surgery, improve nocturia.<sup>6</sup>

There was a consensus from the panel that combination therapy should be considered for nocturia that is refractory to initial treatment (18/19).

### 3.2.2 | Nephrological causes of nocturia and their therapy

Lifestyle interventions aim to prevent rather than treat renal disorders, for example by avoiding obesity, hypertension, and diabetes. Salt, protein, and caloric restriction are advised in patients with renal failure but there is no evidence of its effect on nocturia. Desmopressin can have some effect in partial nephrogenic diabetes insipidus but is not the primary choice in patients with severe renal failure as the risk of hyponatremia is much higher (Table 3). For those undergoing an investigation of renal function, there was a consensus that desmopressin should not be prescribed if eGFR is <50, and that higher limits are dependent on local prescribing information. In patients with low to moderate renal failure, as is seen in most of the older population, a loss of circadian rhythms in diuresis is found and these patients are potentially good candidates for desmopressin therapy.

### 3.2.3 | Hormones and nocturia therapy

In the 2002 standardization document,<sup>1</sup> low estrogen and menopause are recognized as a cause of nocturia, and androgen deprivation is also associated with LUTS and nocturia. There is no evidence-based medicine to demonstrate that hormonal substitution in



**FIGURE 4** Lifestyle interventions in nocturia according to pathophysiology. DM, diabetes mellitus [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

postmenopausal women is an effective treatment of nocturia (ICI-RS 2017).<sup>26</sup> The 2015 NICE guidelines (<https://www.nice.org.uk/guidance/ng23>) state that there is a good evidence that hormonal substitution is helpful for vasomotor symptoms (hot flushes) and for vaginal atrophy and its consequences, but do not mention nocturia.

There was a consensus that menopause-related nocturia and hot flushes should be treated with lifestyle interventions and hormone replacement therapy (17/18). These approaches were not considered useful when

menopause is asymptomatic, except for nocturia (5/18). Desmopressin should not be given during the first treatment consultation in the presence of menopausal symptoms (1/18 if menopausal symptoms), but when there is nocturia without menopausal symptoms, there was nearly a consensus that desmopressin can be given (13/18 [74%]).

Patients with NP due to a blunted increase in AVP secretion at night, leading to an increase in free water clearance, are good candidates for desmopressin therapy.<sup>67</sup> Patients with 24-hour polyuria due to central diabetes insipidus (in which production of AVP is compromised) are also effectively treated with desmopressin,<sup>68</sup> which is in these cases a type of hormone replacement therapy.

**3.2.4 | Sleep and the CNS in nocturia therapy**

There is level 1a evidence for the use of CPAP in patients with OSAS. There is only low level 2 or lower level evidence that sleep aids, treatment of low dopamine and treatment of restless legs syndrome have an impact on nocturia (ICI-RS 2015).<sup>42</sup>

There was a lack of consensus from the panel regarding the treatment of patients with insomnia, nocturia, NP, and a diagnosis of RLS. There was no consensus (10/17) whether patients with insomnia and NP should be treated for insomnia and with desmopressin at the same time (median appropriateness was 7). There was no consensus on treating RLS, insomnia,

**TABLE 2** Prescribing information for different desmopressin formulations indicated for nocturia, which is likely to influence clinician judgments

	Desmopressin 0.2 mg, tablets	Nasal spray 0.83-1.66 µg/ 0.1 mL (Noctiva)	Sublingual wafers 25-50 µg, (Nocdurna)
Age for baseline sodium checks and follow up	65	65	65
Fluid restriction	Restrict	Moderation advised (do not drink large amounts close to bedtime)	Restrict 1 h before to 8 h after administration
GFR (lower limit for prescribing)	50 or 60 <sup>a</sup>	50	50-60 <sup>a</sup>
Sodium checks after baseline (≥65 y)	3 d + after uptitration	Within 7 d + after uptitration	4-8 d + 1 mo or 4-8 d, 1 mo, every 3 to 6 months, depending on clinical need
Cardiovascular contraindication	Cardiac insufficiency or conditions requiring diuretics	NYHA class II or higher CHF Diuretic use	Heart failure, edema
Frail elderly	Not mentioned	Not mentioned	Contraindicated

CHF, congestive heart failure; GFR, glomerular filtration rate; NYHA, New York Heart Association  
<sup>a</sup>Moderate to severe renal failure or <50-60 mL/min depending on the formula used and cut-off used.

**TABLE 3** Consensus summary of risk management for hyponatremia when considering desmopressin administration

Risk management	Standard vigilance to hyponatremia symptoms	Standard vigilance to hyponatremia symptoms + serum sodium check (SSC)	Contraindication
	< 65 y	65 y or older	Frail older people
	Baseline sodium > 135	Baseline sodium 130-135	Baseline sodium below 130
	eGFR > 50-60	eGFR 50-60	eGFR <50
	No concomitant medication that can cause hyponatremia	Concomitant medication weakly or moderately related to hyponatremia	Concomitant medication strongly related to hyponatremia
	No leg edema	Low to moderate leg edema	Important leg oedema
	No heart failure	Heart failure (NYHA class I)	Heart failure (NYHA class II or higher)
	No diabetes mellitus or hypertension	Controlled diabetes mellitus or hypertension	Uncontrolled diabetes mellitus or hypertension
		Need for a higher dose, up-titration	Psychogenic polydipsia (>3 L/d)
		Higher risk in women	Higher risk in women
Formulation	Any desmopressin formulation	Low dose desmopressin	Treat condition if possible and wait with desmopressin
SSC	No consensus on SSC	Consensus on SSC	–

insomnia with RLS, or NP with RLS and insomnia in any combination.

In patients with insomnia, nocturia, and NP without a diagnosis of RLS, there was a consensus to treat NP (14/17) but this was split across treatment of NP per se (8/17), referral to a sleep clinic (3/17), or both (6/17). Reasons for this lack of agreement across the panel on the appropriate steps may relate to a lack of evidence on which to base treatment of insomnia with nocturia/NP, or perhaps to the range of specialisms in the group with inconsistent views on the role of other disciplines, e.g., for example, sleep medicine.

### 3.2.5 | Cardiovascular causes of nocturia and their therapy

There is ample evidence that treating heart conditions, increasing physical activity, salt restriction, losing weight, and preventing edema treats nocturia.<sup>6</sup>

Desmopressin for nocturia is contraindicated in patients with mild (class II) to severe (class IV) congestive heart failure (New York Heart Association Class II to IV) or uncontrolled hypertension, and should be used with caution (eg, monitoring of volume status) in patients with New York Heart Association Class I mild congestive heart failure because of the risk of fluid overload and electrolyte abnormalities. Patients with heart failure may also be at increased risk for low sodium concentrations.<sup>69</sup>

In people with moderate cardiac failure, there was a consensus that this condition should be treated before any attempt to address nocturia specifically (16/17, median 9). Use of desmopressin in such cases is completely inappropriate (16/17, median 2). There was no consensus concerning the use of daytime furosemide (4/17, median appropriateness 5).

In older people with NP, nocturia, and hypertension, there was no consensus as to whether hypertension should be treated first (11/18, median appropriateness 7). Treatment of NP first was considered inappropriate by 8/17 (median 4). The treatment of hypertension and NP simultaneously also had no consensus (5/17 inappropriate, 6/17 uncertain, and 6/17 appropriate; median appropriateness 5). The Delphi panel did not consider it useful to change antihypertensive drugs or their timing (other than diuretics) (8/17, median 6) to address nocturia.

In patients with varicose veins but no cardiac failure, there was no consensus on treating veins first (9/18, median 6) nor on using desmopressin first (10/17 inappropriate, 3/17 uncertain, and 4/17 appropriate; median 4).

### 3.2.6 | Intake as a target of nocturia therapy

Limiting excess fluid intake and changing the type of fluid is advised in most LUTS guidelines.<sup>70</sup> Less is known about the effect of diet and weight loss.<sup>6</sup> Weight loss will decrease hyperfiltration and diuresis. Low protein intake



will decrease salt and ureum output and osmotic diuresis. Salt restriction might decrease osmotic diuresis. Low carbohydrate intake will not change diuresis directly. Low fat intake will not directly affect diuresis. During most diets, an increase in water intake is advised, increasing water diuresis. In conclusion, from a theoretical, nonevidence-based viewpoint, a protein-rich and fat/carbohydrate-restricted diet might increase urine output as well as reduce it in the longer-term via weight loss. A well-balanced calorie-restricted diet seems the most logical approach to avoid high excretion of ureum and salt in patients with nocturia. In general, guidelines suggest caloric restriction and summarize that a high protein intake results in more efficient weight loss.<sup>56,57</sup>

There was no consensus from the Delphi panel on appropriate therapeutic options for patients with high BMI and nocturia (including losing weight [no consensus 9/18, median appropriateness 6]; weight loss with desmopressin [5/18, median 5]; desmopressin alone [6/18, median 5]; and adapting diet when there is a high osmotic load [6/18, median 5]).

#### Therapeutic packages:

- There is only good evidence for desmopressin and for CPAP.
- For all other therapies, the evidence is moderate (furosemide, OAB-BPH medication) or weak for most causalities.
- The safe candidates for desmopressin can be phenotyped as no polydipsia, heart/kidney failure, severe leg edema, or OSAS.

### 3.3 | Initiating desmopressin treatment

NP due to reduced nocturnal vasopressin is the primary target for desmopressin. Salt-related NP is associated with other causes such as sleep apnea (the primary target for CPAP), edema, obesity, hypertension, heart failure, and high salt intake. There is level 1a evidence that desmopressin and CPAP treat nocturia.<sup>4,7</sup> A summary of the prescribing information for available desmopressin formulations for nocturia from the United States, Australia, and Europe is given in Table 2.

The panel agreed that bothersome nocturia should be treated (17/19); however, there was no consensus regarding what level of severity warrants treatment ( $\geq 2$  voids/night [5/19], or any nocturia [12/19]). It was agreed that nonbothersome nocturia or convenience voids (ie, secondary to waking for a different reason) should not be treated with desmopressin (1 and 0/19).

There was no consensus among the Delphi panel as to an appropriate age limit above which serum sodium

should be checked before desmopressin treatment. This was also true for renal function (eGFR). This lack of consensus is likely affected by differences in prescribing information and recommendations between countries. However, there was a consensus that any age limit should not be treated too stringently, and patients who are near the limit may also be checked before treatment (17/19).

The Delphi consensus was that patients with a baseline serum sodium of  $\leq 130$  mmol/L should not be prescribed desmopressin (18/19), with the panel split between a cut-off of  $>130$  mmol/L (6/19) and  $>135$  mmol/L (12/19) for treatment. Again, the panel's views on this issue might be influenced by regional regulatory rules and prescribing information.

Dilutional hyponatremia takes several days of positive water balance to build up. To decrease by 5 mmol/L a positive water balance of 2 L is needed. There was a consensus (15/17) that SSCs can be performed at any time of day and are not affected by whether or not the stomach is empty (although note that polydipsia is a contraindication of the drug). There is sufficient literature to support that a sodium check can be done at any time of the day.<sup>71</sup>

The following conditions are agreed to be contraindications for desmopressin use: congestive heart failure (16/19), polydipsia (15/19), and concomitant medication with a high risk of hyponatremia (16/19). Concomitant medication with low risk for hyponatremia (5/19), peripheral edema (12/19), uncontrolled hypertension (13/19) or diabetes (11/19), oral steroids (6/19), and nasal steroids (0/16) did not reach consensus.

The panel agreed that women are more prone to hyponatremia and that this should have implications for desmopressin therapy and its follow-up (16/19). There is a consensus that some form of fluid restriction is needed by patients prescribed desmopressin (18/19)—either following thirst (14/19) or strict fluid restriction (4/19).

With earlier formulations of desmopressin (0.2 mg tablets), hyponatremia was seen mainly in older populations, leading to a restriction in use to those below 65 years of age. Lowering the dose to provide an antidiuretic effect of 6 to 8 hours was the logical way to treat the older (especially female) population. Low dose therapy is not a well-defined term but is today the best way to describe the newer formulations in the market, which have both been tested in an older population. Low dose therapy is advisable in older (but not frail) patients and serum sodium monitoring is needed; such monitoring can be individualized depending on patient-specific factors (eg, age, concomitant medication) and comorbidities (16/19). Frail older patients with bothersome nocturia and comorbidities or other risk factors should first be treated for other issues and comorbidities and then, if still required, desmopressin should be initiated with careful monitoring (15/18).

Young healthy patients can be treated with any licensed desmopressin formulation (15/18).

Initiating desmopressin:

- Risk management consensus on classification into three clinical pictures: (1) standard vigilance to symptoms of hyponatremia, (2) SSC, and (3) contraindications.
- Decision-based on age, renal function, heart failure, frailness, edema, baseline serum sodium, drinking habits, and medication.
- Low-dose formulations preferred in patients needing SSC.

### 3.4 | Follow-up of desmopressin therapy

Critical to the appropriate use of desmopressin and its analogs is an established schema for monitoring of sodium homeostasis in the acute and chronic phase of therapy. Contingent on stable dosing and otherwise unchanging comorbidities is the realization that shifts in fluid ingestion may potentiate the risk of hyponatremia in an otherwise stable patient. Therefore, an informed and the engaged patient is critical to desmopressin safety. In addition, acute alterations in concomitant comorbidities should be assessed for their potential to impact sodium levels.

There are various approaches to sodium monitoring in the literature. Before starting therapy, baseline sodium levels must be obtained in patients at risk for hyponatremia. Bioavailability and formulation delivery appear to have an impact on desmopressin half-life and the area under the curve (indicative of drug exposure), both of which impact the risk of hyponatremia.<sup>17</sup> There is some evidence from analysis of a merged database<sup>17</sup> that a sodium monitoring plan should begin with a baseline sodium  $\geq 135$  mmol/L with additional SSC at week 1 and month 1 after initiation of desmopressin in patients who are at increased risk (eg, due to older age, or concomitant medications). This conclusion is based on the fact that most clinically significant cases of hyponatremia were seen within 2 to 3 weeks of treatment initiation. A noteworthy observation is that time to return to normal after cessation of treatment was a median of 17 days (range 8–28).

As the optimal monitoring schedule is often debated, the Delphi panel was consulted. When baseline serum sodium levels were judged necessary, there was a consensus that serum sodium should be checked on a fixed schedule, beginning within 7 days of desmopressin initiation, but with no consensus

regarding exactly when in the first week this should occur (Day 3 [7/19] or Day 5–7 [9/19]). Weekly blood samples were not deemed necessary (1/18); 4/18 preferred 2-weekly and 13/18 (or 72%; no consensus) agreed that samples should be taken at the discretion of the physician. There was a consensus to perform an SSC as judged by the clinician at 1 month (17/18). Beyond 1 year, there is no consensus on follow up required—10/18 agree that monitoring should be performed when the patient's medical condition (eg, hospitalization, fever) or concomitant medication changes; 8/18 agreed with annual checks.

In young healthy patients, there was no consensus on SSC needed—the majority believed no checks were necessary (11/18), assuming no underlying medical conditions.

There was a consensus that some form of fluid restriction should be advised for all patients (only 1/18 found it unnecessary)—the consensus was split between advising patients to follow their own thirst (14/18) and strict fluid restriction (4/18).

If the response to desmopressin is insufficient at a low dose, there was a consensus that dose should be up-titrated (18/19), depending upon the frailty of the patient (11/19). An SSC should be carried out before up-titration, depending on the patient (17/19). If the dose is up-titrated and further sodium checks are appropriate (15/19), these should be carried out within 7 days.

If hyponatremia is found after initiating desmopressin therapy, there is a consensus (15/19) that treatment should be discontinued when an SSC is below 130 regardless of the presence of symptoms. If sodium check is between 130 and 135 and the patient is asymptomatic, treatment need not be discontinued (only 1/19 would stop the therapy), but further checks (8/19) or drug-free intervals (3/19) or lowering the dose (7/19) should be performed. See Figure 5 for a summary.

Follow-up of desmopressin therapy:

- If SSCs are necessary, follow-up on day 3 to 7 and 1 month.
- Further checks at clinician discretion.
- Stop therapy if serum sodium is  $<130$  mmol/L regardless of hyponatremia symptoms, and if serum sodium is 130 to 135 mmol/L with symptoms.

### 3.5 | Patient-oriented nocturia care path

Based on existing guidelines, evidenced-based medicine, and the Delphi panel, we developed a patient-oriented

multidisciplinary diagnostic and therapeutic algorithm for bothersome nocturia, aiming for a more holistic approach to nocturia from a multidisciplinary angle (Figure 6). The aim of this algorithm is to ease the work of clinicians and shorten the time to treatment.

#### 4 | DISCUSSION

Diagnostic and treatment packages (Figure 2) are helpful in the visualization of the pathway of nocturia patients. We believe they could be a useful educational tool for training of healthcare professionals to improve patient care for nocturia, to limit the hurdles a patient has to get over to receive appropriate care and decrease the time to treatment.

The lifestyle interventions that are recommended in all LUTS guidelines are a good case in point. There is a growing interest globally in lifestyle interventions as a possible treatment for LUTS and, therefore, also for nocturia. The International Consultation on Incontinence summarized the need for research on conservative management of incontinence,<sup>72</sup> and the possible lifestyle interventions that can be relevant in nocturia are weight loss, diet change, fluid intake modification, and exercise. Of these, weight loss and fluid management have a fair amount of scientific data to support their impact. Weight loss (Level 1 evidence) is mentioned as a first-line treatment to reduce the prevalence of urinary incontinence with a Grade A recommendation. Restricted

fluid intake, which could decrease the voiding frequency, urgency, and volume is mentioned with a Grade B recommendation. For nocturia specifically, no such high levels of evidence exist, with the exception of fluid restriction (Level 1b). In contrast, expert opinion supports weight loss, diet, foods, salt restriction, and protein restriction in the therapy of nocturia.<sup>6</sup> This shows an important scientific knowledge gap in our understanding of approaches to the reduction of LUTS and nocturia.

There are a number of strategies to manage the risk associated with desmopressin therapy (namely hyponatremia risk). In young healthy people with nocturia, it is advised that any desmopressin formulation can be used, and dose can be up- or down-titrated when needed. In older people, the factors summarized in Table 3 should be checked, and a low dose formulation should be used or the patient should be excluded from desmopressin therapy. It is safer to start with a lower dose and to lower the threshold to perform SSC in women compared with men as women have a higher sensitivity to desmopressin and are more prone to hyponatremia. This gender difference in antidiuretic response has been found in animal studies<sup>73</sup> and in clinical studies.<sup>74,75</sup> In female rats, it was shown that this gender difference is explained by a significantly higher expression of the V2 receptor in females.<sup>73</sup> It was suggested that this was caused by escape from X-chromosome inactivation by the X-linked V2R gene, causing increased V2R dosage in females.<sup>76</sup>

**FIGURE 5** Follow-up after desmopressin prescription when serum sodium checks wanted or needed. Symptoms of hyponatremia include: nausea and vomiting, headache, confusion, loss of energy, drowsiness, and fatigue, restlessness and irritability, muscle weakness, spasms or cramps, seizures, and coma. FU, follow up; SSC, serum sodium check [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]



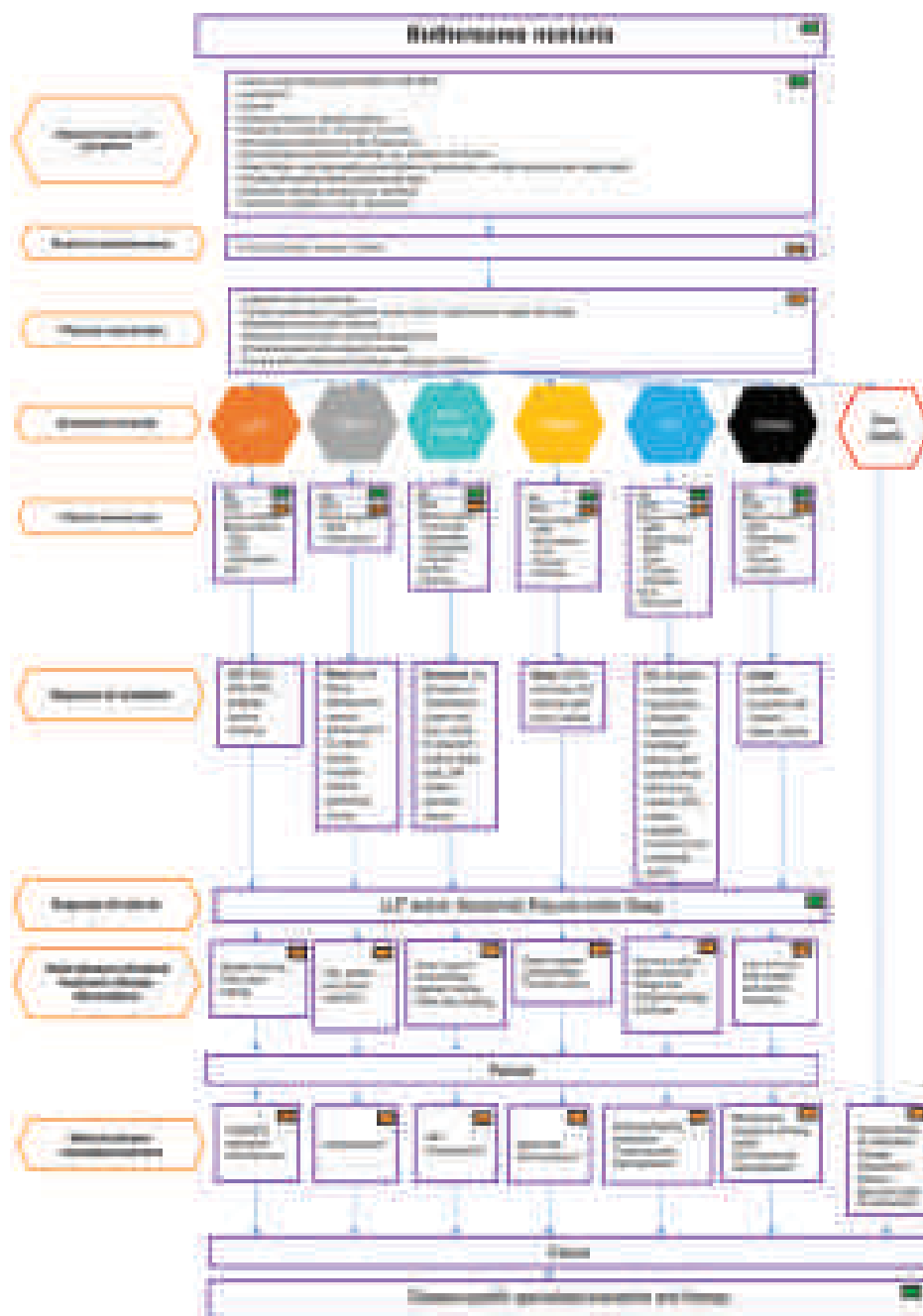


FIGURE 6 Continued.

High-risk medications for hyponatremia are thiazide diuretics, lithium, valproate, and carbamazepine<sup>66</sup> and use of these should be considered as a contraindication for desmopressin therapy. Low-to-moderate risk medications for hyponatremia are loop diuretics, antidepressants, ACE-inhibitors, and angiotensin-II-receptor blockers. These can be used concomitantly with desmopressin after consideration of the other factors from Table 3; concomitant use necessitates follow-up and sodium monitoring. Based on studies with loop diuretics,<sup>6</sup> it is wise not to start both medications at the same time, but to allow an interval of 2 to 3 weeks between their initiation to help the kidney in resetting its salt gradient before administering the second drug.

Since it is important to consider the frail elderly as distinct from other older persons for the purpose of desmopressin therapy, a definition of what is meant by frailty would be helpful. Perhaps the combination of a clinical frailty scale and a Timed Up and Go test (to assess a person's mobility using static and dynamic balance) would capture enough about frailty for most clinicians. The modified frailty index is an 11 item frailty index described for noncancer gynecological patients which captures enough information to detect adverse outcomes and this might be useful.<sup>77</sup> There is also the G8 survey, which captures "frailty."<sup>78</sup> Regarding comorbid conditions, a Charleston comorbidity index would be of use, although it is somewhat limited in older people by a lack of variability.

In the consideration of heart failure and its diagnosis in nocturia patients, heart failure should be suspected when there is a history of heart disease, when edema and/or weight gain with rapid onset is found and/or a patient complains of exertional dyspnea or orthopnea. A normal serum BNP concentration rules out uncontrolled heart failure. It is clear that when this condition is suspected, even in mild form, clinicians should be careful with prescribing desmopressin and it is better to refer the patient to a cardiologist and await instructions.

The monitoring of serum sodium in nocturia patients treated with desmopressin lacks sufficient evidence to produce good guidelines. As hyponatremia is rare in well-selected patients with the currently available low-dose formulations, producing strong evidence for a safety

protocol will be difficult. It is likely that complex statistical studies on merged databases may be a promising strategy for the future and could help to produce a personalized medicine algorithm for serum sodium monitoring after desmopressin initiation. In the meantime, clinicians should err on the side of caution, even if it means more SSC.

From a clinical scientific perspective, when looking at Table 2, it would be interesting to demonstrate the actual plasma levels of desmopressin following the use of the three different formulations, as this explains better the rationale for the dose differentiation. We would suggest focussing on pharmacodynamic studies combined with pharmacokinetic studies to evaluate the strength and duration of the antidiuretic effect, and the effect on serum sodium levels. These studies would ideally be performed in nocturia patients during an overnight evaluation, as performed by Goessaert et al.<sup>79</sup>

It is clear from this Delphi panel experience that items which suffer from a lack of evidence in the literature are difficult to form a consensus on with a multidisciplinary panel. This demonstrates the need for more studies on some of the smallest steps in the care path of nocturia patients. However, the performance of studies that are crucial to our understanding, but do not attract funding from the pharmaceutical industry (eg, effects of lifestyle interventions), will be challenging, as will be the study of low-frequency events and patient risk factors. There is also a difficulty in reaching consensus in relation to diagnostic tests such as serum PSA or clinical prolapse evaluation as the guidelines in these areas originated from urological or gynecological organizations (and indirectly from studies on urological and gynecological patients), whereas the Delphi panel is multidisciplinary and clearly votes from this broader perspective. Our algorithm needs more research mainly in relation to the causalities of the cardiovascular system and intake-related aetiologies. Even in urogynecology, many questions remain unanswered such as the efficacy of medication in nocturia patients with a reduced bladder capacity. For sleep disorders, little research has been done on restless legs syndrome and insomnia as a cause of nocturia. Finally, there is a need to study nocturia based on this multicausal origin, as well as from a diagnostic and a therapeutic angle. Development of a

**FIGURE 6** A patient-oriented multidisciplinary diagnostic and therapeutic algorithm for nocturia. \*If desmopressin, consider Figure 3 and Table 3 before initiating, and consider Figure 5 for follow-up. BD, bladder diary; BNP, brain-derived natriuretic peptide; BOO, bladder outlet obstruction; BPS, bladder pain syndrome; Con Med, concomitant medication; CPAP, continuous positive airway pressure; CV, cardiovascular; DI, diabetes insipidus; DM, diabetes mellitus; DSQ, disease-specific questionnaires; DVT, deep venous thrombosis; ECG, electrocardiogram; GFR, glomerular filtration rate; HRT, hormone replacement therapy; LUT(S), lower urinary tract (symptoms); MS, multiple sclerosis; OAB, overactive bladder; OSAS, obstructive sleep apnoea syndrome; PSA, prostate-specific antigen; PSG, polysomnography; PVR, post void residual; RLS, restless legs syndrome. ■ consensus, ■ consensus "when judged necessary by the clinician," ■ "combinations possible" [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

standalone evidence-based nocturia guideline will probably originate from a multidisciplinary organization, and in the future, we envisage that the nocturia care path will move away from the disciplines of urology and gynecology towards less narrowly focused specialisms such as internal medicine, geriatrics, and general practice.

## 5 | CONCLUSION

A summary of the nocturia patient pathway across different medical specialisms is useful in the visualization and phenotyping of patients for diagnosis and therapy. It also highlights that nocturia is in general not a urological symptom, but predominantly a symptom of a wide variety of causalities, many of which are easy to screen for with history taking, questionnaires, and physical examination. By providing some basic knowledge of desmopressin, its contraindications, safety concerns and follow-up here, we aim to ease its initiation for clinicians and to shorten the patient journey for nocturia.

## ACKNOWLEDGMENT

We would like to thank all the Delphi panel Members: Paul Abrams: Bristol Urological Institute, University of Bristol, Bristol, UK; Marco Blanker: University of Groningen, Department of General Practice, Groningen, The Netherlands; Donald Bliwise: Department of Neurology, Program in Sleep, Aging and Chronobiology, Emory University School of Medicine, Atlanta, Georgia; Ruud Bosch: Urology Department, UMC Utrecht, Utrecht, The Netherlands; Wendy Bower: Department of Medicine and Community Care, University of Melbourne, Melbourne, Australia; Chris Chapple: Department of Urology, Sheffield Teaching Hospitals NHS Foundation Trust, University of Sheffield, Sheffield, UK; Roger Dmochowski: Urology Department, Vanderbilt University Medical Center, Nashville, Tennessee; Marcus Drake: Bristol Urological Institute, University of Bristol, Bristol, UK; Karel Everaert: Urology Department, Ghent University Hospital, Ghent, Belgium; Hashim Hashim: Bristol Urological Institute, University of Bristol, Bristol, UK; Francois Hervé: Urology Department, Ghent University Hospital, Ghent, Belgium; Kristian Juul: Ferring Pharmaceuticals A/S, Copenhagen, Denmark; Sherif Mourad: Urology Department, Ain Shams University, Cairo, Egypt; Jalesh Panicker: Department of Uro-Neurology, The National Hospital for Neurology and Neurosurgery, UCL Institute of Neurology, London, UK; Dudley Robinson: Urogynaecology Department, Kings College Hospital, London, UK; Johan Vande Walle: Department of Paediatric Nephrology, Uronephrology Center, Ghent University Hospital, Ghent, Belgium; Philip Van Kerrebroeck: Urology

Department, Maastricht University Medical Center, Maastricht, The Netherlands; Adrian Wagg: Division of Geriatric Medicine, University of Alberta, Edmonton, Canada; Alan Wein: Urology Department, University of Philadelphia, Philadelphia, Pennsylvania; Jeff Weiss: Department of Urology, SUNY Downstate College of Medicine, New York City, New York.

We would also like to thank Caroline Loat, PhD for editorial assistance.

## ORCID

Francois Hervé  <http://orcid.org/0000-0002-9079-251X>

Marcus Drake  <http://orcid.org/0000-0002-6230-2552>

Hashim Hashim  <http://orcid.org/0000-0003-2467-407X>

Chris Chapple  <http://orcid.org/0000-0002-2960-9931>

## REFERENCES

1. van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology in nocturia: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21(2):179-183.
2. Bosch JLHR, Weiss JP. The prevalence and causes of nocturia. *J Urol*. 2013;189(1 Suppl):S86-S92.
3. Everaert K, Hervé F, Bower W, et al. How can we develop a more clinically useful and robust algorithm for diagnosing and treating nocturia? ICI-RS 2017. *Neurourol Urodyn*. 2018;37:S46-S59.
4. Hashim H, Blanker MH, Drake MJ, et al. International Continence Society (ICS) report on the terminology for nocturia and nocturnal lower urinary tract function [published online ahead of print January 15, 2019]. *Neurourology and Urodynamics*. <https://doi.org/10.1002/nau.23917>
5. Weiss JP, van Kerrebroeck PEV, Klein BM, Nørgaard JP. Excessive nocturnal urine production is a major contributing factor to the etiology of nocturia. *J Urol*. 2011;186(4):1358-1363.
6. Oelke M, Anderson P, Wood R, Holm-Larsen T. Nocturia is often inadequately assessed, diagnosed and treated by physicians: results of an observational, real-life practice database containing 8659 European and US-American patients. *Int J Clin Pract*. 2016;70(11):940-949.
7. Sakalis VI, Karavitakis M, Bedretdinova D, et al. Medical treatment of nocturia in men with lower urinary tract symptoms: systematic review by the European Association of Urology Guidelines Panel for male lower urinary tract symptoms. *Eur Urol*. 2017;72(5):757-769.
8. Callréus T. Use of desmopressin in elderly patients in Denmark. *Pharmacoepidemiol Drug Saf*. 2007;16(9):995-998.
9. Juul KV, Malmberg A, van der Meulen E, Walle JV, Nørgaard JP. Low-dose desmopressin combined with serum sodium monitoring can prevent clinically significant hyponatraemia in patients treated for nocturia. *BJU Int*. 2017;119(5):776-784.
10. Kaminetsky J, Fein S, Dmochowski R, et al. Efficacy and safety of SER120 nasal spray in nocturia patients pooled analysis of 2 randomized, double-blind, placebo-controlled phase 3 trials. *J Urol*. 2018;200:604-611.



11. Bower WF, Rose GE, Ervin CF, Goldin J, Whishaw DM, Khan F. TANGO - a screening tool to identify comorbidities on the causal pathway of nocturia. *BJU Int*. 2017;119(6):933-941.
12. Nambiar AK, Bosch R, Cruz F, et al. EAU guidelines on assessment and nonsurgical management of urinary incontinence. *Eur Urol*. 2018;73(4):596-609.
13. van Haarst EP, Bosch JLHR. The optimal duration of frequency-volume charts related to compliance and reliability. *NeuroUrol Urodyn*. 2014;33(3):296-301.
14. Oelke M, De Wachter S, Drake MJ, et al. A practical approach to the management of nocturia. *Int J Clin Pract*. 2017;71(11):e13027.
15. Burton C, Weiss JP, Parsons M, Blaivas JG, Coats AC. Reference values for the Nocturnal Bladder Capacity Index. *NeuroUrol Urodyn*. 2011;30(1):52-57.
16. Bosch J, Everaert K, Weiss JP, et al. Would a new definition and classification of nocturia and nocturnal polyuria improve our management of patients? ICI-RS 2014. *NeuroUrol Urodyn*. 2016;35(2):283-287.
17. Olesen TK, Denys MA, Vande Walle J, Everaert K. Systematic review of proposed definitions of nocturnal polyuria and population-based evidence of their diagnostic accuracy. *Acta Clin Belg*. 2018;73:268-274.
18. Viaene A, Denys M-A, Goessaert A-S, et al. Evaluation of the occurrence and diagnose definitions for Nocturnal Polyuria in Spinal Cord Injured patients during rehabilitation [published online ahead of print November 3, 2017] *Eur J Phys Rehabil Med*. <http://www.ncbi.nlm.nih.gov/pubmed/29099160>
19. Goessaert AS, Krott L, Hoebeke P, Vande Walle J, Everaert K. Diagnosing the pathophysiologic mechanisms of nocturnal polyuria. *Eur Urol*. 2015;67(2):283-288.
20. Denys MA, Decalf V, Kumps C, Petrovic M, Goessaert AS, Everaert K. Pathophysiology of nocturnal lower urinary tract symptoms in older patients with urinary incontinence. *Int J Urol*. 2017;24(11):808-815.
21. Nørgaard JP, Hashim H, Malmberg L, Robinson D. Antidiuresis therapy: mechanism of action and clinical implications. *NeuroUrol Urodyn*. 2007;26(7):1008-1013.
22. Natsume O. A clinical investigation of nocturnal polyuria in patients with nocturia: a diurnal variation in arginine vasopressin secretion and its relevance to mean blood pressure. *J Urol*. 2006;176(2):660-664.
23. Asplund R, Åberg H. Diurnal variation in the levels of antidiuretic hormone in the elderly. *J Intern Med*. 1991;229(2):131-134.
24. Graugaard-Jensen C, Hvistendahl GM, Frøkiaer J, Bie P, Djurhuus JC. Urinary concentration does not exclusively rely on plasma vasopressin. A study between genders. Gender and diurnal urine regulation. *Acta Physiol*. 2014;212(1):97-105.
25. Stachenfeld NS, Splenser AE, Calzone WL, Taylor MP, Keefe DL. Sex differences in osmotic regulation of AVP and renal sodium handling. *J Appl Physiol*. 2001;91(4):1893-1901.
26. Hanna-Mitchell AT, Robinson D, Cardozo L, Everaert K, Petkov GV. Do we need to know more about the effects of hormones on lower urinary tract dysfunction? ICI-RS 2014. *NeuroUrol Urodyn*. 2016;35(2):299-303.
27. National Institute for Health and Care Excellence. Menopause: diagnosis and management: guidance and guidelines. NICE; 2015.
28. Kamperis K, Hagstroem S, Radvanska E, Rittig S, Djurhuus JC. Excess diuresis and natriuresis during acute sleep deprivation in healthy adults. *Am J Physiol Renal Physiol*. 2010;299(2):F404-F411.
29. Fantus RJ, Packiam VT, Wang CH, Erickson BA, Helfand BT. The relationship between sleep disorders and lower urinary tract symptoms: results from the NHANES. *J Urol*. 2018;200:161-166.
30. Liu F, Zhang H, Liu Y, et al. Sleep Duration interacts with lifestyle risk factors and health status to alter risk of all-cause mortality: the rural Chinese cohort study. *J Clin Sleep Med*. 2018;14(5):857-865.
31. Cappuccio FP, Miller MA. Sleep and cardio-metabolic disease. *Curr Cardiol Rep*. 2017;19(11):110.
32. Cappuccio FP, D'elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep*. 2010;33(5):585-592.
33. Tikkinen KAO, Auvinen A, Johnson TM, et al. A systematic evaluation of factors associated with nocturia--the population-based FINNO study. *Am J Epidemiol*. 2009;170(3):361-368.
34. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28(2):193-213.
35. Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med*. 1999;131(7):485-491.
36. Chung F, Yegneswaran B, Liao P, et al. STOP questionnaire: a tool to screen patients for obstructive sleep apnea. *Anesthesiology*. 2008;108(5):812-821.
37. Triarhou LC. Dopamine and Parkinson's disease. In: *Madame Curie bioscience database*. Austin, TX: Landes Bioscience; 2000-2013. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK6271/>
38. Connor JR, Wang XS, Allen RP, et al. Altered dopaminergic profile in the putamen and substantia nigra in restless leg syndrome. *Brain*. 2009;132(9):2403-2412.
39. Volkow ND, Tomasi D, Wang GJ, et al. Evidence that sleep deprivation downregulates dopamine D2R in ventral striatum in the human brain. *J Neurosci*. 2012;32(19):6711-6717.
40. Batla A, Phé V, De Min L, Panicker JN. Nocturia in Parkinson's disease: why does it occur and how to manage?. *Mov Disord Clin Pract*. 2016;3(5):443-451.
41. Suchowersky O, Furtado S, Rohs G. Beneficial effect of intranasal desmopressin for nocturnal polyuria in Parkinson's disease. *Mov Disord*. 1995;10(3):337-340.
42. Denys MA, Cherian J, Rahnama'i MS, et al. ICI-RS 2015-Is a better understanding of sleep the key in managing nocturia. *NeuroUrol Urodyn*. 2018;37:2048-2052.
43. Romain J, Torny F, Dumas JP, Gamé X, Descazeaud A. Is nocturnal polyuria more frequent among patients with Parkinson's disease? *Prog Urol*. 2015;25(6):312-317.
44. Obayashi K, Saeki K, Kurumatani N. Independent associations between nocturia and nighttime blood pressure/dipping in elderly individuals: the HEIJO-KYO cohort. *J Am Geriatr Soc*. 2015;63(4):733-738.
45. Takayama M, Omori S, Iwasaki K, et al. Relationship between nocturnal polyuria and non-dipping blood pressure in male patients with lower urinary tract symptoms [published online ahead of print May 29, 2018]. *Low Urin Tract Symptoms*. <http://doi.wiley.com/10.1111/luts.12225>
46. Kahraman A, Dursun H, Hatipoglu S, et al. Non-dipping phenomenon in children with monosymptomatic nocturnal enuresis. *Pediatr Nephrol*. 2013;28(7):1099-1103.
47. Birkenhäger AM, van den Meiracker AH. Causes and consequences of a non-dipping blood pressure profile. *Neth J Med*. 2007;65(4):127-131.



48. Stout N, Partsch H, Szolnoky G, et al. Chronic edema of the lower extremities: international consensus recommendations for compression therapy clinical research trials. *Int Angiol.* 2012;31(4):316-329.
49. Traves KP, Studdiford JS, Pickle S, Tully AS. Edema: diagnosis and management. *Am Fam Physician.* 2013;88(2):102-110.
50. O'Brien JG, Chennubhotla SA, Chennubhotla RV. Treatment of edema. *Am Fam Physician.* 2005;71(11):2111-2117.
51. Ely JW, Osheroff JA, Chambliss ML, Ebell MH. Approach to leg edema of unclear etiology. *J Am Board Fam Med.* 2006;19(2):148-160.
52. Ponikowski P, Voors AA, Anker SD, et al. 2016 ESC Guidelines for the Diagnosis and Treatment of Acute and Chronic Heart Failure. *Rev Esp Cardiol.* 2016;69(12):1167.
53. Piepoli MF, Hoes AW, Agewall S, et al. 2016 European Guidelines on cardiovascular disease prevention in clinical practice: The Sixth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts) Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J.* 2016;37(29):2315-2381.
54. Aoki Y, Yokoyama O. Metabolic syndrome and nocturia. *Low Urin Tract Symptoms.* 2012;4(s1):11-15.
55. Denys MA, Anding R, Tubaro A, Abrams P, Everaert K. Lower urinary tract symptoms and metabolic disorders: ICI-RS 2014. *Neurol Urodyn.* 2016;35(2):278-282.
56. Stegenga H, Haines A, Jones K, Wilding J, Guideline Development Group. Identification, assessment, and management of overweight and obesity: summary of updated NICE guidance. *BMJ.* 2014;349:g6608. <http://www.ncbi.nlm.nih.gov/pubmed/25430558>
57. Garvey WT, Mechanick JI, Brett EM, et al. American Association of Clinical Endocrinologists and American College of Endocrinology Comprehensive Clinical Practice Guidelines for Medical Care of Patients with Obesity. *Endocr Pract.* 2016;22(Suppl 3):1-203.
58. Shamseddin MK, Parfrey PS. Mechanisms of the cardiorenal syndromes. *Nat Rev Nephrol.* 2009;5(11):641-649.
59. Hirayama A, Torimoto K, Yamada A, et al. Relationship between nocturnal urine volume, leg edema, and urinary antidiuretic hormone in older men. *Urology.* 2011;77(6):1426-1431.
60. Torimoto K, Hirayama A, Samma S, Yoshida K, Fujimoto K, Hirao Y. The relationship between nocturnal polyuria and the distribution of body fluid: assessment by bioelectric impedance analysis. *J Urol.* 2009;181(1):219-224.
61. Fabiani M, Saponara M, eds. *Diagnosis and therapy of snoring and OSAS*. The Hague, The Netherlands: Kugler Publications; 2000:1-4.
62. Dehoorne JL, Raes AM, van Laecke E, Hoebeke P, Vande Walle JG. Desmopressin resistant nocturnal polyuria secondary to increased nocturnal osmotic excretion. *J Urol.* 2006;176(2):749-753.
63. Vande Walle J, Vande Walle C, Van Sintjan P, et al. Nocturnal polyuria is related to 24-hour diuresis and osmotic excretion in an enuresis population referred to a tertiary center. *J Urol.* 2007;178(6):2630-2634.
64. DeSalvo KB, Olson R, Casavale KO. Dietary guidelines for Americans. *JAMA.* 2016;315(5):457-458. <http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.2015.18396>
65. Luft FC. Calcium-channel-blocking drugs and renal sodium excretion. *Am J Nephrol.* 1987;7(Suppl. 1):39-43.
66. Liamis G, Milionis H, Elisaf M. A review of drug-induced hyponatremia. *Am J Kidney Dis.* 2008;52(1):144-153.
67. Andersson KE. The pharmacological treatment of nocturia. *BJU Int.* 2002;90(Suppl 3):25-27.
68. Robinson AG. DDAVP in the treatment of central diabetes insipidus. *N Engl J Med.* 1976;294(10):507-511.
69. Gudina EK, Ali K, Workicho A. Hyponatremia in patients hospitalized with heart failure: a condition often overlooked in low-income settings. *Int J Gen Med.* 2016;9:267-273.
70. Robinson D, Hanna-Mitchell A, Rantell A, Thiagamoorthy G, Cardozo L. Are we justified in suggesting change to caffeine, alcohol, and carbonated drink intake in lower urinary tract disease? Report from the ICI-RS 2015. *Neurol Urodyn.* 2017;36(4):876-881.
71. Sothorn RB, Vesely DL, Kanabrocki EL, et al. Circadian relationships between circulating atrial natriuretic peptides and serum sodium and chloride in healthy humans. *Am J Nephrol.* 1996;16(6):462-470.
72. Dumoulin C, Hunter KF, Moore K, et al. Conservative management for female urinary incontinence and pelvic organ prolapse review 2013: summary of the 5th International Consultation on Incontinence. *Neurol Urodyn.* 2016;35(1):15-20.
73. Liu J, Sharma N, Zheng W, et al. Sex differences in vasopressin V2 receptor expression and vasopressin-induced antidiuresis. *Am J Physiol Renal Physiol.* 2011;300(2):F433-F440.
74. Juul KV, Klein BM, Sandström R, Erichsen L, Nørgaard JP. Gender difference in antidiuretic response to desmopressin. *Am J Physiol Renal Physiol.* 2011;300(5):F1116-F1122.
75. Yamaguchi O, Nishizawa O, Juul KV, Nørgaard JP. Gender difference in efficacy and dose response in Japanese patients with nocturia treated with four different doses of desmopressin orally disintegrating tablet in a randomized, placebo-controlled trial. *BJU Int.* 2013;111(3):474-484.
76. Carrel L, Willard HF. X-inactivation profile reveals extensive variability in X-linked gene expression in females. *Nature.* 2005;434(7031):400-404.
77. George E, Burke W, Hou J, et al. Measurement and validation of frailty as a predictor of outcomes in women undergoing major gynecologic surgery. *BJOG.* 2016;123(3):455-461.
78. Cesari M, Abellan Van Kan G, Ariogul S, et al. The European Union Geriatric Medicine Society (EUGMS) working group on frailty in older persons. *J Frailty Aging.* 2013;2(3):118-120.
79. Goessaert A-S, Everaert K, Hoebeke P, Vande Walle J. Pharmacokinetics and pharmacodynamics of the oral disintegrating tablet of desmopressin in adults with nocturnal polyuria: a pilot study. *Adv Ther.* 2015;32(9):799-808.

## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**How to cite this article:** Everaert K, Hervé F, Bosch R, et al. International Continence Society consensus on the diagnosis and treatment of nocturia. *Neurourology and Urodynamics.* 2019;38: 478-498. <https://doi.org/10.1002/nau.23939>

## International continence society white paper regarding female genital mutilation/cutting

Christopher K. Payne MD<sup>1</sup> | Jasmine Abdulcadir MD, PD, FECSM<sup>2</sup> |

Charlemagne Ouedraogo MD<sup>3</sup> | Sebastien Madzou MD<sup>4</sup> |

Fasnéwindé Aristide Kabore MD<sup>5</sup> | Elise JB De MD<sup>6</sup>  |

Ethics Committee of the International Continence Society

<sup>1</sup> Department of Urology, Stanford University Medical School, Stanford, California

<sup>2</sup> Department of Gynecology and Obstetrics, Geneva University Hospitals, Faculty of Medicine, UNIGE, Geneva, Switzerland

<sup>3</sup> Department of Obstetrics and Gynecology, Centre Hospitalier Universitaire de Bogodogo, Ouagadougou, Burkina Faso

<sup>4</sup> Department of Obstetrics and Gynecology, Pole Femme Mere Enfants, Angers, France

<sup>5</sup> Department of Urology, Université de Ouagadougou, Centre Region, Burkina Faso

<sup>6</sup> Department of Urology, Massachusetts General Hospital, Boston, Massachusetts

### Correspondence

Elise JB De, MD, Massachusetts General Hospital—Harvard Medical School, Department of Urology, 55 Fruit Street, Boston MA 02114.  
Email: ede@mgh.harvard.edu

Female genital mutilation/cutting (FGM/C)—also known as Female Genital Cutting or Mutilation—is defined as the partial or total removal of the female external genitalia for non-therapeutic reasons. This White Paper, prepared under the auspices of the International Continence Society (ICS), is intended by the ICS as a statement promoting the abandonment of this practice. The ICS also supports the respectful and evidence-based care or treatment of women and girls already affected by FGM/C, in keeping with the World Health Organization (WHO) Guidelines on the Management of Health Complications from Female Genital Mutilation.<sup>1</sup> Our members specialize in pelvic floor disorders from perspectives within a range of specialties; we encounter and treat women living with FGM/C and its consequences—particularly incontinence, infections, voiding dysfunction, sexual dysfunction, chronic pelvic pain, and obstetric trauma. Understanding the ethical, sociocultural, medical and surgical factors surrounding FGM/C is central to caring for women and girls with a history of FGM/C. The ICS voices herein state strong opposition to FGM/C. We encourage members to apply their skills to improve prevention strategies and the management of those affected.

### KEYWORDS

circumcision, complications, cutting, defibulation, female genital mutilation, public health

## 1 | INTRODUCTION

Female Genital Mutilation (FGM/C), in its official World Health Organization Definition, “comprises all procedures that involve the partial or total removal of external genitalia or other injury to the female genital organs for non-medical

reasons.”<sup>1</sup> FGM/C is distinguished from female genital cosmetic surgery by consensual and other factors, as discussed below. This paper specifically addresses non-consensual procedures, which are for the most part performed on minors. There are no health benefits to FGM/C. FGM/C violates basic human rights. In addition there are significant immediate and long-term risks associated with FGM/C including obstetric, neonatal, urologic, gynecologic, infectious, sexual, and psychological health consequences as outlined below. FGM/C is a deeply ingrained sociocultural practice in many countries. The practice is seen within a range

Institutions: The writing was performed at all of the above institutions as well as Albany Medical Center.

Funding: None.

*Neurourology and Urodynamics*. 2019;1–11.

wileyonlinelibrary.com/journal/nau

© 2019 Wiley Periodicals, Inc. | 1

of cultures and ethnicities, and within Muslim, Animist, and Christian societies. However, it predates the Islamic and Christian religions and mention is absent from both the Koran and the Bible. Explanations for the practice may include safeguarding virginity, aesthetics, prevention of rape, ensuring fidelity—and therefore social acceptance, family honor and marriageability—and establishing ethnic identity.<sup>1</sup>

The ICS position is that:

1. FGM/C should be prevented and progressively eradicated.
2. Healthcare professionals should not perform FGM/C, as medicalization<sup>1</sup> of the practice does not prevent many of the complications. Healthcare professionals should be trusted promoters of prevention/abandonment of the practice and care of already affected women and girls.
3. FGM/C complications should be screened, recognized, treated, and recorded appropriately and ultimately prevented.

### 1.1 | Status of FGM/C

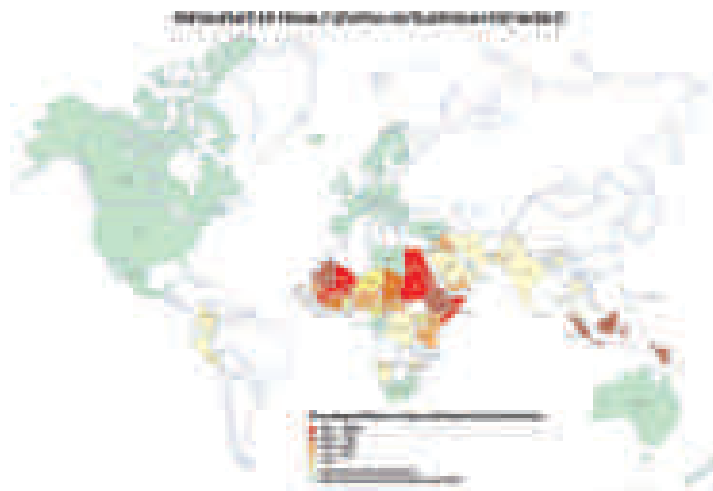
FGM/C is in fact illegal in many countries (Figure 1). However, FGM/C is still practiced in approximately 30 countries around the world,<sup>2</sup> including many where outlawed.<sup>3</sup> An estimated 200 million women have undergone FGM/C to date.<sup>3</sup> A 2013 UNICEF report estimated another 30 million girls are at risk in the coming decade.<sup>3</sup> The vast majority of FGM/C occurs in children prior to the age of 15.<sup>3</sup> Cultural factors continuing the practice of FGM/C are not simple to change and will be explored below.

The WHO classification distinguishes four basic types of FGM/C with subclassifications (See Figure 2). These

comprise a wide range of practices from the excision of the labia with or without the external part of the clitoris, with or without covering/narrowing the introitus, to performing genital piercing, pricking or stretching. Research shows that women can accurately answer whether they have undergone FGM/C; therefore, simple surveys can provide reasonable estimates of prevalence.<sup>4,5</sup> For the most part, women who have undergone FGM/C cannot correctly identify specifically what was done to them; this is not at all surprising as in many countries the majority of girls are cut before age five. Accurate classification requires examination by a trained observer (a visual reference and learning tool describing the WHO classification, including a video, has been published<sup>6</sup>). Proper classification, recording, and coding may have value clinically to individuals living with FGM/C as well as in research efforts to understand risks associated with the condition, optimal treatments, and in communication for academic and clinical endeavors. Classification is important for epidemiological and statistical purposes, for example, to study changing trends of the practice and the quality of care provided to patients. For example, following campaigns aimed at abandoning FGM/C, there is evidence that FGM/C may be performed at an earlier age and/or in a milder form.<sup>3,7</sup>

### 1.2 | FGM/C should be prevented and ultimately eradicated

It is the position of the ICS that FGM/C should be prevented and thereby eradicated. There are no studies showing any medical benefit to any form of FGM/C. FGM/C causes



**FIGURE 1** Prevalence of Female Genital Mutilation in the world. Courtesy of GAMS, based on DHS, MICS March 2016 and other nationally representative surveys, ©GAMS Belgium <http://gams.be>



**FIGURE 2** Classification of FGM/C. Photos courtesy Jasmine Abdulcadir. Drawings reprinted from World Health Organization. WHO guidelines on the management of health complications from female genital mutilation. <https://www.who.int/reproductivehealth/topics/fgm/management-health-complications-fgm/en/> Geneva (Switzerland): World Health Organization; 2016. Box 1.1 pages 2, 3, 4 (drawings of FGM types). (A) FGM Type Ia. (B) FGM Type Ib. (C) FGM Type IIa. (D) FGM Type IIb. (E) FGM Type IIc. (F) FGM Type IIIa. (G) FGM Type IIIb. (H) FGM Type IV.

significant immediate and long term complications. Most importantly, FGM/C is a violation of basic human rights.

### 1.2.1 | FGM/C violates human rights

As the WHO Guidelines state, “FGM/C violates a series of well-established human rights principles, including the principles of equality and non-discrimination on the basis of sex, the right to life when the procedure results in death, and the right to freedom from torture or cruel, inhuman or degrading treatment or punishment, as well as the rights of the child.” Many other international human rights organizations have called for an end to the practice, including the United Nations Populations Fund (UNFPA)/United Nations International Children’s Emergency Fund (UNICEF),<sup>8</sup> the United Nations Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW), the United Nations Convention on the Rights of the Child (CRC), and the Protocol on the Rights of Women in Africa (“the Maputo Protocol”), and the Pan African Parliament (PAP)<sup>9</sup> among others.<sup>10</sup>

### 1.2.2 | Immediate morbidity and mortality of FGM/C

There are no reliable estimates of the morbidity and mortality attributable to FGM/C. Only a portion of the most serious complications ever reach medical attention. Nevertheless, given that the procedures are performed forcibly on young girls who are generally unaware of what will happen, and (the vast majority of the time) without the benefit of anesthesia, it is reasonable to assume that nearly all suffer pain and psychological trauma and that all are at risk of serious adverse events. Most subjects will experience bleeding. In many this will be physically and/or emotionally significant; hemorrhage and death can occur.<sup>11</sup> In a large majority of countries traditional practitioners without medical training do the cutting, typically using crude instruments (Figure 3). The lack of sterile environment and proper antiseptics leads to a risk of tissue infection, sepsis, and even death from infection. Tetanus is a particular risk given the circumstances and the lack of uniform national vaccination programs. Urinary tract infections also occur. There can be inadvertent injury to the urethra or even the



**FIGURE 3** Representative instruments used for typical FGM/C. Courtesy Charlemagne Ouedraogo

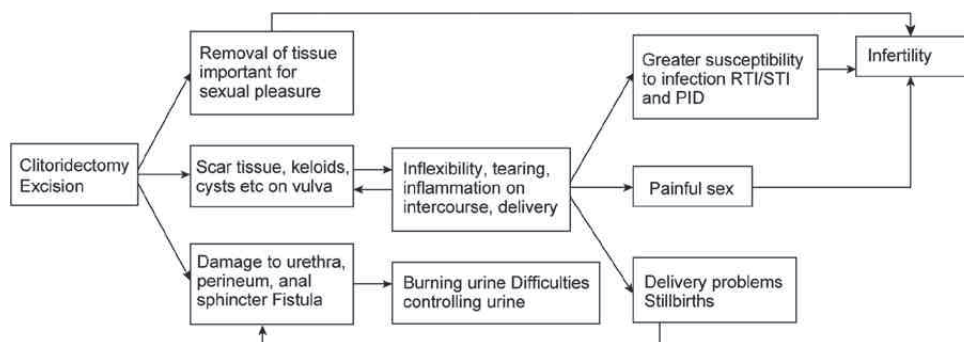
rectum. Swelling and pain can produce acute urinary retention. Although unquantified, these risks are potentially serious and substantial. They are not offset by any type of benefit.

### 1.2.3 | Long-term consequences of FGM/C

Damage caused by FGM/C can have a domino effect leading to many long-term consequences as presented in Figure 4. In 2005, a systematic review regarding the health consequences of FGM/C was published, noting difficulty in study design and capturing the data.<sup>12</sup> Observation itself is complex in limited health delivery systems; reporting may not be accurate (observers or subjects may not identify the FGM/C type correctly); sampling bias is present on multiple levels (incidence of complications, time of data collection, difficulty in finding comparison groups); and confounders abound (FGM/C effect vs poor medical care). Regardless, ICS specialists should be familiar with the spectrum of possible complications following FGM/C, and be prepared to screen, diagnose, record, code and manage them. The WHO has

published a detailed handbook “Care of Girls and Women Living with Female Genital Mutilation” (<http://www.who.int/reproductivehealth/publications/health-care-girls-women-living-with-FGM/en/>) which covers each of these topics as well as the general approach to these patients.

1. Obstetric and Neonatal complications: FGM/C, particularly type III, includes an increased rate of adverse obstetric<sup>13</sup> and neonatal<sup>14</sup> outcomes including hemorrhage, obstructed labor, perineal tears and stillbirth.<sup>15</sup> FGM/C may contribute to the obstetric factors leading to fistula. A 2006 multicenter study by the WHO showed increased relative risks for: cesarean delivery (RR 1.31), postpartum hemorrhage (RR 1.69), extended maternal hospital stay (RR 1.98), infant resuscitation (RR 1.66), and stillbirth or early neonatal death (RR1.55).<sup>16</sup> A secondary analysis of such data showed that women with FGM/C had an increased risk of C-section performed for unclear indications, probably due to a lack of training of providers in performing defibulation or in managing FGM/C.<sup>17</sup> A large systematic review and meta-analysis written in the USA and Europe in 2014<sup>14</sup> as well as a prior review from 2005<sup>12</sup> corroborated these findings. Several studies performed on obstetric outcome after FGM/C in high income countries show that with trained and appropriate management, such risks can be significantly reduced and controlled.<sup>18–20</sup> Educational material on deinfibulation has been published and is available online.<sup>21</sup> A great concern in managing a pregnant woman with FGM/C, particularly Type II and III, is perineal tearing. More recent studies and secondary analysis of the 2006 WHO paper showed that the high rate of C-section in FGM/C seems related to inappropriate indications for the C-section. This probably relates to unfamiliarity of providers concerning defibulation during/outside pregnancy or in labor and a low threshold for Cesarean for women with FGM/C. One study showed that there was no



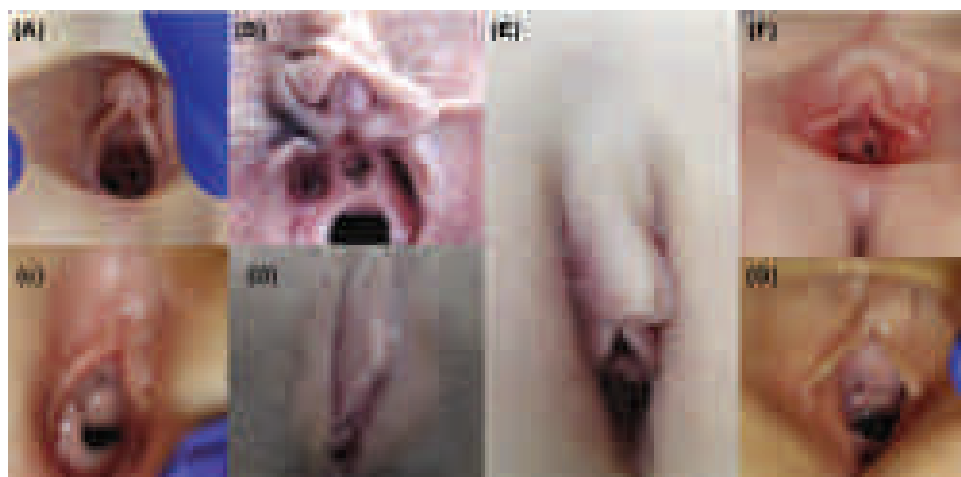
**FIGURE 4** Conceptual framework for long term consequences of FGM/C. Reproduced from Morison L, Scherf C, Ekpo G, Paine K, West B, Coleman R, Walraven G. The long-term reproductive health consequences of female genital cutting in rural Gambia: a community-based survey. *Tropical Medicine and International Health* 2001 6(8) 643–653

difference in the incidence of strong medical indications for C-section between women with and without FGM/C. However, C-sections were performed more often on women with FGM/C lacking a clear medical indication in relation to various maternal factors or arrest disorders.<sup>16</sup> Another study found that episiotomies were protective against anal sphincter tears and post-partum hemorrhage after Type III FGM/C, however in this study it is unclear if an associated defibulation was also performed.<sup>22</sup> Routine episiotomy is not currently recommended for women with FGM/C in the 2016 WHO guidelines,<sup>i</sup> however a lower threshold for episiotomy is recommended in this group.<sup>23</sup>

2. Urinary tract complications: Lower urinary tract complications are of special concern to ICS members and are prevalent following FGM/C.<sup>24</sup> Damage to the urethra at the time of FGM/C is common due to its intimate relation to the clitoris and labia<sup>25</sup> (Figures 5 and 6)—the cephalad apex of the clitoral hood is only 12 mm from the urethral orifice at age 0–3 and 17 mm at age 4–8.<sup>26</sup> Urethral injuries result in scarring/stricture/stenosis and subsequent lower urinary tract dysfunction. Unfortunately, good data on urinary complications is lacking. ICS membership could contribute in research initiatives. A 2005 systematic review reported significant prevalence of dysuria (58–64%), urinary retention (12–70%), urinary tract infection including recurrent UTI (2–38%), incontinence (6%) and unspecified urinary symptoms (15–25%).<sup>12</sup> Another group recruited 251 patients specifically to investigate lower urinary tract symptoms (LUTS). They found at least one LUT symptom was present in 38.8% of women. Nocturia was reported in 38.6%, intermittency in

23.5%, and incomplete voiding in 22.7%, with all three reported in 11.6% of the women. Women with a history of Type II and Type III FGM/C had a significantly higher risk of reporting all 3 LUTS than those with Type I.<sup>27</sup>

3. Infections: Infection is common in the short term after FGM/C.<sup>28</sup> A Tetanus is a serious potential risk and can even cause death after FGM/C in regions where no vaccination/immunoglobulins are available. In the long term, as noted above, girls and women may be at increased risk of urinary tract infections after FGM/C. However, other serious infections including HIV are also possible long-term sequelae as described in a 2013 systematic review.<sup>29</sup> More infections were identified in those with Type III FGM/C.<sup>29</sup>
4. Mental health problems: Women living with FGM/C suffer from psychiatric disorders significantly more commonly than their peers without this history.<sup>30</sup> A small study of Senegalese women who had undergone FGM/C found that over 90% of women recalled their cutting as “appalling and extremely traumatizing” with 30% developing posttraumatic stress disorder and another 47% suffering from other psychiatric disorders.<sup>31</sup> Appreciation of the potential psychiatric sequelae is vital to the approach to many women with FGM/C. However, it is also important for ICS specialists to consider that many women are capable of coping with the impediments and may regard the ritual as “normal” or even enhancing their gender identity or body image rather than a sickness. The experience and memories of FGM/C as well as coping strategies can differ according to the age, conditions, type and consequences of the practice. Diversity in interpreting



**FIGURE 5** Observed clitoral anatomy in the pediatric population. Observed clitoral hood shapes: a) horseshoe; b) trumpet; c) coffee bean; d) tent; and examples of convergence of labia minora under glans and intersection with clitoral hood (e, f, g). Reprinted with permission from Journal of Pediatric Urology, 12/177.e1-177.e6. Brodie KE, Grantham EC, Huguete PS, Caldwell BT, Westfall NJ, Wilcox DT. Study of the clitoral hood anatomy in the pediatric population. pp e1-e6 (2016), with permission from Elsevier



**FIGURE 6** Percentage distribution of ages at which girls have undergone FGM (as reported by their mothers). United Nations Children's Fund, Female Genital Mutilation/Cutting: A statistical overview and exploration of the dynamics of change, UNICEF, New York, 2013

events and the level of remembrance is crucial for experiencing psychopathology.<sup>32</sup> Migration and a different sociocultural setting can make women more aware of their FGM/C; a woman previously well adapted to her experience may then feel stigmatized, socially excluded or ashamed.<sup>33</sup> To avoid contributing to these feelings, ICS specialists will benefit women with FGM/C by approaching care in a neutral manner. Appropriate therapy interventions should be considered for those who are experiencing symptoms consistent with anxiety disorders, depression or post-traumatic stress disorder (PTSD).

5. **Sexual Dysfunction:**<sup>34</sup> There are many research gaps regarding sexual function after FGM/C, especially with regards to type of FGM/C and the specific effects of clitoral involvement.<sup>35</sup> A systematic review of sexual consequences of FGM/C representing 12 671 women reported that those with a history of FGM/C were 52% more likely to have dyspareunia and greater than twice as likely to lack desire versus women without a history of FGM/C.<sup>36</sup> Some forms of FGM/C involve excision of the glans or the glans and part of the body of the clitoris. However, the remaining tumescent sexual structures (the body or part of the body; the crura of the clitoris and the vestibular bulbs and the corpus spongiosum of the urethra) are not involved by the cutting. Because of this, women may still

experience sexual pleasure and orgasm, provided other physical or psychological effects do not interfere.<sup>37</sup> The presence and severity of sexual dysfunction can vary greatly and depends on the specific tissues involved, eventual complications, and on biopsychosocial factors that have to be addressed to treat sexual dysfunction after FGM/C. Dyspareunia among women with FGM/C type III can often be treated with defibulation. Clitoral pain and dyspareunia due to post-traumatic neuromas, cysts, adhesions/synechiae or obstetric trauma can be approached surgically. Pelvic floor muscle dysfunction can be treated with pelvic floor physical therapy. Culturally sensitive sexual health counseling (including education on anatomy and the sexual response) is recommended for both those living with FGM/C and their partners.

6. **Other Gynecologic Problems:** Dysmenorrhea can result from obstructed drainage. Infertility can result from ascending genital infection. Chronic vulvar pain can be a long-term outcome of FGM/C.
7. **Effects of FGM/C on Men:** FGM/C can also affect men negatively within a marriage, and thereby becomes an issue pertaining to them.<sup>38–40</sup> A Sudanese study of married men ( $n = 59$ ) found that most expressed difficulty with vaginal



penetration, wounds or infections on the penis, and psychosexual problems.<sup>39</sup> The majority perceived their wives' suffering as their own problem, and most stated they would have preferred to be married to "uncut" women. According to UNICEF, 67% of women in 29 countries and 63% of men in 18 countries, all aged 15–49 and who are aware of FGM/C believe it should stop.<sup>41</sup> Wahlberg and Johnsdotter demonstrated that most Somali immigrants, including those newly arrived, opposed all forms of FGM/C with increased opposition over time after migration.<sup>42</sup> O'Neill surveyed immigrants in three European countries and found that most men and women reported that FGM/C affected their sex lives in a negative way.<sup>43</sup>

### 1.3 | Healthcare professionals should not perform FGM/C

The ICS stands firmly against all forms of FGM/C as defined at the outset—those non-consensual procedures mostly performed on minors (and less commonly unconsenting adults). This extends to medicalization<sup>1</sup> of FGM/C where such procedures may be performed by professionals with varying degrees of surgical training, with clean instruments and in safer settings. While it is probable that medicalization can reduce some FGM/C complications such as acute infection, it does not prevent the long-term complications. Most importantly, healthcare professionals should be the trusted promoters of prevention/abandonment of the practice and of sexual and reproductive health literacy as well as the healthcare of women and girls already affected by FGM/C.

The aim of the paper does not extend to address the complex and sometimes controversial issues surrounding adult women who request various forms of genital surgery, including reinfibulation and female genital cosmetic surgery. Several researchers are addressing these topics from a legal, medical, social and ethical perspective. Conflicts between the important principle of autonomy and concerns about coercion or social pressure are not easily resolved. The long-term consequences of such surgery are not easily identified and become more nuanced when taken in a sociocultural context. Male circumcision and the concept of "genital autonomy" in intersex conditions are similarly complex issues—the ICS recognizes these as important discussions but beyond the scope of this work.

### 1.4 | FGM/C complications should be screened and recognized, treated appropriately and ultimately prevented

#### 1.4.1 | Screening for FGM/C

The first step in management is to screen and recognize the FGM/C and its eventual complications. In a study in Eastern

Sudan, only 7% of midwives could identify the four types of FGM/C correctly, whereas 81% had practiced the procedure, and in Alexandria, only 7% of nurses could identify the types; in both studies there was little knowledge among these practitioners regarding the medical consequences of the procedure and the majority planned to continue the practice.<sup>44,45</sup> Similar findings have been reported in diaspora countries; therefore, it behooves ICS members to be aware of the condition and to be prepared to identify and care for these patients.<sup>46</sup> As mentioned above, women who have experienced FGM/C may not know what unaltered anatomy looks like, what type of FGM/C they have personally experienced, and the current symptoms may be so remote from the FGM/C that they do not associate the cause and effect.<sup>47</sup>

#### 1.4.2 | Treatment of FGM/C

The WHO Handbook "Care of Girls and Women Living with Female Genital Mutilation" (<http://www.who.int/reproductivehealth/publications/health-care-girls-women-living-with-FGM/en/>) provides excellent advice to the clinician managing FGM/C patients. However, there is a relative paucity of information in many areas. A primary role for the ICS lies in improving training of its members and in sharing research and expertise, workforce, and resources to improve the care of women with FGM/C. We envision:

- Working with providers in high prevalence areas and diaspora countries to design prospective clinical trials that will inform future care.
- Supporting high quality training for front-line ob-gyn, urologists, pediatricians, general practitioners, infectious disease specialists and surgeons in managing complications of FGM/C, offering defibulation and reconstructive techniques.
- Sharing knowledge through regional meetings and via on-line educational resources.
- For those who wish to submit educational material for ICS online content are invited to submit according to the Standard Operating Procedures for format: <https://www.ics.org/committees/education/icssops>

#### 1.4.3 | Prevention of FGM/C

We need to understand the socio-cultural milieu that supports the practice of FGM/C if we are to prevent it. The most effective and durable change will arise from within the practicing societies rather than being imposed upon them. FGM/C stems from long-standing socio-cultural mores; therefore, efforts toward eradication must align

with cultural factors perpetuating the practice. The updated 2013 UNICEF statistical overview emphasizes the challenging dynamics of cultural change, noting according to social science research it “is difficult for individual families to stop the practice on their own. There is a social obligation to conform to the practice and a widespread belief that if they do not, they are likely to pay a price that could include social exclusion, criticism, ridicule, stigma or the inability to find their daughters suitable marriage partners.”<sup>3</sup> According to Mpofu and colleagues, the practice of FGM/C is deeply embedded in social and cultural traditions dating back generations. Over time, interventions have failed to understand the complexities surrounding the practice.<sup>48</sup> “Most campaigns against FGM/C have come about from a viewpoint of outrage, disgust and condemnation, and therefore are seen as a direct and aggressive attack on a people's core values, beliefs and traditions which have been a part of their very existence for generations<sup>49–51</sup>” and can lead to further stigmatization of girls and women who have already undergone FGM/C. “FGM/C is said to enhance marriageability, fertility, and to promote purity or virginity of a woman,<sup>52–54</sup> and is also said to “...temper female sexual urges thereby preserving a girl's virginity for marriage.”<sup>50,55</sup>...The belief in the protection of female virtue goes hand in hand with upholding family status and dignity! When one is [circumcised], it is a symbol of entry into womanhood and marks that one fully belongs to a community.” Marriage and reproduction are essential to the long term economic and social security of most women, and FGM/C is regarded in many communities as a normal and acceptable part of raising the girl child.

Programs aimed at preventing FGM/C and its consequences must therefore:

- Be strongly based on facts and evidence as opposed to aversion and disgust
- Evolve from cultural understanding within the society rather than being imposed from outside.
- Avoid stigmatizing the girls and women who have already undergone FGM/C.

The evidence discussed above regarding the effects of FGM/C on men and the changing attitudes of many immigrants are promising, as they may allow strategies to lift the social obligation of FGM/C, once proper dialogue between genders and within community hierarchies can occur. UNICEF<sup>3</sup> has been developing programs in consultation with communities. These participatory programs have a greater impact as individuals within the community state publicly they will not practice FGM/C, and they then educate others. According to WHO, however, programs that educate women and girls about

their bodies and their rights are very rare.<sup>56</sup> According to UN estimates, most young people lack access to education about their bodies and the impact of FGM/C.<sup>57</sup> WHO recommends that to have the most responsible impact, preventing unintended alienation and retraumatization, educational interventions should be evidence-informed and scientifically accurate, non-prejudicial, non-judgmental, sensitive and respectful, non-stereotypical, and when involving adolescents, geared toward their evolving capacities. A culturally integrated educational approach will favor these goals. Mpofu highlights select programs that emphasize the healthy portions of the coming-of-age rituals associated with FGM/C, teaching girls about the responsibilities associated with adult and married life, while omitting the FGM/C itself.

The fundamental question at hand remains: how can FGM/C be most effectively prevented? Although in decline, it remains distressingly prevalent. The Pan African Parliament (PAP) has recently joined the U.N. Population Fund (UNFPA) in an action plan to ban FGM/C for the whole continent. This is a promising legal and cultural statement on the part of the Parliament. The initiative includes legislation, community mobilization, advocacy, and recruitment of men to speak out against FGM/C.<sup>9</sup> There is some evidence that changing hearts and minds at the community level will ultimately be the most effective strategy.<sup>58</sup>

Looking more closely at specific countries country will highlight the complexity of changing the practice of FGM/C. The prevalence in Kenya decreased from 41% in 1984 to 11% in 2014 (however, these numbers differ from those in Mpofu's study). In 2001, the Kenyan government outlawed the practice, passing the Children's Act.<sup>59</sup> Further, in 2011 it passed the Prohibition of Female Genital Mutilation Act. Lastly, successful public education campaigns have led to relief of social pressures—for example, young men have had an impact by publicly declaring their preference to marry a woman who has not undergone FGM/C.<sup>60</sup> In 1990 Burkina Faso formed the Committee to Fight the Practice of Excision (Comité National de lutte contre la Pratique De l'excision, CNLPE). In November 1996 a penal code was adopted forbidding female genital mutilation, threatening imprisonment of 6 months to 3 years and large fine for all forms of FGM/C. In addition, special emphasis is placed on education of the girl so that in adulthood, she does not seek FGM/C for her daughters. The CNLPE instituted campaigns of sensitization regarding FGM/C; policemen were trained to intervene in keeping with the law; the subject of FGM/C became part of scholastic programs; and women who had endured complications linked to FGM/C were treated free of charge in certain health initiatives identified by CNLPE, in line with WHO Guidelines. A free telephone line called “SOS Excision” (SOS Female genital cutting), was set up to

gather real-time information on the acts of mutilation. According to UNICEF<sup>xi</sup>, the prevalence of FGM/C in Burkina Faso declined from 89% in 1980 to 58% in 2010 (however, not unlike Kenya, according to internal statistics, the prevalence of FGM/C may remain significant: 76 % [EDSBF-MICS IV 2010]).<sup>61</sup> The persistent high prevalence, although decreasing and lower than some surrounding countries, is likely multifactorial—including the low level of population education (30% literacy), the persistence of traditional practices impacting the health of women overall (eg, beliefs impacting nutrition during pregnancy), and inadequate funding for the permanent implementation of the national strategy against FGM/C. The continued high incidence of FGM/C in Burkina Faso, Kenya, and other countries also calls into view the complexity of criminalization. It is possible that this strategy may have a diminished effect by driving the practice underground instead of into the light. It is certain that work across health care disciplines in cooperation with government and non-government organizations engaging community leadership will be required for optimal results.

Medical professionals can help prevent FGM/C by providing healthy, non-judgmental messages in every interaction. For example:

- offer health education on FGM/C during pregnancy (preparing for the issue to arise if the future child is a girl),
- primary doctors must build trusting relationships, including the father or other important family elders and exploring the beliefs of the family,
- pediatricians must discuss this issue with parents over time,
- doctors can provide safeguarding/protection measures according to the local laws in case of real and immediate risks.

## 2 | CONCLUSION

FGM/C is relevant to all who practice pelvic medicine, as understanding the unique health issues significantly impacts care for this population. The ICS position on FGM/C is that it should never be performed in any form on a girl or non-consenting woman. ICS members can educate themselves and others on the practice. Those with significant experience in caring for women with FGM/C can offer information, health education, reconstructive and rehabilitative services to women and girls with a history of FGM/C experiencing urogynecological, infectious, obstetric, sexual and functional pelvic floor consequences. A respectful, neutral, non-judgmental, non-stigmatizing and trained approach should be the tone of the individual patient interaction.

The International Continence Society is uniquely positioned to promote the care for women and girls living with FGM/C. Although a smaller percentage of our members have significant experience in managing patients with FGM/C, as a multidisciplinary, international society, we have significant reach with educational needs around the world. We can lend our expertise to many of the preventative and cure needs such as obstetric trauma, urogynecological and psychosexual consequences. Our expertise in education, research methodology, complex reconstructive surgery, nursing, physiotherapy, psychosexual issues can be of great value. We will start by providing educational opportunities to our members so that they can develop appropriate sociocultural, rehabilitative (including physiotherapy), medical and surgical knowledge of the topic.

ICS and its Members will lend support and act to:

### 1) Educate:

- Support the work of practitioners treating high volumes of patients with FGM/C throughout the world through assistance in creating, presenting, filming and distributing educational material (See [www.ics.org/tv](http://www.ics.org/tv), <http://www.ics.org/committees/education/icssops>).
- Educate health care workers, patients, and communities regarding FGM/C—raising awareness, exploring medical, ethical and cultural issues, consequences of FGM/C, and management.
- Work within communities to engage women and men regarding the medical risks of FGM/C and to lift the myths perpetuating this practice.

### 2) Research:

- Lend our expertise to define the benefits and risks of post-FGM/C intervention, and to further characterize the health consequences.
- Support and/or conduct studies to define optimal care of those with FGM/C.

### 3) Provide Care:

- Provide neutral, clear, non-alienating information to women and girls who have experienced FGM/C regarding its meaning to her individual situation, and options for care.
- To provide holistic care always, high quality reconstructive surgery where appropriate, and to support colleagues in high prevalence areas of the world when opportunities arise.

### 4) Advocate:

- Partner with affected women and girls and other associations regarding FGM/C.
- Promote government support for medical care of women who have had FGM/C, including culturally fluent psychological care.
- Work within communities to promote the healthy coming-of-age rituals associated with FGM/C while removing the permanently damaging risks associated with FGM/C.

## CONFLICTS OF INTEREST

No conflicts of interest.

## ORCID

Elise JB De  <http://orcid.org/0000-0003-0730-9038>

## REFERENCES

1. WHO guidelines on the management of health complications from female genital mutilation. Geneva: World Health Organization; 2016. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK368483/>
2. Female genital mutilation/cutting: a global concern. Geneva: UNICEF; 2016 (<http://data.unicef.org/resources/female-genitalmutilation-cutting-a-global-concern.html>, accessed 26 April 2016).
3. Female genital mutilation/cutting: a statistical overview and exploration of the dynamics of change. New York: United Nations Children's Fund; 2013 (<https://data.unicef.org/resources/female-genital-mutilation-cutting-a-statistical-overview-and-exploration-of-the-dynamics-of-change-executive-summary/>, accessed 22 September 2018).
4. Elmusharaf F, Elhadi N, Almroth L. Reliability of self-reported form of female genital mutilation and WHO classification: cross sectional study. *BMJ Online First*. 2006;333:124.
5. Bjalkander O, Grant DS, Berggren V, Bathija H, Almroth L. Female genital mutilation in Sierra Leone: forms, reliability of reported status, and accuracy of related demographic and health survey questions. *Ob Gyn Int*. 2013;2013:680926.
6. Abdulcadir J, Catania L, Hindin MJ, Say L, Petignat P, Abdulcadir J. Female Genital Mutilation: a visual reference and learning tool for health care professionals. *Obstet Gynecol*. 2016;128:958–963.
7. Bettina Shell-Duncan, Carolyne Njue, and Zhuzhi Moore “The Medicalization of Female Genital Mutilation /Cutting: What do the Data Reveal?” February 2017,” Evidence to End FGM/C: Research to Help Women Thrive. New York: Population Council.
8. 2014 Annual Report of the UNFPA-UNICEF Joint programme on female genital mutilation/cutting <http://www.unfpa.org/publications/2014-annual-report-unfpa-unicef-joint-programme-female-genital-mutilationcutting>
9. <http://www.ipsnews.net/2016/08/pan-african-parliament-endorses-ban-on-fgm/>
10. Article 5: Elimination of harmful practices. In: Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa. Maputo; African Commission on Human and Peoples' Rights; 2003 ([http://www.achpr.org/files/instruments/women-protocol/achpr\\_instr\\_proto\\_women\\_eng.pdf](http://www.achpr.org/files/instruments/women-protocol/achpr_instr_proto_women_eng.pdf), accessed 4 April 2016).
11. <https://www.irishtimes.com/news/world/africa/we-ve-seen-too-many-girls-bleed-to-death-eradicating-fgm-in-uganda-1.3382765>
12. Obermeyer CM. The consequences of female circumcision for health and sexuality: an update on the evidence. *Cult Health Sex*. 2005;7:443–461.
13. WHO study group on female genital mutilation and obstetric outcome, Banks E, Meirik O, et al. Female genital mutilation and obstetric outcome: WHO collaborative prospective study in six African countries. *Lancet*. 2006;367:1835–1841.
14. Berg RC, Odgaard-Jensen J, Fretheim A, Underland V, Vist G. An updated systematic review and meta-analysis of the obstetric consequences of female genital mutilation/cutting. *Obstet Gynecol Int*. 2014;542859.
15. <http://www.who.int/mediacentre/factsheets/fs241/en/>
16. Banks E, Meirik O, Farley T, Akande O, Bathija H, Ali M. WHO studygroup on female genital mutilation and obstetric outcome Female genital mutilation and obstetric outcome; WHO collaborative prospective study in six African countries. *Lancet*. 2006;367:1835–1841.
17. Rodriguez MI, Say L, Abdulcadir J, Hindin MJ. Clinical indications for cesarean delivery among women living with female genital mutilation. *Int J Gynaecol Obstet*. 2017;139:21–27.
18. Varol N, Dawson A, Turkmani S, et al. Obstetric outcomes for women with female genital mutilation at an Australian hospital, 2006–2012: a descriptive study. *BMC Pregnancy Childbirth*. 2016;16:328.
19. Abdulcadir J, Dugerdil A, Yaron M, Irion O, Boulvain M. Obstetric care of women with female genital mutilation attending a specialized clinic in a tertiary center. *Int J Gynaecol Obstet*. 2016;132:174–178.
20. Wuest S, Raio L, Wyssmueller D, et al. Effects of female genital mutilation on birth outcomes in Switzerland. *BJOG*. 2009;116:1204–1209.
21. Abdulcadir J, Marras S, Catania L, Abdulcadir O, Petignat P. Defibulation: a visual reference and learning tool. *J Sex Med*. 2018;15:601–611.
22. Rodriguez MI, Seuc A, Say L, Hindin MJ. Episiotomy and obstetric outcomes among women living with type 3 female genital mutilation: a secondary analysis. *Reprod Health*. 2016;13:131.
23. Royal College of Obstetricians and Gynecologists, Green-top Guideline No. 53: Female Genital Mutilation and its Management. July 2015 p 17 <https://www.rcog.org.uk/globalassets/documents/guidelines/gtg-53-fgm.pdf>
24. Sharfi AR, Elmegboul MA, Abdella AA. The continuing challenge of female genital mutilation in Sudan. *Afr J Urol*. 2013;19:136–140.
25. Okwudili OA, Chukwudi OR. Urinary and genital tract obstruction as a complication of female genital mutilation: case report and literature review. *J Surg Tech Case Rep*. 2012;4:64–66.
26. Brodie KE, Grantham EC, Huguete PS, Caldwell BT, Westfall NJ, Wilcox DT. Study of the clitoral hood anatomy in the pediatric population. *J Pediatr Urol*. 2016;12:177 e1–5.
27. Amin MM, Rasheed S, Salem E. Lower urinary tract symptoms following female genital mutilation. *Int J Gynaecol Obstet*. 2013;123:21–23.
28. Bjalkander O, Bangura L, Leigh B, Berggren V, Bergström S, Almroth L. Health complications of female genital mutilation in Sierra Leone. *Int J Womens Health*. 2012;4:321–331.
29. Iavazzo C, Sardi TA, Gkegkes ID. Female genital mutilation and infections: a systematic review of the clinical evidence. *Arch Gynecol Obstet*. 2013;287:1137–1149.
30. Ahmed MR, Shaaban MM, Meky HK, et al. Psychological impact of female genital mutilation among adolescent Egyptian girls: a cross-sectional study. *Eur J Contracept Reprod Health Care*. 2017;22:280–285.
31. Behrendt A, Moritz S. Posttraumatic stress disorder and memory problems after female genital mutilation. *Am J Psychiatry*. 2005;162:1000–1002.
32. Knipscheer J, Vloeberghs E, van der Kwaak A, van den Muijsenbergh M. Mental health problems associated with female genital mutilation. *BJPsych Bull*. 2015;39:273–277.
33. Vloeberghs E, van der Kwaak A, Knipscheer J, van den Muijsenbergh M. Coping and chronic psychosocial consequences

- of female genital mutilation in The Netherlands. *Ethn Health*. 2012;17:677–695.
34. Berg RC, Denison E, Fretheim A. Psychological, social and sexual consequences of female genital mutilation/cutting (FGM/C): a systematic review on quantitative studies. Report from Kunnskaps-senteret nr 13-2010. Oslo: Nasjonalt kunnskapssenter for helsetjenesten; 2010.
  35. Abdulcadir J, Rodriguez MI, Say L. Research gaps in the care of women with female genital mutilation: an analysis. *BJOG*. 2015;122:294–303.
  36. Berg RC, Denison E. Does female genital mutilation/cutting (FGM/C) affect women's sexual functioning? A systematic review of the sexual consequences of FGM/C. *Sex Res Social Policy*. 2012;9:41–56.
  37. Abdulcadir J, Botsikas D, Bolmont M, et al. Sexual anatomy and function in women with and without genital mutilation: a cross-Sectional study. *J Sex Med*. 2016;13:226–237.
  38. Varol N, Turkmani S, Black K, Hall J, Dawson A. The role of men in abandonment of female genital mutilation: a systematic review. *BMC Public Health* 2015;15:1034.
  39. Almroth L, Almroth-Berggren V, Hassanein OM, et al. Male complications of female genital mutilation. *Soc Sci Med*. 2001;53:1455–1460.
  40. Berggren V, Ahmed SM, Hermlund Y, Johansson E, Habbani B, Edberg A-K. Being victims or beneficiaries? Perspectives on female genital cutting and reinfibulation in Sudan. *Afr J Reprod Health*. 2006;10:24–36.
  41. United Nations Children's Fund, Female Genital Mutilation/Cutting: A global concern, UNICEF, New York, 2016. [https://www.unicef.org/media/files/FGMC\\_2016\\_brochure\\_final\\_UNICEF\\_SPREAD.pdf](https://www.unicef.org/media/files/FGMC_2016_brochure_final_UNICEF_SPREAD.pdf)
  42. Wahlberg A, Johnsdotter S, Selling KE, Källestål C, Essén B. Baseline data from a planned RCT on attitudes to female genital cutting after migration: when are interventions justified? *BMJ Open*. 2017;7:e017506.
  43. O'Neill S, Dubourg D, Florquin S, Bos M, Zewolde S, Richard F. A mixed methods study exploring men's involvement in Female Genital Mutilation in Belgium, the Netherlands and the United Kingdom: Preliminary results. Men Speak Out Project, Brussels, 2016.
  44. Ali AA. Knowledge and attitudes of female genital mutilation among midwives in Eastern Sudan. *Reprod Health*. 2012;9:23.
  45. Ragheb SS, Smith E, Mekhemer SA. Study of knowledge and attitudes of nurses in Alexandria towards female genital circumcision. *Bull High Inst Public Health*. 1979;8:293–306.
  46. Abdulcadir J, Dugerdil A, Boulvain M, et al. Missed opportunities for diagnosis of female genital mutilation. *Int J Gyn Obstet*. 2014;125:256–260.
  47. Clarke E. Female genital mutilation: a urology focus. *Br J Nurs*. 2016;25:1022–1028.
  48. Mpofu S. Female genital cutting and sexual behavior in Kenya and Nigeria. Research Report Submitted to the School of Social Science, University of the Witwatersrand, Student Number 0610960A Department of Demography and Population Studies. 2014 [https://genderlinks.org.za/wp-content/uploads/imported/articles/attachments/19539\\_female\\_genital\\_cutting\\_and\\_sexual\\_behaviour\\_in\\_kenya\\_and\\_nig.pdf](https://genderlinks.org.za/wp-content/uploads/imported/articles/attachments/19539_female_genital_cutting_and_sexual_behaviour_in_kenya_and_nig.pdf)
  49. Nnaemeka, O. African women, colonial discourses, and imperialist interventions: female circumcision as impetus. pp 27–46. In: Female Circumcision and the Politics of Knowledge: African Women in Imperialist Discourses, ed. Obioma Nnaemeka. Westport, Connecticut: Praeger 2005. 288 pages.
  50. Van Rossem R, Gage AJ. The effects of female genital mutilation on the onset of sexual activity and marriage in Guinea. *Arch Sex Behav*. 2009;38:178–185.
  51. Gruenbaum E. Sociocultural dynamics of female genital cutting: research findings, gaps and directions. *Cult Health Sex*. 2005;7:429–441.
  52. Sipsma HL, Chen PG, Ofori-Atta A, Ilozumba UO, Karfo K, Bradley EH. Female genital cutting: current practices and beliefs in Western Africa. *Bull World Health Organ*. 2012;90:120–127.
  53. Ondiek CA. The persistence of female genital mutilation (FGM) and its impact on women's access to education and empowerment: A Study of Kuria District, Nyanza Province, Kenya. Thesis, 2010. Institutional Repository. University of South Africa <http://uir.unisa.ac.za/handle/10500/4121>
  54. Odimegwu C, Okemgbo CN. Female circumcision and sexual activity: Any Relationship. *Unilag Sociological Review*, 2000 (1), pp 159–176.
  55. Afifi M. Egyptian ever-married women's attitude towards female genital cutting. *Singapore Med J*. 2010;51:15–20.
  56. Realizing sexual and reproductive rights: a human rights framework. London: Amnesty International; 2012 ([http://www.amnesty.ca/sites/amnesty/files/act\\_350062012\\_english.pdf](http://www.amnesty.ca/sites/amnesty/files/act_350062012_english.pdf), accessed 27 April 2016).
  57. Monitoring of population programmes, focusing on adolescents and youth. Report of the Secretary-General. Commission on Population and Development, Forty-fifth session, 23–27 April 2012. New York (NY): United Nations Economic and Social Council; 2012 (E/CN.9/2012/5; [http://www.un.org/esa/population/cpd/cpd2012/E.CN.9.2012-5\\_UNFPA-Population-programmes-report\\_Advance%20Unedited%20Copy.pdf](http://www.un.org/esa/population/cpd/cpd2012/E.CN.9.2012-5_UNFPA-Population-programmes-report_Advance%20Unedited%20Copy.pdf), accessed 4 April 2016).
  58. Diop NJ, Askew I. The effectiveness of a community-based education program on abandoning female genital mutilation/cutting in Senegal. *Stud Fam Plann*. 2009;40:307–318.
  59. Livermore L, Monteiro R, Rymer J. Attitudes and awareness of female genital mutilation: a questionnaire-based study in a Kenyan hospital. *J Obstet Gynaecol*. 2007;27:816–818.
  60. UNIFPA-UNICEF Annual Report 2011: Joint Programme on Female Genital Mutilation/Cutting: Accelerating Change. <http://www.unfpa.org/publications/accelerating-change-2011-annual-report>
  61. Enquête Démographique et de Santé et à Indicateurs Multiples (EDSBF-MICS IV). Institut National de la Statistique et de la Démographie (INSD). Ministère de l'Économie et des Finances. Ouagadougou, Burkina Faso. ICF International. Calverton, Maryland, USA Avril 2012. [https://www.unicef.org/bfa/french/bf\\_eds\\_2010.pdf](https://www.unicef.org/bfa/french/bf_eds_2010.pdf)

**How to cite this article:** Payne CK, Abdulcadir J, Ouedraogo C, Madzou S, Kabore FA, De EJ, Ethics Committee of the International Continence Society. International continence society white paper regarding female genital mutilation/cutting. *Neurourology and Urodynamics*. 2019;1–11. <https://doi.org/10.1002/nau.23923>

# International Continence Society

## Best Practice Statement for Use of Sacral Neuromodulation

*Howard B. Goldman, Jessica C. Lloyd, Karen L. Noblett, Marcus P. Carey, Juan Carlos Castañó-Botero, Jerzy B. Gajewski, Paul A. Lehur, Magdy M. Hassouna, Klaus E. Matzel, Ian M. Paquette, Stefan G. de Wachter, Michael J. Ehlert, Emmanuel Chartier-Kastler, Steven W. Siegel*

*Corresponding Author:*

**Howard B. Goldman, MD**

Glickman Urological and Kidney Institute

Lerner College of Medicine

Cleveland Clinic

9500 Euclid Ave, Q10-1

Cleveland, OH 44195

Phone: (216) 445-5121

Fax: (216) 636-4492

goldmah@ccf.org

## Disclosures

Marcus Carey—No disclosures

Juan Carlos Castaño Botero—Consultant: Medtronic, Finetech. Proctor – Medtronic, Boston Scientific, Finetech

Emmanuel Chartier-Kastler—Teaching Activities: Allergan, Astellas, Pfizer, B. Braun, Coloplast; Consultant: Allergan, Astellas, Axonics, Medtronic, Pfizer, Coloplast, Lilly, Promedon, Uromems, Pierre Fabre Médicaments; Invited Speaker: Uromedica, Pierre Fabre Médicaments

Stefan deWachter – Consultant: Medtronic, Allergan, Astellas. Research grant Medtronic

Michael Ehlert—Consultant: Nuvectra; Clinical Investigator: Ipsen Pharmaceuticals

Jerzy Gajewski—Speaker: Astellas, Pfizer, Laborie; Consultant: Astellas, Medtronic; Advisory Board: Pfizer, Medtronic, Duchesnay

Howard Goldman—Consultant: Medtronic, Allergan, Axonics, Nuvectra, NewUro. Study support: Medtronic. Investigator: Cook, Bioness, Ipsen

Magdy Hassouna— Medtronic, Axonics

Paul Lehur—Consultant: Torax Medical, Medtronic, B.Braun

Jessica Lloyd—No disclosures

Klaus Matzel— Consultant: Medtronic

Karen Noblett— Chief Medical Officer, Axonics; Research Support Medtronic

Ian Paquette—Medtronic

Steven Siegel— Consultant: Nuvectra, Medtronic, Allergan. Study: Ipsen, Medtronic, Allergan

Funding for this project: Supported by an ICS-initiated grant from Medtronic



## SACRAL NEUROMODULATION CONSENSUS STATEMENT

### INTRODUCTION

***Sacral neuromodulation (SNM) is an accepted therapy for refractory urinary urgency and frequency, urgency urinary incontinence (UI), non-obstructive urinary retention (NOR), and fecal incontinence (FI).***

- These indications for SNM are approved by the FDA in the United States. In other parts of the world there are some other approved indications for various pelvic floor conditions.
- A need was identified for a comprehensive document reflecting best practices across indications related to SNM

***A panel of experts from the fields of urology, gynecology, and colorectal surgery was convened to determine best practices for use of this therapy.***

- Eight urologists, three colorectal surgeons and two urogynecologists, covering a wide breadth of geographic and specialty interest representation, met for two days in Chicago, Illinois, USA on January 19-20, 2017 to discuss best practices for neuromodulation. Suggestions for statements were submitted in advance and specific topics were assigned to committee members. Committee members prepared each assigned topic and presented supporting data to the group at which time each topic was discussed in depth. Best practice statements were formulated based on available data and expert opinion and then each member prepared a discussion section for each particular topic which reflected the current literature and expert opinion. Another urologist was added to the group during the initial writing process. After multiple rounds of editing within the group the highlights of the statements were presented at the ICS meeting in Florence, Italy in September 2017. This document was then circulated to multiple external reviewers after which final edits were made and approved by the group.
- The meeting and editing expenses were supported by the ICS. Funding to support this project was based on an unrestricted society-initiated grant made by Medtronic to the ICS.
- As many of the recommendations herein are based on expert panel consensus, the recommendations in this document, while meant to aid clinical decision-making, do not pre-empt physician judgment in individual cases.

***The statements and recommendations included in this document pertain to SNM in its present form (Interstim, Medtronic) They may or may not have relevance for future SNM products or therapies which become available for clinical use.***

- At the time this document was created, the only sacral neuromodulation device commercially available was the Medtronic Interstim (Minneapolis, MN). Thus, the data and statements discussed pertain to this device. However, it is clear that other sacral neuromodulation devices will be available in the near future. Accordingly, many of the concepts contained within this document will likely apply to newer devices as well.

- The panel used the International Consultation on Urological Diseases (ICUD) method when determining levels of evidence and grades of recommendation. Table 1 summarizes the criteria used for determining levels of evidence and grades of recommendation.<sup>1</sup>

## **DEFINITIONS**

***SNM: a technique that electrically stimulates a sacral spinal nerve root to modulate a neural pathway with the aim of treating bladder and/or bowel dysfunction.***

- The term neuromodulation vs. neurostimulation was preferred by the committee since SNM, through electrically stimulating nerves, effectively functions by modulating the lower urinary tract or bowels.

***Neurogenic lower urinary tract dysfunction (NLUTD): includes all bladder/urinary sphincter dysfunction related to any relevant neurological disease***

***Peripheral nerve evaluation (PNE) lead: a monopolar, temporary lead which is always removed after an SNM test period and is not designed for long-term therapy.***

***Staged (tined) lead: a quadripolar lead which is designed for potential long-term use after a successful test period.***

## **BACKGROUND**

***SNM is not indicated as a first line therapy for either urinary or bowel disorders.***

- Typically, conservative measures (behavioral, physical therapy) and medical treatment are recommended prior to treatment with SNM.

***In the absence of a comparative study with recommended doses of onabotulinum toxin A (BTX-A) and contemporary SNM tined leads, no recommendations can be made as to whether BTX-A or SNM should be used over the other for the management of refractory overactive bladder (OAB).***

- *The Rosetta trial is a prospective randomized trial that compared SNM to Botulinum toxin.<sup>2</sup> It showed a slight short-term advantage to Botulinum toxin, however, it did not utilize currently recommended doses of Botulinum toxin (200u as opposed to the recommend 100u dose) or the currently available SNM lead technology and thus no conclusions can be drawn relative to contemporary practice.*

***SNM is a minimally invasive technique with good long-term outcomes. SNM can be offered to patients with OAB with or without incontinence who fail to respond to or are intolerant of conservative and medical therapies. (Level of Evidence: I; Grade of Recommendation: A)***

### **OAB Without Incontinence**

The initial SNM prospective, randomized, 12 center study enrolled 51 patients for severe urgency-frequency syndrome. This group reflects the present definition of OAB “dry” (urinary urgency and frequency without urinary urgency incontinence). Subjects who demonstrated a satisfactory response to PNE were randomly assigned either to immediate treatment or implant following a 6-month delay (control group). At 6 months, voiding diary results demonstrated statistically significant

improvements in the immediate implant group in comparison to the control group with respect to the number of daily voids, volume per void and degree of urgency.<sup>3</sup> At 2 years follow-up, 29 urgency-frequency patients showed significant reduction in the number of voids per day, with 56% of patients showing 50% or greater reduction in the average voids per day, including 32% who returned to a normal range of 4 to 7 voids per day.<sup>4</sup>

#### **OAB With Incontinence**

The initial prospective, randomized, multicenter trial included 34 patients with severe urgency incontinence (OAB “wet”) who underwent immediate implantation of SNM after a positive trial test and 42 patients (delayed group) who received standard medical therapy (SMT) for 6 months and then were offered implantation. At 6 months, the number of daily incontinence episodes, severity of episodes and absorbent pads or diapers replaced daily due to incontinence were significantly reduced in the early stimulation compared to the delayed group. In the early stimulation group, 16 patients (47%) were completely dry and an additional 10 (29%) demonstrated a greater than 50% reduction in incontinence episodes 6 months after implantation. Efficacy appeared to be sustained for 18 months. Surgical revision was required in 32.5% of patients.<sup>5</sup>

In this cohort, the long-term efficacy of SNM for refractory urinary urge incontinence remained high. At 3 years, leaking was significantly reduced, with 59% of patients reporting 50% or greater reduction in leaks per day and 46% of patients reporting that they were completely dry.<sup>2</sup> As compared to baseline, the group of 96 implanted patients demonstrated significant reductions in urge incontinence symptoms at an average of 30.8 (range 12-60) months with respect to the number of urge incontinence episodes per day, severity of leaking, and the number of absorbent pads/diapers replaced per day due to incontinence. About 10% of patients underwent device explant due to lack of efficacy, pain or bowel dysfunction but no permanent injuries associated with the devices or therapy were reported.<sup>3</sup> Others demonstrate that after 3 years, 59% of urinary urgency incontinent patients showed greater than 50% reduction in leaking episodes per day with 46% of patients being completely dry.<sup>2</sup> A single center study with median long-term follow-up of 50.7 months showed a success rate of 84.8% for urgency UI. Overall 39% of patients needed revision of the SNM neuromodulation implant.<sup>6</sup> SNM showed superior subjective and objective results compared to pharmacologic-SMT treatment for OAB, at 6 months. SNM is shown to be a safe and effective treatment for OAB patients.<sup>7</sup> Ultimately, a 2009 Cochrane review concluded that implantable neurostimulators have benefits for some patients with OAB symptoms, retention without organic obstruction, and in those for whom other methods of treatment have failed.

***SNM is an effective treatment for Fowler’s Syndrome, voiding dysfunction and NOR. (Level of Evidence: I; Grade of Recommendation: A)***

#### **Non-Obstructive Urinary Retention (NOR)**

The initial SNM prospective, randomized, 12 center study enrolled 177 patients for NOR. All patients had PNE and 38.4% eventually received the implant. Of the 68 patients who qualified for implantation 37 were randomly assigned to an immediate treatment and 31 to a 6-month delayed implant (control group). At 1.5-year follow-up 70% of 42 implanted patients (immediate or late) showed greater than 50% reduction in volume per catheterization.<sup>2</sup> Further publication of 18-month follow-up showed that of the patients treated with implants 69% eliminated catheterization at 6 months and an additional 14% had a 50% or greater reduction in volume per catheterization. Therefore, successful results were achieved in 83% of the implant group with retention compared to 9% of the control group at 6 months.

Temporary inactivation of SNM therapy resulted in a significant increase in residual volumes but effectiveness of SNM was sustained through 18 months after implantation.<sup>8</sup> Extension of this study with 5-year follow-up showed significant reduction in the mean volume per catheterization and the mean number of catheterizations. The clinical success rate of 71% was observed at 5 years after implantation.<sup>9</sup> In another single center study, out of 60 women implanted there was a spontaneous voiding rate of 72% over a mean follow-up of 4 years. After surgery, of the 43 women who voided, 13 required the continued use of clean intermittent self-catheterization up to twice a day, but this was less than before surgery. Women with abnormal EMG did better, with 76% of patients experiencing restoration of voiding.<sup>10</sup> Another study confirmed that the presence of Fowler's syndrome is a positive predictive factor for SNM in female urinary retention.<sup>11</sup> Several single center studies reported good long-term outcomes between 73%<sup>12</sup> and 87%.<sup>5</sup>

### **SACRAL NEUROMODULATION FOR INTERSTITIAL CYSTITIS/BLADDER PAIN SYNDROME**

***There is limited evidence supporting the role of SNM for patients with interstitial cystitis (IC)/bladder pain syndrome (BPS).***

***SNM is an option for IC/BPS non-responsive to conservative therapies after appropriate assessment. (Level of Evidence: III; Grade of Recommendation: C)***

IC/BPS is a condition characterized by bladder, urethral and pelvic pain along with urinary frequency, urgency and nocturia.<sup>13</sup> SNM may be considered for patients with IC/BPS who do not sufficiently respond to first, second or third-line treatments. However, SNM has approval for pelvic pain conditions in only a few countries, and is not approved specifically for IC in any nation. There is limited evidence supporting the role of SNM for patients with IC/BPS - typically small observational case series all reporting different criteria for success. Based on these small observational studies, the success rate for SNM for IC/BPS using intention to treat analysis was 48% to 72%.<sup>14,15,16,17,18,19</sup>

Based on the available limited evidence, SNM may be an option for IC/BPS non-responsive to conservative therapies after appropriate assessment and multidisciplinary team review. The AUA IC/BPS Guidelines lists SNM as a 4<sup>th</sup> line therapy.<sup>20</sup>

***There is a lack of evidence supporting SNM as a treatment option for patients with non-IC/BPS chronic pelvic pain. (Level of Evidence: III; Grade of Recommendation: C)***

Chronic pelvic pain is defined as “chronic or persistent pain perceived in structures related to the pelvis of either men or women. It is often associated with negative cognitive, behavioral, sexual and emotional consequences as well as with symptoms suggestive of lower urinary tract, sexual, bowel, pelvic floor or gynecological dysfunction. Pain must have been continuous or recurrent for at least 6 months”.<sup>21</sup>

There is minimal evidence reporting the efficacy of SNM for chronic pelvic pain.<sup>22</sup> Based on available evidence, SNM cannot be recommended as a treatment option for patients with non-IC/BPS chronic pelvic pain. However, pelvic pain is not necessarily a contraindication in patients with concomitant voiding symptoms such as frequency and urgency, if those voiding symptoms improve during the trial period and the patient endorses an associated improvement in quality of life.

## **SACRAL NEUROMODULATION (SNM) FOR NEUROGENIC LOWER URINARY TRACT DYSFUNCTION (NLUTD)**

***SNM is an option for symptom control in patients with NLUTD who are at low risk of upper urinary tract deterioration. (Level of Evidence: III, Grade of Recommendation: C)***

SNM for NLUTD is of growing interest, although it is still as an “off-label” indication. There have been many reports of good outcomes in NLUTD but with a lack of standardized criteria in terms of patient selection, success definition, etc. Most of the evidence is focused on incomplete SCI and multiple sclerosis (MS) but patients with cerebrovascular accident, brain trauma, cerebral palsy, and Parkinson’s disease have been implanted as well with similar outcomes as in patients with non-neurogenic indications.<sup>23,24</sup>

SNM has been utilized in the treatment of detrusor overactivity (DO), NOR, detrusor sphincter dyssynergia (DSD) and FI due to incomplete SCI. Although there are no clinical or urodynamic criteria to select ideal candidates for SNM in SCI, in one study ASIA D (incomplete injury with some preservation of motor function below the lesion) and E (normal sensory and motor functions below the injury level) lesions and sensation of bladder filling were associated with higher success rate during the test trial.<sup>25</sup> We recommend that in SCI patients, SNM should be limited to ASIA D and E patients with preserved bladder filling sensation.<sup>33</sup>

The success rate of SNM in patients with upper motor neuron injury may be higher than in patients with lower motor neuron injury since the former preserves afferent integrity and contractility of the detrusor. One study demonstrated an improvement in bladder emptying with SNM in patients with acontractile or hypocontractile bladder, but the mechanism of action is unclear.<sup>26</sup>

In patients with MS, SNM has demonstrated good results treating DO and NOR due to DSD but a low success rate in treatment of NOR has been reported in those with an acontractile or hypocontractile bladder.<sup>27</sup> Patients with MS being considered for SNM should have stable disease without an expected requirement for frequent or routine magnetic resonance imaging (MRI); patients with rapidly progressive MS typically should not have SNM systems implanted.

The most recent studies in SNM for NLUTD utilize longer periods of the test trial than for patients with idiopathic dysfunctions.<sup>28</sup> Longer test periods might be more appropriate for more complex conditions such as NOR<sup>29</sup> as well as NLUTD.

Since SNM is used after all other therapies have failed and prior to more invasive procedures, a 50% improvement during the trial period is adequate to define success. Most studies define success with the same parameters as in non-neurogenic patients, such as reduction of urinary frequency, urgency incontinence episodes, number of catheterizations, volume per catheterization and FI episodes.

## **NEED FOR URODYNAMIC TESTING PRIOR TO SNM**

***There is a lack of evidence to suggest that urodynamic testing can predict SNM outcomes. (Level of Evidence III, Grade of Recommendation C).***

Patient characteristics such as age, sex, comorbidities, duration and severity of symptoms, and results of examination and testing such as cystoscopy, imaging and urodynamic studies (UDS) have shown insignificant value in predicting which patients will respond to a trial of SNM. Indeed, in some parts of

the world, UDS are commonly performed prior to SNM trial, whereas in other areas, they are not, without an obvious difference in outcomes.

With regard to clinical studies, while some case series<sup>30</sup> have shown that older patients and longer duration of symptoms are less likely to respond, others<sup>31,32</sup> have contradicted this. One study suggested that combining traditional urodynamics and ambulatory monitoring might have additional predictive value<sup>33</sup> over conventional studies alone. None appear to be more sensitive, specific, or cost effective for the prediction of response to SNM as the screening trial, consisting of a PNE or a staged lead implant.<sup>34,35,36</sup> There is however a single recent prospective study showing that children with bowel and bladder dysfunction who had detrusor overactivity on videourodynamic testing had significantly greater improvement in symptoms with 2 stage SNM implant.<sup>37</sup>

***The trial phase of SNM is the single most valuable tool for predicting the potential therapeutic success of SNM for urinary indications. (Level of Evidence II, Grade of Recommendation B).***

Several large, multicenter trials have shown that the PNE<sup>4</sup> and the staged trial<sup>6</sup> predict which patients are likely to respond, and also which will likely have long term benefit from the therapy.<sup>1,8,9,39</sup> A unique advantage of SNM is this inherent ability to predict which patients are likely to benefit with its own specific trial. **UDS is unlikely to add significant diagnostic benefit in the evaluation of routine idiopathic OAB.**<sup>38</sup>

The index patient suffering from refractory OAB is female, has no neurologic disease, has not had prior pelvic surgery, and has no or minimal SUI. On physical exam there is no significant pelvic organ prolapse or urinary residual. She has failed first and second line options, and has significant bothersome symptoms. In this scenario, the panel agreed that there is scant evidence that the result of a UDS is likely to change the third line therapy options or outcomes. Patients with neurologic disease, an unclear degree of SUI or bladder emptying symptoms, significant prolapse, male patients, and prior pelvic surgeries including outlet reduction procedures (e.g. transurethral resection of prostate) and slings are more likely to benefit from UDS to aid in the correct differential diagnosis.

***Pressure flow study or Video UDS may be valuable in the diagnosis of NOR. (Expert Opinion).***

Urodynamics is particularly helpful to rule out obstruction when considering the diagnosis of NOR or incomplete bladder evacuation.<sup>39,40</sup> Another study showed that SNM treatment response in male patients with impaired bladder emptying can be predicted with a bladder outlet obstruction (BOO)-contractility nomogram.<sup>41</sup> In this study of 18 men, the authors found that only 20% of patients below the 10th percentile of contractility, but 86% of men between the 10 and 25th percentiles of the Maastricht-Hannover nomogram were treated successfully with SNM. All successfully treated patients voided without needing self-catheterization. Other studies have shown that EMG study of the external urethral sphincter may be helpful in defining Fowlers syndrome.<sup>42</sup> In females, the combination of video imaging and real time urodynamic data has been determined to be the best method of defining BOO.<sup>43</sup> Video studies in men may also be useful in determining the level of obstruction, for example benign prostatic hypertrophy vs. pseudodyssynergia.<sup>44</sup>

***In cases where SNM has been tried and failed, UDS may be considered to further define the underlying disorder. (Expert Opinion)***

Considering that the PNE or staged lead placement have the best predictive value for determining which patients will benefit from long term treatment with SNM, patients who fail screening, or those who have declining efficacy over time may benefit the most from initial or repeat urodynamic assessment, which may reveal bladder pathologies not amenable to SNM and direct another therapeutic course.

**FECAL INCONTINENCE (FI)**

***SNM should be considered as a second line treatment option for bothersome FI in patients who have failed conservative measures. (Level of Evidence: 2, Grade of Recommendation: B)***

Conservative medical measures are the first line treatment for FI, however, SNM should be considered as the second line of treatment in most patients with FI.<sup>45,46,47</sup> Physicians should consider SNM if the patient has failed medical measures, as SNM has been shown to be superior to best medical management in a randomized trial.<sup>13</sup> Results of pooled analysis has suggested that 79% of patients with permanent implant for chronic stimulation experience  $\geq 50\%$  improvement in incontinence episodes in the short-term, while 84% achieve this endpoint with 3 years of follow-up.<sup>48</sup> Comparative studies are scarce. One study compared 23 patients randomized to SNM vs. 17 randomized to percutaneous tibial nerve stimulation.<sup>49,50</sup> Though short-term outcomes were acceptable in both groups, the design of the study did not allow statistical comparison between groups. One study compared 15 patients treated with SNM to 15 historical controls treated with the artificial bowel sphincter. Postoperative incontinence scores were slightly better with the artificial sphincter, though constipation scores were worse.<sup>51</sup> Importantly, both the artificial bowel sphincter and the magnetic sphincter, another recent option for FI, are currently unavailable. There are no comparative studies of SNM vs. sphincteroplasty, the major competing procedure for FI.

***An anal sphincter muscle defect is not a contraindication for SNM. (Level of Evidence: 3, Grade of Recommendation: C)***

There is a large and growing body of evidence that a defect of the internal or external sphincter is not a contraindication for SNM for FI.<sup>50,52,53,54,55,56,57,58,59,60,61</sup> Though clinical success has been reported in patients with sphincter defects up to 180 degrees,<sup>13,57,62</sup> most would agree that the size of the defect does not matter and should not affect decision making.<sup>50,54</sup> This is likely because the proposed mechanism of action relies more on sensory nerve fibers and bowel motility than on muscular contraction.<sup>63,64</sup> Given the extent of the available evidence stating that a sphincter defect does not impact the success of SNM, some authors have advocated using preoperative ultrasound only in selected patients with FI.<sup>65</sup>

In a patient who is a good candidate for a sphincter reconstruction, typically in a younger woman with relatively recent obstetric injury, it is appropriate to have a full discussion of risks and benefits of a sphincteroplasty vs. SNM. Though there is no evidence to compare the outcomes of these two techniques, many young women with new onset obstetric sphincter defect may be good candidates for sphincter muscle repair.



Other factors such as pudendal neuropathy and the presence of a prior sphincter repair do not predict the outcome for SNM and should not be among the factors considered when deciding which patients to test for SNM.<sup>45,65</sup>

***Patients who have FI after Low Anterior Resection for rectal cancer may be a candidate for SNM test lead implantation if conservative treatment fails. (Level of Evidence: 3, Grade of Recommendation: D)***

As treatment for rectal cancer has evolved and sphincter preservation strategies have emerged, many of these patients are cured of their disease, but as many as 50-90% will suffer at least some degree of bowel dysfunction.<sup>66</sup> Many patients will suffer from debilitating low anterior resection syndrome (LARS), a constellation of fecal urgency, clustering of bowel movements, and FI. As these patients have altered anatomy after resection of the rectum, it is unclear how much benefit SNM may play in achieving relief of symptoms. Two separate studies were conducted on the utility of SNS in LARS.<sup>67,68,69</sup> Success was noted in 47-100% of patients subjected to a test implantation and QOL was generally improved.<sup>67</sup> The difficulty in interpreting this data is that the patient groups are heterogeneous. Some, but not all, of the patients had radiation for rectal cancer, and the rectal resections were done for different disease processes such as cancer or Crohn's disease. Additionally, LARS is a constellation of symptoms with many dimensions such as bowel movement clustering, urgency, and incontinence. Though most studies report on improvement in continence, further research should use a more comprehensive scoring system such as the LARS score<sup>70</sup> to determine which elements of the overall syndrome are improved by SNM. Though it is reasonable to consider SNM test stimulation in the clinical setting of LARS, conservative treatment such as medical bowel management and lifestyle modification should be attempted first.

***SNM is the preferred therapy in an appropriate patient with combined urinary and bowel symptoms. (Level of Evidence: III, Grade of Recommendation: C)***

#### **Combined Urinary and Bowel Symptoms**

Early studies of 14 patents with FI and associated urinary disturbances showed encouraging results with permanent SNM implant.<sup>71</sup> A study of 24 female patients with combined FI and UI showed improvement in both symptoms after SNM implant in 31.8% of patients with a mean follow-up of 28 months. SNM may be beneficial in selected patients with FI and UI.<sup>72</sup> A recent study showed improvement of bowel dysfunction in patients implanted with SNM for urinary urgency incontinence. There was significant improvement in mean urinary and bowel symptom scores, though only urinary quality of life (QOL) scores improved.<sup>73</sup>

SNM for combined urinary and fecal incontinence has been also explored in children with a positive response. Based on prospective clinical data and patient-reported measures, 29 patients showed between 55% and 91% improvement in both bowel and bladder dysfunction.<sup>74</sup>

SNM should be considered for combined urinary and FI after the work-up for both conditions has been completed.

## **OTHER BOWEL CONDITIONS**

***SNM for constipation should only be considered for patients who have had symptoms for more than one year and have failed conservative treatment, as results of clinical studies have been disappointing. There should be no mechanically correctable cause. (Level of Evidence: 4, Grade of Recommendation: D)***

Reported outcomes of SNM in patients with constipation have been mixed,<sup>75,76,77,78,79,80</sup> thus this remains an area of considerable debate. Success rates with test lead implantation have been reported at 42-100%, and extended testing periods of 2-3 weeks are often necessary.<sup>81</sup> Contradictory studies have emerged, suggesting much lower rates of clinical success. A study by Graf et al<sup>82</sup> indicated that only 11% of patients were improved at 24 months. A double-blind randomized trial of SNM vs. Sham indicated that only 28% of SNM patients met the criteria for device implantation and there was no benefit of this therapy over sham treatment.<sup>83</sup> Additionally, this therapy is not approved by the US Food and Drug Administration, and is not universally covered by insurers in Europe. Best evidence suggests that all less invasive medical and surgical measures should likely be taken prior to proceeding with SNM in these patients.

## **NEED FOR BOWEL TESTING PRIOR TO SNM**

***A 2-3-week bowel diary is necessary prior to SNM test for bowel dysfunction. Anorectal physiology testing (manometry, anorectal sensation, volume tolerance, compliance) can be considered to help define the elements of dysfunction and guide management. (Level of Evidence: 4, Grade of Recommendation: C)***

It is difficult to identify from the literature the optimal work-up prior to SNM in bowel indications. Some clinicians even consider the PNE test itself as a part of the pre-SNM work-up in FI patients, as there is no known physiologic predictor of success of SNM in these patients.<sup>84</sup>

However before embarking on an SNM trial, common bowel investigations are typically done to identify those patients for whom such a test could be of greatest potential benefit.<sup>85</sup> Typically, the patient proposed for SNM test has chronic, severe FI which is defined as more than “one leak per week, over a 3 to 4-week period, lasting for more than 6 months” and that has failed conservative measures. A 2-3-week bowel diary is the most important document prior to SNM test for bowel dysfunction. The following is recorded and will be compared with a similar diary done during the test phase: leaks (minor and major), normal evacuated stools, time to defer as a mean by day, and medications taken. The Bristol stool chart is useful to characterize the bowel habits and to allow exclusion of patients with diarrhea from SNM since a normalized stool pattern has not been reached.

Additional investigations **may** include the following:

- Anorectal physiology testing (manometry, anorectal sensation, rectal volume tolerance and compliance) can be considered to help define the elements of dysfunction and guide management. It is usually done before surgical decision-making, as part of the FI work-up and plays a role to guide pelvic floor retraining.
- Endoanal ultrasound is the recommended tool to assess the anal sphincter complex and to identify any sphincter defects. It would guide the discussion to proceed for repair vs. SNM trial according to the different aspects of the defect.

- Dynamic defecography, either standard or MRI, is nowadays also a test to consider prior to SNM trial.<sup>86</sup> This exam allows for identification of any posterior pelvic floor disorder including high-grade rectal intussusception, which can be clinically difficult to identify and a potential cause of FI. In such a case, many clinicians would first correct the rectal prolapse followed by an SNM trial if FI persists.
- Neurophysiology testing may be performed in some neurologic conditions, but is not part of the usual investigations.
- A/P and lateral views of the sacrum could exclude some abnormalities/malformations making the needle and electrode placement difficult for instance in the case of sacral agenesis associated with anorectal malformations.

### **SNM FOR THE PEDIATRIC POPULATION**

***SNM may be considered in children who have failed an extended period of behavioral modification, biofeedback, and pharmacologic therapy and should be considered before irreversible surgery.***

***Safety and effectiveness have not been established for pediatric indications. (Level of Evidence: III, Grade of Recommendation: C)***

***Anatomical differences and somatic growth make implantation technically more challenging (Level of Evidence: IV, Grade of Recommendation: D)***

SNM has been reported to be effective in children in several single center pilot studies. In one, a total of 23 patients, ranging from 6 to 15 years old with presenting symptoms of dysfunctional voiding, enuresis, incontinence, urinary tract infections, bladder pain, urinary retention, urgency, frequency, constipation and/or fecal soiling were followed for a mean of 13.3 months after SNM. The overall patient satisfaction rate was 64%, while that of the caregiver was 67%. Explantation rate was 10%.<sup>87</sup> Another study with 30 children with refractory bowel and bladder dysfunction showed significant improvements.<sup>37</sup>

There are only two prospective randomized trials utilizing SNM in children. The first study of 42 children with incontinence due to neurogenic LUTD showed subjective improvement in about half of children undergoing SNM, including improved bowel function in 9 children, resolution of urinary tract infections in 5 children, and improved bladder sensation in 6 children.<sup>88</sup> The other randomized study of 33 patients (24 boys) with mostly neurogenic LUTS and with a mean age of 12.2 years compared SNM to standard conservative treatment. Incontinence was mixed urinary and fecal in 19 cases, urinary only in 9 and fecal only in 5. Overall positive response rate was more than 75% for urinary and bowel dysfunction.<sup>89</sup>

A study with longer follow-up (average 3.2 years) in consecutive children with UI, constipation, frequency and/or urgency, and nocturnal enuresis from a single center showed that nearly all children (99 of 105) experienced improvement of at least 1 symptom. Reoperations occurred in 56% of children, mainly for device malfunction. Explantation was performed in 35%, mainly for complete symptom resolution.<sup>90</sup> Of note, certain health preventive measures are of greater importance in children, mainly reduced radiation exposure. Also, anatomical differences and somatic growth must be considered with SNM implantation in the pediatric population.

## **CONTRAINDICATIONS FOR SNM IMPLANTATION**

***Absolute contraindications for SNM includes: Inadequate clinical response to a therapeutic trial, inability to operate the device with lack of supportive caregivers who could otherwise offer assistance, and pregnant patients (Level of Evidence: IV, Grade of Recommendation: C).***

***Relative contraindications for SNM includes: patients with severe or rapidly progressive neurologic disease, patients with established complete SCI, patients with known anticipated need for MRI of body parts below the head and patients with abnormal sacral anatomy (Level of Evidence: III, Grade of Recommendation: C).***

The manufacturer of the currently most widely available system (InterStim II) has approved the safety of the current device for 1.5 Tesla MRI of the head. See manufacturer's website for further detail.<sup>91</sup> Recent studies have shown that the risk of heating is low for clinical lumbar and pelvic MRI at 1.5-Tesla, both in an intact SNM system and with a fractured lead.<sup>92</sup>

In pregnant women, no negative effects of SNS on the fetus, mother or device have been reported. However, further studies are needed to conclude if it is a safe practice to implant or to leave a device activated in a pregnant woman.<sup>93,94</sup> Indeed, a recent review that included 16 Cesarean and 9 vaginal deliveries, comprising 25 pregnancies with SNM devices in situ (8 with device left on during gestation, 18 with device deactivated, typically between 3-12 weeks gestation) reported that post-delivery SNM dysfunction was present in 32%, with 3 after vaginal delivery and 5 after c-section. Ultimately, the authors suggested that "within the current limited evidence, the decision regarding SNM activation or deactivation should be individualized [in pregnancy]."93 Until more data is available, for example from a patient registry, the panel recommends not implanting a SNM device in a pregnant woman and deactivating the device when a patient already on SNM therapy becomes pregnant.

## **TIPS FOR INTRODUCTION OF SNM TO PATIENTS**

***SNM therapy should be discussed with all patients as part of their bowel or bladder control treatment pathway. (Level of Evidence: IV, Grade of Recommendation: C)***

***Surgeons should review the need for life-long follow-up, eventual battery replacement, complications, and expected symptom improvement. (Level of Evidence: IV, Grade of Recommendation: C)***

SNM is classified as a 3<sup>rd</sup> line option for treating OAB symptoms,<sup>95</sup> and as a 2<sup>nd</sup> line therapy for FI. Medications and non-invasive interventions comprise first line therapy. It is known that many patients will not respond to initial therapies and will potentially be offered neuromodulation as an option. There is no documented 'best practice' for introducing SNM to patients, however at least one study showed that group-education visits made patients more informed and prepared for the test phase, which translated into improved patient-reported outcomes compared to those undergoing standard preoperative counseling, despite voiding diary outcomes being no different between the groups.<sup>96</sup> As no reliable predictor for patient response to more conservative therapies exists, it is our recommendation that all patients be informed of this therapy as early as possible in the treatment pathway. Similarly, for FI, where limited therapies exist beyond pelvic-floor therapy and modification of stool consistency, patients should be alerted that SNM therapy exists.<sup>97</sup> Patients with dual bladder and bowel disorders stand to benefit with respect to both symptoms,<sup>73</sup> which may direct the clinician

to educate the patient about SNM almost at the first encounter. This is discussed in further detail elsewhere in this consensus statement.

As patients are introduced to SNM it is important to review the limitations and implications of the therapy. Currently, the InterStim II device is labeled for an expected battery life of 3-5 years, though some have shown longer periods with lower energy settings.<sup>5</sup> Long-term follow-up, the need for battery replacement, possible revision of the lead or programming changes are all important aspects of SNM therapy,<sup>98</sup> and should be communicated to the patient, in particular given that a recent study using contemporary technology found a 32% rate of surgical intervention at 3 years following implantation.<sup>31</sup> Furthermore, while symptom improvement can be dramatic in some patients, the target response of >50% improvement both objectively and subjectively as the implant threshold indicates this is not a cure in most patients. Expectations for the patient are important and should be balanced against the known response to trial and long-term implant success.

## **PREOPERATIVE COUNSELING - ADVERSE EVENTS**

***Preoperative counseling prior to SNM should include a discussion of risks including implant site pain, infection, paresthesia, leg pain, and/or need for reprogramming or for device revision. (Level of Evidence: 3, Grade of Recommendation: C)***

Though SNM is a relatively safe surgical procedure, adverse events do occur. The most complete report on adverse events comes from the North American Multi-Center trial, as investigators were required to report all adverse events. The most common adverse events were implant site pain (32.5%), paresthesia (19.2%), implant site infection (10%), leg pain (5.8%) or buttock pain (5.0%).<sup>99</sup> The 5-year clinical data on implants for bowel indications from Hull et al<sup>16</sup> suggest that preoperative counseling and long-term follow-up are necessary, as 24.4% required revision or replacement by 5 years, and 19% were permanently explanted by 5 years. Close follow-up with programming parameter optimization, may increase clinical efficacy, while decreasing paresthesias and leg pain.<sup>100</sup>

In a recent multicenter trial, the infectious complication rate was 3.3%.<sup>101</sup> It may be helpful to distinguish between early (<1 month after implantation) vs. late (>1 month after implantation) infections. Wexner et al<sup>102</sup> reported that in colorectal patients, 5/7 early device infections resolved with antibiotics, while all 4 late infections required device explantation. As testing strategies evolve over time, there is increasing interest in the percutaneous office approach to testing, as at least one publication suggested an overall infection incidence of 0% in patients tested via office PNE vs. 10.5% in patients who received a staged approach in the operating room (OR).<sup>103</sup>

## **RATIONALE for PNE vs STAGED PROCEDURE**

***Both PNE and staged trial play a role in SNM. The advantages and disadvantages of each must be taken into consideration when selecting the approach. (Level of Evidence: II, Grade of Recommendation: C)***

One of the unique aspects of SNM is that patients are allowed to undergo a trial period to evaluate whether the therapy is efficacious and provides adequate symptom relief.

Both PNE and the staged trial play a role in SNM. The advantages and disadvantages of each must be taken into consideration when selecting the approach.<sup>2,6,104,105</sup> An ideal candidate for PNE is one who

is comfortable undergoing a procedure under local anesthesia (LA) and who is able to tolerate the potential, mild discomfort related to the procedure. Patients with heightened levels of anxiety or a low pain threshold may benefit from a staged procedure in the OR under monitored anesthesia care (MAC) sedation /local or general anesthesia (GA).<sup>106</sup>

***PNE is less invasive, less costly and can provide reliable sensory responses. (Level of Evidence: III, Grade of Recommendation: C)***

***This form of test stimulation may be required by insurance carriers and may also act as a bridge to therapy acceptance. However, PNE lead migration can be problematic, and there may be limitations in pediatric populations and patients with NLUTD. (Level of Evidence: II, Grade of Recommendation: C)***

Overall, the PNE approach is less invasive, less costly if performed in an office setting, and can provide reliable sensory as well as motor responses.<sup>107</sup> As it is generally performed in the office setting, it may also be more convenient for the patient as it has the potential to avoid one trip to the OR. This advantage would reduce the risks associated with anesthesia and hospital admission by having only one procedure in the hospital vs. two. Additionally, this form of test stimulation may be required by insurance carriers as well as acting as a bridge to accepting therapy. However, there are issues with PNE lead migration, and it may have limitations in a pediatric population and patients with neurogenic voiding dysfunction.<sup>93</sup>

***Staged implant is superior to PNE with regards to conversion rates to chronic therapeutic stimulation in OAB and FI. (Level of Evidence: II, Grade of Recommendation: B)***

***This approach also has the advantage of a longer trial period.***

***However, this approach may be more costly, may require two trips to the OR and may be associated with a greater rate of adverse events.***

The advantage of the staged implant is that there is a longer trial period, and the lead that is being tested is the lead the patient will use long-term. The patient is also allowed to trial multiple programs to achieve optimal outcomes. The conversion to permanent implant is consistently higher in the staged vs. the PNE at rates of 80% vs. 44-52%, respectively.<sup>2,93,94,103,108</sup> Now with the use of fluoroscopy at the time of PNE lead placement, the PNE conversion rate may be higher, however there is no current data to support this supposition.

***More data is needed to identify ideal candidates for PNE vs. staged implant. Reliable predictors of test stimulation success are currently lacking in both bladder and bowel dysfunction. (Level of Evidence: III, Grade of Recommendation: D)***

***For patients with FI who have continent periods of >5-7days punctuated by intermittent episodes of FI, a staged implant may be preferable to ensure an adequate trial period. (Level of Evidence: IV, Grade of Recommendation: D)***

***Since NLUTD is a complex condition and given the lower rate of positive tests using PNE, a staged procedure should be considered for the majority of NLUTD patients. (Level of Evidence: III, Grade of Recommendation: D)***

In patients with underlying neurological conditions, since NLUTD is a complex condition and given the lower rate of positive tests using PNE, a staged procedure should be considered for the majority of NLUTD patients. The majority of studies recently published in this area reported exclusively on the use of tined lead electrodes for the test trial in NLUTD patients.<sup>36</sup> Even though these studies do not report comparative results between the two techniques it has been demonstrated that PNE testing has disadvantages compared to the staged procedure such as lead migration 11-18%,<sup>2</sup> lower rate of positive tests 46% vs 88%<sup>109</sup> (9) and different responses between temporal and definitive lead – up to 20%.

## **SCREENING FOR SUCCESS DURING THE TEST PERIOD**

***Patients who achieve  $\geq 50\%$  improvement in one or more of their bothersome urinary or bowel parameters during PNE or Stage 1 test period may be offered a full system implantation.***

For both PNE and stage 1 trials, both objective and subjective measures of improvement should be assessed. Success during the SNM trial is defined as at least 50% improvement in one or more of the bothersome parameters.<sup>9</sup> Patients who achieve this benchmark should be offered full implantation.

PNE duration is typically 7 days for bladder indications. As the PNE leads are not anchored with tines, there has historically been concern regarding lead migration causing an inconclusive trial; thus, PNE trials are typically not done for more than about 7 days. However, some implanters do utilize longer PNE trials with little ill effect (in particular European implanters for bowel indications).

***PNE test stimulation period is typically 7 days for bladder and 10-21 days for bowel indications. (Level of Evidence: III, Grade of Recommendation: 3)***

PNE duration for urinary urgency/frequency and urgency incontinence is typically 7 days. This can be extended in cases of NOR. The period for SNM trial recommended by the manufacturer is two-weeks for bowel indications. It has been strictly applied in the US with a 10-14 day trial in the major published studies.<sup>16</sup> However, in Europe this is considered too short a duration as stated in the published consensus statement based on a Delphi process in 2015.<sup>54</sup> Assuming the lead remains viable without significant migration, a 3-week trial period has been chosen as an empirical compromise.<sup>110</sup>

Thus, for bowel indications, it is suggested that SNM test duration last from 10 days to 4 weeks, allowing for testing of various stimulation programs, which may be beneficial when a satisfactory result is not immediately achieved.<sup>111</sup> Ultimately, the goal of any trial (whether PNE or staged), is to provide an adequate duration to determine whether at least a 50% improvement in symptoms has been achieved.

***Stage 1 test period duration is typically 2-3 weeks.***

***Stage 1 testing can be attempted if PNE is inconclusive, particularly if a longer test period is required for screening.***

***A repeat stage 1 test may be performed at the physician's discretion.***

Stage 1 duration is typically 2-3 weeks. There are some experts who do utilize up to four weeks, in part to avoid any possible placebo effect, or in instances when it is unclear if the patient has met the 50% improvement criterion, or for patients with incomplete emptying.<sup>112</sup> Kessler and colleagues followed a series of 44 patients who underwent prolonged tined lead testing for a median of 30 days,



with 70% proceeding to full implantation. The complication rate was 5% during the prolonged tined lead testing, but none of these were attributable to the extended testing itself.<sup>113</sup>

Patients should be encouraged to adjust the stimulation settings during their test period to optimize the trial.<sup>2</sup> If PNE testing is inconclusive, it is reasonable to consider a Stage 1 trial, in particular if a longer duration of testing is required. Stage 1 trials are typically not repeated, but can be attempted at the physician's discretion in select circumstances.

## **REMOVAL OF SCREENING LEAD**

***PNE electrode(s) removal preferably occurs in the clinician's office, but may be removed by patient/family at home.***

***Stage 1 tined leads can be removed under local anesthetic (in the office or OR) with or without sedation to ensure patient comfort during removal of all components.***

There are no published studies regarding removal of the PNE lead at home by the patient versus in the office by the clinician. Removal at home is convenient for patients, especially those who travel a great distance to their clinician's facility; however, removal in the office allows for both confirmation that the lead was removed intact, as well as an opportunity to review outcomes of the trial (though this could also be done via phone in conjunction with home lead removal). The panel agrees that removal of a PNE lead can likely be safely performed in either setting

Stage 1 tined leads should be removed by a physician.<sup>114</sup> These can be removed under local anesthetic in the office or the OR setting, with or without sedation, as needed to ensure patient comfort.

## **PREVENTION OF SURGICAL SITE INFECTION (SSI)**

***A perioperative antibiotic aimed at coverage of skin flora should be given intravenously within 60 minutes of incision for both bowel and bladder indications.***

***The specific antibiotic of choice should be guided by the local antibiogram and the patient's allergy profile. (Level of Evidence: IV, Grade of Recommendation D)***

The most significant complication after SNM device implantation is wound infection. Reported wound infection rates range from 2–11% and are most commonly caused by *Staphylococcus aureus*.<sup>115</sup> A recent large multicenter trial reported a wound infection rate of 3.3%.<sup>116</sup>

No defined perioperative or postoperative antibiotic protocol is uniformly agreed upon for neurostimulator implantation; instead, this decision should be guided by the local antibiogram and surgeon discretion. For the staged procedure, preoperative intravenous antibiotics should be given within 60 minutes prior to the incision and aseptic techniques should be closely followed.

The AUA Best Practice Statement for perioperative antibiotic prophylaxis recommends the use of a first-generation cephalosporin for open surgical procedures that do not involve entry into the urinary tract and does not recommend prolonged antibiotic usage, since there is no evidence to support it.<sup>101</sup> Prostheses implantation surgeries are recommended to receive prophylaxis with an aminoglycoside plus a first-/second-generation cephalosporin or vancomycin. It is debatable how to categorize the SNM procedure because it is an open surgical procedure not entering the urinary tract as well as an implanted procedure.

In a study done by Haraway et al,<sup>104</sup> the use of cefazolin as the preoperative antibiotic was the only significant risk factor for subsequent infection and explanation of the SNM device. Indeed, cefazolin was less effective than vancomycin with or without gentamicin in preventing infection in this study, likely due to resistant organisms.

Antibiotic recommendations for bowel and bladder indications are similar. The European consensus statement for sacral nerve stimulation for FI and constipation recommends a single dose of prophylactic antibiotics before both the tined lead and the IPG implantation procedures, and suggests that routine postoperative antibiotics are not required.<sup>54</sup>

Chlorhexidine-based skin prep is commonly used for perioperative cleansing of the patient's back and upper buttocks, but this varies between clinicians. Care should be taken in preparation of the buttocks and anus. If the implanter chooses to visualize the anus during test stimulation to observe the anal sphincter contraction, it should be covered with a separate plastic drape until visualization is required during surgery.

Other investigators suggest minimizing the risk of SSI with a preoperative shower with antiseptic, as well as allowing the dressing to remain in place for 48 hours postoperatively following stage 2 procedures.<sup>117</sup>

## **IDEAL ANESTHESIA**

***No data suggest superiority of local anesthesia (LA) with IV sedation vs. general anesthesia (GA) for a successful staged neuromodulation trial.***

***Muscle relaxants with GA and regional anesthesia causing neuromuscular blockade must be avoided.***

***LA is preferred for PNE, and LA with IV sedation for IPG implant. GA may be considered.***

There are two current methods for trialing SNM to screen for efficacy.

The first is the PNE, which is generally done in the office under LA. There is the option to perform the PNE in an ambulatory surgical center (ASC) or even in the hospital and provide monitored anesthesia care (MAC) or GA. The second method is the staged approach, which is typically done in an ASC or hospital setting under MAC or GA. When SNM was first approved, this involved a PNE screening trial, and if the patient was determined to be a success, they then underwent implant of the long-term device. This required a large cut-down to the posterior aspect of the sacrum and was routinely performed under GA with high success rates. This suggests that the use of GA does not negatively impact the success of SNM.

In general, LA is considered to be safer than MAC, which is itself considered safer than GA. There is no current data that suggests any type of anesthesia is superior over another in terms of outcomes for SNM. As one of the parameters for determining a successful implant is appropriate motor response (bellows and great toe flexion), the use of a paralytic agent should be avoided if using GA. ***(Level of Evidence: V, Grade of Recommendation: C)***

LA is preferred for PNE if patients are able to tolerate it, and LA with IV sedation (MAC) for tined lead and IPG implant. GA may be considered under certain circumstances according to physician discretion,

however there is no evidence that the choice of anesthesia impacts outcomes (**Level of Evidence: II, Grade of Recommendation: B**).<sup>9,97</sup>

## **IMPLANT TECHNIQUE**

***The clinician should strive to achieve appropriate motor and/or sensory responses on all 4 contacts at stimulus amplitudes of <2 volts. (Level of Evidence: II, Grade of Recommendation: B)***

The concept of “Optimal Lead Placement” derives from the notion that while the overall success of SNM is excellent,<sup>118</sup> there is a potential for an individual patient to experience an incomplete benefit, or a “false negative” response due to technique and imprecise lead positioning<sup>2</sup>. Although it remains to be proven scientifically, logically it is hard to dispute that the quality of the interface between the neuromodulation device and the nervous system is of general importance to the therapeutic outcome of SNM. The current 3023 tined lead is an electrode array, consisting of four equally spaced contacts in a flexible assembly. By taking readily reproducible steps to steer the lead into position it is often possible to follow the course of the sacral nerve target, and achieve similar motor and sensory responses at each individual contact.<sup>119,120,121</sup> Some have demonstrated more accurate placement with the curved lead.<sup>121</sup> These electrode contacts may then be employed singly or in combination to achieve neuromodulation for clinical benefit.

The closer the lead is to the intended target, the lesser is the amount of energy that will be required to obtain a neuromodulation response. On one level, effective programing at lower thresholds is more efficient, and is likely to result in longer lasting battery life and less frequent need for replacement thus increasing the cost efficacy of the therapy and reducing risks related to re-operation.<sup>122,123</sup> On another, electrode placement near the nerve means that the chance of stimulation of unwanted tissues (ie, the piriformis muscle), which may trigger uncomfortable stimulation or paresthesias, will be minimized. In turn, the need for reprogramming or re-operation to resolve uncomfortable stimulation should be lessened.

***Leads that require higher thresholds or offer responses at fewer than 4 contacts can be successful. (Level of Evidence: II, Grade of Recommendation: B)***

Sub-optimal lead placement can be therapeutically beneficial. Initial techniques for chronic lead placement were performed in a “blind” fashion, guided only by anatomical landmarks, without the routine use of fluoroscopy.<sup>4</sup> The depth of lead placement, lead direction, and even the final sacral level of placement was not standardized. Many subsequent series have shown excellent symptom benefit before the concept of lead optimization was widely suggested. However, it is unknown if the overall degree of symptom relief could potentially have been greater, and the rate of screen failure, re-operation, or eventual therapy abandonment might have been reduced within these study populations, had lead optimization been a standard.<sup>124,125</sup> Another unknown is whether the demands for precise lead placement may differ for various indications. An example of this concept is the notion that the target for lead placement for the indication of FI seems to be more robust, with a relatively large neuromodulation target (S3 or S4), while placement for urinary frequency and urgency without urge incontinence, and with a component of pelvic pain, may require hitting a narrower target (S3 or pudendal lead placement).

***S3 is the preferred target for SNM. Bellows and toe dorsiflexion are the motor responses consistent with S3 placement. Thresholds for bellows should be lower than for toe. Leads placed in S4 may be appropriate in some cases. S2 should be avoided due to the risk of aberrant sensation and motor response in the leg. (Level of Evidence: 3, Grade of Recommendation: C)***

From the initial studies on SNM, S3 is the preferred target for SNM. A typical S3-mediated response is a contraction of the pelvic floor along with plantar flexion of the first and second toes, whereas S4 stimulation does not produce any toe response.<sup>126</sup> There is individual variation in composition of the sacral roots. A direct ventral sacral root electrical stimulation study measuring bladder contraction by means of intravesical pressure showed that in 100% of the patients, bladder pressure increase was measured upon stimulation of the S3 anterior sacral root, but also in 60%, upon stimulation of S4, 40% on S2 and around 15% at S5. There is an individual difference in distribution of bladder efferent fibers.<sup>127</sup> It is unknown if the distribution of motor nerves activated directly by neurostimulation is similar to the distribution of the rootlets stimulated for the indirect neuromodulation effect.

In a retrospective study on patients with FI however, there was no difference in success rate upon S3 or S4 stimulation during a 3-week PNE test.<sup>128</sup> These findings are also supported by reports of accidentally or deliberately implanted leads in S4.

S2 stimulation produces outward rotation of the leg and sensation running down the leg.<sup>116</sup> These effects may bother the patient, and S2 stimulation should therefore be avoided.

***The clinician should consider both sensory and motor responses important for success. (Level of Evidence: IV, Grade of Recommendation: C)***

The most readily quantifiable responses are motor (bellows and toe) with the patient under sedation. It is easier to obtain sensory responses than motor during a PNE, when the patient may not be able to relax and is fully conscious.<sup>116,129</sup> A purported mechanism of action of SNM is sensory afferent neuromodulation, so the sensory side of the response may be meaningful. Indeed, given that sensory responses are used when reprogramming, having appropriate sensory responses during initial placement may help guide successful reprogramming and eliminate the need for revisions.

***Motor responses alone may be utilized in patients who undergo GA. (Level of Evidence: IV, Grade of Recommendation: C)***

With patients under heavy sedation or GA, sensory responses are unlikely to be elicited. The pattern of motor responses can be helpful in predicting where paresthesias will be felt. For example, all bellows and no toe, or toe only at a significantly higher threshold than bellows, is likely to be associated with anal sensation, while bellows followed by toe response immediately or at slightly higher thresholds is more likely to be associated with genital sensation. Toe movement at a lower threshold than bellows is likely to be associated with uncomfortable sensation down the leg.

***Sensation down the leg or in the buttock and discomfort in the anal, perianal, or genital areas should be avoided. (Level of Evidence: II, Grade of Recommendation: B)***

Although sub-sensory thresholds are potentially associated with good patient outcomes, generally patients tend to do better when the stimulation is comfortable. One of the most common adverse events of SNM is uncomfortable stimulation.<sup>105</sup> Most patients find stimulation in the buttocks or down the leg less comfortable, than in the anal, perineal, or genital areas.<sup>116</sup>

Patients are more likely to require reprogramming when stimulation is uncomfortable.<sup>105</sup> It is unclear whether anal, perineal, or genital sensations are associated with higher success in individual patients or between patient groups depending on diagnosis, ie, FI vs. urinary frequency with or without a component of pelvic pain.

***Standard frequency and pulse width settings of 10-20 Hz should be used. (Level of Evidence: II, Grade of Recommendation: B)***

***Other frequencies and pulse widths can be used during troubleshooting procedures. (Level of Evidence: IV, Grade of Recommendation: D)***

There are no studies which show definitive advantages of specific programming settings over others for a condition or indication. Low frequency stimulation of 10-20 Hz, with pulse width between 180-210  $\mu$ s, has been associated with therapeutic success for all the indications approved for SNM. These settings should be used initially. If patient comfort or therapeutic efficacy is not achieved, it is reasonable to experiment with alternative programming, though consistent success is anecdotal.

## **ROLE OF FLUOROSCOPY**

***Fluoroscopy is recommended for staged lead positioning to control depth of foramen puncture and optimize placement of the lead. (Level of Evidence IV, Grade of Recommendation D)***

***Fluoroscopy may be used for PNE to confirm proper lead placement. Alternatively, use of bony landmarks to determine lead placement is acceptable if fluoroscopy is not available. (Level of Evidence III, Grade of Recommendation C)***

Fluoroscopy is a key element underlying quality tined lead placement, allowing the surgeon to control both depth of puncture and the placement of the lead. In many countries, labeling of the therapy indicates that fluoroscopy must be used for tined lead placement. Fluoroscopy may also be used during PNE, but not all clinicians do this during their office procedures.

Siegel and colleagues first described fluoroscopic lead placement in 1992.<sup>130</sup> Their description is still useful today, and very much in keeping with the modern technique; however, they described an open surgical procedure, which contrasts with the modern, minimally-invasive approach to tined lead placement. The role of fluoroscopy has become even more crucial following conversion to the minimally-invasive placement technique, as it allows for consistent, reproducible and optimal positioning of the lead in the foramen, as well as confirming curvature along the path of the S3 nerve, plausibly avoiding multiple punctures, minimizing bleeding, infection risk, post-operative pain and surgical time.

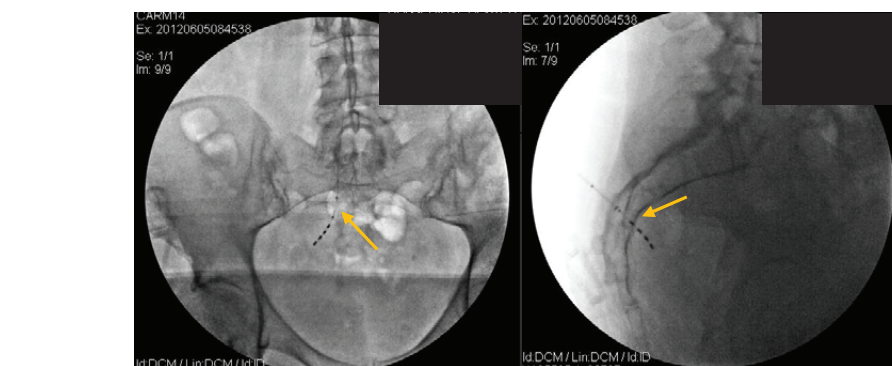
- **Active lateral fluoroscopy should be used during final tined lead deployment.**
- **The distal end of the lead introducer should be placed only ½ to 2/3 through the sacral bone table.**
- **The motor and sensory responses and the stimulus amplitude at which they occur, along with AP and lateral x-ray images associated with final deployment, should be recorded in the medical record.**
- **Radiographic appearance consistent with ideal lead placement entails:**

- In the lateral view, the lead parallels the fusion plane between third and fourth sacral segments, enters above the hillock, and curves caudally. Distal lead contacts appear to be spaced more closely together than proximal contacts.
- In the AP view, the lead starts close to the medial edge of the foramen, and curves out mediolaterally. Proximal contacts appear to be spaced more closely together than distal contacts.
- The curved stylet may be able to increase the number of responding contacts at lower stimulus amplitudes. (Level of Evidence IV, Grade of Recommendation C)

There remains debate regarding optimal lead placement, and no prospective studies exist to correlate clinical response (in bowel or bladder conditions) with lead positioning. Jairam et al<sup>131</sup> from Maastricht retrospectively reviewed lead placement in 189 patients, and found no correlation between the position of the tined lead in the Stage 1 trial, with regard to depth, angle, and deflection, and the number of active electrodes, and the likelihood of a successful trial in either the OAB group or the NOR group. Nonetheless, expert consensus dictates that placement close to the nerve may reduce voltage used and improve programming options and long-term battery life.

**Figure 1a: A/P image demonstrating medial placement in the S3 foramen (arrow)**

**Figure 1b: Lateral image demonstrating 3 contacts below the sacral plate**



## **IPG PLACEMENT**

***IPG buttock placement in the lateral upper quadrant is preferred but abdominal placement may be required in some cases. (Level of Evidence: 3, Grade of Recommendation: C)***

***IPG should be placed above the muscle layer, no deeper than 2.5 cm (1 in). (Level of Evidence: 3, Grade of Recommendation: C)***

When SNM was first introduced, the IPG was placed in the anterior abdominal wall. This required repositioning of the patient during surgery and prolonged the procedure, and, of note, the lead extension required for this type of placement is no longer manufactured. Buttock placement of the IPG was described by Scheepens et al<sup>132</sup> in 2001. This technique simplified the procedure and reduced

operative time in all 39 trial patients by approximately 1 hour, given that no repositioning of the patient was required during surgery. Pain was reduced and there were no infections.<sup>121</sup> It is, however, difficult to assess the true advantage of buttock vs. abdominal placement, since no direct randomized trials have been published. In some patients with very limited fat, an abdominal placement might be utilized.

Because of the distance limitation of the wireless communication with the programmer, the IPG should be placed no deeper than 2.5 cm (1 in). [Product information data]

## **POST PROCEDURAL PATIENT RESTRICTIONS**

***PNE test stimulation is associated with a risk of lead migration. Limited physical activity during the trial is advised to reduce this risk. (Level of Evidence: 3, Grade of Recommendation: C)***

***Risk of lead infection is greater with Stage 1 testing than with PNE. Operative dressings should not be removed during the test period, unless permitted by the surgeon. (Level of Evidence: 3, Grade of Recommendation: C)***

***Following Stage 1 and Stage 2 procedures, patients should be encouraged to minimize vigorous activity for several weeks to allow the tined lead to scar in place and prevent lead migration. (Level of Evidence: 3, Grade of Recommendation: C)***

Besides the manufacturer's recommendations (Manual InterStim 3889, 3058, etc.) very limited data has been published regarding specific post procedural patient restrictions. However, the two main risks to the implants are infection and dislodgement.

For test stimulation with temporary leads, which are only secured by external dressing and not by internal fixation like the tined lead, secure fixation with splash-resistant, transparent dressing allowing for washing and showering after disconnection of the external pulse generator is advised.<sup>133</sup> Patients should be instructed to avoid strenuous physical activities, which result in tension on the electrode.

For test stimulation with a tined lead, the risk of dislodgement appears to be less;<sup>134</sup> however, the risk of infection becomes more relevant. In a retrospective review of 669 SNM procedures, one group did find substantial decreases in infection rates after instituting an at-home chlorhexidine washing protocol.<sup>135</sup> The removal of the dressing throughout the test period should, however, still be avoided unless the physician has concern upon inspection of the dressing for infection or bleeding. There is no consensus on the use or efficacy of continued antibiotics during the trial period.

In one study<sup>136</sup> of 235 patients, lead migration occurred 1 subject when using a tined lead. In another study, with 2 years follow-up after tined lead implantation, there was a 10% rate of lead migration following tined lead implantation.<sup>137</sup> Regardless, after implantation, vigorous activity and excessive bending or twisting at the waist should be avoided for sufficient time to allow scarring and fixation of the implanted device.

## **POST-OPERATIVE AND FOLLOW-UP CARE**

***Routine follow up should include a clinical examination, symptom evaluation, system check of the stimulation device and confirmation that it is functioning. (Level of Evidence: III, Grade of Recommendation: C)***



***In patients with urinary retention, a post-void residual should be assessed.***

***Suggested routine follow up consultations during the first year should occur at 1, 6 and 12 months postoperatively, then annually thereafter. (Level of Evidence: IV, Grade of Recommendation: D)***

***Follow up consultations on demand should also be available. (Level of Evidence: IV, Grade of Recommendation: C)***

The purpose of post-operative follow-up care is to confirm adequate functioning of the therapy and to address potential complications/side effects. Different patterns of follow up visits have been described.<sup>100</sup>

It is recommended that the initial follow-up visits and subsequent follow-up visits should be spaced at least 1 month apart because full evaluation of setting changes may not be meaningful if the interval is less.<sup>138</sup> Based on the experience that a proportion of patients requires reprogramming in the early phase of follow-up, more than one follow-up visit in the first year is recommended.<sup>100,139</sup>

Subsequent yearly follow-up visits are advised by international expert groups,<sup>100,125</sup> but no consensus on the timing and interval of follow-up was determined on recent systematic review.<sup>54</sup> Follow up visits are uniformly recommended when problems occur.<sup>54,100,125</sup> A clinical evaluation of the efficacy of SNM (eg, bowel and bladder diaries, scoring of the severity of symptoms, measurement of the impact of symptoms on QOL) and evaluation of the correct functioning of the neurostimulation device (eg, stimulation settings, impedances and side effects) are considered minimum requirements of follow-up.<sup>100</sup>

***Radiological imaging of the tined lead is advised at final implantation, which allows for comparison and evaluation of lead migration in case of dysfunction or unexpected loss of efficacy. (Level of Evidence: 3, Grade of Recommendation: C)***

Whether postoperative radiological imaging after temporary lead insertion may be helpful to confirm the position remains controversial.<sup>54</sup> Intraoperative fluoroscopic monitoring/documentation during the implantation phase and/or postoperative documentation of the implanted hardware is recommended to document positioning of the electrode in the sacral foramen. Post-implantation radiological imaging at routine follow up is not required, unless there is loss of efficacy potentially due to electrode dislodgement or breakage.<sup>140</sup>

## **SUCCESSFUL OUTCOME—BLADDER AND BOWEL**

***A patient who is satisfied with the treatment is considered to have a successful treatment outcome. (Level of Evidence: III, Grade of Recommendation: C)***

For SNM, the most commonly used criterion for successful test stimulation is an improvement in the patient's bothersome symptoms of  $\geq 50\%$  during the period of observation monitored by bladder or bowel diaries.<sup>54,100</sup> Some data suggest that greater improvement during test stimulation may predict better long-term outcomes.<sup>141,142,143</sup> Regardless, the symptom improvement should be associated with concomitant patient satisfaction before pursuing full implantation.

***For patients with voiding dysfunction or NLUTD, further evaluations may be necessary to ensure long-term safety of the urologic tract. (Level of Evidence: III, Grade of Recommendation: C)***

Of note, in patients with voiding dysfunction in the setting of NLUTD, further evaluation may be necessary to ensure the long-term safety of the upper urinary tract. The clinical evaluation of patients' LUT symptoms often includes a bladder diary, uroflowmetry followed by measurement of post-void residual urine volume in spontaneous voiders, urinalysis, renal-bladder ultrasonography, assessment of renal function, quality-of-life measurements and sometimes urodynamic investigations and/or cystoscopy.<sup>144</sup> UDS, with or without fluoroscopy, can at times be essential in these patients as a means to assess detrusor and bladder outlet function and give fundamental information about detrusor pressure and thus the risk factor for upper tract damage.<sup>145</sup> Additional interventions, ranging from oral medication or intradetrusor BTX-A injections, to augmentation cystoplasty or even urinary diversion, may be required and are not contraindicated in the setting of SNM.

## **SNM INFECTION**

***Explantation of the IPG and lead and debridement of the infected tissue is recommended in instances of SNM infection. The wound should be irrigated and a course of oral antibiotics can be considered. (Level of Evidence: III, Grade of Recommendation: C)***

Infection rate of SNM is low at 2-11% for urinary indications,<sup>2</sup> as well as for FI.<sup>102</sup> In one large investigational trial of SNM for FI, in which patients were followed for an average of 28 months (range 2.2-69.5), 10.8% of subjects reported infection with SNM implant. One infection spontaneously resolved and five were successfully treated with antibiotics. Seven infections (5.8%) required surgical intervention, with infections in six patients requiring full permanent device explanation.<sup>102</sup>

A study of staged SNM implantation revealed lead infection in 12% and IPG infection in 11%. The only significant difference in clinical/surgical characteristics between infected and non-infected patients was a longer operative time for Stage 2 in infected patients.<sup>146</sup> A prolonged first stage implant trial with permanent quadripolar electrode has shown colonization in 13/34 electrode extension leads with the mean stage 1 SNM evaluation period of 52.3 (27–116) days but this was not associated with an increased risk of wound infection. The most frequent colonization was with *Staphylococcus epidermidis*, *Staphylococcus capitis*, *Peptostreptococcus* spp., *Enterococcus faecalis* and *Micrococcus luteus*.<sup>101</sup> In the urinary literature, one study demonstrated that Cefazolin alone was less effective in preventing infection compared with the other antibiotic regimens, with 88% of infections that required explantation stemming from *Staphylococcus aureus* species resistant to cephalosporins.<sup>104</sup>

There are no specific published reports regarding treatment of SNM device infections. Based on common general surgical principle, guidelines and expert opinion the infected device must be removed in its entirety, the wound irrigated/drained and oral/systemic antibiotic therapy started. The choice of the antibiotic should depend on local institutional guidelines. In very rare instances, removal of only one component of SNM implant may be contemplated with adequate antibiotic coverage. The choice to close the wound primarily or allow it to heal by secondary intention should be decided on a case by case basis. Other techniques to combat infection can be considered.<sup>147</sup>

***A 3-month waiting period prior to reimplantation is advised and use of the contralateral side for the IPG pocket should be considered. (Level of Evidence: IV, Grade of Recommendation: D)***

There is no reliable data regarding the waiting period for reimplantation after removal of the infected device. The recommendation of a 3-month waiting time is based on expert opinion.

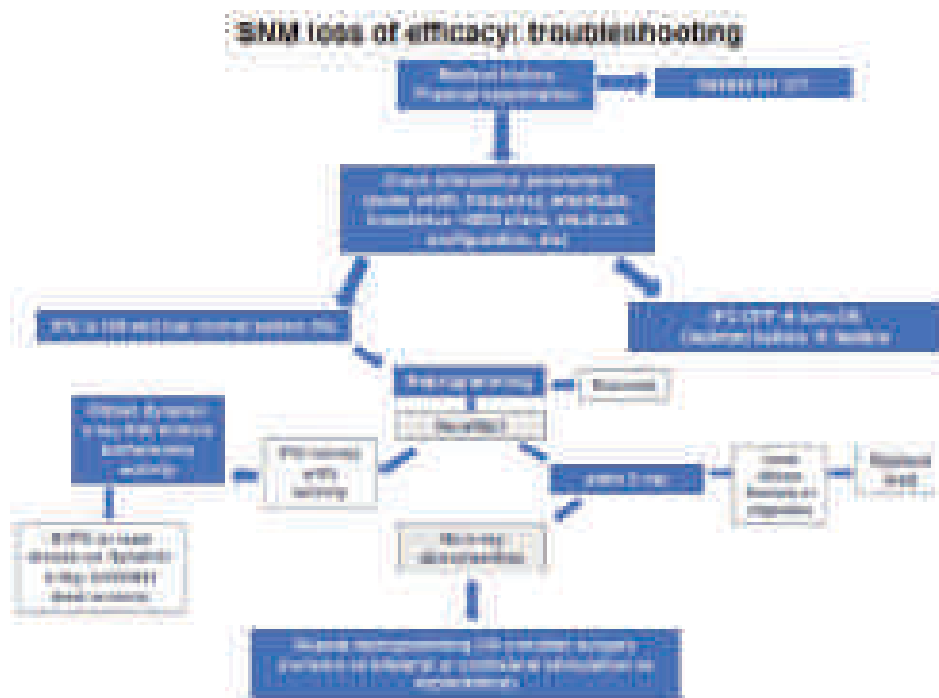
## **TROUBLESHOOTING DEVICE MALFUNCTION – LOSS OF EFFICACY & PAINFUL STIMULATION**

***Patients with declining efficacy or painful stimulation should undergo device assessment. Turning off the device will differentiate painful stimulation vs. local pain at site of IPG. Changing program voltage or lead configuration may correct painful stimulation prior to attempting lead revision. (Level of evidence III, Grade of Recommendation C)***

After permanent implantation, patients should be followed considering their primary reason for implant and clinical effect obtained at the time of their trial. Common complaints include discomfort at the site of the IPG, painful stimulation, recurrence of symptoms, absent stimulation, and stimulation in non-target areas.<sup>5,148</sup>

Such complications can be related either to the device, implantation technique, or parameters of stimulation. The most recent prospective, controlled data with 3 year follow-up is now available,<sup>31</sup> reporting a global device-related adverse event rate of 16%. Concerning the IPG, 47% of patients in the series reported adverse events, of which 91% were resolved at the time of analysis. These included an undesirable change in stimulation (49/272, 18%), implant site pain (34/272, 13%) and lack of efficacy (16/272, 6%). Loss of efficacy may develop either due to failure of the therapy to achieve significant clinical improvement of symptoms (> 50%) or due to a depleted battery.

Little has been published regarding the troubleshooting of sacral neuromodulation systems since the description by the Cleveland Clinic in 2005. As such, the following algorithm is recommended:



When a patient presents with a side-effect which may be related to stimulation, such as declining efficacy, painful stimulation, or aberrant neurological stimulation, the first action by the clinician should be to turn off the IPG. Should symptoms disappear, the IPG may be turned back on and reprogrammed, trying to avoid return of the presenting symptom. Pain related to stimulation should disappear when turning off the IPG and reprogramming, which may include decreasing voltage, decreasing frequency and/or changing the lead configuration. This can be done by the physician, or by a physician assistant or dedicated nurse if they are adequately trained in programming as well as clinical analysis of patient complaints. If pain persists after the IPG is turned off, the pain is may be due to the position of the IPG itself and IPG repositioning may be required, or it may be unrelated to the device. At minimum, other etiologies should be considered.

***Device programming should be performed by experienced clinicians targeting comfortable low sensory thresholds to the perineum. (Level of Evidence IV, Grade of Recommendation C)***

Follow-up of patients undergoing permanent SNM depends somewhat on the local health care system. As most of the adverse events require the clinician to analyze symptoms and then try to correlate those symptoms with any device malfunction, office evaluation (rather than a telemedicine visit) is usually required.

***Patients given a complement of programs should try a new program for at least 1 week, unless it is not tolerable secondary to unpleasant stimulation or severe worsening of symptoms. (Level of Evidence IV, Grade of Recommendation C)***

Since voiding and bowel disorders are not always constant over time, any new program should be tested for at least one week unless the patient experiences side effects from the new program. In a recent prospective trial<sup>118</sup> 22% of patients needed reprogramming due to an undesirable change in stimulation, decrease in therapeutic efficacy, or pain, within 5 years of implantation.

***If reprogramming does not improve the patient's symptoms, radiographic imaging should be performed to assess for lead breakage or migration. (Level of Evidence IV, Grade of Recommendation C)***

X-ray images can reveal lead fractures or migration of system components that subsequently necessitate replacement of the system. Moreover, impedances > 4000 ohms are also diagnostic of a lead fracture or microfracture (which may not be visible on imaging) and likely requires lead replacement, although evidence from a large retrospective series shows many abnormal impedances can be programmed around to salvage a lead.<sup>98</sup>

## **WHEN TO STOP SNM TESTING/THERAPY**

***SNM testing or therapy should be discontinued if the patient no longer wishes to proceed, or if in the judgment of the clinician, further testing/lead revision will not lead to symptom improvement. (Level of Evidence: III, Grade of Recommendation: C)***

The only documented predictor for treatment success is the response to a trial of stimulation. Since implanted patients may experience declining efficacy over time,<sup>39</sup> therapy may need to be altered. As outlined elsewhere in this text, patients may elect to undergo device interrogation, re-programming, or surgical revision when symptoms are not well controlled with SNM. If at any time the patient does not desire to continue with SNM, or would prefer to transition to other 3<sup>rd</sup> line treatments, then therapy should be discontinued. Furthermore, once a patient has exhausted the possible revisions and alterations of therapy (lead location and side, programming options) and the clinician determines that no further benefit can be expected, then SNM should be discontinued.

## **DEPLETED IMPLANTABLE PULSE GENERATOR (IPG)**

***Exchange of IPG should occur when end of service is confirmed and the patient has maintained a successful response to SNM prior to battery depletion.***

***Check the impedance of the lead and, if indicated, replace the lead when exchanging the IPG. (Level of Evidence: III; Grade of Recommendation: C)***

Patients with a depleted IPG battery (end of service) will usually present with loss of SNM stimulation and/or loss of efficacy of SNM. Occasionally, increased stimulation may be experienced. When patients present with a depleted IPG battery, confirm end of service by running a battery check with a physician programmer. Exchange the IPG when the end of service is confirmed and the patient has maintained a successful response to SNM prior to battery depletion. Check the impedance of the lead and, if indicated, replace the lead when exchanging the IPG.

## **NON-FUNCTIONING SYSTEM**

***When patients present with a non-functioning system, confirm impedances by checking all combinations with a physician programmer. If all of the combinations are non-functional, then the IPG should be turned off to conserve battery life and the lead replaced. The lead should also be replaced if there is a therapy-limiting number of programming options. (Level of Evidence: III; Grade of Recommendation: C)***

Patients with a non-functioning lead will usually present with loss of SNM stimulation and/or loss of efficacy of SNM. When patients present with a non-functioning lead, confirm by an impedance check all combinations with a physician programmer. At least one functioning lead electrode is required for a lead to operate unipolar and two functioning leads for bipolar stimulation. If all of the combinations are non-functional, the IPG should be turned off and the lead replaced.

When assessing the lead with the physician programmer, run an impedance check at 2.0 volts to deliver sufficient energy for a complete check and assess all the seven possible circuit combinations. A non-functioning combination will return a reading above 4,000 ohms or 0 ohms. If all of the combinations are non-functional, the IPG should be turned off and the lead replaced (consider a trial of unipolar stimulation if only one electrode is functioning). If not all of the combinations are non-functional then, by a process of elimination, the non-functioning electrode(s) can be identified and not used in future programming. Many devices with non-functional electrodes can be salvaged and used to provide continued therapy after programming around the broken lead.<sup>98</sup>

Before replacing a non-functioning lead, the clinician should discuss the implications of lead removal, including the risk of retained fragments. Confirmation of the lead site should be sought, in the form of a sacral X-ray if the prior operative reports or intraoperative films are not available. It is recommended that the lead be removed through the pre-sacral incision. When removing the lead through the pre-sacral incision, use gentle traction in a straight-line direction with respect to the lead tines. If too much resistance is encountered during lead removal, further dissection through lumbosacral fascia and pre-sacral periosteum may be required. The prevalence of lead breakage during lead removal is 1-3.6%.<sup>103,149,150</sup> Of note, some anecdotally report successful lead removal through the buttock incision using gentle traction on the lead. Nonetheless, leads left in for prolonged periods of time may be more challenging to remove this way and strong consideration should be given to midline removal.

## **RESIDUAL LEAD FRAGMENTS FOLLOWING LEAD REMOVAL**

***Patients with residual lead fragments should be advised of the presence, nature and safety of the residual fragments. Current evidence suggests it may be safe for residual lead fragments to remain long-term. (Level of Evidence: III, Grade of Recommendation: C)***

Patients with residual lead fragments should be advised of the presence, nature and safety of the residual fragments. This should include providing patients with information regarding composition, size and location of residual lead fragments. Although not reported for SNM, migration, infection, and injury to surrounding structures from residual lead fragments are theoretical risks. Current evidence suggests it is generally safe, for residual lead fragments to remain *in situ* long-term, including in patients undergoing MRI.<sup>85</sup>

## **BILATERAL AND PUDENDAL LEADS**

***During PNE testing, bilateral temporary lead placement is recommended to reduce the risk of test failure due to lead migration. (Level of Evidence: III, Grade of Recommendation: C)***

***There is no published evidence that bilateral tined lead placement is more efficacious than unilateral placement. (Level of Evidence: 3, Grade of Recommendation: C)***

For PNE test, a non-tined electrode is used. The currently available version is a thin wire without any anchoring system and is prone to migration. The risk of migration is related to the duration of the test and thus only a few days of reliable stimulation are possible. Placing bilateral PNE leads increases the possibility of a correctly placed lead, and increases the possibility of a successful test. Tined leads are more expensive than non-tined, and it may be difficult in some countries due to insurance to place bilateral tined leads for testing. In a retrospective study of 55 patients with unilateral tined leads and 69 with bilateral tined leads, 76% of patients with bilateral leads went on to full implantation, versus only 58% of those trialed with a unilateral lead. It should be noted that in patients with bilateral leads, both leads were consecutively stimulated—not simultaneously.<sup>151</sup>

Theoretically, bilateral stimulation may be more efficacious than unilateral. This hypothesis is supported by animal experiments which demonstrate that with bilateral stimulation more nerve fibers can be stimulated enhancing the neuromodulatory effects.<sup>152</sup> However, in a prospective randomized trial on 25 patients, no beneficial effect was found with bilateral PNE lead stimulation compared to unilateral stimulation.<sup>153</sup> In patients with loss of efficacy, adding a contralateral PNE lead to achieve bilateral stimulation resulted in a significant decrease in the number of voids and pads per day. However, no benefit was found between bilateral or contralateral stimulation.<sup>154</sup> In FI, a study exploring the benefit of bilateral over unilateral sacral neuromodulation had to be discontinued prematurely after an interim analysis of 20 patients demonstrated no additional benefit in symptom score, quality-of-life score, or findings on anorectal manometry.

***Placement of pudendal leads can be considered as an alternative option if SNM fails after sacral lead positioning and programming has been optimized, especially if the IPG is already in place or if the patient is refractory to other minimally-invasive treatments. (Level of Evidence: III, Grade of Recommendation: Grade C)***

The currently available system for SNM can be used off-label for pudendal stimulation. However no long-term data are yet available. A retrospective study in a mixed patient group including OAB wet/dry, NOR and painful bladder syndrome showed successful responses upon pudendal stimulation in 93% of patients failing SNM.<sup>155</sup> In two prospective studies, patients (OAB wet/dry; painful bladder) were implanted with leads at both S3 and close to the pudendal nerve. Of the patients responding successfully to the test, 78% subjectively favored the pudendal lead for chronic stimulation; however, it should be noted that the pudendal leads were placed with EMG guidance, while the sacral leads were not.<sup>156,157</sup>

## **MRI CONSENSUS STATEMENT**

***For current devices, manufacturer labeling should be followed for MRI imaging of the head or extremities. (Level of evidence: Grade IV, Grade D)***



MRI imaging is used to diagnose and monitor an increasing number of conditions. There are three magnetic fields during MRI that can react with implanted neuromodulation devices including mechanical force and torque induced by a static magnetic field, induced voltages and current on leads by a pulsed gradient field, and current induced into the generator body by the radiofrequency magnetic field.<sup>158,159,160</sup> These forces could potentially result in local tissue injury or damage to the implanted devices. Until the development of MR conditional neuromodulation systems, it is necessary to consider explantation of entire systems in order to perform MRI, exposing the patient to loss of therapy benefit, additional surgical risks, and costs.

According to the manufacturer's labeling (2012 manufacturer's instructions for use [IFU]), non-clinical testing has demonstrated that InterStim Therapy systems have been found to be MR Conditional. If a patient is implanted with an InterStim II Model 3058 Neurostimulator or an eligible serial number of an InterStim Model 3023 Neurostimulator (when implanted as a system including a neurostimulator, lead, and extension as applicable), MRI examinations of the head only may be safely performed under the following conditions:

- 1.5-Tesla (T) horizontal closed bore
- Maximum spatial gradient of 19 T/m (1900 gauss/cm)
- RF transmit/receive head coil only (no RF transmit body coil)
- Gradient slew rate limited to 200 T/m/s
- Normal operating mode (Scanning frequency of approximately 64 MHz only)
- If possible, do not sedate the patient
- Model 3058 and eligible Model 3023 Neurostimulators: Turn the neurostimulator off
- Eligible Model 3023 Neurostimulators only: Disable the magnet switch

According to the manufacturer, scanning under different conditions may result in severe patient injury or device malfunction, and is currently not recommended by FDA labelling. As a matter of course, implant surgeons and radiologists should recognize these guidelines.

***There appears to be an increasing body of evidence that axial MRI imaging can be performed safely with present devices under certain circumstances. (Level of Evidence: II, Grade of Recommendation: B)***

Two separate studies have shown that MRI studies of the extremities other than the head and body MRI scanning including the lumbar spine and pelvis can be performed safely with earlier and current InterStim devices. Elkelini<sup>147</sup> as well as Chermanski<sup>161</sup> reported the results from individual small series of patients studied without event using the Interstim I device, using 1.5 and 0.6 Tesla machines. In one case, a generator (IPG) was found to be damaged after study due to leaving the magnet switch on, and both studies recommended setting the amplitude to zero and turning the magnet switch off.

In an ex vivo phantom model simulator study of the contemporary InterStim II device,<sup>162</sup> there was no significant heating, defined as an increase in temperature of  $>1^{\circ}\text{C}$ , found using an intact system or with a 5cm distal lead fragment meant to simulate a retained lead fragment after partial extraction. Significant heating was found when a full-length lead, not connected to an IPG, was evaluated. Based on these findings, a prospective in vivo study was performed<sup>163</sup> wherein a pelvic or lumbosacral MRI was performed on a series of eleven patients with their devices in situ, and turned off (no magnet switches as part of these devices). No serious adverse events were reported during the MRI study and there were no changes in the devices after, though two patients did report a sensation of warmth at the IPG site during the scan, which resolved afterward. A caveat is that the patients were studied on

31

the same MRI machine used to study the phantom model, and they were not willing to generalize to other machines and specific locations.

***Alternative forms of imaging should be considered carefully before device removal for MRI imaging. (Level of Evidence: IV, Grade of Recommendation: D)***

Although it appears that less restrictive use of MRI may be safe in certain clinical settings, it is recommended that implanting physicians and radiologists follow the manufacturer's guidelines at the present time. Thoughtful discussion and planning with radiologists may be helpful in obtaining MRI imaging of extremities that are geographically separate from the pelvis, using the principles outlined in the manufacturers' IFU for study of the head only. It remains prudent to consider imaging modalities that can serve as a substitute for MRI whenever appropriate; indeed, a study by Lloyd et al suggests that up to 24% of patients who undergo SNM device removal for MRI ultimately do not go on to receive an MRI study, and that only 56% of MRIs lead to a change in clinical management, emphasizing that it is of paramount importance to confirm the necessity of MRI before removing a functional SNM device.<sup>164</sup> Clearly, full body MRI conditional safety will be a highly valuable feature if and when it becomes available with future systems and devices.

## **FUTURE RESEARCH**

***Future research, including newer technologies, mechanisms for patient-response driven programming, and techniques for optimal lead placement, is needed.***

***This research will be aided by a better understanding of the mechanism of action of SNM***

***Attention should also be directed toward the development of better composite measures of therapy outcomes.***

This consensus statement highlights the complex nature of neuromodulation therapy. Broadly, we have a low level of evidence for many of our recommendations. Patient selection is based on symptoms, not biochemical or functional testing. Pelvic floor, urinary and bowel studies have not reliably predicted the best candidates for SNM, nor have patient symptoms.<sup>165</sup> One study has shown an association of treatment satisfaction with pudendal nerve terminal motor latency in FI<sup>128</sup> and another suggests that strong toe responses at as many electrodes as possible intraoperatively may reduce the risk of future lead revision,<sup>166</sup> but only response to a trial of stimulation can currently predict response to treatment. This opens the door to newer technologies which incorporate the lead trial into long-term therapy, possibly with a one-step implant if costs can be contained. The current IPG (InterStim, Medtronic) is costly which is the reasoning behind a staged-implant approach. Other perceived weaknesses of this device, including lead fracture, battery life, clinician-dependent programming, and MRI compatibility, need to be addressed, as does the long-term effect of SNM on bladder and bowel physiology.

Surgical technique has not changed much since the introduction of the tined-electrode, which eliminated the need to suture directly to the periosteum. There remains debate regarding how precisely the lead must be positioned. Some studies suggest that only one active electrode is needed for a clinical response<sup>114</sup>, though most advocate for 4-electrodes targeted at low voltages.<sup>167</sup> CT guidance has been used for those with complex anatomical findings,<sup>168</sup> while others have shown intra-operative EMG to be of help.<sup>169</sup> Nevertheless, further outcomes-based research is needed to clarify the best method for placing the lead. ***(Level of Evidence: III, Grade of Recommendation: C)***

Furthermore, there are no specific programming recommendations besides the 4-program settings and patient selection based on perceived symptom improvement. More novel approaches may incorporate a patient's "vote" for a program or a setting based on bowel/bladder diaries kept in real time. There are already available smart-phone applications for patients to track their symptoms which may be utilized in device programming.<sup>170</sup>

Economic modeling suggests that SNM becomes cost-effective relative to intradetrusor botulinum toxin injections for idiopathic OAB after about 5 years of treatment.<sup>171</sup> At 10 years, models suggest that SNM is also cost-effective relative to oral medical therapy for OAB.<sup>172</sup> There is little data on SNM cost-effectiveness relative to other treatments for urinary retention and fecal incontinence. Such studies would need to incorporate patient reported outcome measures to best characterize therapeutic benefit versus the cost of therapy.

#### ACKNOWLEDGEMENTS

The following physicians reviewed the manuscript and made critical suggestions:

Riyad Al Mousa, Marcio Averbeck, Kevin Benson, Karel Everaert, Bradley Gill, Michael Guralnick, Hashim Hashim, Kathleen Kobashi, Anders Mellgren, Javier Pizarro-Berdichevsky, Steven Wexner

**TABLE: International Consultation on Urological Diseases (ICUD) modification of The Oxford Centre for Evidence-Based Medicine guidelines on the levels of evidence that generate the subsequent grades of recommendations**

Level of Evidence	Criteria	Grade of Recommendation	Criteria
I	Meta-analysis of RCTs or high-quality RCT	A	Usually consistent with level I evidence
II	Low-quality RCT or good-quality prospective cohort study	B	Consistent level II or III evidence or "majority evidence" from RCTs
III	Good-quality retrospective case-control study or cohort study	C	Level IV evidence or "majority evidence" from level II or III studies, Delphi processed expert opinion
IV	Expert opinion	D	No recommendation possible because of inadequate or conflicting evidence

## REFERENCES

- <sup>1</sup> Abrams P, Khoury S, Grant A. Evidence-based medicine overview of the main steps for developing and grading guideline recommendations. *Prog Urol*. 2007 May;17(3):681-4.
- <sup>2</sup> Amundsen CL, Richter HE, Menefee SA, Komesu YM, Arya LA, Gregory WT, Myers DL, Zyczynski HM, Vasavada S, Nolen TL, Wallace D, Meikle SF. OnabotulinumtoxinA vs sacral neuromodulation on refractory urgency urinary incontinence in women: a randomized clinical trial. *JAMA*. 2016 Oct 4;316(13):1366-74.
- <sup>3</sup> Hassouna MM, Siegel SW, Nyeholt AA, Elhilali MM, van Kerrebroeck PE, Das AK, Gajewski JB, Janknegt RA, Rivas DA, Dijkema H, Milam DF, Oleson KA, Schmidt RA. Sacral neuromodulation in the treatment of urgency-frequency symptoms: a multicenter study on efficacy and safety. *J Urol*. 2000 Jun;163(6):1849-54.
- <sup>4</sup> Siegel SW, Catanzaro F, Dijkema HE, Elhilali MM, Fowler CJ, Gajewski JB, Hassouna MM, Janknegt RA, Jonas U, van Kerrebroeck PEV, A.A.B. Nijeholt LA, Oleson KA, Schmidt RA; Long-term results of a multicenter study on sacral nerve stimulation for treatment of urinary urge incontinence, urgency-frequency, and retention. *Urology*. 2000 Dec;56(6 Suppl 1):87-91.
- <sup>5</sup> Schmidt RA, Jonas U, Oleson KA, Janknegt RA, Hassouna MM, Siegel SW, van Kerrebroeck PE. Sacral nerve stimulation for treatment of refractory urinary urge incontinence. Sacral Nerve Stimulation Study Group. *J Urol*. 1999 Aug;162(2):352-7.
- <sup>6</sup> Al-zahrani AA, Elzayat EA, Gajewski JB. Long-term outcome and surgical interventions after sacral neuromodulation implant for lower urinary tract symptoms: 14-year experience at 1 center. *J Urol*. 2011 Mar;185(3):981-6.
- <sup>7</sup> Siegel S, Noblett K, Mangel J, Griebing TL, Sutherland SE, Bird ET, Comiter C, Culkin D, Bennett J, Zylstra S, Berg KC, Kan F, Irwin CP. Results of a prospective, randomized, multicenter study evaluating sacral neuromodulation with InterSTim therapy compared to standard medical therapy at 6-months in subjects with mild symptoms of overactive bladder. *Neurourol Urodyn*. 2015 Mar;34(3):224-30.
- <sup>8</sup> Jonas U, Fowler CJ, Chancellor MB, Elhilali MM, Fall M, Gajewski JB, Grunewald V, Hassouna MM, Hombergh U, Janknegt R, van Kerrebroeck PE, Lylcklama a Nijeholt AA, Siegel SW, Schmidt RA. Efficacy of sacral nerve stimulation for urinary retention: results 18 months after implantation. *J Urol*. 2001 Jan;165(1):15-9.
- <sup>9</sup> van Kerrebroeck PE, van Voskuilen AC, Heesakkers JP, Lycklama a Nijeholt AA, Siegel S, Jonas U, Fowler CJ, Fall M, Gajewski JB, Hassouna MM, Cappellano F, Elhilali MM, Milam DF, Das AK, Dijkema HE, van den Hombergh U. Results of sacral neuromodulation therapy for urinary voiding dysfunction: outcomes of a prospective, worldwide clinical study. *J Urol*. 2007 Nov;178(5):2029-34.
- <sup>10</sup> Datta SN, Chaliha C, Singh A, Gonzales G, Mishra VC, Kavia RBC, Kitchen N, Fowler CJ, Elneil S. Sacral neurostimulation for urinary retention: 10-year experience from one UK centre. *BJU Int*. 2008 Jan;101(2):192-6.
- <sup>11</sup> De Ridder D, Ost D, Bruyninckx F. The presence of Fowler's syndrome predicts successful long-term outcome of sacral nerve stimulation in women with urinary retention. *Eur Urol*. 2007 Jan;51(1):229-33.
- <sup>12</sup> Peeters K, Sahai A, De Ridder D, Van Der Aa F. Long-term follow-up of sacral neuromodulation for lower urinary tract dysfunction. *BJU Int*. 2014 May;113(5):789-94.

- 
- <sup>13</sup>Hanno P, Dmochowski R. Status of international consensus on interstitial cystitis/bladder pain syndrome/painful bladder syndrome: 2008 snapshot. *Neurourol Urodyn*. 2009;28(4):274-86.
  - <sup>14</sup>Gajewski JB, Al-Zahrani AA. The long-term effects of sacral neuromodulation in the management of intractable cases of bladder pain syndrome: 14 years of experience in one centre. *BJU Int*. 2011 Apr;107(8):1258-64.
  - <sup>15</sup>Maier CM, Carey MP, Dwyer PL, Schluter PL. Percutaneous sacral nerve root neuromodulation for intractable interstitial cystitis. *J Urol*. 2001 Mar;165(3):884-6.
  - <sup>16</sup>Ghazwani YQ, Elkelini MS, Hassouna MM. Efficacy of sacral neuromodulation in treatment of bladder pain syndrome: long-term follow-up. *Neurourol Urodyn*. 2011 Sep;30(7):1271-5.
  - <sup>17</sup>Marinkovic SP, Gillen LM, Marinkovic CM. Minimum six-year outcomes for interstitial cystitis treated with sacral neuromodulation. *Int Urogynecol J*. 2011 Apr;22(4):407-12.
  - <sup>18</sup>Powell CR, Kreder KJ. Long-term outcomes of urinary frequency syndrome due to painful bladder syndrome treated with sacral neuromodulation and analysis of failures. *J Urol*. 2010 Jan;183(1): 173-6.
  - <sup>19</sup>Comiter CV. Sacral neuromodulation for the symptomatic treatment of refractory interstitial cystitis: a prospective study. *J Urol*. 2003 Apr;169(4):1369-73.
  - <sup>20</sup>Hanno PM, Burks DA, Clemens JQ, Dmochowski RR, Erickson D, FitzGerald MP, Forrest JB, Gordon B, Gray M, Mayer RD, Moldwin R, Newman DK, Nyberg L Jr, Payne CK, Wesselmann U, Faraday MM. American Urological Association (AUA) Guideline: Diagnosis and treatment of interstitial cystitis/bladder pain syndrome. Website: [http://www.auanet.org/guidelines/interstitial-cystitis/bladder-pain-syndrome-\(2011-amended-2014\)](http://www.auanet.org/guidelines/interstitial-cystitis/bladder-pain-syndrome-(2011-amended-2014)). Accessed November 27, 2017.
  - <sup>21</sup>Engeler DS, Baranowski AP, Dinis-Olivera P, Elneil S, Hughes J, Messelink EJ, van Ophoven A, Williams AC, European Association of Urology. The 2013 EUA guidelines on chronic pelvic pain: is management of chronic pelvic pain a habit, a philosophy, or a science? 10 years of development. *Eur Urol*. 2013 Sep;64(3):431-9.
  - <sup>22</sup>Fariello JY, Whitmore K. Sacral neuromodulation stimulation for interstitial cystitis/bladder pain syndrome, chronic pelvic pain, and sexual dysfunction. *Int Urogynecol J*. 2010 Dec;21(12):1553-8.
  - <sup>23</sup>Kessler TM, La Framboise D, Trelle S, Fowler CJ, Kiss G, Pannek J, Schurch B, Sievert KD, Engeler DS. Sacral neuromodulation for neurogenic lower urinary tract dysfunction: systematic review and meta-analysis. *Eur Urol*. 2010 Dec;58(6):865-74.
  - <sup>24</sup>Peters KM, Kandagatla P, Killinger KA, Wolfert C, Boura JA. Clinical outcomes of sacral neuromodulation in patients with neurologic conditions. *Urology*. 2013 Apr;81(4):738-43.
  - <sup>25</sup>Lombardi G, Musco S, Celso M, Ierardi A, Nelli F, Del Corso F, Del Popolo G. Intravesical electrostimulation versus sacral neuromodulation for incomplete spinal cord patients suffering from neurogenic non-obstructive urinary retention. *Spinal Cord*. 2013 Jul;51(7):571-8.
  - <sup>26</sup>Lombardi G, Nelli F, Mencarini M, Del Popolo G. Clinical concomitant benefits on pelvic floor dysfunctions after sacral neuromodulation in patients with incomplete spinal cord injury. *Spinal Cord*. 2011 May;49(5):629-36.
  - <sup>27</sup>Minardi D, Muzzonigro G. Sacral neuromodulation in patients with multiple sclerosis. *World J Urol*. 2012 Feb;30(1):123-8.

- 
- <sup>28</sup> Averbach M, Medes C. Worldwide utilization patterns of sacral neuromodulation for neurogenic lower urinary tract dysfunction. *Curr Bladder Dysfunct Rep* DOI 10.1007/s11884-016-0383-2
- <sup>29</sup> Elneil S. Optimizing the duration of assessment of stage-1 sacral neuromodulation in nonobstructive chronic urinary retention. *Neuromodulation*. 2014 Jan;17(1):66-70.
- <sup>30</sup> Amundsen CL, Romero AA, Jamison MG, Webster GD. Sacral neuromodulation for intractable urge incontinence: are there factors associated with cure? *Urology*. 2005 Oct;66(4):746-50.
- <sup>31</sup> Siegel S, Noblett K, Mangel J, Griebeling TL, Sutherland SE, Bird ET, Comiter C, Culkin D, Bennett J, Zylstra S, Kan F, Thiery E. Three-year follow-up results of a prospective, multicenter study in overactive bladder subjects treated with sacral neuromodulation. *Urology*. 2016 Aug;94:57-63.
- <sup>32</sup> Faris AER, Gill BC, Pizarro-Berdichevsky J, Dielubanza E, Clifton MM, Okafor H, Goldman HB, Moore Ck, Rackley RR, Vasavada Sp. Impact of age and comorbidities on use of sacral neuromodulation. *J Urol*. 2017 Jul;198(10):161-6.
- <sup>33</sup> Drossaerts J, Rademakers K, van Koeveeringe G, Van Kerrebroeck P. The value of urodynamic tools to guide patient selection in sacral neuromodulation. *World J Urol*. 2015 Nov;33(11):1889-95.
- <sup>34</sup> Leong RK, De Wachter SG, Nieman FJ, de Bie RA, van Kerrebroeck PE. Peripheral nerve evaluation versus 1<sup>st</sup> stage timed lead procedure: a direct comparison to select the most sensitive test method to identify patients suitable for sacral neuromodulation therapy. *Neurourol Urodyn*. 2011 Sep;30(7):1249-52.
- <sup>35</sup> Koldewijn EL, Rosier PF, Mueleman EJ, Koster AM, Debruyne FM, van Kerrebroeck PE. Predictors of success with neuromodulation in lower urinary tract dysfunction: results of trial stimulation in 100 patients. *J Urol*. 1994;152(6 Pt 1):2071-5.
- <sup>36</sup> Banakhar M, Hassouna M. Percutaneous nerve evaluation test versus staged test trials for sacral neuromodulation: sensitivity, specificity, and predictive values of each technique. *Int Neurourol J*. 2016 Sep;20(3):250-4.
- <sup>37</sup> Mason MD, Stephany HA, Casella PD, Clayton BD, Tanaka ST, Thomas JC, Adams MC, Brock III JW and Pope IV JC. Prospective evaluation of sacral neuromodulation in children: outcomes and urodynamic predictors of success. *J Urol*. 2016 Apr;195:1239-44.
- <sup>38</sup> Dielubanza E, Gill B, Agarawal S, Okafor H, Lloyd J, Guzman J, Moore C, Goldman HB. The value of urodynamics prior to sacral neuromodulation in men. *J Urol*. 2017 Apr;197(4):e843.
- <sup>39</sup> Scarpero H. Urodynamics in the evaluation of female LUTS: when are they helpful and how do we use them? *Urol Clin North Am*. 2014 Aug;41(3):429-38.
- <sup>40</sup> Winters JC, Dmochowski RR, Goldman HB, Herndon CDA, Kobashi KC, Kraus SR, Lemack GE, Nitti VW, Rovner ES, Wein AJ. Urodynamic studies in adults: AUA/SUFU Guideline. *J Urol*. 2012 Dec;188(6):2464-72.
- <sup>41</sup> Rademakers KL, Drossaerts JM, van Kerrebroeck PE, Oelke M, van Koeveeringe GA. Prediction of sacral neuromodulation treatment success in men with impaired bladder emptying-time for a new diagnostic approach. *Neurourol Urodyn*. 2017 Mar;36(3):808-10.
- <sup>42</sup> Fowler CJ, Dasgupta R. Electromyography in urinary retention and obstructed voiding in women. *Scand J Urol Nephrol Suppl*. 2002;(210):55-8.

- 
- <sup>43</sup>Nitti V, Tu LM, Gitlin J. Diagnosing bladder outlet obstruction in women. *J Urol*. 1999 May;161(5):1535-40.
- <sup>44</sup>Nitti VW, Lefkowitz G, Ficazzola M, Dixon CM. Lower urinary tract symptoms in young men: videourodynamic findings and correlation with noninvasive measures. *J Urol*. 2002 Jul;168(1):135-8.
- <sup>45</sup>Paquette IM, Varma MG, Kaiser AM, Steele SR, Rafferty JF. The American Society of Colon and Rectal Surgeons' Clinical Practice Guideline for the Treatment of FI. *Dis Colon Rectum*. 2015 Jul;58(7):623-36.
- <sup>46</sup>Surgery for faecal incontinence. In: *Incontinence*, 6<sup>th</sup> edition. Abrams P, Cardozo L, Wagg A, Wein A, (eds). 2017, Volume 2, p. 2099-2108.
- <sup>47</sup>Leroi AM, Parc Y, Lehur PA, Mion F, Barth X, Rullier E, Bresler L, Portier G, Michot F. Efficacy of sacral nerve stimulation for fecal incontinence: results of a multicenter double-blind crossover study. *Ann Surg*. 2005 Nov;242(5):662-9.
- <sup>48</sup>Thin NN, Horrocks EJ, Hotouras A, Palit S, Thaha MA, Chan CL, Matzel KE, Knowles CH. Systematic review of the clinical effectiveness of neuromodulation in the treatment of faecal incontinence. [Review] *Br J Surg*. 2013 Oct;100(11):1430-47.
- <sup>49</sup>Thin NN, Taylor SJ, Bremner SA, Emmanuel AV, Hounscome N, Williams NS, Knowles CH. Neuromodulation Trial Study Group. Randomized clinical trial of sacral versus percutaneous tibial nerve stimulation in patients with faecal incontinence. *Br J Surg*. 2015 Mar;102(4):349-58.
- <sup>50</sup>Al Asari S, Meurette G, Mantoo S, Kubis C, Wyart V, Lehur PA. Percutaneous tibial nerve stimulation vs sacral nerve stimulation for faecal incontinence: a comparative case-matched study. *Colorectal Dis*. 2014;16(11):O393-9.
- <sup>51</sup>Meurette G, La Torre M, Regenet N, Robert-Yap J, Lehur PA. Value of sacral nerve stimulation in the treatment of severe faecal incontinence: a comparison to the artificial bowel sphincter. *Colorectal Dis*. 2009 Jul;11(6):631-5.
- <sup>52</sup>Maeda Y, O'Connell PR, Lehur PA, Matzel KE, Laurberg S, European SNSBSG. Sacral nerve stimulation for faecal incontinence and constipation: a European consensus statement. *Colorectal Dis*. 2015 Apr;17(4):O74-87.
- <sup>53</sup>Johnson BL, 3rd, Abodeely A, Ferguson MA, Davis BR, Rafferty JF, Paquette IM. Is sacral neuromodulation here to stay? Clinical outcomes of a new treatment for FI. *J Gastrointest Surg*. 2015 Jan;19(1):15-19; discussion 19-20.
- <sup>54</sup>Conaghan P, Farouk R. Sacral nerve stimulation can be successful in patients with ultrasound evidence of external anal sphincter disruption. *Dis Colon Rectum*. 2005 Aug;48(8):1610-4.
- <sup>55</sup>Jarrett ME, Dudding TC, Nicholls RJ, Vaizey CJ, Cohen CR, Kamm MA. Sacral nerve stimulation for fecal incontinence related to obstetric anal sphincter damage. *Dis Colon Rectum*. 2008 May;51(5):531-7.
- <sup>56</sup>Melenhorst J, Koch SM, Uludag O, van Gemert WG, Baeten CG. Is a morphologically intact anal sphincter necessary for success with sacral nerve modulation in patients with faecal incontinence? *Colorectal Dis*. 2008 Mar;10(3):257-62.
- <sup>57</sup>Boyle DJ, Knowles CH, Lunniss PJ, Scott SM, Williams NS, Gill KA. Efficacy of sacral nerve stimulation for fecal incontinence in patients with anal sphincter defects. *Dis Colon Rectum*. 2009 Jul;52(7):1234-9.



- 
- <sup>58</sup>Brouwer R, Duthie G. Sacral nerve neuromodulation is effective treatment for fecal incontinence in the presence of a sphincter defect, pudendal neuropathy, or previous sphincter repair. *Dis Colon Rectum*. 2010 Mar;53(3):273-8.
- <sup>59</sup>Dudding TC, Pares D, Vaizey CJ, Kamm MA. Sacral nerve stimulation for the treatment of faecal incontinence related to dysfunction of the internal anal sphincter. *Int J Colorectal Dis*. 2010 May;25(5):625-30.
- <sup>60</sup>Oom DM, Steensma AB, van Lanschot JJ, Schouten WR. Is sacral neuromodulation for fecal incontinence worthwhile in patients with associated pelvic floor injury? *Dis Colon Rectum*. 2010 Apr;53(4):422-7.
- <sup>61</sup>Ratto C, Litta F, Parello A, Donisi L, Doglietto GB. Sacral nerve stimulation is a valid approach in fecal incontinence due to sphincter lesions when compared to sphincter repair. *Dis Colon Rectum*. 2010 Mar;53(3):264-72.
- <sup>62</sup>Matzel KE. Sacral nerve stimulation for faecal incontinence: its role in the treatment algorithm. *Colorectal Dis*. 2011 Mar;13 Suppl 2:10-4.
- <sup>63</sup>Lundby L, Moller A, Buntzen S, et al. Relief of fecal incontinence by sacral nerve stimulation linked to focal brain activation. *Dis Colon Rectum*. 2011 Mar;54(3):318-23.
- <sup>64</sup>Carrington EV, Evers J, Grossi U, Dinning PG, Scott SM, O'Connell PR, Jones JF, Knowles CH. A systematic review of sacral nerve stimulation mechanisms in the treatment of fecal incontinence and constipation. *Neurogastroenterol Motil*. 2014 Sep;26(9):1222-37.
- <sup>65</sup>Quezada Y, Whiteside JL, Rice T, Karram M, Rafferty JF, Paquette IM. Does preoperative anal physiology testing or ultrasonography predict clinical outcome with sacral neuromodulation for fecal incontinence? *Int Urogynecol J*. 2015 Nov;26(11):1613-7.
- <sup>66</sup>Juul T, Ahlberg M, Biondo S, Espin E, Jimenez LM, Matzel KE, Palmer GJ, Sauermann A, Trenti L, Zhang W, Laurberg S, Christensen P. Low anterior resection syndrome and quality of life: an international multicenter study. *Dis Colon Rectum*. 2014 May;57(5):585-91.
- <sup>67</sup>Thomas GP, Bradshaw E, Vaizey CJ. A review of sacral nerve stimulation for faecal incontinence following rectal surgery and radiotherapy. *Colorectal Dis*. 2015 Nov;17(11):939-42.
- <sup>68</sup>Ramage L, Qiu S, Kontovounisios C, Tekkis P, Rasheed S, Tan E. A systematic review of sacral nerve stimulation for low anterior resection syndrome. *Colorectal Dis*. 2015 Sep;17(9):762-71.
- <sup>69</sup>Eftaiha SM, Balachandran B, Marecik SJ, Mellgren A, Nordenstam J, Melich G, Prasad LM, Park JJ. *Colorectal Dis*. 2017 Oct;19(10):927-33.
- <sup>70</sup>Emmertsen KJ, Laurberg S. Low anterior resection syndrome score: development and validation of a symptom-based scoring system for bowel dysfunction after low anterior resection for rectal cancer. *Ann Surg*. 2012 May;255(5):922-8.
- <sup>71</sup>Altomare DF, Rinaldi M, Petrolino M, Monitillo V, Sallustio P, Veglia A, De Fazio M, Guglielmi A, Memeo V. Permanent sacral nerve modulation for fecal incontinence and associated urinary disturbances. *Int J Colorectal Dis*. 2004 May;19(3):203-9.
- <sup>72</sup>El-Gazzaz G1, Zutshi M, Salcedo L, Hammel J, Rackley R, Hull T. Sacral neuromodulation for the treatment of fecal incontinence and urinary incontinence in female patients: long-term follow-up. *Int J Colorectal Dis*. 2009 Dec;24(12):1377-81.

- 
- <sup>73</sup>Gill BC, Swartz MA, Rackley RR, Moore CK, Goldman HB, Vasavada SP. Improvement of bowel dysfunction with sacral neuromodulation for refractory urge urinary incontinence. *Int Urogynecol J*. 2012 Jun;23(6):735-41.
- <sup>74</sup>Sulkowski JP, Nacion KM, Deans KJ, Minneci PC, Levitt MA, Mousa HM, Alpert SA, Teich S. Sacral nerve stimulation: a promising therapy for fecal and UI and constipation in children. *J Pediatr Surg*. 2015 Oct;50(10):1644-7.
- <sup>75</sup>Ratto C, Ganio E, Naldini G, Gins. Long-term results following sacral nerve stimulation for chronic constipation. *Colorectal Dis*. 2015 Apr;17(4):320-8.
- <sup>76</sup>Paquette IM, Varma M, Ternent C, et al. The American Society of Colon and Rectal Surgeons' Clinical Practice Guideline for the Evaluation and Management of Constipation. *Dis Colon Rectum*. 2016 Jun;59(6):479-92.
- <sup>77</sup>Kamm MA, Dudding TC, Melenhorst J, et al. Sacral nerve stimulation for intractable constipation. *Gut*. 2010 Mar;59(3):333-40.
- <sup>78</sup>Sharma A, Liu B, Waudby P, Duthie GS. Sacral neuromodulation for the management of severe constipation: development of a constipation treatment protocol. *Int J Colorectal Dis*. 2011 Dec;26(12):1583-7.
- <sup>79</sup>Zerbib F, Simon M, Denost Q, Lopicard P, Lehur PA, Meurette G, Wyart V, Kubis C, Mion F, Roman S, Damon H, Barth X, Leroi AM, Bridoux V, Gourcerol G, Coffin B, Castel B, Gorbachev C, Sidaner AL, Mathonnet M, Vitton V, Lesavre N, Orsoni P, Siproudhis L, Brochard C, Desfourneaux V. Randomized clinical trial of sacral nerve stimulation for refractory constipation. *Br J Surg*. 2017 Feb;104(3):205-13.
- <sup>80</sup>Maeda Y, Kamm MA, Vaizey CJ, et al. Long-term outcome of sacral neuromodulation for chronic refractory constipation. *Tech Coloproctol*. 2017;21(4):277-86.
- <sup>81</sup>Thomas GP, Dudding TC, Rahbour G, Nicholls RJ, Vaizey CJ. Sacral nerve stimulation for constipation. *Br J Surg*. 2013 Feb;100(2):174-81.
- <sup>82</sup>Graf W, Sonesson AC, Lindberg B, Akerud P, Karlsson U. Results after sacral nerve stimulation for chronic constipation. *Neurogastroenterol Motil*. 2015 May;27(5):734-9.
- <sup>83</sup>Dinning PG, Hunt L, Patton V, et al. Treatment efficacy of sacral nerve stimulation in slow transit constipation: a two-phase, double-blind randomized controlled crossover study. *Am J Gastroenterol*. 2015 May;110(5):733-40.
- <sup>84</sup>Uludağ O, Koch SM, van Gemert WG, Dejong CH, Baeten CG. Sacral neuromodulation in patients with fecal incontinence: a single-center study. *Dis Colon Rectum*. 2004 Aug;47(8):1350-7.
- <sup>85</sup>*Incontinence*, 6<sup>th</sup> edition. Abrams P, Cardozo L, Wagg A, Wein A, (eds). 2017, Volume 2, p. 2594.
- <sup>86</sup>Bloemendaal AL, Buchs NC, Prapasrivorakul S, Cunningham C, Jones OM, Hompes R, Lindsey I. High-grade internal rectal prolapse: does it explain so-called "idiopathic" faecal incontinence? *Int J Surg*. 2016 Jan;25:118-22.
- <sup>87</sup>Humphreys MR, Vandersteen DR, Slezak JM, Hollatz P, Smith CA, Smith JE, Reinberg YE. Preliminary results of sacral neuromodulation in 23 children. *J Urol*. 2006 Nov;176(5):2227-31.
- <sup>88</sup>Guys JM, Haddad M, Planche D, Torre M, Louis-Borrione C, Breaud J. Sacral neuromodulation for neurogenic bladder dysfunction in children. *J Urol*. 2004 Oct;172(4 Pt 2):1673-6.

- 
- <sup>89</sup>Haddad M, Besson R, Aubert D, Ravasse P, Lemelle J, El Ghoneimi A, Moscovici J, Hameury F, Baumstarck-Barrau K, Hery G, Guys JM. Sacral neuromodulation in children with urinary and fecal incontinence: a multicenter, open label, randomized, crossover study. *J Urol*. 2010 Aug;184(2):696-701.
- <sup>90</sup>Dwyer ME, Vandersteen DR, Hollatz P, Reinberg YE. Sacral neuromodulation for the dysfunctional elimination syndrome: a 10-year single-center experience with 105 consecutive children. *Urology*. 2014 Oct;84(4):911-7.
- <sup>91</sup>Medtronic (2017) Sacral neuromodulation. [http://manuals.medtronic.com/wcm/groups/mdtcom\\_sg/@emanuals/@era/@neuro/documents/documents/contrib\\_214172.pdf](http://manuals.medtronic.com/wcm/groups/mdtcom_sg/@emanuals/@era/@neuro/documents/documents/contrib_214172.pdf). Accessed July 17, 2017.
- <sup>92</sup>Quirouet A, Bhattacharyya PK, Dielubanza EJ, Gill BC, Jones SE, Goldman HB. Sacral neuromodulation device heating during lumbar and pelvic MRI - a phantom study. *Urology*. 2017 Jun 14. [Epub ahead of print].
- <sup>93</sup>Mahran A, Soriano A, Safwat A, Hijaz A, Mahajan ST, Trabuco E, Siegel S, El-Nashar SA. The effect of sacral neuromodulation on pregnancy: a systematic review. *Int Urogynecol J*. 2017 Feb 3. [Epub ahead of print]
- <sup>94</sup>Yaiesh SM, Al-Terki AE, Al-Shaiji TF. Safety of sacral nerve stimulation in pregnancy: a literature review. *Neuromodulation*. 2016 Oct;19(7):770-9.
- <sup>95</sup>Gormley EA, Lightner DJ, Faraday M, Vasavada SP. Diagnosis and treatment of overactive bladder (non-neurogenic) in adults: AUA/SUFU guideline amendment. *J Urol*. 2015 May;193(5):1572-80.
- <sup>96</sup>Firoozi F, Gill B, Ingber MS, Moore CK, Rackley RR, Goldman HB, Vasavada SP. Increasing patient preparedness for sacral neuromodulation improves patient reported outcomes despite leaving objective measures of success unchanged. *J Urol*. 2013 Aug;190(2):594-7.
- <sup>97</sup>Assessment and Conservative Management of Faecal Incontinence and Quality of Life in Adults. In: *Incontinence*, 6<sup>th</sup> edition. Abrams P, Cardozo L, Wagg A, Wein A, (eds). 2017, Volume 2, Chapter 16, p. 1996-2086.
- <sup>98</sup>Lenis AT, Bill BC, Carmel ME, Rajki M, Moore CK, Vasavada SP, Goldman HB. Patterns of hardware related electrode failures in sacral nerve stimulation devices. *J Urol*. 2013 Jul;190(1):175-9.
- <sup>99</sup>Wexner SD, Collier JA, Devroede G, Hull T, McCallum R, Chan M, Ayscue JM, Shobeiri AS, Margolin D, England M, Kaufman H, Snape WJ, Mutlu E, Chua H, Pettit P, Nagle D, Madoff RD, Lerew DR, Mellgren A. Sacral nerve stimulation for fecal incontinence: results of a 120-patient prospective multicenter study. *Ann Surg*. 201 Mar;251(3):441-9.
- <sup>100</sup>Dudding TC, Vaizey CJ, Gibbs A, Kamm MA. Improving the efficacy of sacral nerve stimulation for faecal incontinence by alteration of stimulation parameters. *Br J Surg*. 2009 Jul;96(7):778-84.
- <sup>101</sup>American Urological Association (2008) Best practice policy statement on urologic surgery antimicrobial prophylaxis. [http://www.auanet.org/guidelines/antimicrobial-prophylaxis-\(2008-reviewed-and-validity-confirmed-2011-amended-2012\)](http://www.auanet.org/guidelines/antimicrobial-prophylaxis-(2008-reviewed-and-validity-confirmed-2011-amended-2012)). Accessed July 27, 2017.
- <sup>102</sup>Wexner SD, Hull T, Edden Y, et al. Infection rates in a large investigational trial of sacral nerve stimulation for fecal incontinence. *J Gastrointest Surg*. 2010 Jul;14(7):1081-9.
- <sup>103</sup>Rice TC, Quezada Y, Rafferty JF, Paquette IM. Dynamic Article: Percutaneous nerve evaluation versus staged sacral nerve stimulation for fecal incontinence. *Dis Colon Rectum*. 2016 Oct;59(10):962-7. 40

- 
- <sup>104</sup>Janknegt R, Weil E, Eerdmans P. Improving neuromodulation technique for refractory voiding dysfunctions: two stage implant. *Urology*. 1997 Mar;49(3):358-62.
- <sup>105</sup>Spinelli M, Giardiello G, Gerber M, Arduini A, van den Hombergh U, Malaguti S. New sacral neuromodulation lead for percutaneous implantation using local anesthesia: description and first experience. *J Urol*. 2003 Nov;170(5):1905-7.
- <sup>106</sup>El-Azab A, Siegel S. Specific tips for general controversies in sacral neuromodulation. *Curr Urol Rep*. 2016 Nov;17(11):79.
- <sup>107</sup>Auterio SW, Hallas N, Betts CD, Ockrim JL. The cost-effectiveness of sacral nerve stimulation (SNS) for the treatment of idiopathic medically refractory overactive bladder (wet) in the UK. *BJU Int*. 2015 Dec;116(6):945-54.
- <sup>108</sup>Noblett K, Siegel S, Mangel J, et al. Results of a prospective, multicenter study evaluating QOL, safety, and efficacy of sacral neuromodulation at twelve months in subjects with symptoms of overactive bladder. *Neurourol Urodyn*. 2016 Feb;35(2):246-51.
- <sup>109</sup>Borawski KM, Foster RT, Webster GD, Amundsen CL. Predicting implantation with a neuromodulator using two different test stimulation techniques: A prospective randomized study in urge incontinent women. *Neurourol Urodyn*. 2007; 26(1):14-8.
- <sup>110</sup>Gallas S, Michot F, Faucheron JL, Meurette G, Lehur PA, Barth X, Damon H, Mion F, Rullier E, Zerbib F, Sielezneff I, Ouaisi M, Orsoni P, Desfourneaux V, Siproudhis L, Mathonnet M, Menard JF, Leroi AM, Club NEMO. Predictive factors for successful sacral nerve stimulation in the treatment of faecal incontinence: results of trial stimulation in 200 patients. *Colorectal Dis*. 201 Jun;13(6):689-96.
- <sup>111</sup>Leroi AM, Damon H, Faucheron JL, Lehur PA, Siproudhis L, Slim K, Barbieux JP, Barth X, Borie F, Bresler L, Desfourneaux V, Goudet P, Hutten N, Lebreton G, Mathieu P, Meurette G, Mathonnet M, Mion F, Orsoni P, Parc Y, Portier G, Rullier E, Sielezneff I, Zerbib F, Michot F; Club NEMO. Sacral nerve stimulation in faecal incontinence: position statement based on a collective experience. *Colorectal Dis*. 2009 Jul;11(6):572-83.
- <sup>112</sup>Amend B, Bedke J, Khalil MK, Stenzl A, Sievert KD. Prolonged percutaneous SNM testing does not cause infection-related explanation. *BJU Int*. 2013 Mar;111(3):485-91.
- <sup>113</sup>Kessler TM, Burkhard FC, Madersbacher H, Kofler A, Poewe W, Kiss G. Safety of prolonged sacral neuromodulation tined lead testing. *Curr Med Res Opin*. 2008 Feb;24(2):343-7.
- <sup>114</sup>Sterling ME, Hartigan SM, Wein AJ, Smith AL. A standardized surgical technique for removal of the InterStim tined lead. *Can J Urol*. 2016 Oct;23(5):8471-5.
- <sup>115</sup>Haraway AM, Atiemo HO, Cameron AP, He C, Stroup C, Clemens JQ. Differences in sacral neuromodulation device infection rates based on preoperative antibiotic selection. *Int Urogynecol J*. 2013 Dec;24(12):2081-5.
- <sup>116</sup>Noblett K, Benson K, Kreder K. Detailed analysis of adverse events and surgical interventions in a large prospective trial of sacral neuromodulation therapy for overactive bladder patients. *Neurourol Urodyn*. 2017 Apr;36(4):1136-9.
- <sup>117</sup>Pettit P. Current opinion: complications and troubleshooting of sacral neuromodulation. *Int Urogynecol J*. 2010 Dec;21(Suppl 2):S491-6.

- 
- <sup>118</sup>Siegel S, Noblett K, Mangel J, Bennett J, Griebing T, et al. Five year follow-up results of a prospective, multicenter study in overactive bladder subjects treated with sacral neuromodulation. *J Urol*. 2017 Jul 11. [Epub ahead of print].
- <sup>119</sup>Matzel K, Chartier-Kastler E, Knowles C, et al. Sacral neuromodulation: standardized electrode placement technique. *Neuromodulation*. Accepted August 2017.
- <sup>120</sup>Williams ER, Siegel SW. Procedural techniques in sacral nerve modulation. *Int Urogynecol J*. 2010 Dec;21 Suppl 2:S453-60.
- <sup>121</sup>Jacobs SA, Lane FL, Osann KE, Noblett KL. Randomized prospective crossover study of interstim lead wire placement with curved versus straight stylet. *Neurol Urodyn*. 2014 Jun;33(5):488-92.
- <sup>122</sup>Lieberman D, Johnson-Mitchell M, Olszewska P, Siegel S. Assessment of battery life of the 2<sup>nd</sup> generation implantable pulse generator in a practice of high volume implanters. *Neurol Urod*. 2016 Feb;35(S1):S32-33.
- <sup>123</sup>Bin-Mahfoodh M, Hamani C, Sime E, Lozano AM. Longevity of batteries in internal pulse generators used for deep brain stimulation. *Stereotact Funct Neurosurg*. 2003;80(1-4):56-60.
- <sup>124</sup>Gillera J, Killinger K, Boura J, Peters KM. Number of active electrodes at time of staged tined lead interstim implant does not impact clinical outcomes. *Neurol Urodyn*. 2016 Jun;35(5):625-9.
- <sup>125</sup>Pizarro-Berdichevsky J, Quirouet A, Clifton MM, Gill BC, Dielubanza EJ, Okafor HT, Faris AE, Moore CK, Rackley RR, Vasavada SP, Goldman HB. Lower risk of lead revision based on “optimal” lead placement during stage 1 sacral neuromodulation. *J Urol*. 2016 May;195(4S):e851.
- <sup>126</sup>Schmidt RA, Senn E, Tanagho EA. Functional evaluation of sacral nerve root integrity. Report of a technique. *Urology*. 1990 May;35(5):388-92.
- <sup>127</sup>Carlucci L, Wavasseur T, Bénard A, Sesay M, Delleci C, Goossens D, Vignes JR. Functional variability of sacral roots in bladder control. *J Neurosurg Spine*. 2014 Dec;21(6):961-5.
- <sup>128</sup>Govaert B, Melenhorst J, van Gemert WG, Baeten CG. Can sensory and/or motor reactions during percutaneous nerve evaluation predict outcome of sacral nerve modulation? *Dis Colon Rectum*. 2009 Aug;52(8):1423-6.
- <sup>129</sup>Cohen BL, Tunuguntla HS, Gousse A. Predictors of success for first stage neuromodulation: motor versus sensory response. *J Urol*. 2006 Jun;175(6):2178-80; discussion 2180-1.
- <sup>130</sup>Siegel SW. Management of voiding dysfunction with an implantable neuroprosthesis. *Urol Clin North Am*. 1992 Feb;19(1):163-70.
- <sup>131</sup>Jairam R, Marcelissen T, van Koevinge G, van Kerrebroeck P. Optimal lead positioning in sacral neuromodulation: which factors are related to treatment outcome? *Neuromodulation*. 2017 Sep 6. [Epub ahead of print]
- <sup>132</sup>Scheepens WA, Weil EH, van Koevinge GA, Rohrmann D, Hedlund HE, Schurch B. Buttock placement of the implantable pulse generator: a new implantation technique for sacral neuromodulation – a multicenter study. *Eur Urol*. 2001 Oct;40(4):434-8.
- <sup>133</sup>Dudding TC, Hollingshead JR, Nicholls RJ, Vaizey CJ. Sacral nerve stimulation for faecal incontinence: patient selection, service provision and operative technique. *Colorectal Dis*. 2011 Aug;13(8):e187-95.

- 
- <sup>134</sup>Baxter C, Kim JH. Contrasting the percutaneous nerve evaluation versus staged implantation in sacral neuromodulation. *Curr Urol Rep* 2010 Sep;11(5):310-4.
- <sup>135</sup>Brueske T, Livingston B, Warda H, Osann K, Noblett K. Risk factors for surgical site infection in patients undergoing sacral nerve modulation therapy. *Female Pelvic Med Reconstr Surg*. 2015 Jul-Aug;21(4):198-204.
- <sup>136</sup>Deng DY, Gulati M, Rutman M, Raz S, Rodriguez LV. Failure of sacral nerve stimulation due to migration of tined lead. *J Urol*. 2006 Jun;175(6):2182-5.
- <sup>137</sup>Siddiqui NY, Amundsen CL, Corey EG, Wu JM. Lead migration after sacral neuromodulation: surgical revision in fascial versus tined anchoring systems. *Int Urogynecol J*. 2011 Apr;22(4):49-23.
- <sup>138</sup>Dudding TC, Hollingshead JR, Nicholls RJ, Vaizey CJ. Sacral nerve stimulation for faecal incontinence: optimizing outcome and managing complications. *Colorectal Dis*. 2011 Aug;13(8):e196-e202.
- <sup>139</sup>Kahlke V, Fürst A, D. Leder D, Löhnert M, Schwandner O, Schwandner T, Weimann D, Matzel KE. Sakrale Nervenstimulation bei Stuhlinkontinenz - Versorgungsrealität in Deutschland. *Coloproctology*. 2017;39(Suppl 1):1-15.
- <sup>140</sup>Falletto E, Ganio E, Naldini G, Ratto C, Altomare DF. Sacral neuromodulation for bowel dysfunction: a consensus statement from the Italian group. *Tech Coloproctol*. 2014 Jan;18(1):53-64.
- <sup>141</sup>Foster RT Sr, Anoa EJ, Webster GD, Amundsen CL. In patients undergoing neuromodulation for intractable urge incontinence a reduction in 24-hr pad weight after the initial test stimulation best predicts long-term patient satisfaction. *Neurol Urodyn*. 2007;26(2):213-7.
- <sup>142</sup>Maeda Y, Norton C, Lundby L, Buntzen S, Laurberg S. Predictors of the outcome of percutaneous nerve evaluation for faecal incontinence. *Br J Surg*. 2010 Jul;97(7):1096-102.
- <sup>143</sup>Duelund-Jakobsen J, van Wunnik B, Buntzen S, Lundby L, Laurberg S, Baeten C. Baseline factors predictive of patient satisfaction with sacral neuromodulation for idiopathic FI. *Int J Colorectal Dis*. 2014 Jul;29(7):793-8.
- <sup>144</sup>Phé V, Chartier-Kastler E, Panicker JN. Management of neurogenic bladder in patients with multiple sclerosis. *Nat Rev Urol*. 2016 May;13(5):275-88.
- <sup>145</sup>Panicker JN, de Séze M, Fowler CJ. Rehabilitation in practice: neurogenic lower urinary tract dysfunction and its management. *Clin Rehabil*. 2010 Jul;24(7):579-89.
- <sup>146</sup>Guralnick ML, Benouni SB, O'Connor RC, Edmiston C. Characteristics of infections in patients undergoing staged implantation for sacral nerve stimulation. *Urology*. 2007 Jun;69(6):1073-6.
- <sup>147</sup>Deer TR, Provenzano DA, Hanes M, Pope JE, Thomson SJ, Russo MA, McJunkin T, Saulino M, Raso LJ, Lad SP, Narouze S, Falowski SM, Levy RM, Baranidharan G, Golovac S, Demesmin D, Witt WO, Simpson B, Krames E, Mekhail N. The Neurostimulation Appropriateness Consensus Committee (NACC) Recommendations for Infection Prevention and Management. *Neuromodulation* 2017 Jan;20(1):31-50.
- <sup>148</sup>Hijaz A, Vasavada S. Complications and troubleshooting of sacral neuromodulation therapy. *Urol Clin North Am*. 2005 Feb;32(1):65-9.
- <sup>149</sup>Schultz DG. FDA Public Health Notification: Unretrieved Device Fragments. January 2008.
- <sup>150</sup>Hijaz A, Vasavada S, Daneshgari F Et Al. Complications and troubleshooting of two-stage sacral neuromodulation therapy: a single-institution experience. *Urology*. 2006 Sep;68(3):533-7.

- 
- <sup>151</sup>Pham K, Guralnick ML, O'Connor RC. Unilateral versus bilateral stage I neuromodulator lead placement for the treatment of refractory voiding dysfunction. *Neurourol Urodyn*. 2008;27(8):779-81.
- <sup>152</sup>Kaufmann S, Naumann CM, Hamann MF, Seif C, Braun PM, Jünemann KP, van der Horst C. Unilateral vs bilateral sacral neuromodulation in pigs with formalin-induced detrusor hyperactivity. *BJU Int*. 2009 Jan;103(2):260-3.
- <sup>153</sup>Scheepens WA, de Bie RA, Weil EH, van Kerrebroeck PE. Unilateral versus bilateral sacral neuromodulation in patients with chronic voiding dysfunction. *J Urol*. 2002 Nov;168(5):2046-50.
- <sup>154</sup>Marcelissen TA, Leong RK, Serroyen J, van Kerrebroeck PE, De Wachter SG. The use of bilateral sacral nerve stimulation in patients with loss of unilateral treatment efficacy. *J Urol*. 2011 Mar;185(3):976-80.
- <sup>155</sup>Peters KM, Killinger KA, Boguslawski BM, Boura JA. Chronic pudendal neuromodulation: expanding available treatment options for refractory urologic symptoms. *Neurourol Urodyn*. 2010 Sep;29(7):1267-71.
- <sup>156</sup>Peters KM, Feber KM, Bennett RC. Sacral versus pudendal nerve stimulation for voiding dysfunction: a prospective, single-blinded, randomized, crossover trial. *Neurourol Urodyn*. 2005;24(7):643-7.
- <sup>157</sup>Peters KM, Feber KM, Bennett RC. A prospective, single-blind, randomized crossover trial of sacral vs pudendal nerve stimulation for interstitial cystitis. *BJU Int*. 2007 Oct;100(4):835-9.
- <sup>158</sup>Rubino S, Adepoju A, Kumar V, Prusik J, Murphy N, Owusu-Sarpong S, Pilitsis JG. MRI conditionally in patients with spinal cord stimulation devices. *Stereotact Funct Neurosurg*. 2016;94(4):254-8.
- <sup>159</sup>De Andres J, Valia JC, Cerda-Olmedo G, Quiroz C, Villaneuva V, Martinez-Sanjuan V, de Leon-Casasola O. Magnetic resonance imaging in patients with spinal neurostimulation systems. *Anesthesiology*. 2007 Apr;106(4):779-86.
- <sup>160</sup>Elkelini MS, Hassouna MM. Safety of MRI at 1.5Tesla in patients with implanted sacral nerve neurostimulator. *Eur Urol*. 2006 Aug;50(2):311-6.
- <sup>161</sup>Chermansky CJ, Krlin RM, Holley TD, Woo HH, Winers JC. Magnetic resonance imaging following InterStim®: an institutional experience with imaging safety and patient satisfaction. *Neurourol Urodyn*. 2011 Nov;30(8):1486-8.
- <sup>162</sup>Quirouet A, Bhattacharyya PK, Dielubanza EJ, Gill BC, Jones SE, Goldman HB. Sacral neuromodulation device heating during lumbar and pelvic magnetic resonance imaging-a phantom study. *Urology*. 2017 Sep;107:61-6.
- <sup>163</sup>Goldman HB. Personal communication.
- <sup>164</sup>Lloyd JC, Gill BC, Pizarro-Berdichevsky J, Goldman HB. Removal of sacral nerve stimulation devices for magnetic resonance imaging: what happens next? *Neuromodulation*. 2017 Oct 11. [Epub ahead of print]
- <sup>165</sup>Killinger KA, Gupta P, Gilleran JP, Bartley J, Ehlert M, Boura JA, Peters KM. The impact of baseline functional bladder capacity on short-term neuromodulation outcomes. *Urology*. 2017 Apr;102:68-72.
- <sup>166</sup>Pizarro-Berdichevsky J, Gill BC, Clifton M, Okafor HT, Faris AE, Vasavada SP, Goldman HB. Motor response matters: optimizing lead placement improves sacral neuromodulation outcomes. *J Urol*. 2017 Nov 14. [Epub ahead of print]
- <sup>167</sup>Lieberman D, Ehlert MJ, Siegel SW. Sacral neuromodulation in urological practice. *Urology*. 2017 Jan;99:14-22.



- 
- <sup>168</sup>Meissnitzer T, Trubel S, Posch-Zimmermann R, Meissnitzer MW. CT-guided lead placement for selective sacral neuromodulation to treat lower urinary tract dysfunctions. *AJR Am J Roentgenol*. 2015 Nov;205(5):1139-42.
- <sup>169</sup>Taghva A, Romer J, Barolat G. Intraoperative electromyography as an adjunct to sacral neuromodulation for chronic pelvic pain. *Neuromodulation*. 2015 Jan;18(1):62-6.
- <sup>170</sup>Abrams P, Paty J, Martina R, Newgreen DT, van Maanen R, Pairedy A, Kuipers-deGroot T, Ridder A. Electronic bladder diaries of differing duration versus a paper diary for data collection in overactive bladder. *Neurol Urodyn*. 2016 Aug;35(6):743-9.
- <sup>171</sup>Leong RK, de Wachter SG, Joore MA, van Kerrebroeck PE. Cost-effectiveness analysis of sacral neuromodulation and botulinum toxin A treatment for patients with idiopathic overactive bladder. *BJU Int*. 2011 Aug;108(4):558-64.
- <sup>172</sup>Arlandis S, Castro D, Errando C, Fernandez E, Jimenez M, Gonzalez P, Cresp C, Staeuble F, Rodriguez J, Brosa M. Cost-effectiveness of sacral neuromodulation compared to botulinum neurotoxin a or continued medical management in refractory overactive bladder. *Value Health*. 2011 Mar-Apr;14(2):219-28.



## The clinical role of LASER for vulvar and vaginal treatments in gynecology and female urology: An ICS/ISSVD best practice consensus document

Mario Preti MD<sup>1</sup> | Pedro Vieira-Baptista MD<sup>2,3</sup> |  
Giuseppe Alessandro Digesu PhD<sup>4</sup> | Carol Emi Bretschneider MD<sup>5</sup> |  
Margot Damaser PhD<sup>5,6,7</sup> | Oktay Demirkesen MD<sup>8</sup> | Debra S. Heller MD<sup>9</sup> |  
Naside Mangir MD<sup>10,11</sup> | Claudia Marchitelli MD<sup>12</sup> | Sherif Mourad MD<sup>13</sup> |  
Micheline Moyal-Barracco MD<sup>14</sup> | Sol Peremateu MD<sup>12</sup> | Visha Tailor MD<sup>4</sup> |  
Tufan Tarcan MD<sup>15</sup> | Elise J.B. De MD<sup>16</sup> | Colleen K. Stockdale MD, MS<sup>17</sup>

<sup>1</sup> Department of Obstetrics and Gynecology, University of Torino, Torino, Italy

<sup>2</sup> Hospital Lusíadas Porto, Porto, Portugal

<sup>3</sup> Lower Genital Tract Unit, Centro Hospitalar de São João, Porto, Portugal

<sup>4</sup> Department of Urogynaecology, Imperial College Healthcare, London, UK

<sup>5</sup> Center for Urogynecology and Pelvic Reconstructive Surgery, Obstetrics, Gynecology and Women's Health Institute, Cleveland Clinic, Cleveland, Ohio

<sup>6</sup> Glickman Urological and Kidney Institute and Department of Biomedical Engineering Lerner Research Institute, Cleveland Clinic, Cleveland, Ohio

<sup>7</sup> Advanced Platform Technology Center, Louis Stokes Cleveland VA Medical Center, Cleveland, Ohio

<sup>8</sup> Faculty of Medicine, Department of Urology, Istanbul University Cerrahpaşa, Istanbul, Turkey

<sup>9</sup> Department of Pathology and Laboratory Medicine, Rutgers-New Jersey Medical School, Newark, New Jersey

<sup>10</sup> Kroto Research Institute, Department of Material Science and Engineering, University of Sheffield, Sheffield, UK

<sup>11</sup> Department of Urology, Royal Hallamshire Hospital, Sheffield, UK

<sup>12</sup> Department of Gynecology, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina

<sup>13</sup> Department of Urology, Massachusetts General Hospital—Harvard Medical School Boston, Boston, Massachusetts

<sup>14</sup> Department of Dermatology, Hôpital Tarnier-Cochin, Paris, France

<sup>15</sup> Department of Urology, Ain Shams University, Cairo, Egypt

<sup>16</sup> Department of Urology, Marmara University School of Medicine, Istanbul, Turkey

<sup>17</sup> Department of Obstetrics and Gynecology, University of Iowa, Iowa City, Iowa

### Correspondence

Giuseppe Alessandro Digesu, Imperial College Healthcare, Department of Urogynaecology, London, UK.  
Email: alex.digesu@nhs.net

**BACKGROUND:** The clinical role of LASER for vulvar and vaginal treatments in gynecology and female urology is controversial.

**AIMS:** In this best practice document, we propose recommendations for the use of LASER for gynecologic and urologic conditions such as vulvovaginal atrophy, urinary incontinence, vulvodynia, and lichen sclerosis based on a thorough literature review.

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

*Neurourology and Urodynamics*. 2018;1–15.

wileyonlinelibrary.com/journal/nau

© 2019 Wiley Periodicals, Inc. | 1

**MATERIALS & METHODS:** This project was developed between January and September 2018. The development of this document followed the ICS White Paper Standard Operating Procedures.

**RESULTS:** Most of the available studies are limited by their design; for example they lack a control group, patients are not randomized, follow up is short term, series are small, LASER is not compared with standard treatments, and studies are industry sponsored. Due to these limitations, the level of evidence for the use of LASER in the treatment of these conditions remains low and does not allow for definitive recommendations for its use in routine clinical practice. Histological evidence is commonly reported as proof of tissue regeneration following LASER treatment. However, the histological changes noted can also be consistent with reparative changes after a thermal injury rather than necessarily representing regeneration or restoration of function. The use of LASER in women with vulvodynia or lichen sclerosus should not be recommended in routine clinical practice. There is no biological plausibility or safety data on its use on this population of women.

**DISCUSSION:** The available clinical studies do not present convincing data regarding the efficacy of LASER for the treatment of vaginal atrophy or urinary incontinence. Also, while short-term complications seem to be uncommon, data concerning long-term outcomes are lacking.

**CONCLUSION:** At this point, LASER is not recommended for routine treatment of the aforementioned conditions unless part of well-designed clinical trials or with special arrangements for clinical governance, consent, and audit.

#### KEYWORDS

genitourinary syndrome of menopause, ICS, ISSVD, LASER, lichen sclerosus, urinary incontinence, vulvovaginal atrophy, vaginal laxity

## 1 | INTRODUCTION

“Light Amplification by Stimulated Emission of Radiation” (LASER) has been widely used in gynecology and urology for more than 40 years. It is well established in the management of HPV-related genital lesions, prostate vaporization, and lithotripsy.<sup>1,2</sup> More recently the use of trans-vaginal or vulvar LASER has escalated to be used as a panacea for several urological and gynecological conditions, such as: lichen sclerosus, vulvodynia, “vaginal laxity”, overactive bladder, and pelvic organ prolapse.

Limited ex-vivo studies have suggested that LASER has the potential to modify tissue characteristics. Clinically it has already been adopted for tissue remodeling of non-mucosal scars and wrinkles with relative success. These findings have led to the concept that LASER technology could be used in the treatment of vaginal atrophy<sup>3</sup> and has already been utilized and marketed as a “treatment” or therapy for vaginal “rejuvenation” and “Designer LASER Vaginoplasty” by the aesthetics industry.

Several published studies have suggested that fractional microablative CO<sub>2</sub> and Er:Yag LASER effectively treat not only atrophic vaginal mucosa (2014)(3), but also improve urinary incontinence (2015).<sup>4</sup> From the initial studies, the jump to aggressive marketing and widespread adoption of the LASER technology was quick. However, the studies failed to provide definitive evidence of its safety and effectiveness. Flaws of these studies include short follow-up time, absence of control groups, lack of standardized outcome measures, and the involvement of industry sponsorship.

Vaginal atrophy related to hypoestrogenism is recognized as a prevalent and significant cause of morbidity in the postmenopausal population.<sup>5</sup> In 2014 it was integrated into the broader definition of “genitourinary syndrome of menopause” (GSM).<sup>6</sup> GSM classifies an extensive list of signs and symptoms common to the natural process of female menopause as a syndrome. This umbrella term also carries the risk of classifying true disease (ie, lichen sclerosus) as GSM.<sup>7</sup>

Despite the lack of a true functional or anatomical definition, the use of the term “vaginal laxity” has become more widespread.<sup>8</sup> The term has been defined by the International Urogynecological Association (IUGA) and the International Continence Society as a feeling of vaginal looseness,<sup>9</sup> a woman's subjective sensation of vaginal “looseness.” “Vaginal rejuvenation” with LASER is targeted to women with “vaginal laxity” as a procedure to improve the sensation of laxity and thus enhance sexual function in those with decreased vaginal sensation.<sup>10</sup>

In 2007 the American College of Obstetrics and Gynecology (ACOG) included “vaginal rejuvenation” and “designer vaginoplasty” in a list of procedures that were “not medically indicated” due to a “lack of evidence confirming safety and effectiveness.”<sup>11</sup> However the US Food and Drug Administration (FDA) licenced the CO<sub>2</sub> LASER systems for “incision, excision, ablation, vaporization, and coagulation of body soft tissues and was used by specialties such as aesthetics (...), otolaryngology (...), gynecology, neurosurgery, and genitourinary surgery” in 2010.<sup>12</sup> Other LASER manufacturers requested FDA approval in 2014, with similar licence terms approved.<sup>13</sup> Er:YAG LASERs were licensed for dermatologic uses: coagulation, vaporization, ablation, or cutting of skin in dermatology and plastic/aesthetic surgery (2011).<sup>14</sup> The Nd:YAG had a similar approval in 2014.<sup>15</sup>

Treatment of vaginal atrophy and other gynecological disorders with LASER devices gained popularity and was marketed for this purpose. In response to this surge, ACOG issued a warning in 2016 clarifying that the FDA had not approved the use of these devices for the treatment of vulvovaginal atrophy.<sup>16</sup> Despite this announcement, claims that the devices had received FDA approval for such conditions were circulated.<sup>17,18</sup>

Several authors<sup>19,20</sup> and groups, such as the International Society for the Study of Vulvovaginal Disease (ISSVD)<sup>10</sup> and the Society of Obstetricians and Gynecologists of Canada (SOGC),<sup>21</sup> have raised concerns about the lack of evidence sustaining the use of LASER technologies for these gynecological indications. Finally, on the July 30th, 2018, the FDA issued a warning that the effectiveness and safety of energy-based devices (LASER and radiofrequency) for urinary incontinence, vaginal “rejuvenation” or cosmetic vaginal procedures has not been established.<sup>22</sup>

The executive council of the International Society for the Study of Vulvovaginal Disease (ISSVD) and the board of trustees of the International Continence Society (ICS) acknowledge the need to establish scientifically based recommendations on the new uses of LASER in their fields. This best practice document has therefore been developed to provide guidance on the use of LASER for the treatment of gynecological and urogynecological conditions and to educate providers about the weaknesses of the available data.

## 2 | MATERIAL AND METHODS

The ISSVD and the ICS identified and invited members to develop this project; participants were assigned a specific topic to be thoroughly researched and summarized in order to produce recommendations. The project was developed between January and September 2018. The development of this document followed the ICS White Paper Standard Operating Procedures.<sup>23</sup>

Literature searches were performed using Pubmed, Google Scholar, Ovid, Cochrane, and Embase to identify relevant papers. Search results were limited to papers written in English and published prior to June 2018.

Search strings for each topic were:

1. Vaginal atrophy/“rejuvenation”:
  - a. “genitourinary syndrome of menopause,” “vulvovaginal atrophy,” “atrophic vaginitis,” “vaginal atrophy,” “vaginal rejuvenation,” “menopause” and “LASER.”
2. Urinary incontinence and/or pelvic organ prolapse:
  - a. “urinary incontinence,” “incontinence,” “prolapse,” “POP,” “pelvic organ prolapse,” “cystocele,” “rectocele,” “hysterocele,” and “LASER.”
3. Vaginal laxity:
  - a. “vaginal tightening,” “vaginal laxity syndrome,” and “LASER.”
4. Vulvodynia:
  - a. “vulvodynia,” “vestibulodynia,” and “LASER.”
5. Lichen sclerosus:
  - a. “lichen sclerosus” and “LASER.”
6. Other possible uses of LASER:
  - a. “bleaching,” “whitening,” “brightening” “labiaplasty,” “labioplasty,” “nymphoplasty” and “LASER.”

Evidence was graded according to the Center of Evidence Based-Medicine's “Levels of Evidence for Therapeutic Studies” and recommendations according to the American Society of Plastic Surgeons' “Grade Practice Recommendations.”<sup>24</sup>

After discussion and consensus among all participants, the final version of the text was approved by the Executive Council of the ISSVD and the Board of Trustees of the ICS.

## 3 | BASIC SCIENCE EVIDENCE

### 3.1 | Proposed mechanism of action of LASER on skin and vaginal tissue

Human skin is comprised of three layers: the epidermis, the dermis, and the subcutaneous fat.<sup>25</sup> Currently, the hypothesized mechanism by which the LASER rejuvenates the vaginal mucosal epithelium has been developed based on the effects of LASER on epidermal skin epithelium. The LASER is believed to induce controlled injury to the epithelial layer of the skin, which stimulates tissue repair and remodeling.<sup>26</sup>

Wound repair in skin epithelium is a well-defined process characterized by inflammation, proliferation leading to tissue restoration, and tissue remodeling.<sup>27</sup> LASER is believed to normalize the cycle of collagenesis and collagenolysis<sup>28–30</sup> by inducing break down of disorganized collagen fibrils,<sup>31</sup> creating more organized collagen bundles, and decreasing collagen bundle thickness and density.<sup>32</sup>

Similar to skin, the vaginal wall is composed of three histologically unique layers. The most superficial layer of the vaginal mucosa is made up of stratified squamous epithelium but, unlike the skin epidermis, is devoid of keratinocytes and is therefore non-keratinized. Also unlike skin, vaginal tissue undergoes a number of discrete histologic changes during menopause. Thinning of the vaginal epithelium, reduced vaginal blood flow, diminished lubrication, increased pH, and a change in the vaginal microbiome, as well as decreased elasticity of the vaginal wall can occur.<sup>33</sup>

Neocollagenesis and restoration of the trabecular architecture of collagen is the proposed basis for vaginal rejuvenation with CO<sub>2</sub> LASER treatment. Investigators have hypothesized that the molecular and histologic changes demonstrated in the skin in response to LASER treatment can be recreated in the vaginal wall. However, given the differences in anatomy as well as histologic changes in response to hormone balance, such as those seen during menopause, it is unclear whether the effects of the LASER on skin could be expected for the vaginal wall.

In 2011, Gaspar et al<sup>34</sup> demonstrated that vaginal fractional CO<sub>2</sub> LASER treatment increased the thickness of the vaginal epithelium and increased the fibrillary component of the extracellular matrix. In 2015, Salvatore et al<sup>35</sup> described fibrillogenesis and neocollagenesis of vaginal tissue following vaginal LASER treatment in postmenopausal women. Zerbinati et al<sup>36</sup> in 2015 carried out a similar study and examined the tissue of postmenopausal patients with severe symptoms of GSM following CO<sub>2</sub> LASER treatment. They concluded that the histological changes seen support the theory that the LASER stimulates fibroblasts to produce collagen. It is unclear, however, if these histologic changes following LASER treatment can be directly correlated with improvement of clinical symptoms, as no control group was used (discussed in section 3.2).

**TABLE 1** The use of LASER in the vagina for the treatment of atrophy/rejuvenation

	Level of evidence	Grade of recommendation
The mechanism of action of LASER on vaginal tissue in normal or diseased states is not known and cannot be used to justify treatment results	3b/4	C

Current published literature on the specific use of LASER in the vagina for the treatment of GSM is limited in the basic science results as well as clinical outcomes and the potential correlation to the histology findings (level of evidence 3b/4, grade of recommendation C). Thus, clinical conclusions drawn from these studies are highly speculative (Table 1).

### 3.2 | Histological effects

There is little known about the histology of the vaginal mucosa after LASER therapy for vaginal rejuvenation or functional remodeling. What is reported is based on small studies of patients over a short period of time.

Salvatore et al<sup>37</sup> described a single case, with a post-treatment biopsy performed 1 hour after the CO<sub>2</sub> fractional LASER treatment. The biopsy showed superficial epithelial desquamation. In comparison, animal skin burn studies report signs of injury to include desquamation. Desquamation therefore cannot be interpreted as beneficial remodeling.<sup>38</sup>

In a prospective study from the same group,<sup>35</sup> the authors compared treated vaginal mucosa with mucosa out of the field of therapy from the same patient. They noted neovascularization, neocollagenesis, and restoration of the trabecular architecture of collagen in the treated mucosa, which was interpreted as remodeling changes. These biopsies however were taken at the time of the LASER procedure, which would have provided insufficient time for remodeling to occur. In comparison, skin studies have shown changes of wound healing in the first few days after LASER therapy, while restorative changes ensue weeks later.<sup>39</sup> The histology images in the paper mentioned show denuding of the epithelium and different degrees of tissue coagulation, which are consistent with thermal injury.

Zerbinati et al<sup>36</sup> biopsied five patients before vaginal treatment, and at 1 and 2 months after treatment, which would allow early changes to be appreciated. At 1 and 2 months, changes were similar, noting thickened epithelium with superficial shedding, increased dermal papilla with elongated capillaries, giving the epidermal-dermal junction an undulating pattern, increased glycogen in the epithelial cells, and an increase in fibroblast activity. Increased collagen and ground substance have also been described in existing studies.<sup>35,36</sup> The illustrations in Zerbinati's paper show epidermal thickening with acanthosis, and some show parakeratosis and increase in dermal chronic inflammatory cells.<sup>36</sup> These changes are consistent with repair, as might be seen in lichen simplex chronicus, and alone do not indicate functional remodeling.

Histology changes to the vaginal mucosa following intravaginal LASER therapy have also been compared to a healing vaginal wound at the 2-month time point. A lack of significant capillary density and the increase in cellularity of connective tissue is consistent with this. It has not been confirmed if these changes are favorable for functional

**TABLE 2** The histology of vaginal LASER “rejuvenation”

	Level of evidence	Grade of recommendation
The histological changes present after LASER therapy are consistent with reparative changes after a thermal injury. They do not necessarily represent restoration of function, and cannot be used to justify treatment results.	4	C

remodeling or if they would be sustained at the 6 and 12 month marks.<sup>21</sup>

Interpretation of available studies overall is limited by the lack of long-term follow-up, and hence complications such as scarring may not have been detected.<sup>40</sup> In addition, in a review of the literature on LASER therapy for treating GSM, the authors noted that in one pilot study, the maturation index (a ratio obtained by performing a random cell count of the three major cell types shed from the vaginal squamous epithelium: parabasal, intermediate, and superficial cells) was not considered.<sup>3,40</sup>

In summary, the histology of vaginal LASER “rejuvenation” is not well studied. Only small series have been published, with short follow-up. The changes present after therapy are consistent with reparative changes after a thermal injury. Whether they represent restoration of function has not yet been demonstrated by the histology. Further study is needed (level of evidence 4, grade of recommendation C). Further study is needed (Table 2).

**3.3 | Impact on the vaginal microbiome**

In postmenopausal women, lactobacilli concentration and diversity tend to be lower, while there is a higher diversity of other species.<sup>41–43</sup> These changes have been correlated to the severity of vulvovaginal atrophy symptoms with normalization using hormonal replacement therapy (HRT) associated with symptom improvement.<sup>44</sup> Based on the limited and controversial evidence demonstrating that vaginal LASER improves sexual health, vaginal glycogen, and vaginal epithelial thickness, its impact on the vaginal microbiome was evaluated in two studies.

Athanasiou et al<sup>46</sup> enrolled 53 women with at least one moderate or severe symptom of GSM. The methodology is insufficient as it assumes that one symptom can be used as a surrogate of an entire syndrome<sup>45</sup> and does not describe which scale of severity was used.

Following vaginal LASER treatment, the authors report a significant decrease in vaginal pH, but only one third reached a pH lower than 4.5. This decrease was accompanied by an

**TABLE 3** Impact on the vaginal microbiome

	Level of evidence	Grade of recommendation
LASER cannot be recommended as a means to improve the vaginal microbiome.	2b	B
The use of CO <sub>2</sub> LASER does not negatively impact the vaginal microbiome.	2b	B

increase in the number of lactobacilli although the techniques used to estimate the lactobacilli population are known to produce an inaccurate estimation. Interestingly, with an inclusion criteria of vaginal pH in the range 4.5-5 at baseline, nearly half of the women had normal vaginal flora according to Nugent and Ison-Hay scores. Following treatment and at the end of the study, this increased to approximately 90%. Colonization by *Candida* was very low (1.9%) and remained stable. The vaginal maturation index improved, but no changes regarding the presence of leukocytes in the vagina were noted.

Becorpi et al<sup>47</sup> studied the vaginal microbiome in 20 breast cancer survivors treated with two sessions of CO<sub>2</sub> LASER. The study reported an almost unchanged microbiome following treatment. The authors suggested that any possible benefits would be derived from a possible anti-inflammatory effect.

While LASER cannot be recommended as a means to improve the vaginal microbiome, it does not seem to have a deleterious effect on it (level of evidence 2b, grade of recommendation B) (Table 3).

**4 | “GENITOURINARY SYNDROME OF MENOPAUSE” AND VAGINAL ATROPHY**

GSM and vulvovaginal atrophy (VVA) are commonly seen in women after menopause. Nearly 50% of postmenopausal women report a vaginal symptom.<sup>48</sup> These symptoms have a significant impact on the quality of life, interfering with the ability to be intimate, and enjoy sexual intercourse in 60-70% of sexually active postmenopausal women.<sup>49,50</sup> However, many women consider their symptoms to be a natural part of aging. A survey of American women with a median age of 58 years revealed that 81% did not think VVA was a medical condition, of whom 71% had never sought treatment.<sup>5</sup>

A total of 24<sup>51–74</sup> clinical studies were identified that investigated transvaginal LASER in women with GSM/VVA. Two studies appeared to include the same study population (separate analyses).<sup>55,67</sup> The vast majority of the studies used

either Er:YAG or fractional, micro ablative CO<sub>2</sub> LASER. Some studies used ablative Er:YAG LASER.<sup>62</sup> All studies but four were prospective or retrospective case series without a control group. There was one randomized placebo/estriol controlled study<sup>74</sup> (level of evidence 2b) and three prospective, non-randomized studies using estradiol gel (or lubricant) as the comparative arm (level of evidence 3b).<sup>51,53,69</sup>

The clinical outcomes measured were inconsistent throughout the studies. Both subjective non-validated outcome measures and validated clinical outcomes scores were used to assess symptoms, quality of life impact, and general health. Samples taken varied from vaginal punch biopsy after treatment in one study,<sup>75</sup> to cytology, and pH evaluation<sup>66</sup> in others. Most studies had a follow up period of less than 12 months, although three studies presented 18-24 month follow up data. In addition, conflicts of interest were not always clearly specified and adverse events were rarely specifically outlined.

LASER treatment for women with a history of breast cancer and vaginal atrophy was investigated in one paper. In this group of women hormonal treatment is either contraindicated or patients are reluctant to take low dose topical estrogens for symptoms of GSM. This limited study drew similar conclusions to those reached for other women and was hindered by similar study design flaws.<sup>70,71,76</sup>

Recent developments for the use of LASER in women with GSM/VVA include an international multicenter observational study aiming to evaluate 1500 women treated with vaginal Er:YAG LASER.<sup>77</sup> There is also an ongoing randomized study comparing the effects of CO<sub>2</sub> LASER to vaginal estrogen treatment. This study aims to enrol nearly 200 patients and is expected to finish by the end of 2018.<sup>78</sup> However there is still a need for a prospective randomized controlled trial with a placebo or sham control arm to understand the differences. For example a recent meta-analysis demonstrated that 67.7% of the treatment effect for female sexual dysfunction is accounted for by placebo.<sup>79</sup>

The available studies on the use of LASER to treat vaginal atrophy have overall not provided sufficient evidence of efficacy and long term safety (level of evidence 2b/3b, grade of recommendation C) (Table 4).

**TABLE 4** “Genitourinary syndrome of menopause” and vaginal atrophy

	Level of evidence	Grade of recommendation
There is currently not enough scientific data demonstrating efficacy and safety of LASER for treating vulvovaginal atrophy.	2b/3b	C

## 5 | STRESS URINARY INCONTINENCE AND/OR PELVIC ORGAN PROLAPSE

Some evidence on the role of vaginal LASER exists for its use in urinary incontinence and pelvic organ prolapse.<sup>4,34,77,80–86</sup>

The data on its use in stress urinary incontinence comprises mainly short-term observational studies. Participants varied from 19 to 205 women. Treatment response was usually assessed with validated questionnaires and showed favorable outcomes in terms of improvement of symptoms, but only one study followed patients for 24 months. None of the studies had a control or placebo group.<sup>4,34,80–83</sup>

There is minimal published data on the use of LASER in treating female pelvic organ prolapse. Its use has been described in women with grade II (prolapse to the hymen) to IV (maximum descent) cystoceles and follow up at 12 months has demonstrated an improvement in prolapse grade, with some patients sustaining the effect at 36 months.<sup>86</sup>

While the use of LASER to treat stress urinary incontinence and/or pelvic organ prolapse may seem appealing, the lack of good quality evidence in the form of multi-center randomized placebo-controlled trials is concerning.

Use of LASER may lead to serious adverse events such as vaginal burns, scarring, dyspareunia, and chronic pain. Although reports of adverse events in the literature is minimal, the sample sizes are small hence minimal reassurance can be taken from this.<sup>87</sup> The histological effects of LASER to the vaginal wall remain unclear leaving further questions regarding the effect of LASER therapy on surgical dissection and outcomes in women who may eventually require reconstructive pelvic or anti-incontinence surgery.

A recent review article looking at the evidence relating to the risks and benefits of intravaginal LASER technology in the management of stress urinary incontinence confirmed that despite the short-term observational studies of small patient numbers demonstrating improvements, there is still insufficient evidence to offer it as an effective modality for the treatment of stress urinary incontinence over alternative managements, such as pelvic floor physiotherapy, incontinence pessaries, or continence surgery.<sup>21</sup> Similarly there is insufficient evidence to offer intravaginal LASER therapy for vaginal prolapse (level of evidence 4, recommendation grade D) (Table 5).

## 6 | VAGINAL LAXITY SYNDROME

Vaginal laxity as a subjective patient complaint has been described by IUGA and ICS as a feeling of vaginal looseness.<sup>9</sup> Its anatomical definition, quality of life impact and treatment are poorly understood<sup>88</sup> and not widely recognized. “Vaginal laxity syndrome” (VLS) or even



TABLE 5 Stress urinary incontinence and/or pelvic organ prolapse

	Level of evidence	Grade of recommendation
There is limited evidence supporting the use of LASER for stress urinary incontinence	4	D
There is limited data concerning the safety of LASER for stress urinary incontinence	4	D
The evidence supporting the use of LASER for pelvic organ prolapse is limited	4	D
The data concerning the safety of LASER for pelvic organ prolapse is limited	4	D

“vaginal hyperlaxity syndrome” are concepts and marketing terminology with a lack of a standardized definition.

Some believe that VLS is an evolution of the aesthetic designation of “vaginal rejuvenation.”<sup>89</sup> It is described as a disorder derived from the excessive laxity of the vaginal walls, leading to a sensation of looseness, diminished sensation of penile friction, and may be associated with urinary incontinence (urgency or stress).<sup>61</sup> VLS is considered a consequence of aging and related to having had vaginal deliveries. The term VLS and therefore its therapy, vaginal rejuvenation, is not endorsed or formally defined by the leading gynecological societies.<sup>11</sup> However, management of the symptoms have evolved from techniques involving sutures and the adaptation of traditional urogynecological procedures to the use of LASER<sup>61,90</sup> and radiofrequency procedures.<sup>91–99</sup>

In 2011, there was an attempt to restore the *rugae* of the vagina in postmenopausal women (“vaginal rugation rejuvenation”), by vaporization of the vaginal wall in order to create parallel grooves. The procedure was performed in women with a sensation of a loose or smooth vagina. In a small observational trial (10 patients in each arm), there was an apparent improvement of sexual function and no complications. The design and small sample size did not allow the authors to draw conclusions from the study.<sup>90</sup>

In 2014, Lee evaluated two different protocols (15 patients in each arm), using Er:YAG LASER. Women in both groups were evaluated 2 months after the procedure. There were no complications or adverse effects, although mild heating of the vagina and ecchymosis were reported. There was an objective (perineometer) and subjective improvement for 70% of the subjects with 76.6% of their partners reporting an improvement in sexual function. No validated scales were used for evaluation of the sexual function. A histological improvement was also suggested, but no analysis was shown in Ref.<sup>61</sup>

TABLE 6 “Vaginal Laxity Syndrome”

	Level of evidence	Grade of recommendation
There are no data supporting the recommendation of performing “vaginal rugation rejuvenation” or showing its safety	4	D
Er:YAG LASER for vaginal looseness or laxity has not been shown to be safe or efficacious	4	D

In total, two small studies on the use of LASER in vaginal relaxation syndrome comprising 51 women showed non-validated patient-reported improvements in sexual experience after LASER treatment but follow up was short term.<sup>84,85</sup> We could not find any study in the literature evaluating the role of CO<sub>2</sub> LASER for vaginal tightening specifically. Several studies have arisen using radiofrequency. The available data, in comparison to that for LASER use, are more robust and sustained by studies with a better design. So far, there has been no comparison between the different types of energy. There are no data supporting the recommendation of performing “vaginal rugation rejuvenation” or showing its safety (level of evidence 4, grade of recommendation D) (Table 6).

7 | VULVODYNIA

Vulvodynia is a chronic, complex pain disorder of multifactorial aetiology that can be difficult to manage. It is common, affecting more than 4-16% of women and can occur at any age, including postmenopausal women, particularly among those who remain sexually active.<sup>100,101</sup>

In 2015, the ISSVD, the International Society for the Study of Sexual Health of Women (ISSWSH) and the International Pelvic Pain Society (IPPS) adopted new terminology for vulvar pain and vulvodynia.<sup>102</sup> It is classified according to the site of pain (generalized or localized), the need of a stimulus (provoked, not provoked [spontaneous], or mixed), and the onset (primary or secondary). Treatment is difficult, and rapid resolution is unusual even with proper treatment. Decrease in pain may take weeks to months and may not be complete. No single treatment is successful in all women.<sup>103</sup> The vulvodynia treatment algorithm includes vulvar skin care guidelines, topical, oral, and injectable medications, pudendal nerve block, biofeedback, physical therapy, dietary modifications, cognitive behavioral therapy, sexual counseling and surgery, as well as alternative therapies such as acupuncture and hypnotherapy.<sup>104</sup>

Few studies have been conducted evaluating the usefulness of LASER therapy in the treatment of vulvodynia.<sup>59,105,106</sup>

A retrospective study indicated less pain with sexual intercourse among 24 of 37 women treated with LASER pulse therapy for vestibulodynia. However, 35% of the patients in the study required a vestibulectomy to control the symptoms.<sup>105</sup>

In 2016, in a study involving 70 patients who underwent fractional micro-ablative CO<sub>2</sub> LASER treatment for vestibular pain plus vestibulodynia ( $n = 37$ ) or menopausal patients (age > 50 years) who presented with vulvar pain secondary to GSM/VVA ( $n = 33$ ), showed statistically significant improvement of dyspareunia and pain scores, with gradual improvement over each time point persisting through 4-month follow-up. Average overall vestibular health index score (a non-validated score, that intends to assess vestibular atrophy) improved significantly in the two groups after each of the three individual treatments. There was no statistically significant difference in outcomes between the two study groups.<sup>59</sup>

More recently, a placebo-controlled, double-blinded, randomized clinical trial involving 34 women aged 19-46 years old using low-level LASER therapy (LLLT) versus placebo showed *Clinical Pain Report* improvement in 78% in the LLLT group and 44% in the placebo group. Nevertheless, other measurable parameters (Q-tip test, intercourse pain on the Visual Analog Scale, and tampon tests before and after treatment, severity of discomfort in daily activities and/or in daily pain intensity) did not show a difference between groups. Although none of the patients reported side effects during the study, recurrence of pain was evidenced in 33% of the LLLT group.<sup>106</sup>

Interestingly, LASER (pulse or scan), used to treat vulvar mucosa disease (warts or vulvar HSIL) has been shown to be a possible cause of chronic vulvar pain.<sup>107</sup>

The few available studies concerning the treatment of vulvodynia with LASER have not proven it to be efficacious or safe, therefore its use should not be considered in these patients (level of evidence 2b, grade of recommendation B) (Table 7).

**TABLE 7** Vulvodynia

	Level of evidence	Grade of recommendation
LASER therapy cannot be recommended as a means to improve pain in vulvodynia.	2b	B
The use of low-level LASER does not negatively impact symptoms in vestibulodynia.	2b	B

## 8 | LICHEN SCLEROSUS

Lichen sclerosis (LS) is a complex chronic inflammatory autoimmune dermatosis that can be found in patients of any age and race.<sup>108</sup> It is 10 times more common in females.<sup>109</sup> The incidence rate is around 10 per 100 000 woman-years, rising to over 30 per 100 000 woman-years in women older than 55.<sup>110</sup> The main symptoms are itching, burning, and dyspareunia, with impact on health-related quality of life.<sup>111</sup>

Vulvar LS (VLS) clinical aspects can vary significantly. Differentiated (dVIN), the HPV-independent pathway to vulvar carcinoma, must be suspected and biopsied promptly in treatment-resistant cases, and in the presence of erosion or hyperkeratotic plaques in a field of VLS.<sup>112</sup> The risk of vulvar cancer in VLS is estimated to be 2-5%, with higher risk in older women and with longer duration of disease.<sup>110,113,114</sup> Long term therapy, however, seems to be protective.<sup>115,116</sup> Current guidelines recommend the use of super-potent topical corticosteroids as first-line. Both the risk of cancer and the need of long term follow up must be taken into account when new treatment options are presented for LS, given the proven efficacy of topical corticosteroids.<sup>117-120</sup>

In 1991 a Canadian study reported seven women with LS refractory to topical testosterone who became asymptomatic following LASER ablation (600-900 W/cm<sup>2</sup> depth of tissue destruction 2 mm under general anesthesia). No biopsy after treatment was performed to confirm histological changes.<sup>121</sup> Similar results and depth of tissue vaporization was described by Kartamaa and Reitamo<sup>122</sup> in two patients with VLS. The aim to "remove the epithelium and papillary dermis involved in LS" for resolution of symptoms was reported in another two cases study in the absence of post treatment biopsies.<sup>123</sup>

In a recent case series,<sup>124</sup> five women underwent fractional CO<sub>2</sub> LASER treatment for hyperkeratotic VLS not responding to topical clobetasol. After 1-3 treatments with CO<sub>2</sub> LASER, energy 140-170 MJ and treatment depth 150 µm, symptoms had complete resolution in three, partial in one, and one was asymptomatic before treatment. Median follow up was 9 months (range 6-48). Re-epithelialization occurred in 3-4 weeks in all cases. Hyperkeratosis recurred after 6-8 months. In all patients, maintenance treatment was clobetasol. The objective to ablate the improper function of dermal epidermal zone, creating a new zone with proper function, is not supported by the published data.

All the papers considered are studies with very small series of patients, who did not undergo randomization, with short follow-up time. Neither visual acuity scale (VAS) for symptoms, nor details of pre/post treatment vulvar lesions were reported. The lack of description of the corticosteroid regimen utilized is another common weakness in the reported studies that prevent correct analysis of CO<sub>2</sub> LASER-treated patients and interpretation of its true efficacy. Furthermore, injuries (mechanical, chemical, burning, etc.) can be a cause

TABLE 8 Lichen sclerosis

	Level of evidence	Grade of recommendation
There are no data supporting the use of CO <sub>2</sub> LASER in VLS	4	C
There are no data concerning the long term safety of the use of CO <sub>2</sub> LASER in VLS treatment	4	C

of isomorphic or Koeber phenomenon in LS patients.<sup>125</sup> Currently, there is no evidence that fractional LASER is exempt from this risk in LS patients. Up to now the description of CO<sub>2</sub> LASER as a safe and effective therapy for recalcitrant VLS has no evidence within the literature data (level of evidence 4, grade of recommendation C) (Table 8).

9 | OTHER POSSIBLE USES OF LASER (VULVAR BLEACHING/WHITENING/BRIGHTENING, LABIAPLASTY)

While the labia tend to be more pigmented than the surrounding structures, some women have the desire to whiten it. It can represent up to 6.8% of the patients consulting a gynecological aesthetical unit.<sup>126</sup> This procedure, using LASER, is commonly offered, but there are no studies showing its efficacy or safety. We could only find reference to it in one study, but LASER was done in combination with other procedures, such as labiaplasty, augmentation of the labia *majora*, *mons pubis* liposuction, or vaginal tightening.<sup>127</sup> Of note, even the use of LASER for hair removal has been related to serious urogynecological complications, such as labial adhesion with cryptomenorrhea, and acute urinary retention.<sup>128</sup> In one survey, 85.9% of physicians stated that there is no medical indication for the performance of such procedures.<sup>129</sup>

Labiaplasty is one of the most performed female cosmetic genital procedures worldwide. There are several techniques described, some with the use of LASER. Despite the misleading anatomical description, the procedure coined “Designer LASER Vaginoplasty” is also a form of labiaplasty.<sup>130</sup> Of note, this procedure has been considered unethical by the American College of Obstetricians and Gynecologists, due to the lack of supporting evidence.<sup>11</sup>

In 2006, the use of Nd:YAG LASER for the treatment of hypertrophy of the labia *minora* was reported. In a series of 55 women (including 4 children 10-15 years old), of whom 11 (20%) lacked the authors’ established criteria of hypertrophy of the labia *minora* (>2 cm of width), there were no intraoperative complications, dehiscence occurred in 5.4%, and there was no pain after 7 days. Satisfaction rates were very high (>90%).<sup>131</sup> In another series, comprising 231

TABLE 9 Other possible uses of LASER (vulvar bleaching/whitening /brightening, labiaplasty)

	Level of evidence	Grade of recommendation
There is no medical indication for the use of LASER for vulvar bleaching	4	C
There are no data concerning the safety of the use of LASER for vulvar bleaching	4	C
Nd:YAG and CO <sub>2</sub> LASER appear to be safe options for labiaplasty	3b	C
There is no data supporting the use of LASER labiaplasty to enhance sexual function	4	C

women who underwent reduction of the labia *minora* using CO<sub>2</sub> LASER to make a lambda shaped incision, a 100% satisfaction rate was reported, along with a low complication rate (11 wound dehiscence, 3 hematomas, 1 acute bleed requiring return to the operating room); however, there is no reference to the duration of follow up.<sup>132</sup> More recently, in a study involving 112 women aged 15-62 years old using CO<sub>2</sub> LASER, improvement in overall satisfaction and comfort during intercourse were reported. The rate of complications and the duration of follow-up were not mentioned.<sup>133</sup>

None of the studies have included a control group. In at least two of the studies children were enrolled. In at least one study, women did not meet the (controversial) study definition of hypertrophy of the labia *minora*. There appears to be no sufficient good quality data showing the safety of or justification of the use of LASER for cosmetic indications.

There is no universally accepted definition of hypertrophy of the labia *minora*; some authors have described it as a width superior to 4 or 5 cm, or protruding beyond the labia *majora*.<sup>133</sup> There is no correlation between the size of the labia *minora* and the ability to feel sexual pleasure or orgasm.<sup>134</sup> Brodie et al evaluated normal adolescents and pointed that there can be significant variance in the size of labia *minora*, according to being stretched or non-stretched (1-13 mm), that asymmetry is common (>50% of adolescent women), and that the mean width of labia *minora* was 10 mm (3-70 mm) (unstretched) and 20.5 mm (5-62 mm) (stretched).<sup>135</sup> If those definitions were applied to adolescents, a significant number would be considered “abnormal”!

There appears to be no sufficient good quality data showing the safety of or justification of the use of LASER for gynecological cosmetic indications in general (level of evidence 4, grade of recommendation C). It appears, however, to be safe for labiaplasty (level of evidence 3b grade of recommendation C) (Table 9).

## 10 | CONCLUSIONS

Advances in science, including medicine, are often questioned. However, as science evolves, we must remain committed to maintaining a high ethical standard. The four pillars of ethics—autonomy, beneficence, non-maleficence, and justice<sup>134</sup>—must guide medicine in both clinical practice and research.

The lack of quality studies regarding the use of trans-vaginal and vulvar LASER for gynecology and urology raises the question of whether such therapy provides beneficence and absence of maleficence; its use also hinders the patient's autonomy and choice. In order to give truly informed consent, there is need for clear and definitive information. Many questions remain unanswered from the safety profile of the therapies, comparison to current treatments, and long-term effects on tissues. Interestingly, the majority of LASER research carried out so far has been industry-funded, leading to significant risk of bias. There is an attraction to this office procedure which is profitable to the individual provider, however this should not drive un-guided practice.

Controversial applications regarding the use of LASER that have been promoted recently without rigid scientific validation, regulation, or oversight include the reconstructive therapy for “vaginal rejuvenation,” and design LASER vaginoplasty.<sup>130</sup> The deceptive marketing of unproven treatments may not only cause injuries but may also keep patients from accessing appropriate and recognized therapies. It is imperative that providers protect patients from potential unknown harm due to the understudied clinical application of LASER technology and protect themselves from potentially indefensible lawsuits.

While there is potential for utilization of LASER to treat some proposed clinical conditions, most commonly vaginal atrophy and stress urinary incontinence, the scientific evidence remains exploratory. The existing literature is almost all post-marketing, in the setting of daily practice, rather than within controlled clinical trials. As with other innovations this is unacceptable, as safety must be proven before reaching the consumer. LASER has been available for use and disseminated among clinicians before sufficient data regarding quality, safety, and efficacy were provided.<sup>135</sup> Use of this technology prior to rigorous scientific examination may end in adversity, as has been demonstrated by previous technologies such as vaginal mesh for prolapse repair and power tissue morcellation.<sup>136</sup>

Although LASER technology seems promising for select indications, long-term efficacy and safety data are lacking. In order to elucidate its optimal clinical application, LASER therapy must be evaluated in rigorous, well-designed studies that are of appropriate time scale, randomized and sham-controlled, to evaluate safety and efficacy. Therefore, despite its appeal to clinicians and women, assumptions cannot yet be made regarding the durability of this treatment nor its long-term effects, either positive or negative to date. Until further literature emerges, this technology should be considered experimental and

remain within the domain of clinical trials or with special arrangements for clinical governance, consent, and audit.

## 11 | RECOMMENDATIONS

Based on the available scientific evidence, with no supporting long term follow-up data, the use of LASER should, at present, not be recommended for the treatment of vaginal atrophy, vulvodynia, or lichen sclerosus. The data for the role of LASER for stress urinary incontinence and vaginal laxity are inadequate to draw any conclusions or safe practice recommendations. Therefore based on the available scientific evidence and on the lack of long term follow-up, the use of LASER should, so far, not be recommended for the treatment of vaginal atrophy, vulvodynia, lichen sclerosus, stress urinary incontinence, vaginal prolapse, or vaginal laxity.

## ACKNOWLEDGMENTS

The authors thank Debbie Roepe and Dan Snowdon for facilitating the development and publication of this best practice consensus document. No funds were received for the elaboration of this paper.

## CONFLICT OF INTEREST

No conflicts of interest to declare.

## ORCID

Giuseppe Alessandro Digesu  <http://orcid.org/0000-0002-3914-8147>

Margot Damaser  <http://orcid.org/0000-0003-4743-9283>

Naside Mangir  <http://orcid.org/0000-0002-3062-6480>

## REFERENCES

- Schellhas HF. Laser surgery in gynecology. *Surg Clin North Am* [Internet]. 1978;58:151–166. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/148108>
- Herrmann TRW, Bach T. Update on lasers in urology 2015. *World J Urol* [Internet]. 2015;33:457–460. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/25777277>
- Salvatore S, Nappi RE, Zerbinati N, et al. A 12-week treatment with fractional CO2 laser for vulvovaginal atrophy: a pilot study. *Climacteric* [Internet]. 2014;17:363–369. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/24605832>
- Ogrinc UB, Senčar S, Lenasi H. Novel minimally invasive laser treatment of urinary incontinence in women. *Lasers Surg Med* [Internet]. 2015;47:689–697. Available online at: <http://doi.wiley.com/10.1002/lsm.22416>
- Kingsberg SA, Krychman M, Graham S, Bernick B, Mirkin S. The women's EMPOWER survey: identifying women's perceptions on vulvar and vaginal atrophy and its treatment. *J Sex Med*. 2017;14:413–424.

6. Portman DJ, Gass MLS. Vulvovaginal Atrophy Terminology Consensus Conference Panel. Genitourinary syndrome of menopause: new terminology for vulvovaginal atrophy from the International Society for the Study of Women's Sexual Health and the North American Menopause Society. *Maturitas*. 2014 Nov;79(3):349-54. Available online at: <https://doi.org/10.1016/j.maturitas.2014.07.013>. Epub 2014 Aug 19.
7. Vieira-Baptista P, Marchitelli C, Haefner HK. The "Genitourinary syndrome of menopause": a leap forward? *J Low Genit Tract Dis* [Internet]. 2015;19:362-363. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/26083333>
8. Pauls RN, Fellner AN, Davila GW. Vaginal laxity: a poorly understood quality of life problem; a survey of physician members of the International Urogynecological Association (IUGA). *Int Urogynecol J* [Internet]. 2012;23:1435-1448. Available online at: <http://link.springer.com/10.1007/s00192-012-1757-4>
9. An international urogynecological association (IUGA)/international continence society (ICS) joint report on the terminology for female pelvic floor dysfunction. *NeuroUrol Urodyn*. 2010;29:4-20. <https://doi.org/10.1002/nau>.
10. Vieira-Baptista P, Almeida G, Bogliatto F, et al. International society for the study of vulvovaginal disease recommendations regarding female cosmetic genital surgery. *J Low Genit Tract Dis* [Internet]. 2018;22:415-434. Available online at: <http://insights.ovid.com/crossref?an=00128360-900000000-99476>
11. ACOG committee opinion No. 378: vaginal "rejuvenation" and cosmetic vaginal procedures. *Obstet Gynecol* [Internet]. 2007;110:737-738. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/17766626>
12. 510(K) Summary [Internet]. Available online at: [https://www.accessdata.fda.gov/cdrh\\_docs/pdf10/K101904.pdf](https://www.accessdata.fda.gov/cdrh_docs/pdf10/K101904.pdf)
13. 510(K) Summary DEKA SmartXide2 Laser System [Internet]. Available online at: [https://www.accessdata.fda.gov/cdrh\\_docs/pdf13/k133895.pdf](https://www.accessdata.fda.gov/cdrh_docs/pdf13/k133895.pdf)
14. 510(K) Summary Apex Er:YAG/IPL System [Internet]. Available online at: [https://www.accessdata.fda.gov/cdrh\\_docs/pdf11/K110304.pdf](https://www.accessdata.fda.gov/cdrh_docs/pdf11/K110304.pdf)
15. 510(k) Summary for RevLite 0-Switched Nd: YAG Laser System [Internet]. Available online at: [https://www.accessdata.fda.gov/cdrh\\_docs/pdf13/k133254.pdf](https://www.accessdata.fda.gov/cdrh_docs/pdf13/k133254.pdf)
16. Fractional Laser Treatment of Vulvovaginal Atrophy and U.S. Food and Drug Administration Clearance [Internet]. Available online at: <https://www.acog.org/Clinical-Guidance-and-Publications/Position-Statements/Fractional-Laser-Treatment-of-Vulvovaginal-Atrophy-and-US-Food-and-Drug-Administration-Clearance>
17. Streicher LF. Vulvar and vaginal fractional CO2 laser treatments for genitourinary syndrome of menopause. *Menopause* [Internet]. 2018;25:571-573. Available online at: <http://insights.ovid.com/crossref?an=00042192-201805000-00016>
18. Vieira-Baptista P, Damaser M, Digesu A, Marchitelli C, Preti M, Stockdale C. To the editor. *Menopause* [Internet]. 2018;25:1166-1167. Available online at: <http://insights.ovid.com/crossref?an=00042192-900000000-97541>
19. Digesu GA, Swift S. Laser treatment in urogynaecology and the myth of the scientific evidence. *Int Urogynecol J* [Internet]. 2017;28:1443-1444. Available online at: <http://link.springer.com/10.1007/s00192-017-3458-5>
20. Singh A, Swift S, Khullar V, Digesu GA. Laser vaginal rejuvenation: not ready for prime time. *Int Urogynecol J* [Internet]. 2015;26:163-164. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/25477142>
21. Walter J-E, Larochelle A. No. 358-intravaginal laser for genitourinary syndrome of menopause and stress urinary incontinence. *J Obstet Gynaecol Canada* [Internet]. 2018;40:503-511. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S1701216317312082>
22. FDA Warns Against Use of Energy-Based Devices to Perform Vaginal "Rejuvenation" or Vaginal Cosmetic Procedures: FDA Safety Communication [Internet]. Available online at: <https://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm615013.htm>
23. Standard Operating Procedure: ICS White Paper [Internet]. Available online at: <https://www.ics.org/committees/education/icsops>
24. Burns PB, Rohrich RJ, Chung KC. The levels of evidence and their role in evidence-based medicine. *Plast Reconstr Surg* [Internet]. 2011;128:305-310. Available online at: [http://content.wkhealth.com/linkback/openurl?sid=WKP\\_TLP:landingpage&an=00006534-201107000-00046](http://content.wkhealth.com/linkback/openurl?sid=WKP_TLP:landingpage&an=00006534-201107000-00046)
25. Bologna J, Schaffer J, Cerroni L. *Basic Principles of Dermatology: Anatomy and Physiology in Dermatology*. 4th ed. China: Elsevier, 2018, ISBN 978-0-7020-6275-9.
26. Ross EV, McKinlay JR, Anderson RR. Why does carbon dioxide resurfacing work? A review. *Arch Dermatol*. 1999;135:444-454.
27. Eming SA, Wynn TA, Martin P. Inflammation and metabolism in tissue repair and regeneration. *Science*. 2017;356:1026-1030.
28. Lee SJ, Suh DH, Lee JM, Song KY, Ryu HJ. Dermal remodeling of burn scar by fractional CO2 laser. *Aesthetic Plast Surg*. 2016;40:761-768.
29. Tierney EP, Hanke CW, Petersen J. Ablative fractionated CO2 laser treatment of photoaging: a clinical and histologic study. *Dermatologic Surg*. 2012;38:1777-1789.
30. Alster TS, Tanzi EL, Lazarus M. The use of fractional laser photothermolysis for the treatment of atrophic scars. *Dermatol Surg*. 2007;33:295-299.
31. Levi B, Ibrahim A, Mathews K, et al. The use of CO2 fractional photothermolysis for the treatment of burn scars. *J Burn Care Res*. 2016;37:106-114.
32. El-Zawahry BM, Sobhi RM, Bassiouny DA, Tabak SA. Ablative CO2 fractional resurfacing in treatment of thermal burn scars: an open-label controlled clinical and histopathological study. *J Cosmet Dermatol*. 2015;14:324-331.
33. Portman DJ, Gass MLS. Genitourinary syndrome of menopause: new terminology for vulvovaginal atrophy from the International Society for the Study of Women's Sexual Health and the North American Menopause Society. *Maturitas* [Internet]. 2014;79:349-354. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/25179577>
34. Gaspar A, Addamo G, Brandi H. Vaginal fractional CO2 laser: a minimally invasive option for vaginal rejuvenation. *Am J Cosmet Surg* [Internet]. 2011;28:156-162. Available online at: <http://journals.sagepub.com/doi/10.1177/074880681102800309>
35. Salvatore S, Leone Roberti Maggiore U, Athanasios S, et al. Histological study on the effects of microablative fractional CO2 laser on atrophic vaginal tissue: an ex vivo study. *Menopause* [Internet]. 2015;22:845-849. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/25608269>
36. Zerbinati N, Serati M, Origoni M, et al. Microscopic and ultrastructural modifications of postmenopausal atrophic vaginal



- mucosa after fractional carbon dioxide laser treatment. *Lasers Med Sci*. 2015;30:429–436.
37. Salvatore S, França K, Lotti T, et al. Early regenerative modifications of human postmenopausal atrophic vaginal mucosa following fractional CO<sub>2</sub> laser treatment. *Open Access Maced J Med Sci* [Internet]. 2018;6:6. Available online at: <https://www.idpress.eu/mjms/article/view/oamjms.2018.058>
  38. Chhibber T, Wadhwa S, Chadha P, Sharma G, Katara OP. Phospholipid structured microemulsion as effective carrier system with potential in methicillin sensitive *Staphylococcus aureus* (MSSA) involved burn wound infection. *J Drug Target* [Internet]. 2015;23:943–952. Available online at: <http://www.tandfonline.com/doi/full/10.3109/1061186X.2015.1048518>
  39. Tadir Y, Gaspar A, Lev-Sagie A, et al. Light and energy based therapeutics for genitourinary syndrome of menopause: consensus and controversies. *Lasers Surg Med* [Internet]. 2017;49:137–159. Available online at: <http://doi.wiley.com/10.1002/lsm.22637>
  40. Arunkalaivanan A, Kaur H, Onuma O. Laser therapy as a treatment modality for genitourinary syndrome of menopause: a critical appraisal of evidence. *Int Urogynecol J* [Internet]. 2017;28:681–685. Available online at: <http://link.springer.com/10.1007/s00192-017-3282-y>
  41. Ravel J, Gajer P, Abdo Z, et al. Vaginal microbiome of reproductive-age women. *Proc Natl Acad Sci USA*. 2011;108Suppl 1:4680–7. <https://doi.org/10.1073/pnas.1002611107>. Epub 2010 Jun 3.
  42. Hummelen R, Macklaim JM, Bisanz JE, et al. Vaginal microbiome and epithelial gene array in post-menopausal women with moderate to severe dryness. *PLoS ONE*. [Internet]. 2011;6:e26602. Available online at: <https://doi.org/10.1371/journal.pone.0026602>. Epub 2011 Nov 2.
  43. Brotman RM, Shardt MD, Gajer P, et al. Association between the vaginal microbiota, menopause status, and signs of vulvovaginal atrophy. *Menopause* [Internet]. 2014;21:450–458. Available online at: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00042192-201405000-00005>
  44. Heinemann C, Reid G. Vaginal microbial diversity among postmenopausal women with and without hormone replacement therapy. *Can J Microbiol*. [Internet]. 2005;51:777–781. Available online at: <http://www.nrcresearchpress.com/doi/abs/10.1139/w05-070>
  45. Vieira-Baptista P, Marchitelli C, Haefner HK, Donders G, Pérez-López F. Deconstructing the genitourinary syndrome of menopause. *Int Urogynecol J* [Internet]. 2017;28:675–679. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/28293790>
  46. Athanasiou S, Pitsouni E, Antonopoulou S, et al. The effect of microablative fractional CO<sub>2</sub> laser on vaginal flora of postmenopausal women. *Climacteric* [Internet]. 2016;19:512–518. Available online at: <https://www.tandfonline.com/doi/full/10.1080/13697137.2016.1212006>
  47. Becorpi A, Campisciano G, Zanotta N, et al. Fractional CO<sub>2</sub> laser for genitourinary syndrome of menopause in breast cancer survivors: clinical, immunological, and microbiological aspects. *Lasers Med Sci*. [Internet]. 2018;33:1047–1054. Available online at: <https://doi.org/10.1007/s10103-018-2471-3>. Epub 2018 Mar 1.
  48. Nappi RE, Palacios S, Panay N, Particco M, Krychman ML. Vulvar and vaginal atrophy in four European countries: evidence from the European REVIVE Survey. *Climacteric*. 2016;19: 188–197.
  49. Nappi RE, Palacios S, Panay N, Particco M, Krychman ML. Vulvar and vaginal atrophy in four European countries: evidence from the European REVIVE Survey. *Climacteric*. 2016;19:188–197.
  50. Simon JA, Nappi RE, Kingsberg SA, Maamari R, Brown V. Clarifying vaginal atrophy's impact on sex and relationships (CLOSER) survey. *Menopause*. 2014;21:137–142.
  51. Gambacciani M, Levancini M, Cervigni M. Vaginal erbium laser: the second-generation thermotherapy for the genitourinary syndrome of menopause. *Climacteric* [Internet]. 2015;18: 757–763. Available online at: <http://www.tandfonline.com/doi/full/10.3109/13697137.2015.1045485>
  52. Gambacciani M, Levancini M. Vaginal erbium laser as second-generation thermotherapy for the genitourinary syndrome of menopause. *Menopause*. 2017;24:316–319.
  53. Gaspar A, Brandi H, Gomez V, Luque D. Efficacy of Erbium: YAG laser treatment compared to topical estriol treatment for symptoms of genitourinary syndrome of menopause. *Lasers Surg Med*. 2017;49:160–168.
  54. Salvatore S, Nappi RE, Zerbinati N, et al. A 12-week treatment with fractional CO<sub>2</sub> laser for vulvovaginal atrophy: a pilot study. *Climacteric*. 2014;17:363–369.
  55. Sokol ER, Karra MM. Use of a novel fractional CO<sub>2</sub> laser for the treatment of genitourinary syndrome of menopause. *Menopause*. 2017;24:810–814.
  56. Perino A, Calligaro A, Forlani F, et al. Vulvo-vaginal atrophy: a new treatment modality using thermo-ablative fractional CO<sub>2</sub> laser. *Maturitas* [Internet]. 2015;80:296–301. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S037851221400396X>
  57. Athanasiou S, Pitsouni E, Antonopoulou S, et al. The effect of microablative fractional CO<sub>2</sub> laser on vaginal flora of postmenopausal women. *Climacteric*. 2016;19:512–518.
  58. Behnia-Willison F, Sarraf S, Miller J, et al. Safety and long-term efficacy of fractional CO<sub>2</sub> laser treatment in women suffering from genitourinary syndrome of menopause. *Eur J Obstet Gynecol Reprod Biol*. 2017;213:39–44.
  59. Murina F, Karra M, Salvatore S, Felice R. Fractional CO<sub>2</sub> laser treatment of the vestibule for patients with vestibulodynia and genitourinary syndrome of menopause: a pilot study. *J Sex Med*. 2016;13:1915–1917.
  60. Pagano T, De Rosa P, Vallone R, et al. Fractional microablative CO<sub>2</sub> laser for vulvovaginal atrophy in women treated with chemotherapy and/or hormonal therapy for breast cancer. *Menopause*. 2016;23:1108–1113.
  61. Lee MS. Treatment of vaginal relaxation syndrome with an Erbium:YAG laser using 90° and 360° scanning scopes: a pilot study & short-term results. *LASER Ther* [Internet]. 2014;23:129–138. Available online at: <http://jlc.jst.go.jp/DN/JST.JSTAGE/islm/14-OR-11?lang=en&from=CrossRef&type=abstract>
  62. Mothes AR, Runnebaum M, Runnebaum IB. Ablative dual-phase Erbium:YAG laser treatment of atrophy-related vaginal symptoms in post-menopausal breast cancer survivors omitting hormonal treatment. *J Cancer Res Clin Oncol*. 2018;144: 955–960.
  63. Salvatore S, Nappi RE, Parma M, et al. Sexual function after fractional microablative CO<sub>2</sub> laser in women with vulvovaginal atrophy. *Climacteric* [Internet]. 2015;18:219–225. Available online at: <http://www.tandfonline.com/doi/full/10.3109/13697137.2014.975197>
  64. Siliquini GP, Tuninetti V, Bounous VE, Bert F, Biglia N. Fractional CO<sub>2</sub> laser therapy: a new challenge for vulvovaginal atrophy in postmenopausal women. *Climacteric* [Internet]. 2017;20:379–384. Available online at: <https://www.tandfonline.com/doi/full/10.1080/13697137.2017.1319815>

65. Filippini M, Del Duca E, Negosanti F, et al. Fractional CO2 laser: from skin rejuvenation to vulvo-vaginal reshaping. *Photomed Laser Surg* [Internet]. 2017;35:171–175. Available online at: <http://online.liebertpub.com/doi/10.1089/pho.2016.4173>
66. Pitsouni E, Grigoriadis T, Tsiveleka A, Zacharakis D, Salvatore S, Athanasiou S. Microablative fractional CO2 –laser therapy and the genitourinary syndrome of menopause: an observational study. *Maturitas*. 2016;94:131–136.
67. Sokol ER, Karram MM. An assessment of the safety and efficacy of a fractional CO2 laser system for the treatment of vulvovaginal atrophy. *Menopause* [Internet]. 2016;23:1102–1107. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/27404032>
68. Pieralli A, Fallani MG, Becorpi A, et al. Fractional CO2 laser for vulvovaginal atrophy (VVA) dyspareunia relief in breast cancer survivors. *Arch Gynecol Obstet* [Internet]. 2016;294:841–846. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/27170261>
69. Gambacciani M, Levancini M, Russo E, Vacca L, Simoncini T, Cervigni M. Long-term effects of vaginal erbium laser in the treatment of genitourinary syndrome of menopause. *Climacteric* [Internet]. 2018;21:148–152. Available online at: <https://www.tandfonline.com/doi/full/10.1080/13697137.2018.1436538>
70. Pagano T, De Rosa P, Vallone R, et al. Fractional microablative CO2 laser in breast cancer survivors affected by iatrogenic vulvovaginal atrophy after failure of nonestrogenic local treatments. *Menopause* [Internet]. 2018;25:657–662. Available online at: <http://insights.ovid.com/crossref?an=00042192-201806000-00014>
71. Pagano I, Gieri S, Nocera F, et al. Evaluation of the CO2 laser therapy on vulvo-vaginal atrophy (VVA) in oncological patients: preliminary results. *J Cancer Ther* [Internet]. 2017;8:452–463. Available online at: <http://www.scirp.org/journal/doi.aspx?DOI=10.4236/jct.2017.85039>
72. Arroyo C. Fractional CO2 laser treatment for vulvovaginal atrophy symptoms and vaginal rejuvenation in perimenopausal women. *Int J Womens Health* [Internet]. 2017;9:591–595. Available online at: <https://www.dovepress.com/fractional-co2-laser-treatment-for-vulvovaginal-atrophy-symptoms-and-v-peer-reviewed-article-IJWH>
73. Pieralli A, Bianchi C, Longinotti M, et al. Long-term reliability of fractioned CO2 laser as a treatment for vulvovaginal atrophy (VVA) symptoms. *Arch Gynecol Obstet* [Internet]. 2017;296:973–978. Available online at: <http://link.springer.com/10.1007/s00404-017-4504-8>
74. Cruz VL, Steiner ML, Pompei LM, et al. Randomized, double-blind, placebo-controlled clinical trial for evaluating the efficacy of fractional CO2 laser compared with topical estriol in the treatment of vaginal atrophy in postmenopausal women. *Menopause*. [Internet]. 2018;25:21–28. Available online at: <https://doi.org/10.1097/GME.0000000000000955>
75. Lapii GA, Yakovleva AY, Neimark AI. Structural reorganization of the vaginal mucosa in stress urinary incontinence under conditions of Er:YAG laser treatment. *Bull Exp Biol Med*. 2017;162:510–514.
76. Pieralli A, Fallani MG, Becorpi A, et al. Fractional CO2 laser for vulvovaginal atrophy (VVA) dyspareunia relief in breast cancer survivors. *Arch Gynecol Obstet* [Internet]. 2016;294:841–846. Available online at: <http://link.springer.com/10.1007/s00404-016-4118-6>
77. Gambacciani M, Torelli MG, Martella L, et al. Rationale and design for the Vaginal Erbium Laser Academy Study (VELAS): an international multicenter observational study on genitourinary syndrome of menopause and stress urinary incontinence. *Climacteric* [Internet]. 2015;18:43–48. Available online at: <http://www.tandfonline.com/doi/full/10.3109/13697137.2015.1071608>
78. Comparison of Vaginal Laser Therapy to Vaginal Estrogen Therapy (VeLVET) [Internet]. Available online at: <https://clinicaltrials.gov/ct2/show/study/NCT02691936>
79. Weinberger JM, Houman J, Caron AT, et al. Female sexual dysfunction and the placebo effect. *Obstet Gynecol* [Internet]. 2018;132:453–458. Available online at: <http://insights.ovid.com/crossref?an=00006250-201808000-00024>
80. Fistončić N, Fistončić I, Guštek ŠF, et al. Minimally invasive, non-ablative Er:YAG laser treatment of stress urinary incontinence in women—a pilot study. *Lasers Med Sci*. 2016;31:635–643.
81. Fistončić N, Fistončić I, Lukanović A, Guštek ŠF, Turina ISB, Franić D. First assessment of short-term efficacy of Er:YAG laser treatment on stress urinary incontinence in women: prospective cohort study. *Climacteric*. 2015;18:37–42.
82. Pardo JI, Solà VR, Morales AA. Treatment of female stress urinary incontinence with Erbium-YAG laser in non-ablative mode. *Eur J Obstet Gynecol Reprod Biol*. 2016;204:1–4.
83. Gaspar A, Brandi H. Non-ablative erbium YAG laser for the treatment of type III stress urinary incontinence (intrinsic sphincter deficiency). *Lasers Med Sci*. 2017;32:685–691.
84. Gaviria J, Lanz J. Laser Vaginal Tightening (LVT) – evaluation of a novel noninvasive laser treatment for vaginal relaxation syndrome. *J Laser Heal Acad*. 2012;1:59–66.
85. Bizjak-Ogrinc U, Sencar S. Non-surgical minimally invasive ER: YAG LASER treatment for higher-grade cystocele. In: 38th Annual IUGA Meeting, 2013.
86. Bizjak-Ogrinc U, Sencar S, Vizintin Z. #178 3 years follow-up of pelvic organ prolapses treated with Er:YAG laser. *Lasers Surg Med* [Internet]. 2017;49:63. Available online at: <http://doi.wiley.com/10.1002/lsm.22650>
87. Pauls RN, Fellner AN, Davila GW. Vaginal laxity: a poorly understood quality of life problem: a survey of physician members of the International Urogynecological Association (IUGA). *Int Urogynecol J*. 2012;23:1435–1448.
88. Food and Drug Administration (FDA). Statement from FDA Commissioner Scott Gottlieb, M.D., on efforts to safeguard women's health from deceptive health claims and significant risks related to devices marketed for use in medical procedures for “vaginal rejuvenation” [Internet]. Available online at: <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm615130.htm>
89. Palacios S. Vaginal hyperlaxity syndrome: a new concept and challenge. *Gynecol Endocrinol* [Internet]. 2018;34:360–362. Available online at: <https://www.tandfonline.com/doi/full/10.1080/09513590.2017.1418312>
90. Ostrzenski A. Vaginal rugation rejuvenation (Restoration): a new surgical technique for an acquired sensation of wide/smooth vagina. *Gynecol Obstet Invest* [Internet]. 2012;73:48–52. Available online at: <https://www.karger.com/Article/FullText/329338>
91. Lalji S, Lozanova P. Evaluation of the safety and efficacy of a monopolar nonablative radiofrequency device for the improvement of vulvo-vaginal laxity and urinary incontinence. *J Cosmet Dermatol* [Internet]. 2017;16:230–234. Available online at: <http://doi.wiley.com/10.1111/jocd.12348>






92. Vanaman Wilson MJ, Bolton J, Jones IT, Wu DC, Calame A, Goldman MP. Histologic and clinical changes in vulvovaginal tissue after treatment with a transcutaneous temperature-controlled radiofrequency device. *Dermatol Surg* [Internet]. 2018;44:705–713. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/29701623>
93. Krychman M, Rowan CG, Allan BB, Durbin S, Yacoubian A, Wilkerson D. Effect of single-Session, cryogen-cooled monopolar radiofrequency therapy on sexual function in women with vaginal laxity: the VIVEVE I trial. *J Women's Heal* [Internet]. 2018;27:297–304. Available online at: <http://www.liebertpub.com/doi/10.1089/jwh.2017.6335>
94. Krychman M, Rowan CG, Allan BB, et al. Effect of single-Treatment, surface-cooled radiofrequency therapy on vaginal laxity and female sexual function: the VIVEVE I randomized controlled trial. *J Sex Med* [Internet]. 2017;14:215–225. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/28161079>
95. Vicariotto F, DE Seta F, Faoro V, Raichi M. Dynamic quadripolar radiofrequency treatment of vaginal laxity/menopausal vulvovaginal atrophy: 12-month efficacy and safety. *Minerva Ginecol* [Internet]. 2017;69:342–349. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/28608667>
96. Ulubay M, Keskin U, Fidan U, et al. Safety, efficiency, and outcomes of perineoplasty: treatment of the sensation of a wide vagina. *Biomed Res Int* [Internet]. 2016;2016:1–5. Available online at: <http://www.hindawi.com/journals/bmri/2016/2495105/>
97. Vicariotto F, Raichi M. Technological evolution in the radio-frequency treatment of vaginal laxity and menopausal vulvovaginal atrophy and other genitourinary symptoms: first experiences with a novel dynamic quadripolar device. *Minerva Ginecol* [Internet]. 2016;68:225–236. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/27206062>
98. Sekiguchi Y, Utsugisawa Y, Azekosi Y, et al. Laxity of the vaginal introitus after childbirth: nonsurgical outpatient procedure for vaginal tissue restoration and improved sexual satisfaction using low-energy radiofrequency thermal therapy. *J Women's Heal* [Internet]. 2013;22:775–781. Available online at: <http://online.liebertpub.com/doi/abs/10.1089/jwh.2012.4123>
99. Millheiser LS, Pauls RN, Herbst SJ, Chen BH. Radiofrequency treatment of vaginal laxity after vaginal delivery: nonsurgical vaginal tightening. *J Sex Med*. [Internet]. 2010;7:3088–3095. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S1743609515331593>
100. Reed BD, Harlow SD, Sen A, et al. Prevalence and demographic characteristics of vulvodynia in a population-based sample. *Am J Obstet Gynecol* [Internet]. 2012;206:170. e1-9 Available online at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3779055&tool=pmcentrez&rendertype=abstract>.
101. Eppsteiner E, Boardman L, Stockdale CK. Vulvodynia. *Best Pract Res Clin Obstet Gynaecol* [Internet]. 2014;28:1000–12. Available online at: <https://doi.org/10.1016/j.bpobgyn.2014.07.009>. Epub 2014 Jul 18.
102. Bornstein J, Goldstein AT, Stockdale CK, et al. 2015 ISSVD, ISSWSH and IPPS consensus terminology and classification of persistent vulvar pain and vulvodynia. *Obstet Gynecol* [Internet]. 2016;127:745–751. Available online at: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00006250-201604000-00017>.
103. ACOG Committee on Gynecologic Practice ACOG committee opinion: number 345, october 2006: vulvodynia. *Obstet Gynecol* [Internet]. 2006;108:1049–1052. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/17012483>.
104. Haefner HK, Collins ME, Davis GD, et al. The Vulvodynia Guideline. *J Low Genit Tract Dis*. 2005;9:40–51.
105. Leclair CM, Goetsch MF, Lee KK, Jensen JT. KTP-nd:YAG laser therapy for the treatment of vestibulodynia: a follow-up study. *J Reprod Med* [Internet]. 2007;52:53–58. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/17286070>
106. Lev-Sagie A, Kopitman A, Brzezinski A. Low-Level laser therapy for the treatment of provoked Vestibulodynia—A randomized, placebo-controlled pilot trial. *J Sex Med* [Internet]. 2017;14:1403–1411. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S1743609517314145>
107. Tschanz C, Salomon D, Skaria A, Masouyé I, Vecchiotti GL, Harms M. Vulvodynia after CO2 laser treatment of the female genital mucosa. *Dermatology* [Internet]. 2001;202:371–372. Available online at: <https://www.karger.com/Article/FullText/51686>
108. Murphy R. Lichen sclerosus. *Dermatol Clin*. 2010;28:707–715.
109. Powell JJ, Wojnarowska F. Lichen sclerosus. *Lancet (London, England)* [Internet]. 1999;353:1777–1783. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/10348006>
110. Blecker MCG, Visser PJ, Overbeek LIH, van Beurden M, Berkhof J. Lichen sclerosus: incidence and risk of vulvar squamous cell carcinoma. *Cancer Epidemiol Biomarkers Prev* [Internet]. 2016;25:1224–1230. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/27257093>
111. Lansdorp CA, Van Den Hondel KE, Korfage IJ, Van Gestel MJ, Van Der Meijden WI. Quality of life in Dutch women with lichen sclerosus. *Br J Dermatol*. 2013;168:787–793.
112. Preti M, Scurry J, Marchitelli CE, Micheletti L. Vulvar intraepithelial neoplasia. *Best Pract Res Clin Obstet Gynaecol* [Internet]. 2014;28:1051–1062. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S1521693414001345>
113. Micheletti L, Preti M, Radici G, et al. Vulvar lichen sclerosus and neoplastic transformation: a retrospective study of 976 cases. *J Low Genit Tract Dis* [Internet]. 2016;20:180–183. Available online at: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00128360-201604000-00013>
114. Halonen P, Jakobsson M, Heikinheimo O, Riska A, Gissler M, Pukkala E. Lichen sclerosus and risk of cancer. *Int J Cancer* [Internet]. 2017;140:1998–2002. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/28124469>
115. Renaud-Vilmer C, Cavelier-Balloy B, Porcher R, Dubertret L. Vulvar lichen sclerosus: effect of long-term topical application of a potent steroid on the course of the disease. *Arch Dermatol*. 2004;140:709–712.
116. Lee A, Bradford J, Fischer G. Long-term management of adult vulvar lichen sclerosus. *JAMA Dermatol*. 2015;151:1061.
117. Edwards SK, Bates CM, Lewis F, Sethi G, Grover D. UK national guideline on the management of vulval conditions. *Int J STD AIDS*. 2014;26:611–624.
118. Kirtschig G, Becker K, Günthert A, et al. Evidence-based (S3) guideline on (anogenital) lichen sclerosus. *J Eur Acad Dermatol Venereol* [Internet]. 2015;29:e1–43. Available online at: <http://doi.wiley.com/10.1111/jdv.13136>
119. van der Meijden W, Boffa MJ, Ter Harmsel WA, et al. European guideline for the management of vulval conditions. *J Eur Acad Dermatol Venereol*. 2017;31:925–941. Available online at: <https://doi.org/10.1111/jdv.14096>. Epub 2017 Feb 6.
120. Kreuter PA, Germany O, Aberer PW. Guideline on Lichen sclerosus. 2017.

121. Stuart GC, Nation JG, Malliah VS, Robertson DI. Laser therapy for vulvar lichen sclerosus. *CJS*. 1991;34:469–470.
122. Kartamaa M, Reitamo S. Treatment of lichen sclerosus with carbon dioxide laser vaporization. *Br J Dermatol*. 1997;136:356–359.
123. Peterson CM, Lane JE, Ratz JL. Successful carbon dioxide laser therapy for refractory anogenital lichen sclerosus. *Dermatol Surg*. 2004;30:1148–1151.
124. Lee A, Lim A, Fischer G. Fractional carbon dioxide laser in recalcitrant vulvar lichen sclerosus. *Australas J Dermatol*. 2016;57:39–43. Available online at: <https://doi.org/10.1111/ajd.12305>. Epub 2015 Mar 5.
125. Camargo CM dos S, Brotas AM, Ramos-e-Silva M, Carneiro S. Isomorphic phenomenon of Koebner: facts and controversies. *Clin Dermatol* [Internet]. 2013;31:741–749. Available online at: <http://linkinghub.elsevier.com/retrieve/pii/S0738081x13000795>
126. Marchitelli CE, Sluga MC, Perrotta M, Testa R. Initial experience in a vulvovaginal aesthetic surgery unit within a general gynecology department. *J Low Genit Tract Dis* [Internet]. 2010;14:295–300. Available online at: <https://insights.ovid.com/crossref?an=00128360-201010000-00004>.
127. Cihantimur B, Herold C. Genital beautification: a concept that offers more than reduction of the labia minora. *Aesthetic Plast Surg* [Internet]. 2013;37:1128–1133. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/24042737>
128. Fadul-Elahi T, Janjua N. Laser-induced synlabia, cryptomenorrhea, and urine retention: a case report and literature review. *Urol Ann* [Internet]. 2017;9:380. Available online at: <http://www.urologyannals.com/text.asp?2017/9/4/380/216325>
129. Vieira-Baptista P, Lima-Silva J, Fonseca-Moutinho J, Monteiro V, Águas F. Survey on aesthetic vulvovaginal procedures: what do portuguese doctors and medical students think? *Rev Bras Ginecol Obs/RBGO Gynecol Obstet* [Internet]. 2017;39:415–423. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/28645122>
130. No Title [Internet]. Available online at: <http://www.drmatlock.com/body-procedures-beverly-hills/laser-vaginal-rejuvenation-with-designer-laser-vaginoplasty-combination/>.
131. Pardo J, Solà V, Ricci P, Guilloff E. Laser labioplasty of labia minora. *Int J Gynecol Obstet* [Internet]. 2006;93:38–43. Available online at: <http://doi.wiley.com/10.1016/j.ijgo.2006.01.002>
132. Smarrito S. Lambda laser nymphoplasty: retrospective study of 231 cases. *Plast Reconstr Surg* [Internet]. 2014;133:231e–232e. Available online at: <http://www.ncbi.nlm.nih.gov/pubmed/24469206>
133. González-Isaza P, Lotti T, França K, et al. Carbon dioxide with a new pulse profile and shape: a perfect tool to perform labioplasty for functional and cosmetic purpose. *Open Access Maced J Med Sci* [Internet]. 2018;6:25–27. Available online at: <https://doi.org/10.3889/oamjms.2018.043>
134. Beauchamp TL, Childress JF. *Principles of Biomedical Ethics*. (7th ed). New York: Oxford University Press; 2012.
135. DeLeon F, Baggish M. Lasers in gynecology. *Glob Libr Women's Med* [Internet]. 2008 (ISSN: 1756-2228); Available online at: <https://doi.org/10.3843/GLOWM.10023>
136. Song S, Budden A, Short A, Nesbitt-Hawes E, Deans R, Abbott J. The evidence for laser treatments to the vulvo-vagina: making sure we do not repeat past mistakes. *Aust New Zeal J Obstet Gynaecol* [Internet]. 2018;58:148–162. Available online at: <http://doi.wiley.com/10.1111/ajo.12735>

**How to cite this article:** Preti M, Vieira-Baptista P, Digesu GA, et al. The clinical role of LASER for vulvar and vaginal treatments in gynecology and female urology: An ICS/ISSVD best practice consensus document. *Neuourology and Urodynamics*. 2019;1–15.  
<https://doi.org/10.1002/nau.23931>

## Terminology report from the International Continence Society (ICS) Working Group on Underactive Bladder (UAB)

Christopher R. Chapple<sup>1</sup>  | Nadir I. Osman<sup>1</sup> | Lori Birder<sup>2</sup> |  
Roger Dmochowski<sup>3</sup> | Marcus J. Drake<sup>4</sup>  | Gommert van Koevinge<sup>5</sup> |  
Victor W. Nitti<sup>6</sup> | Matthias Oelke<sup>7</sup> | Phillip P. Smith<sup>8</sup>  | Osamu Yamaguchi<sup>9</sup> |  
Alan Wein<sup>10</sup> | Paul Abrams<sup>11</sup>

<sup>1</sup> Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom

<sup>2</sup> Pittsburgh University, Pittsburgh, Pennsylvania

<sup>3</sup> Vanderbilt University Medical Center, Nashville, Tennessee

<sup>4</sup> University of Bristol and Bristol Urological Institute, Bristol, United Kingdom

<sup>5</sup> Maastricht University Medical Center, Maastricht, Netherlands

<sup>6</sup> New York University, New York, New York

<sup>7</sup> St. Antonius Hospital, Gronau, Germany

<sup>8</sup> University of Connecticut, Farmington, Connecticut

<sup>9</sup> Nihon University, Koriyama, Japan

<sup>10</sup> University of Philadelphia, Philadelphia, Pennsylvania

<sup>11</sup> Bristol Urological Institute, Bristol, United Kingdom

### Correspondence

Christopher R. Chapple, Department of Urology, Sheffield Teaching Hospitals NHS Foundation Trust, Royal Hallamshire Hospital, Glossop Road, Sheffield, S10 2JF, United Kingdom.  
Email: c.r.chapple@shef.ac.uk

### KEYWORDS

International Continence Society, lower urinary tract function, standardisation, terminology

## 1 | INTRODUCTION

This report presents definitions of the symptoms, signs, urodynamic observations, and conditions associated with detrusor underactivity (DU) and the potentially associated lower urinary tract symptom complex of the underactive bladder (UAB), relating to DU in all patients groups from children to the elderly. It is important to emphasize that in the past the use of the term UAB has been used in a non standardized and imprecise fashion.

Detrusor underactivity (DU) may be an aspect of (or contributor to) lower urinary tract symptoms (LUTS),

especially in later life. While DU is a urodynamic definition describing the detrusor voiding contraction, the clinical component of the definition—reduced urinary flow rate and/or an increased post-void residual (PVR)—have often and imprecisely been described as “underactive bladder” (UAB).<sup>1,2</sup> In contrast to overactive bladder (OAB) and detrusor overactivity (DO), UAB and DU have remained largely unrecognized and poorly researched.<sup>1,2</sup> There is a paucity of data regarding the pathogenesis and treatment of DU, and the definitions of DU and UAB remain imprecise, with a variety of definitions and diagnostic criteria found within contemporary literature.<sup>1,2</sup> This lack of uniformity creates difficulties in characterizing UAB, in researching its effect on patient quality of life, and in evaluating possible treatments.

John Heesakkers led the peer-review process as the Associate Editor responsible for the paper.

The symptoms associated with UAB are common<sup>3</sup> and likely to impact on quality of life.<sup>4</sup> In the absence of a specific consensus-based definition of UAB, the true burden cannot be fully appreciated, nor can appropriately robust clinical trials be conducted.<sup>1-4</sup> In this report, we discuss a new definition for UAB that could be used as a platform for future discussion and research.

Although DU is an increasingly recognized urodynamic observation contributing to LUTS in both men and women, there has been a lack of research into all aspects of this dysfunction, and as yet, no effective treatments exist. DU can be diagnosed only on the basis of an invasive urodynamic study. An international consensus group met at the International Consultation on Incontinence-Research Society (ICI-RS) and International Continence Society (ICS) annual meetings in 2014 and again at these meetings in 2015 to consider the feasibility of developing a working definition of a symptom complex associated with DU. Drawing an analogy to detrusor overactivity (urodynamic observation) and overactive bladder (clinical diagnosis based on a symptom complex), the aim of this document is to help identify affected patients of all ages and to facilitate further clinical and epidemiological research.

## 2 | METHODS

The definitions restate or update those presented in previous International Continence Society Standardisation of Terminology reports.<sup>5-14</sup>

As far as possible, the definitions are descriptive of observations, without implying underlying assumptions that may later prove to be incorrect or incomplete. By following this principle, the ICS aims to facilitate comparison of results and enable effective communication by investigators who use urodynamic methods.

This document was developed according to the published methodology of the ICS Standardization Steering Committee.<sup>5</sup> The group commissioned for this report developed an outline of proposed content and revised this in the light of a workshop held at the 4th International Neuro-Urology Meeting in Zurich, Switzerland in August 2015. The subsequent text was reviewed by the working group before a final draft was discussed at a workshop during the ICS meeting in Montreal in October 2015.

## 3 | DEFINITIONS

LUTS are defined from the individual's perspective who is usually, but not necessarily, a patient within the healthcare system. Symptoms are either volunteered by, or elicited from, the individual or may be described by the individual's caregiver.

LUTS are divided into three groups: storage, voiding, and post micturition symptoms.

LUTS are not disease specific. The symptoms of hesitancy, straining to void, and a slow urinary stream can be characteristic of both bladder outflow obstruction (BOO) and detrusor underactivity (DU).

**Storage Symptoms** are experienced during the storage phase of the micturition cycle.

- **Increased daytime frequency** is the complaint by the patient who considers that he/she voids too often by day.
- **Nocturia** is the complaint that the individual has to wake at night one or more times to void.
- **Urgency** is the complaint of a sudden compelling desire to pass urine which is difficult to defer.

**Voiding Symptoms** are experienced during the voiding phase. Since UAB is a disorder of emptying these seem to be the predominant ones but voiding symptoms may also be associated with storage symptoms in case of incomplete bladder emptying.

- **Slow stream** is reported by the individual as his or her perception of reduced urine flow, usually compared to previous performance or in comparison to others.
- **Intermittent stream (intermittency)** is the term used when the individual describes urine flow which stops and starts, on one or more occasions, during micturition.
- **Hesitancy** is the term used when an individual describes difficulty in initiating micturition resulting in a delay in the onset of voiding after the individual is ready to pass urine.
- **Straining** to void describes the muscular effort used to either initiate, maintain, or improve the urinary stream.
- **Feeling of incomplete emptying of the bladder** during voiding
- **Terminal dribble** is the term used when an individual describes a prolonged final part of micturition, when the flow has slowed to a trickle/dribble.

**Post Micturition Symptoms** are experienced immediately after micturition.

- **Feeling of incomplete emptying** is a self-explanatory term for a feeling experienced by the individual after passing urine.
- **Post micturition dribble** is the term used when an individual describes the involuntary loss of urine immediately after he or she has finished passing urine, usually after leaving the toilet in men, or after rising from the toilet in women.

### Symptom syndromes suggestive of lower urinary tract dysfunction

In clinical practice, empirical diagnoses are often used as the basis for initial management after assessing the individual's lower urinary tract symptoms, physical findings and the results of urinalysis and other indicated investigations.

- Urgency, with or without urgency incontinence, usually with frequency and nocturia, can be described as the overactive bladder syndrome, urge syndrome, or urgency-frequency syndrome.

These symptom combinations are suggestive of urodynamically demonstrable detrusor overactivity but can be due to other forms of urethro-vesical dysfunction. These terms can be used if there is no proven infection or other obvious pathology.

- **Lower urinary tract symptoms suggestive of bladder outlet obstruction** is a term used when a man complains predominately of voiding symptoms in the absence of infection or obvious pathology other than possible causes of outlet obstruction
- **Underactive bladder** is characterized by a slow urinary stream, hesitancy and straining to void,<sup>a</sup> with or without a feeling of incomplete bladder emptying sometimes with storage symptoms.<sup>b</sup> (NEW)

## 4 URODYNAMIC OBSERVATIONS AND CONDITIONS

In the context of urodynamics we would affirm the ICS standardisation report definitions:

### Detrusor function during voiding

#### - Normal detrusor function

Normal voiding is achieved by a voluntarily initiated continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in the absence of BOO. For a given detrusor contraction, the magnitude of the recorded pressure rise will depend on the degree of outlet resistance.<sup>c</sup>

- **Abnormal detrusor activity** can be subdivided:

- **Detrusor underactivity** is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span<sup>d</sup>.
- **Acontractile detrusor** is one that cannot be demonstrated to contract during urodynamic studies.

- **Post void residual (PVR)** is defined as the volume of urine left in the bladder at the end of micturition.<sup>e</sup>

**Abnormal detrusor activity** in the voiding phase does not exclude the presence of **detrusor overactivity** in the storage phase. This may then be described as, for example, storage phase detrusor overactivity combined with voiding phase detrusor underactivity.

## 5 | CONCLUSIONS

DU is diagnosed urodynamically and has a pressure/flow-based ICS definition, however, it is not feasible to utilize urodynamics outside a secondary care centre. DU is characterized by an absent or low-pressure, and/or poorly-sustained detrusor contraction in combination with low urinary flow. In contrast, UAB has no ICS definition but we would propose UAB as the clinical syndrome that includes DU. Because UAB is largely undefined in the literature, there is, in our view, the need for a new symptomatic definition.

For the sake of symptom quantification in much-needed research moving forward, it appears that a crystallized definition of UAB would be of definite value. In properly defining UAB, it will be important to consider the entire symptom complex, describing the sensation of incomplete or impaired voiding that may include hesitancy, straining to void, incomplete bladder emptying, slow or prolonged stream, or intermittent stream, without implying any specific urodynamic/functional findings or causative physiology.

Properly defined, UAB could be to DU as OAB is to DO, where treatment according to a symptom-based diagnosis would be possible if the diagnosis was sufficiently robust. Patient choice, practical, and cost reasons often necessitate treatment without a pressure/flow-based diagnosis

We propose that this definition should now be tested to check its validity. In particular the factors to be considered are the influence of gender, age, and origin (neurogenic versus non-neurogenic), combining the interpretation of symptoms along with bladder diaries, flow rates, PVR volumes, and urodynamic data. It is hoped that this suggested definition may be used as a springboard for future UAB research and discussion, in terms of both qualitative research to look for characteristic symptoms, and quantitative research in urodynamically-defined DU patients.

## CONFLICTS OF INTEREST

CRC is a researcher, author, consultant and/or speaker for Astellas, Boston Scientific, GlaxoSmithKline, and Pfizer. PA is a consultant for Astellas, Ferring, and Ipsen, a researcher for Astellas, and a speaker for Astellas, Pfizer, and Ferring. MO is a researcher and/or speaker for Apogepha, Astellas, Bayer, Duchesnay, Ferring, GlaxoSmithKline, Lilly, Pfizer and Recordati. MJD is a researcher and speaker for Allergan, Astellas and Ferring. GvK is a consultant and/or researcher for

Astellas, Solace therapeutics, Boston Scientific, Allergan and Medtronic. NO has received speaker fees and travel grants from Astellas. OY is a researcher and/or a speaker for Astellas, Ferring, Pfizer, Hisamitsu and Asahikasei. AW is a consultant/advisor to Avadel, Allergan, Axonics, Valencia, Urovant, and Medtronic. VN is a researcher for Allergan, Astellas, and Medtronic.

## ENDNOTES

<sup>a</sup> FOOTNOTE a) Underactive bladder occurs in association with diverse pathophysiologicals and based on current knowledge there is no single distinguishing symptom.

<sup>b</sup> FOOTNOTE b) Storage symptoms are varied and may be highly prevalent, including nocturia, increased daytime frequency, reduced sensation of filling and incontinence. Underlying mechanisms of storage symptoms are diverse, and are often related to a significant post voiding residual urine volume.

<sup>c</sup> FOOTNOTE c) In women voiding symptoms are usually less likely to be caused by anatomical bladder outlet obstruction, therefore, detrusor underactivity and functional causes of outlet dysfunction are more likely (such as dysfunctional voiding).

<sup>d</sup> FOOTNOTE d) A urodynamic study is essential to differentiate between Bladder outlet Obstruction and Detrusor Underactivity. A normal detrusor contraction will be recorded as: high pressure if there is high outlet resistance, normal pressure if there is normal outlet resistance or low pressure if urethral resistance is low.

<sup>e</sup> FOOTNOTE e) If after repeated free uroflowmetry no residual urine is demonstrated, then the finding of residual urine during urodynamic studies should be considered an artefact, due to the circumstances of the test.

## ORCID

Christopher R. Chapple  <http://orcid.org/0000-0002-2960-9931>

Marcus J. Drake  <http://orcid.org/0000-0002-6230-2552>

Phillip P. Smith  <http://orcid.org/0000-0003-0160-8387>

## REFERENCES

- Osman NI, Chapple CR, Abrams P, et al. Detrusor underactivity and the underactive bladder: a new clinical entity? a review of current terminology, definitions, epidemiology, aetiology, and diagnosis. *Eur Urol*. 2014;65:389–398.
- van Koeveeringe GA, Vahabi B, Andersson KE, Kirschner-Hermanns R, Oelke M. Detrusor underactivity: a plea for new approaches to a common bladder dysfunction. *Neurourol Urodyn*. 2011;30:723–728.
- Valente S, DuBeau C, Chancellor D, et al. Epidemiology and demographics of the underactive bladder: a cross-sectional survey. *Int Urol Nephrol*. 2014;46:S7–10.
- Chancellor MB, Diokno A. CURE-UAB: shedding light on the underactive bladder syndrome. *Int Urol Nephrol*. 2014;46:S1.
- Abrams P, Cardozo L, Fall M, et al. Standardisation Sub-committee of the International Continence Society. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
- Abrams P, Blaivas JG, Stanton SL, Andersen JT. The standardisation of terminology of lower urinary tract function. The International Continence Society Committee on Standardisation of Terminology. *Scand J Urol Nephrol Suppl*. 1988;114:5–19.
- Abrams P, Blaivas JG, Stanton SL, Andersen JT. ICS 6th Report on the Standardisation of Terminology of Lower Urinary Tract Function. *Neurourol Urodyn*. 1992;11:593–603.
- Andersen JT, Blaivas JG, Cardozo L, Thüroff J. Seventh report on the standardisation of terminology of lower urinary tract function: lower urinary tract rehabilitation techniques. *Scand J Urol Nephrol*. 1992;26:99–106.
- Bump RC, Mattiasson A, Bo K, et al. The standardisation of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol*. 1996;175:10–17.
- Griffiths D, Höfner K, van Mastrigt R, Rollema HJ, Spangberg A, Gleason D. Standardisation of terminology of lower urinary tract function: pressure-flow studies of voiding, urethral resistance, and urethral obstruction. International Continence Society Subcommittee on Standardization of Terminology of Pressure-Flow Studies. *Neurourol Urodyn*. 1997;16:1–18.
- Stöhrer M, Goepel M, Kondo A, et al. The standardisation of terminology in neurogenic lower urinary tract dysfunction: with suggestions for diagnostic procedures. International Continence Society Standardization Committee. *Neurourol Urodyn*. 1999; 18:139–158.
- van Waalwijk van Doorn E, Anders K, Khullar V, et al. Standardisation of ambulatory urodynamic monitoring: report of the standardisation sub-committee of the international continence society for ambulatory urodynamic studies. *Neurourol Urodyn*. 2000;19:113–125.
- Lose G, Griffiths D, Hosker G, et al. Standardisation of urethral pressure measurement: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:258–260.
- van Kerrebroeck P, Abrams P, Chaikin D, et al. The standardisation of terminology in nocturia: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:179–183.

**How to cite this article:** Chapple CR, Osman NI, Birder L, et al. Terminology report from the International Continence Society (ICS) Working Group on Underactive Bladder (UAB). *Neurourology and Urodynamics*. 2018;37: 2928–2931. <https://doi.org/10.1002/nau.23701>



## 5. ICS EDUCATION MODULES

An ICS Education Module is an endorsed, evidence based, standardised module designed to teach best practice in the clinical or basic science of urinary, bowel and pelvic floor disorders. The module represents the gold standard of education for the ICS and is proposed and planned according to ICS Standard Operating Procedure.

The module includes a 3-part format:

- Official ICS-consensus PowerPoint available for download
- A studio-quality video (hosted on the ICS website) and
- A peer-reviewed published article published in NAU

These modules represent the highest level in the ICS educational mission: ICS seeks to develop and distribute high quality global health educational modules; define standards and competencies in health education; and address the needs of students, educators, and trainees as they seek to gain the skills and knowledge necessary to become healthcare leaders. All ICS modules are created to be used by educators around the world who can download the ICS module and present this to their students/colleagues. It is also expected that when an ICS speaker is invited to speak at an educational course or guest lecture the educational modules are used to provide the standardised educational content. The outcome of these modules is that educators around the world, and ICS faculty, can download the ICS module and present this to their students/colleagues. Additionally, if people are unable to attend a course on the topic the video can serve as an excellent educational tool.

**All of the modules can be found on ICS TV: [www.ics.org/tv](http://www.ics.org/tv)**

If one clicks on the module one will see the text below the video- click 'show more' and this will include the PPT slide and publication.

### **ICS Education Module Standard Operating Procedure (SOP)**

ICS Education Modules are created according to SOP:

[www.ics.org/education/icsstandardoperatingprocedures/videosops/icseducation3partmodule](http://www.ics.org/education/icsstandardoperatingprocedures/videosops/icseducation3partmodule)



**Elise De**  
ICS Education Committee Chair



# ICS Teaching Module: Ambulatory Urodynamic Monitoring

A Digesu, C Gargasole, C Hendricken, M Gore, E Kociancic, V Khullar & P Rosier



International Continence Society  
Teaching Module

## ICS teaching module

- To assist clinicians in performing and interpreting AUM
- This teaching module should be used together with the manuscript: 'ICS teaching module: Ambulatory Urodynamic Monitoring (AUM)'
- This manuscript includes the best available evidence but also contains experts' opinions reported as "so" if reliable evidence is unavailable
- This module can, only in its complete form, freely be used for teaching purposes

# Introduction

- A summary of the published literature on the role of AUM in clinical and research practice
- Indications
- Technique and Protocol for AUM
- Troubleshooting
- Interpretation of AUM traces
- Advantages and disadvantages of AUM compared to laboratory cystometry (routine saline urodynamics)

# Philosophy & Pathophysiology

- AUM has been recognized by the ICS as a useful tool to investigate LUTS in patients with inconclusive urodynamics diagnoses (19% to 44%)

## Philosophy & Pathophysiology

### ADVANTAGES

- Natural (orthograde) filling of the bladder
- Less embarrassing test since the patients are fully dressed
- The pressure are recorded for several hours (3-4)
- The patients able to leave the urodynamic room
- Increased diagnostic accuracy in the detection of DO

## Philosophy & Pathophysiology

### DISADVANTAGES

- Time-consuming test
- It requires trained and dedicated personnel
- It requires specialized equipment
- A high rate of abnormal detrusor contractions using AUM in asymptomatic controls

## Catheters

- Catheter-mounted microtip transducers:
  - silicone-covered braided metal makes them very flexible
  - low stiffness and the circumferential configuration
  - allow greater patient's mobility
  - low incidence of artifacts <sup>(24)</sup>
- Fluid-filled catheters: possible but use not yet proven
- Air - charged catheters: possible but use not yet proven

## Single use Catheters

- The use of single use catheters would be ideal as:
  - it would reduce the costs
  - save the time needed to reprocess/clean the multi-use electronic microtip transducers catheters
- Although recent studies have shown promising results in performing AUM with water filled catheters (for Pves/Pabd) scientific evidence is still lacking

## Pressure sensor systems

- Tiny airtight capsules inserted into the bladder and rectum which then communicate with a portable recorder attached to the body to reduce artifacts
- The clinical use has not been proven & validated yet

## Recording systems

- **Gaeltec Devices**
  - the oldest systems using electronic catheters-mounted microtip transducers
  - large recorder box which is very awkward to carry around
  - Lack of a patient event-marker capability to capture the patient sensation data and timing for urgency, voids, accidents, etc.

## Recording systems

- Goby, Laborie Medical or Luna, MMS:
  - Newer systems
  - Small remote-control attachment to capture data
  - Compatible with water, air and microtip catheters

## Patient preparation

- Information leaflets explaining the test are posted to patients prior to the appointment
- Comfortably full bladder
- A uroflow and a urine analysis are performed
- AUM test can be performed if there are no signs of urine infections (nitrites and leucocytes)
- Wearing comfortable clothes (preferably gown for women)
- Empty bowel if possible

## Technique

- Similar to laboratory cystometry
- Catheters are inserted into the bladder and the rectum
- Sufficient catheter length into bladder/rectum
- Catheters should be securely taped adjacent to the anus and external urethral meatus to reduce the risk of catheters falling out as well as to reduce artifacts
- Transducers set to zero
- The patient can then dress and the catheters can be connected to the AUM recording system

## Zero setting: water filled catheters

- Transducers must be set to zero at the atmospheric pressure
- Two three-way taps can be attached to the vesical and rectal transducers
- 10 ml syringe is used to flush fluid through the tubing system to eliminate bubbles from the transducers and catheters
- Transducers and the open end of the three-way tap must be at the same horizontal level of the symphysis pubis after having excluded the syringe by closing the tap where the syringe is attached



## Zero setting: Air-charged & microtip transducers catheters

- Set zero prior to recording
- Before or after insertion into the bladder & rectum
- Not necessarily at the atmospheric pressure

## Technique

- Prior to commence recording the patient is asked to cough to check the intravesical, abdominal and subtracted detrusor pressures
- AUM can be started if there is a similar increase of the intravesical and abdominal pressures and the subtracted detrusor pressure does not change
- Any problem must be rectified!

## Technique

- Before the patient leaves the urodynamic room it is mandatory to ensure that the patient:

1. Understands and is able to follow instructions
2. Records on a diary all the urinary symptoms reported during AUM test

Since symptoms are compared against the pressures recorded, an accurate recording of symptoms and the times when they occur is essential for the final AUM diagnosis

## Technique: recording urine leakage

- Method has not yet been standardized
- This may be recorded by:
  - An electronic pad
  - A remote control with event marker button
  - Completing a urinary symptom diary
  - All the above

## Instructions to the patient

- To record episodes of urgency, incontinence, pain, voluntary voids, time and volume of fluid intake, feeling of catheter displacement, any provocative maneuvers (running, washing hands, coughing etc)
- How to use the event buttons on the AUM device
- To drink about 200-400 ml/hour or a fluid load up to 1 litre drunk over 30 minutes (unless a fluid load is contraindicated the AUM time would take longer <sup>10</sup>)

## Instructions to the patient

- To return to the urodynamic room:
  - Every hour to check the system is recording the pressures correctly and subtraction is accurate
  - If need to void
  - If one of the catheter falls out (if a diagnosis has not be revealed the pressure transducers would need to be re-inserted, re-zeroed and the test will be re-started thus the length of the test will be altered from the suggested standard)
  - If the patient needs to defecate the catheter would need to be removed and reinserted accordingly

## Quality control assessment

To ensure a good quality control it is important to check the signal quality by:

- Setting each transducer to zero prior to commencing to record the pressures or during the test if needed;
- Ensure that the intravesical/abdominal pressures are similar by asking the patient to cough prior to commencing the test and every hour
- Asking the patient to cough before and after each void when pressure flow studies are recorded (LE 2a)

## Quality control assessment

- Ensure that all the catheters are securely taped on the patient's thigh, the catheter's length is reduced to the shortest length possible to avoid accidental displacement during the test
- If filled fluid catheters are used, ensure that there is no air in the system that may affect the quality control
- Provide information to patients advising to attend the appointment with an empty bowel if possible

## Analysis and interpretation of AUM trace

- Assessment of the quality of data (signal) recorded:
  - Is the trace “active”?
  - Is the baseline static or highly variable?
  - Are the cough tests regularly present?
  - Is the subtraction adequate?
- At the end of the test, hourly or if any problem arises, to reduce the risk of missing or uninterpretable data
- The use of a detailed patient diary or event markers on the newer AUM systems is strongly recommended to improve the analysis of events occurring during AUM [14,15]

## Contraindications

- Poor patient mobility
- Cognitive impairment
- Inability to follow instructions
- Severe constipation
- Active urinary tract infection
- Medical conditions which limit patient's participation (clinician's discretion)

## Recommendations

- AUM is most sensitive for the detection or exclusion of detrusor overactivity compared to laboratory cystometry (LE 2a<sup>(1)</sup>)
- AUM is valuable when all other diagnostic tests have failed to detect the underlying cause of LUTS and/or LUTS do not correlate to laboratory cystometry diagnosis (LE 2a)
- Stress urinary incontinence is better detected by laboratory cystometry than AUM <sup>(1)(2)</sup> (LE1B)
- UTI must be excluded prior to commencing the test

## Scientific Evidence

- No scientific evidence demonstrating that routine antibiotic cover before and after the test is needed
- Post procedure broad spectrum antibiotic cover may be considered in patients with:
  - Diabetes
  - Recurrent urinary tract infections
  - High post micturition residual<sup>(1)</sup>
- Although there is no scientific evidence supporting the use of routine bowel evacuation agents before AUM test (as they can cause rectal activity and/or abdominal discomfort) an impacted bowel should be avoided
- To date there is no clear LE about AUM role in the assessment of neurogenic LUTS

## Conclusions

- ADM is a valuable and effective second line test where laboratory cystometry has failed to give a satisfactory diagnosis (LE2a)
- ADM improves the outcome of continence surgery by unmasking preoperative underlying DO (<sup>10</sup>, unpublished data)
- ADM is a more time consuming test than laboratory cystometry
- ADM requires expertise as well as specialised equipment
- To make the most of its diagnostic capability and to avoid over diagnosis of DO, a detailed record of urinary symptoms during the test is always recommended





## ICS Teaching Module: Ambulatory Urodynamic Monitoring

G. Alessandro Digesu,<sup>1\*</sup> Clara Gargasole,<sup>1</sup> Caroline Hendricks,<sup>1</sup> Michelle Gore,<sup>1</sup> Ervin Kocjancic,<sup>2</sup>  
Vik Khullar,<sup>1</sup> and Peter F. Rosier<sup>3</sup>

<sup>1</sup>Department of Urogynaecology, Imperial College Healthcare NHS Trust, London, United Kingdom

<sup>2</sup>Department of Urology, University of Illinois at Chicago, Chicago, Illinois

<sup>3</sup>University Medical Centre Utrecht—Urology, The Netherlands

**Aim:** To present the ICS Teaching Module on ambulatory urodynamics monitoring (AUM). **Methods:** This teaching module has been developed by the ICS Urodynamics Committee to assist ICS members in their routine clinical practice. A detailed literature search on studies published on the clinical role of AUM as well as expert opinions have been considered. A slide set on AUM has been developed, approved by all members of the ICS Urodynamics Committee and is available to the ICS membership on the ICS website. The final approved teaching module has been presented at the ICS Annual Scientific Meeting in Brazil 2014. **Results:** The scientific evidence on the clinical role of AUM in patients with lower urinary tract symptoms is summarized. The catheters and recording systems used, the patient preparation for the test, the technique, the instructions to the patient, the analysis, interpretation, and quality control assessment of AUM trace as well as the contraindications for AUM are described. **Conclusions:** The clinical role of AUM is still controversial. The scientific evidence on the usefulness of AUM is still limited but the ICS Urodynamics Committee recommends its use as a second line diagnostic tool when office laboratory urodynamics have failed to achieve a diagnosis. AUM has been showed to be more sensitive than laboratory urodynamics in diagnosing detrusor overactivity but the level of evidence for this measurement is not high. This manuscript summarizes the evidence and provides practice recommendations on AUM for teaching purposes in the framework of an ICS teaching module. *Neurourol. Urodynam.* 36:364–367, 2017.

© 2015 Wiley Periodicals, Inc.

**Key words:** ambulatory urodynamics; ICS teaching module; inconclusive urodynamics; lower urinary tract symptoms

### INTRODUCTION

Ambulatory Urodynamic Monitoring (AUM) has been mentioned in International Continence Society (ICS) standards.<sup>1–2</sup> AUM may be considered a useful tool to investigate lower urinary tract dysfunction (LUTD) in patients with lower urinary tract symptoms (LUTS) and inconclusive results on laboratory urodynamic testing.<sup>3,4</sup> The clinical sensitivity and specificity of AUM are not very well established and the specific technical demands and the technical reliability are deliberated.<sup>1–2,5</sup> To date there is no clear consensus about the role of AUM in the assessment of LUTD.<sup>6,7</sup> Although the here above mentioned standards suggest some practical aspects, they do not cover all issues arising with clinical testing. The ICS Urodynamics Committee presents the teaching module “Ambulatory Urodynamic Monitoring” to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, performing AUM. The teaching module consists of a PowerPoint presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base for the ICS PowerPoint presentation, which is available via <http://www.icsoffice.org/eLearning>. The presentation explains testing requirements, clinical workup, and analysis. The presentation and this manuscript are based on the highest-level available published evidence, graded according to the modification of the Oxford Center for Evidence-Based Medicine levels of evidence as also used by the 5th International Consultation on Incontinence. Where evidence is unavailable, experts’ opinion has been used and the sentence is marked as “eo” (experts’ opinion). The aim of this ICS Teaching Module is to provide a summary of the published literature on the role of AUM in clinical research practice, including indications. Furthermore the technique and

a practice protocol for AUM including troubleshooting and interpretation are presented.

### Evidence and Philosophy of AUM

Conventional urodynamics is the standard clinical tool to investigate LUTD.<sup>2,8</sup> However, it has been reported that it can fail to precisely demonstrate the cause of (storage) LUTS in 19–44% of the cases.<sup>2–4</sup> This may be due to the shorter duration of the test, thus abnormalities are not detected before the end of recording. Lack of correlation between abnormalities detected and symptoms reported by patients may also play a role since it is well known that in LUTD, signs and symptoms are neither very specific nor sensitive towards the dysfunction.<sup>9</sup> When conventional urodynamics is inconclusive, AUM may be helpful in diagnosing the cause of the symptoms and guiding more appropriate management of patients. In particular, AUM has been observed to have an increased detection of detrusor overactivity.<sup>10–16</sup> However, the fact that AUM shows abnormalities, especially detrusor overactivity, in healthy volunteers may also be considered a sign of lesser specificity, apart from the fact that a person’s perception of LUT function may be “false negative.”<sup>17–20</sup> There is single center expert retrospective evidence that stress urinary incontinence became detectable during AUM with a leakage

Prof. Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Nothing to disclose.

\*Correspondence to: G. Alessandro Digesu, M.D., Ph.D., Department Of Urogynaecology, St. Mary’s Hospital, Cambridge Wing, Praed Street, W2 1NY London, United Kingdom. E-mail: a.digesu@imperial.ac.uk

Received 3 November 2015; Accepted 5 November 2015

Published online 23 November 2015 in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.22933

© 2015 Wiley Periodicals, Inc.

detector<sup>15</sup> (LE3). The sensitivity and or specificity of AUM towards voiding dysfunction or abnormalities is at present unknown.

AUM is performed in a similar way to conventional cystometry but differs in some specific elements: It uses natural (orthograde) filling of the bladder (the patients are usually asked to drink extra) and testing lasts for approximately 2–4 hr. Patients are fully dressed after the initiation of the test and are able to leave the urodynamic room, which may reduce embarrassment.<sup>11,12</sup> Disadvantages of AUM may be that the test and analysis are time-consuming and require specialized equipment with trained and dedicated personnel.

### Catheters

The majority of the reported studies on AUM have used catheter-mounted microtip transducers since they allow greater patient mobility and have a lesser incidence of movement artifacts.<sup>(eo)</sup> Although it is possible to measure pressures during AUM with fluid-filled lines, with intravesical capsules or with air filled catheters, the evidence of their usefulness has still to be proven.<sup>10</sup>

### Recording Systems

The oldest systems (Gaeltec Devices Ltd, Isle of Skye, Scotland) are mostly known for their catheters, made of flexible silicone-covered braided metal, with mounted electronic microtip transducers. The main disadvantage of this system is the large recorder box which has been awkward to carry around. The newer systems (i.e., Goby, Laborie Medical, Canada or Luna, Medical Measurement Systems, Mississauga, Canada) have a smaller remote control attachment that also allows data capturing of the important physiological events. These newer systems can also accommodate water filled, air filled, and electronic (microtip) options. (Comparative) evidence about the clinical or technical reliability of each system or combination is lacking.

### Patient Preparation

The patient is asked to come to the department with an empty bowel if possible, with a comfortably full bladder and wearing comfortable (not too tight) clothes. If the rectum is loaded with feces at the start this may need to be sorted prior to commencement to prevent “fecal urgency” during the test. Active urinary tract infection must be excluded prior to commencing the test. There is no scientific evidence demonstrating that routine antibiotics before and or after the test are needed nor evidence supporting the use of routine bowel evacuation agents before AUM. Furthermore, laxatives can cause rectal activity and/or abdominal discomfort and therefore hinder the representativeness of the test.<sup>(eo)</sup>

To record episodes of urgency, incontinence, pain, start and end of voluntary voids, time and volume of fluid intake, feeling of catheter displacement as well as any provocative manoeuvres (running, washing hands, coughing, sneezing etc) a remote control might be useful. Information leaflets explaining the test should be made available for patients prior to their appointment to explain what the test involves and how they can cooperate with the test. Preferably a uroflow and post void residual urine test are performed before AUM is started. If there are no signs of urinary tract infection the AUM test can be performed.

### Technique

Before the test is started it is mandatory to ensure that the patient understands and is able to follow some important

instructions (described more in detail in the following section) and will be able to record on a diary all the (LUT) signs and symptoms perceived during the AUM test. Since symptoms are compared against the pressures recorded, an accurate recording of symptoms and the times when they occur is essential for the final AUM diagnosis.<sup>21–23</sup>

Similar to conventional cystometry the catheters are inserted into the bladder and the rectal canal. Air-filled or microtip transducers catheters need to be zeroed prior to insertion at the atmospheric pressure by having the open end of three-way taps, attached to the catheters, at the level of the symphysis pubis. Via these three-way taps some gentle fluid flush can eliminate entrapped air and debris from the catheters and can also check them for leaks. Sufficient catheter length should be inserted into the bladder/rectum and the catheters must be securely taped adjacent to the anus and external urethral meatus to reduce the risk of catheters falling out as well as to reduce movement artifacts. The patient can then dress and the catheters can be connected to the AUM recording system.

Prior to commencing recording the patient is asked to cough to check the intravesical, abdominal, and subtracted detrusor pressures. If there is a prompt and steep increase of the vesical and abdominal pressures during cough and the subtracted detrusor pressure does not change then the test can be started. Otherwise any problem must be rectified.

The method of recording urine leakage has not yet been standardized. An electronic pad and/or the patient using a remote control and pressing an event marker button and/or completing a urinary symptom diary are possibilities. No evidence exists for any of the methods being more specific, predictive, or reliable.

### Instructions to the Patient and AUM Test

As stated above, during AUM the bladder filling is accomplished with the patient's own urine production instead of filling the bladder through a catheter. The test may last from 2 to 4 hr. Patients should receive instructions prior to leaving the urodynamic room (See Table I) in an easy to understand manner. In order to maximize AUM diagnostic power, the use of a detailed patient diary is strongly recommended to improve the analysis of events occurring during AUM.<sup>14,60</sup> However the availability of event markers on the newer AUM systems may replace the use of the diary allowing more freedom, ease, and flexibility for the patient.

Usually patients are instructed to drink extra during the test, to be able to record some storage to voiding cycles in a reasonable amount of time. Forced diuresis may unmask/provoke detrusor overactivity, however voiding an equivalent of 4 L/24 hr may be an unusual challenge for the LUT.<sup>20</sup>

The patient instruction includes advice to return to the urodynamic office in case of problems. If a catheter is displaced or evacuated, or the system is malfunctioning, the trace, the recorded pressures, subtractions, and quality of the trace the test duration may need to be reviewed. If a diagnosis has not been revealed, in case of malfunction and test prolongation the pressure transducers would need to be re-zeroed, re-inserted, and the test re-started.

### Quality Control Assessment

There is risk of losing signal quality associated with AUM. Therefore, there are a number of additional precautions to consider while performing AUM compared to conventional cystometry. Obviously it is relevant to ensure that all the catheters are securely taped adjacent to the meatus and the

**TABLE I. Outline of Patient Instructions for Ambulatory Urodynamic Test**  
**How to you use the event buttons on the AUM device**

Drink about 200–400 ml per hour or a fluid load up to 1 L drunk over 30 min.  
 If a fluid load is contraindicated the AUM time would take longer.<sup>60</sup>  
 Register urgency, incontinence, pain, start and end of voluntary voids, time and volume of fluid intake.  
 Register activity and maneuvers that (usually tends to) provoke symptoms like example drinking, running, lifting weight, washing hands, coughing, sneezing etc.  
 Return to the urodynamic room every hour to allow to check the system is recording the pressures correctly.  
 Return to the urodynamic room whenever you need to void.  
 This may allow recording up to three pressure flow studies during the whole study.<sup>60</sup>  
 Return to the urodynamic room when a catheter (or both) falls out, or is expelled during voiding (or defecation).

anus. The catheter's length should be fixed to the lower abdomen (stay inside the pants) and the rest of the length to the monitor box should be as short as possible and secured underneath the clothes to further avoid accidental displacement during the test.

To ensure good quality control it is important to check the signal quality by setting each transducer to zero prior to commencing to record the pressures and to ensure that the intravesical and abdominal pressures are similar by asking the patient to cough. Thus it can be checked that the subtracted detrusor pressure is within the normal range prior to commencing the test and this may be checked every hour to make sure that the pressures are correctly recorded and that the catheters are not displaced. The instructions should also preferably ask the patient to cough before and after each void when pressure flow studies are recorded (LE 2a).

#### Analysis and Interpretation of AUM Trace

The first step in the analysis of an AUM trace is the assessment of the quality of data (signal) recorded and to judge whether the trace appears "active" with clearly visible coughs and pressure variations due to the movement of the patient. A dead (flat) signal in one or both of the pressures indicates a problem and depending on the duration the test may not be evaluable. If both pressures have been recorded for a sufficient amount of time, the detrusor pressure should be evaluated. Evaluation of detrusor pressure is possible for the period that the movement and cough responses have been "balanced," without causing significant positive or negative deflections in this pressure; though inevitably rectal activity may play a role in (negative) deflections of detrusor "pressure" and these must be recognized.

Analysis and interpretation of the trace should be performed immediately following the test to allow discussion of the findings and management options with the patient, thus avoiding unnecessary repeat visits.<sup>60</sup>

#### Contraindications for AUM

Poor patient mobility, cognitive impairment, or inability to follow instructions are relative contraindications for AUM. Severe constipation and active urinary tract infection may need to be treated before the test.

#### CONCLUSIONS

AUM may be performed when conventional urodynamic tests have failed to detect any underlying cause of LUTS and/or may be useful when conventional cystometry diagnosis does not explain the symptoms. AUM is a more time consuming test than conventional cystometry and requires expertise as well as specialized equipment. In order to make the most of its

diagnostic capability a standardized workup and systematic analysis by a skilled physician is mandatory. Analysis should be built on an as reliable as possible measurement including a detailed record of lower urinary tract signs and symptoms. For this reason, it is also very relevant to ensure patient cooperation. We have presented an evidence based teaching module to support good clinical practice regarding AUM with recommended elements of standardization for the physician as well as for the instructions to the patient.

#### REFERENCES

1. van Waalwijk van Doorn E, Anders K, Khullar V, et al. Standardisation of ambulatory urodynamic monitoring: Report of the standardisation sub-committee of the International Continence Society for ambulatory urodynamic studies. *Neurourol Urodyn* 2000;19:113–25.
2. Schäfer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
3. Salvatore S, Khullar V, Cardozo L, et al. Evaluating ambulatory urodynamics: A prospective study in asymptomatic women. *BJOG* 2001;108:107–11.
4. Radley SC, Rosario DJ, Chapple CR, et al. Conventional and ambulatory urodynamic findings in women with symptoms suggestive of bladder overactivity. *J Urol* 2001;166:2253–8.
5. Bradshaw H, Radley SC, Rosario DJ, et al. Evaluating ambulatory urodynamics: A prospective study in asymptomatic women. *BJOG* 2003;110:83–4.
6. Collins CW, Winters JC. AUA/SUFU adult urodynamics guideline: A clinical review. *Urol Clin North Am* 2014;41:353–62.
7. Lucas MG, Bosch RJ, Burkhard FC, et al. EAU guidelines on assessment and nonsurgical management of urinary incontinence. *Eur Urol* 2012;62:1130–42.
8. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology in lower urinary tract function: Report from the standardisation sub-committee of the International Continence Society. *Urology* 2003;61:37–49.
9. Cardozo L, Stanton S, Williams JE. Detrusor instability following surgery for genuine stress incontinence. *Br J Urol* 1979;51:204–7.
10. Jarvis GJ, Hall S, Stamp S, et al. An assessment of urodynamic examination in incontinent women. *Br J Obstet Gynaecol* 1980;87:893–6.
11. Versi E, Cardozo L, Anand D, et al. Symptoms analysis for the diagnosis of genuine stress incontinence. *Br J Obstet Gynaecol* 1991;98:815–9.
12. Wall L. Diagnosis and management of urinary incontinence due to detrusor instability. *Obstet Gynecol Survey* 1990;45:85–115.
13. Blaivas J. Diagnostic evaluation of urinary incontinence. *Urology* 1990;36:11–20.
14. Patravali N. Ambulatory urodynamic monitoring: Are we wasting our time? *J Obstet Gynaecol* 2007;27:413–5.
15. Pannek J, Pieper P. Clinical usefulness of ambulatory urodynamics in the diagnosis and treatment of lower urinary tract dysfunction. *Scand J Urol Nephrol* 2008;42:428–32.
16. Salvatore S, Khullar V, Cardozo L, et al. Evaluating ambulatory urodynamics: A prospective study in asymptomatic women. *BJOG* 2001;108:107–11.
17. Heslington K, Hilton P. Ambulatory monitoring and conventional cystometry in asymptomatic female volunteers. *Br J Obstet Gynaecol* 1996;103:434–41.
18. van Waalwijk van Doorn ES, Remmers A, Janknegt RA. Conventional and extramural ambulatory urodynamic testing of the lower urinary tract in female volunteers. *J Urol* 1992;147:1319–25.
19. Webb RJ, Ramsden PD, Neal DE. Ambulatory monitoring and electronic measurement of urinary leakage in the diagnosis of detrusor instability and incontinence. *Br J Urol* 1991;68:148–52.
20. van Venrooij GE, Boon TA. Extensive urodynamic investigation: interaction among diuresis, detrusor instability, urethral relaxation,

- incontinence and complaints in women with a history of urge incontinence. *J Urol* 1994;152:1535–8.
21. Martens FM, van Kuppevelt HJ, Beekman JA, et al. No primary role of ambulatory urodynamics for the management of spinal cord injury patients compared to conventional urodynamics. *Neurourol Urodyn* 2010;29:1380–6.
  22. Davila GW. Ambulatory urodynamics in urge incontinence evaluation. *Int Urogynecol J* 1994;5:25–30.
  23. Dokmeci F, Seval M, Gok H. Comparison of ambulatory versus conventional urodynamics in females with urinary incontinence. *Neurourol Urodyn* 2010;29:518–21.

# ICS Teaching Module: Analysis of voiding; Pressure flow test (Basic module)

R.F.W.M. Rosier, R. Kirschner-Hermanns, J. Svilar, Y. Homma & A. Wein



International Continence Society  
Teaching Module

## ICS teaching module

- This teaching module should be used together with the manuscript:
- ICS teaching module: Analysis of Voiding: Pressure Flow Analysis published in: *Neurology and Urodynamics*
- The manuscript provides the scientific background and the evidence base of pressure flow analysis as well as the references.
- This teaching module contains expert opinion recommendations to compensate for lacking evidence where necessary. Expert opinions are marked with 'eo' in the title of the slide.
- Reference to this presentation and teaching module
- *Neurology and Urodynamics* 2014 **33**: nnn
- This teaching module contains 20 slides and can, only in its complete form, freely be used for teaching purposes.

## Normal lower urinary tract function

- Bladder filling begins (Storage LUT function -phase)
- Nervous system maintains relaxed detrusor
  - and ensures low intravesical pressure
- Distension activates muscle stretch receptors
  - Perception (proprioception) of fullness develops
- Cortical determination of desire to void
- Voiding (Voiding LUT function -phase)
  - Until bladder emptied
- Bladder filling, again

## Normal voiding

- Voiding is desired (and socially acceptable)
- Pelvic floor relaxes by will...
  - ...subsequently and automatically the...
- ...urethral sphincter relaxes and (antagonistic) detrusor-dome contracts;
- Detrusor pressure forces the (relaxed) bladder neck, the urethra and pelvic floor to open;
- Urine flow begins;
- Detrusor contraction ends;
- Urethral sphincter and pelvic floor contraction resume.

## Control of lower urinary tract function

- **Central control and influence**
  - Cognition
  - Social
  - Emotional
- **Central & peripheral pathways**
  - **Afferent (sensory)**
    - Somatic
    - Autonomic/visceral
  - **Efferent (motor)**
    - Somatic
    - Autonomic/visceral
- While testing: (sub-) conscious central influence may (in comparison to storage phase) play a larger role in voiding function.<sup>10</sup>

## General principles of urodynamic testing\*

### Well informed patient

- **Appropriate environment**
  - Physical (warm, least uncomfortable position...)
  - Emotional (adequate draping, private...)
- **Antiseptic procedure**
  - Urinary tract infection as a result of urodynamic testing should be prevented
    - (Not 'corrected' with prophylactic antibiotics)

\* See also Basic module Definitions



## Voiding: pressure flow test(s)

- Because the pressure flow test may be more influenced through the patient's emotion:
  - Ask patient (after voiding)
    - "Do the voiding always succeed?"
    - "Was the bladder comfortably full?"
  - You have:<sup>28</sup>
    - Indicated on cystometry: first sensation of filling
    - Indicated on cystometry: initial desire to void
    - Indicated on cystometry: strong desire to void = end of filling AND
    - Indicated on cystometry: permission to void
      - The sensation to void indicates the strength and timing of IT pressure
  - Compare with free (without catheter) flow)

<sup>28</sup> Grosse-Bardoni et al. (2006)

## Voiding: pressure flow test(s)

- Negative influence on voiding:
  - Uncomfortably large intravesical volume at the start of voiding<sup>29</sup>
  - Very unrepresentative urgency at the start of voiding<sup>29</sup>
  - Extreme inhibition of overactive detrusor contractions before the start of voiding<sup>29</sup>
  - Rectal catheter hindering pelvic muscle relaxation

## Voiding: Pressure flow test(s)

- Be aware that the transurethral catheter:
  - Causes (some) passive effect
    - May be obstructive (esp. when stricture exists)
    - May 'stent' kinking urethra in female
  - Causes active effect (hinders normal behaviour)
    - alters voiding sensation
      - Anaesthetic (lubricant) gel
    - (Fear for) pain during voiding
  - May –partially– slip out

## Set up for the test

- (ICS-) Good urodynamic practice:
  - See also ICS Module: Cystometry
- Ensure balanced intravesical and intra-abdominal (intra-rectal) pressure recording
- Cough (pressures balance) check before and after voiding
- Ensure correction of flow curve for the systematic delay between (recorded) flow and pressure:
  - depending on the micturitor/flowmeter distance
  - before a pressure flow analysis is done

## Set up for the test

- Best possible (= most comfortable for patient), position during voiding.
- Flowmeter as close as possible to the meatus.
  - Minimize time delay between flow at meatus and entering flowmeter.
- No hindering of stream between funnel and beaker or spinning disk.
  - (e.g. No long tube between funnel and beaker or disk.)
- Use thin transurethral catheter.
- Use thin rectal catheter.
- Tape catheters alongside meatus / anus.

## Mechanics of voiding

- Detrusor pressure (cmH<sub>2</sub>O) generates flow (ml/s)
  - intravesical pressure minus intra-abdominal pressure
- Urethra (normally) functions as a tube...
  - with passive distension (until Q<sub>max</sub>)
  - and passive collapse (after Q<sub>max</sub>)
- Flow (Q<sub>max</sub>) is limited by the "flow-controlling zone" (FCZ)
  - The FCZ is the virtual (i by definition) point in the urethra that gives the highest resistance to flow
  - Increased resistance drives detrusor to higher pressures to generate flow
- Urethral catheter (6F) causes +10cm H<sub>2</sub>O increase of detrusor pressure
  - (Systematic) increase of measured outlet obstruction.
  - Should be corrected for if urological catheter is used.

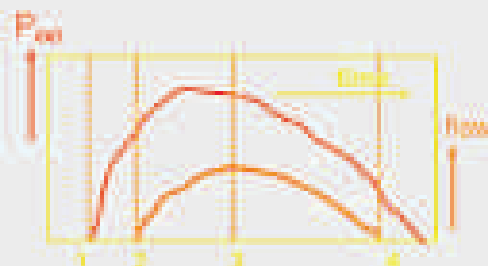
## Mechanics of voiding: phases

Start of pressure flow = end of storage: indicated by "permission to void", after voluntary void flow initiation after:

- "Permission to void"

The voiding reflex starts and:

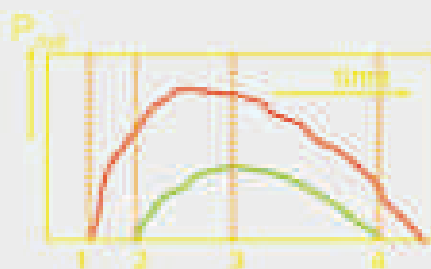
- Detrusor: pressure flow (1)
- Outlet: tension and becomes distended
  - \* "opening pressure"...
- "Detrusor opening pressure" when flow starts (2)
- "Maximum flow" when distension is maximal (3)
  - \* linked to IEC
- Steady state / balanced force: with ...
- Outlet collapse:
  - \* ...collapse seen
- "Closing pressure" end of flow (4)



## Voiding phases

- start of voiding = detrusor pressure rise (see graph):
- >> distension of outlet = opening pressure = start of flow:
- >> maximum flow = beginning of "steady state outlet"
- >> end of flow = collapse of outlet: closing pressure:

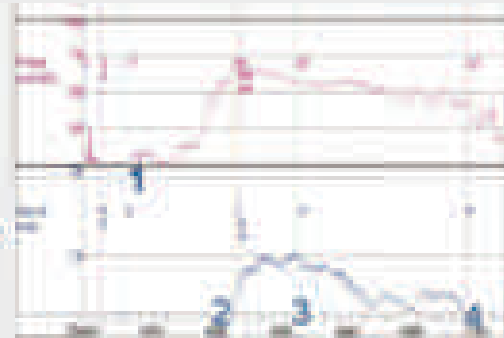
- 1 >>
- 2 >>
- 3 >>
- 4



\* During a normal voiding there exist a balance between the forces outside and inside the bladder outlet (urethra) between 3 and 4.

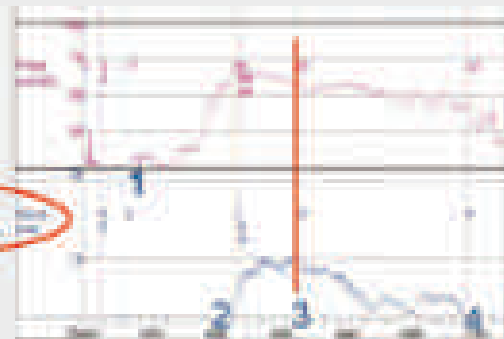
## ICS terms

- Pre-induction pressure (1)
- Opening detrusor pressure (2)
- Opening time
- Maximum detrusor pressure
- Maximum flow (3)
- Detrusor pressure at maximum flow (3)
- Closing detrusor pressure (4)
- Minimum voiding detrusor pressure
- Flow delay time



## ICS terms

- Pre-induction pressure (1)
- Opening detrusor pressure (2)
- Opening time
- Maximum detrusor pressure
- Maximum flow (3)
- Detrusor pressure at maximum flow (3)
- Closing detrusor pressure (4)
- Minimum voiding detrusor pressure
- Flow delay time



- Detrusor pressure at maximum flow (PointQmax) and maximum flow (Qmax) are, in combination, the most relevant for the analysis of U/T voiding function

## Provisional ICS method for definition of obstruction

- Easy way to grade pressure-flow result<sup>\*</sup>:
- On the basis of:
  - Detrusor pressure at maximum flow (PdetQmax) and maximum flow (Qmax)
- calculate  $P_{det}Q_{max} - 2 \times Q_{max}$  (H)
- (pressure at maximum flow minus 2 times maximum flow rate)
- use cmH2O for pressure & ml/s for flow rate

A Provisional ICS method for definition of OAB

<sup>\*</sup> See also ICS guideline: Pressure-flow testing: Obstructed micturition

## Provisional ICS method for definition of obstruction

- p-ICS method is 'clinically calibrated' for elderly male patients with an enlarged prostate
  - if p-ICS method < 20: No BOO
  - if p-ICS method > 40: BOO
  - if p-ICS method 20 to 40: Equivocal/intermediate
- Might be interpreted for male patients with an enlarged prostate as<sup>\*</sup> (see)
 

– No BOO	obstruction will not change (leaking very small
– BOO	obstruction will likely be effective in response to drug
– Equivocal	the result of this obstruction is not predictable (50% chance of symptomatic improvement)

<sup>\*</sup> This does not take PVR into account (see module 4 for details)

## Quality control

- Before:
  - Is the patient adequately informed and instructed?
  - Is anything changed after the indication for UDI testing was settled?
- During:
  - Are sterile catheters and filling medium used?
  - Are antiseptic procedures applied?
  - Is the patient clothed/covered as much as possible?
  - Is the patient comfortably positioned?
  - (Especially if male.) Preferred position for voiding?
  - Has everyone who is unnecessary left the site of testing?
- After:
  - Is the patient instructed to drink  $\pm$  0,5-1lcm immediately after the test?

## Quality control (p/Q analysis)

- Ask the patient:
  - Was this voiding more or less as usual / as at home?
    - If non-clinical urodynamic diagnosis may be irrelevant:
      - E.g. Not being able to void does frequently (but not always) not mean if the void function used is therefore irrelevant during UDI
- Observe the tracings (of the entire cystometry)
  - Are the pressures in the physiological range
  - Are the intravesical and (also abdominal) pressures reacting synchronously on patients' movements and coughing (balanced pressures) also after the voiding?
  - Is permission to void adequately marked / indicated?



## Quality control (continued)

- **Observe pressure and flow:**
  - Is the flow lag (pressure to flow) or flow to pressure (pressure to flow) correct?
    - May be a standard flow correction per module
  - Are flow rate and flow volume/connections correct?
  - Are pressure artifacts/leakage/corrections correct?
    - Compensate pressure for leaks and flow rate
  - Is post void residual (PVR) measured?
  - Is it possible to make an adequate, complete and correct diagnosis of lower urinary tract voiding function?
  - If not, repeat the test
- **Is pressure flow post analysis correct?**
  - Quantification of ICC may be less reliable with (severe) obstructive uropathy
  - Is it physiologically plausible pressure flow 'test' results?
  - Can the lower pressure border be recognized?
  - Can obstructive uropathy pattern plausible with void results?

From ICS module: Pressure flow testing: Advanced analysis

## Clinical Quality

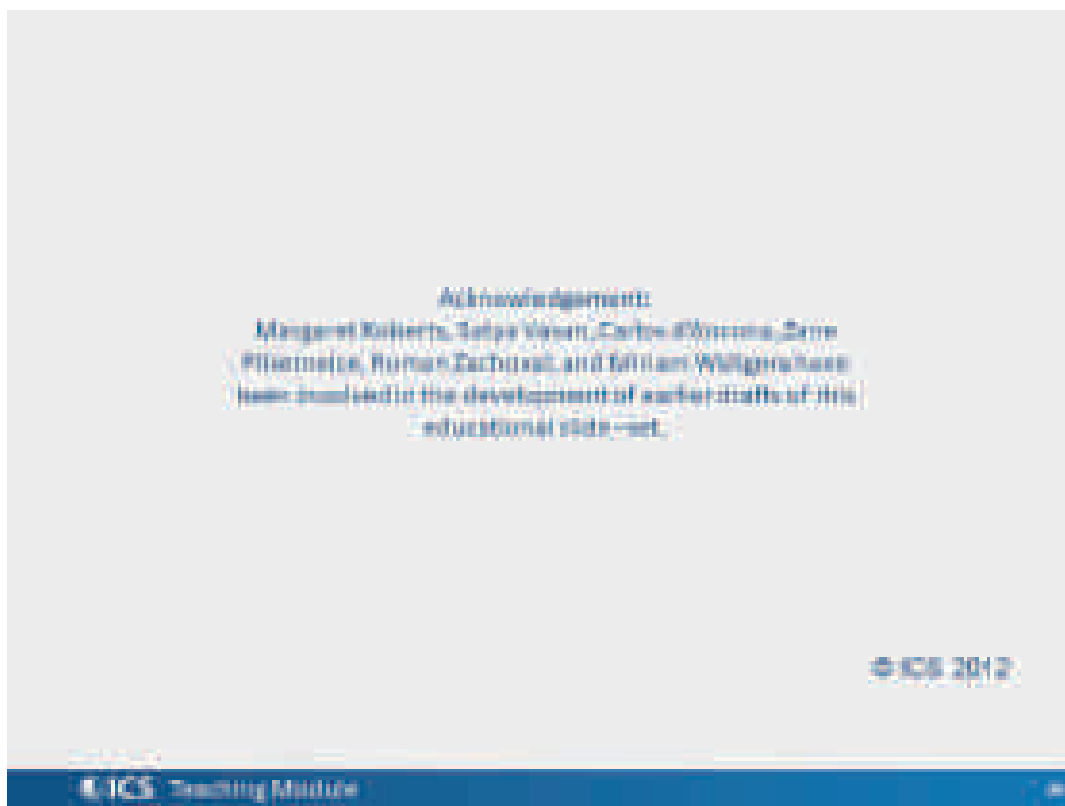
- **Patients unable to void because of the test situation:**
  - Might be not unexpected (Why voiders / shy bladder / nervous?)
    - Advise not flow; ensure absolute privacy, dim the lights
    - Allow voiding (cold water) to start
    - Drink of / running tap-water
  - Some contraction is seen but no, or very little voiding:
    - not contractility not representative, BIC response to follow-up?
  - No contraction is observed and no voiding:
    - if patient is usually able to void:
      - not definite contractility; not representative
- "patients need to start drinking usually not productive and not representative"
- **Formal pressure flow analysis and diagnosis (outlet or contractility) of voiding (other than 'why') is impossible now.**

# Clinical Quality: Pressure flow analysis

- For (older) men (with a larger prostate):
  - Pressure flow (relation and) analysis is straightforward
  - Clinically applicable limits for grading of outlet properties exist
- For young men, women and children (wq)
  - Basic principles of voiding and/or analysis are known and applicable
  - Universally agreed clinical grading of outlet properties does not exist
- Dynamic outlet obstruction/dysfunctional voiding (wq)
  - No (standard) grading of outlet disorders is available
  - No urodynamic (pressure-flow relation) criteria
- Neurogenic dysynergia or neurogenic dynamic outlet obstruction (wq)
  - No (standard) grading is available
  - No urodynamic (pressure-flow relation) criteria
    - However (abstruse) Leak Point Pressure is relevant

## Pressure flow analysis: concluding

- Flow relates to pressure and is determined (or limited) by outlet properties
  - Representative voiding and clinically relevant pressure flow analysis depends on good urodynamic practice and properly ascertained patient cooperation
  - A very unrepresentative voiding and/or significant underactive detrusor contraction limit the validity of the pressure flow analysis
- Pressure flow starts: after permission to void
- Bladder outlet obstruction can be graded by:
  - p-ICS-method =  $P_{det} Q_{max} - 2 \times Q_{cutoff}$





## ICS Teaching Module: Analysis of Voiding, Pressure Flow Analysis (Basic Module)

Peter F.W.M. Rosier,<sup>1\*</sup> Ruth Kirschner-Hermanns,<sup>2</sup> Jan Svihra,<sup>3</sup> Yukio Homma,<sup>4</sup> and Alan J. Wein<sup>5</sup>

<sup>1</sup>University Medical Centre Utrecht - Urology, The Netherlands

<sup>2</sup>University Clinic, Rheinisch Friedrich-Wilhelms University - Clinic of Urology/Neuro-Urology Bonn, Germany

<sup>3</sup>School of Medicine - Department of Urology, Slovakia

<sup>4</sup>University of Tokyo - Department of Urology, Bunkyo-ku, Tokyo, Japan

<sup>5</sup>University of Pennsylvania Health System - Division of Urology, Philadelphia, Pennsylvania

**Aims:** To present the evidence background for an ICS teaching module for the urodynamic analysis of voiding. **Methods:** Literature analysis and expert opinion are combined to collate an outline and explanation of a preferred and good urodynamic practice. **Result:** Patient's preparation, pathophysiology, technique and principles of pressure flow analysis are summarized in this manuscript. **Conclusions:** This manuscript serves as scientific background for a slides set, made available on the ICS website to teach the basic and practical elements of pressure flow analysis. *Neurourol. Urodynam.* 35:36–38, 2016. © 2014 Wiley Periodicals, Inc.

**Key words:** bladder outlet obstruction; diagnosis; pressure flow analysis; review; teaching module; underactive detrusor; voiding

### INTRODUCTION

The ICS Urodynamics Committee presents the teaching module Analysis of Voiding; Pressure Flow Analysis-basic module to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, performing analysis of voiding. The teaching module consists of a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base, for the ICS Power Point presentation; available via <http://www.icsoffice.org/eLearning/>. The presentation explains normal physiology, testing requirements, pressure flow analysis methods, and introduces the nomograms. The presentation and this manuscript uses experts opinion where evidence is, especially for the clinical practice aspects, unavailable and is marked with:<sup>eo</sup> (experts' opinion).

### PREPARATION OF THE PATIENT

Urodynamic testing requires an optimally informed patient, after adequate relevant medical history, systematic symptoms analysis, laboratory, and clinical (neuro-gyneco-urological) exam and, preferably, at least one, not-catheterized (free) flowmetry with post-void residual determination.<sup>1–3</sup> Pressure flow analysis is the element of urodynamic testing to diagnose voiding dysfunction. Although voiding is, plausibly, negatively influenced by the shift of the autonomic system to sympatrical dominance in the situation of mental stress, there is not very much evidence, that voiding in laboratory circumstances is unacceptably unrepresentative.<sup>eo</sup> Some indirect evidence exists that differences between office and home are not large in (elderly) male,<sup>4,5</sup> as long as the bladder is not uncomfortably full.<sup>6</sup> Perceivably, it is patient friendly to ensure adequate draping, normal seating (or standing, if preferred by the –male patient) and maximum possible privacy during voiding as well as quiet, relaxing circumstances with as little number as possible persons involved during urodynamic testing.<sup>eo</sup>

Infection prophylaxis necessitates sterile catheterization but for this short time catheterization in the noncompromised

patient prophylactic antibiotics is unnecessary.<sup>7,eo</sup> Laxatives are also unnecessary and might cause unwanted bowel (over) activity and fecal urgency during the test, but is advantageous to ask the patient to arrive with an empty bowel if possible.<sup>eo</sup> If high incidences of urinary tract infections after urodynamic testing are observed in a given practice, the first step should be that the procedures are changed so that strict antisepsis is followed.<sup>eo</sup> Thin (6–8F) double lumen or micro tip with lumen catheters for intravesical filling and pressure recording are advised<sup>2</sup> with adequate fixation alongside the meatus over the penis or a labium.

### PATHOPHYSIOLOGY

Voiding is an autonomic reflex that is, in the normal situation, initiated through voluntary and conscious pelvic floor relaxation. The detrusor dome, when parasympathetically activated delivers the energy to void. The bladder outlet or bladderneck (or autonomic sphincter) relaxes as a result of inhibition of sympathetic input and allows emptying. The normal outlet controls the flow by passive distension and through its visco-elasticity. The outlet collapses when the intravesical pressure is too low to overcome the forces that close the outlet.<sup>8</sup> Typically, reduced patency of the bladder outlet through an enlarged prostate or a urethral stricture, is limiting the (maximum) flowrate and driving the detrusor muscle to higher power contraction, thus higher intravesical pressures, during voiding.

Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Nothing to disclose.

\*Corresponding Author: Peter F.W.M. Rosier, University Medical Centre Utrecht - Urology Hp C04 236, Heidelberglaan 100, P.O. Box 85500, Utrecht 3508 GA, The Netherlands.

E-mail: PeterF.W.M.Rosier@umcutrecht.nl

Received 18 April 2014; Accepted 2 July 2014

Published online 11 September 2014 in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.22660

© 2014 Wiley Periodicals, Inc.

Clinical nomograms to quantify pressure flow analysis results in a standard manner are available for symptomatic elderly male with an enlarged prostate.<sup>9–11</sup> All of those methods give very consistent results.<sup>12,13</sup> Women (and young men) voiding dynamics differs from elderly men because there is no prostate to act as a stable nozzle and pressure flow nomograms are more difficult to construct. Time based pressure and flow graphs allow judgement of the voiding; post processing with pressure and flow on an X-Y graph is possible on all contemporary urodynamic equipment, and allows precise appreciation of bladder outlet obstruction (BOO) and outlet dynamics throughout voiding. Nevertheless, good quality and plausibility control as well as an evaluation of clinical representativity are necessary.<sup>2</sup>

## TECHNIQUE AND INTERPRETATION

### Technique

Pressure flow starts after permission to void and hesitancy can be recognized if that permission is precisely marked. More important, permission to void indicates the end of storage phase and differentiates between detrusor overactivity (DO) and detrusor voiding contraction; DO to be diagnosed only in the storage phase.

Pressure flow analysis relies on the simultaneous recording of pressures and flow. Pressures in the storage phase are interpreted as pattern; DO or reduced compliance, and there is no evidence that the absolute pressures play a role. In pressure flow analysis however, the absolute pressures, referred to atmospheric pressure, are relevant for the clinical interpretation with the nomograms (v.i.).

There is no specific evidence for the preferred position during pressure flow testing. Plausibly women shall perform best while comfortably sitting, however, many women never really sit on the toilet, or are used to squat.<sup>14,15</sup> Sitting uncomfortably and voiding in a manner that does not adequately represent the usual way of voiding may likely occur on a videourodynamic equipment, because of the restrictions of the equipment. More in general: in the semi recumbent, supine, or gynecological position, voiding can hardly be as usual, however, direct comparative evidence is lacking.<sup>60</sup> As in adults, position is of influence for storage phase results, but the relevance of voiding position seems not studied in children and is not mentioned in the standard.<sup>16,17</sup> Free flow in men is, in group-wise comparisons, influenced by position, however, individuals might have a preferred position and the possibility to allow the patient preferred position seems relevant.<sup>18–20</sup> To include the lag-time from meatus to flow recording is necessary in any way,<sup>21</sup> but a very short meatus to flowmeter distance is beneficial.<sup>60</sup>

If the patient's position is changed during the test, external pressure transducers (if used) must be adjusted to the height of the symphysis pubis again.

### Interpretation

Analysis of bladder outlet obstruction is done on the second, passive phase of micturition, usually from the moment maximum of flow when detrusor and outlet act in a steady state and are in balance.<sup>9,10</sup> Before maximum flow, pelvic floor relaxation and outlet distension dynamics are predominant, but after maximum flow, the true passive outlet resistance is obtained. Pressure at maximum flow in combination with corresponding maximum flow gives a clinically relevant grading of bladder outlet obstruction when used in a formula.<sup>11</sup>

This grading number is presented, and subsequently adopted, as the ICS-obstruction number.<sup>22,23</sup>

Likewise, maximum of detrusor contraction (or contractility) can be calculated with the ICS contraction number.<sup>22</sup> Detrusor contraction power during voiding can also be calculated throughout the entire voiding<sup>24</sup> and relates to bladder outlet obstruction and affectivity of voiding.<sup>25</sup> Both analysis methods give similar results.<sup>26</sup>

Analysis of female micturition is less standardized but follows the principles as mentioned here above. There is usually more flowrate and pressure variation during the time of one female voiding. Most women however, empty with high peak flowrates and because high flowrate rules out static outlet obstruction, outlet dynamics is the cause of variation here. Relatively high detrusor pressure during voiding is also in women regarded as a sign of (static) bladder outlet obstruction.<sup>27</sup> This is captured in a nomogram that integrates maximum of (not catheterized) free flowrate with a minimum cut-off pressure, to be observed during voiding cystometry or with observations during radiography.<sup>28,29</sup> Although frequently used, in variations of application, this nomogram has never been ICS-standard. Pressure at maximum flow is at present accepted as the most relevant parameter.<sup>30</sup>

Pressure flow voiding can occur in a manner that does not represent the patients' usual behaviour. Comparison with free flowmetry and asking the patients' opinion in this regard are valuable.<sup>60</sup>

Artefacts arise when the (intravesical pressure recording) catheter is slipping out during voiding. This can be suspected already from the pressure recording during voiding and also from the pressures response on cough testing after voiding.<sup>2</sup> All artefacts that are known from uroflowmetry are to be expected, and should be controlled for, also in pressure flow cystometry.<sup>2,31</sup>

Very low pressure-voiding, inability to void, or to inability to initiate a full voiding reflex as usual, limits the applicability of pressure flow analysis. Especially in shy voiders, it can become a problem to objectively diagnose the bladder outlet properties, or the real ability of the detrusor muscle to generate sufficient pressure. However, if (little) fluid leaves the bladder during a weak or incomplete voiding reflex, serious bladder outlet obstruction is relatively unlikely when this happens with low pressure, although the level of uncertainty of this diagnosis is high.

## CONCLUSIONS

Pressure flow analysis is the golden standard for the analysis of voiding. For male patients, precise and clinically relevant limits for bladder outlet obstruction are available. For female and children, the limits are less precisely defined however, on the basis of what can be expected from normal lower urinary tract physiology, closely linked to the methods and nomograms that are calibrated for male patients. Strict adherence to antisepsis and a patient-centred approach before, during and after testing limits unwanted effects and enhances representativity. Adherence to good urodynamic practice standards, with adequate reference to atmospheric pressure ensures optimal quality of analysis and diagnosis. This ICS educational module provides the background for the basic education of the analysis of voiding in patient with lower urinary tract symptoms.

## REFERENCES

1. Rosier PFWM, Kuo HC, GennaroM de, et al. Urodynamic testing. In: Abrams P, Cardozo L, Khoury, Wein A. Incontinence: International consultation

- incontinence 2012. Incontinence ICUD-EAU 2013 editors. 429–506. ISBN 978-9953-493-21-3.
2. Schäfer W, Abrams P, Liao L, et al. International Continence Society. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
3. Abrams P, Cardozo L, Fall M, et al. Standardisation Sub-committee of the International Continence Society. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
4. Boci R, Fall M, Waldén M, et al. Home uroflowmetry: Improved accuracy in outflow assessment. *Neurourol Urodyn* 1999;18:25–32.
5. Cohen DD, Steinberg JR, Rossignol M, et al. Normal variation and influence of stress, caffeine intake, and sexual activity on uroflowmetry parameters of a middle-aged asymptomatic cohort of volunteer male urologists. *Neurourol Urodyn* 2002;21:491–4.
6. Tong YC. The effect of psychological motivation on volumes voided during uroflowmetry in healthy aged male volunteers. *Neurourol Urodyn* 2006;25:8–12.
7. Porru D, Madeddu G, Campus G, et al. Evaluation of morbidity of multi-channel pressure-flow studies. *Neurourol Urodyn* 1999;18:647–52.
8. Griffiths D. The pressure within a collapsed tube, with special reference to urethral pressure. *Phys Med Biol* 1985;30:951–63.
9. Schäfer W. Analysis of bladder-outlet function with the linearized passive urethral resistance relation, linPURR, and a disease-specific approach for grading obstruction: from complex to simple. *World J Urol* 1995;13:47–58.
10. Griffiths D, van Mastrigt R, Bosch R. Quantification of urethral resistance and bladder function during voiding, with special reference to the effects of prostate size reduction on urethral obstruction due to benign prostatic hyperplasia. *Neurourol. Urodyn* 1989;8:17–27.
11. Lim CS, Abrams P. The Abrams-Griffiths nomogram. *World J Urol* 1995;13:34–9.
12. Rosier PF, de la Rosette JJ, de Wildt MJ, et al. Comparison of passive urethral resistance relation and urethral resistance factor in analysis of bladder outlet obstruction in patients with benign prostatic enlargement. *Neurourol Urodyn* 1996;15:1–10 discussion 10–5.
13. Ding YY, Lieu PK. Comparison of three methods of quantifying urethral resistance in men. *Urology* 1998;52:858–62.
14. Moore KH, Richmond DH, Sutherst JR, et al. Crouching over the toilet seat: Prevalence among British gynaecological outpatients and its effect upon micturition. *Br J Obstet Gynaecol* 1991;98:569–72.
15. Yang KN, Chen SC, Chen SY, et al. Female voiding postures and their effects on micturition. *Int Urogynecol J* 2010;21:1371–6.
16. Lorenzo AJ, Wallis MC, Cook A, et al. What is the variability in urodynamic parameters with position change in children? Analysis of a prospectively enrolled cohort. *J Urol* 2007;178:2567–70.
17. Neveus T, von Gontard A, Hoebeke P, et al. The standardization of terminology of lower urinary tract function in children and adolescents: Report from the Standardisation Committee of the International Children's Continence Society *J Urol* 176: 2006; 314.
18. Unsal A, Cimentepe E. Voiding position does not affect uroflowmetric parameters and post-void residual urine volume in healthy volunteers. *Scand J Urol Nephrol* 2004;38:469–71.
19. Unsal A, Cimentepe E. Effect of voiding position on uroflowmetric parameters and post-void residual urine volume in patients with benign prostatic hyperplasia. *Scand J Urol Nephrol* 2004;38:240–2.
20. Choudhury S, Agarwal MM, Mandal AK, et al. Which voiding position is associated with lowest flow rates in healthy adult men? Role of natural voiding position. *Neurourol Urodyn* 2010;29:413–7.
21. Kranse R, van Mastrigt R, Bosch R. Estimation of the lag time between detrusor pressure- and flow rate-signals. *Neurourol Urodyn* 1995;14: 217–29.
22. Abrams P. Bladder outlet, obstruction index and bladder contractility index and bladder voiding efficiency: Three simple indices to define bladder voiding function. *BJU Int* 1999;84:14–5.
23. Nitti VW. Pressure flow urodynamic studies: The gold standard for diagnosing bladder outlet obstruction. *Rev Urol* 2005;7:514–21.
24. van Mastrigt R, Griffiths DJ. An evaluation of contractility parameters determined from isometric contractions and micturition studies. *Urol Res* 1986;14:45–52.
25. Rosier PF, de Wildt MJ, de la Rosette JJ, et al. Analysis of maximum detrusor contraction power in relation to bladder emptying in patients with lower urinary tract symptoms and benign prostatic enlargement. *J Urol* 1995;154:2137–42.
26. Rosier PF, de Wildt MJ, Debruyne FM, et al. Evaluation of detrusor activity during micturition in patients with benign prostatic enlargement with a clinical nomogram. *J Urol* 1996;156:473–8 discussion 478–9.
27. Haylen BT, de Ridder D, Freeman RM, et al. An international urogynecological association (iuga)/international continence society (ics) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010. 29:4–20.
28. Groutz A, Blaivas J, Chaikin D. Bladder outlet obstruction in women: Definition and characteristics. *Neurourol Urodyn* 2000;19:213–20.
29. Blaivas JG, Groutz A. Bladder outlet obstruction nomogram for women with lower urinary tract symptomatology. *Neurourol Urodyn* 2000;19:553–64.
30. Nitti VW, Tu LM, Gitlin J. Diagnosing bladder outlet obstruction in women. *J Urol* 1999;161:1535–40.
31. Addla SK, Marri RR, Daayana SL, et al. Avoid cruising on the uroflowmeter: Evaluation of cruising artifact on spinning disc flowmeters in an experimental setup. *Neurourol Urodyn* 2010;29:1301–5.

# Best Practices: Basic Care in Indwelling Urinary Catheter Management

January 2016

**Mary H. Wilde, PhD, RN**

Professor, School of Nursing, University of Rochester, USA  
Member of the ICS Nurses' Committee



International Continence Society  
Teaching Module

## Objectives

- Our purpose is to educate continence nurses to improve patient care **and** **health outcomes** globally.

At the conclusion of this presentation, readers should be able to:

- 1. Describe best practices for basic care of people using indwelling urinary catheters.
- 2. **Understand** the differences and similarities in **shorter-term care** in acute settings as compared with **long-term care** in the community.



## Prevalence of catheter use

### Prevalence in the USA

- Acute care, 15–25%; 5% nursing homes (Jensen et al., 2004)
- Long term catheter users overall estimate is 151,818,
  - 9% home care, 13% hospice (National Longitudinal Health Study, 2004; <http://www.cdc.gov/nchs/data/brb/brb040102.htm>)
  - 14% in home care were long-term users (Jensen et al., 2004)
  - Spinal cord injury- 23% of those discharged from rehabilitation, but some use an intermittent catheter later (Karnes et al., 2003)

### Prevalence in England

- England & Wales, 19 hospitals 1997 cited by Scottish Nurses Association, 26.7% in acute care, range 12–40% depending on specialty (Jensen et al., 2004)
- England, survey in acute care, 18%, varied by specialty, more in ICU, 18% survey on short and intermittent use across acute hospitals (Jensen et al., 2004)
- England, 0.07% community study of 827,595 over two years (0.05% > 75 yrs old) (Jensen et al., 2004)

## Indications for short-term catheter use

- Urinary retention or bladder outlet obstruction
- Improving comfort for end-of-life care if needed
- Critically-ill and need for accurate measurements of I&O (e.g., hourly monitoring)
- Selected surgical procedures (GU surgery/colorectal surgery)
- Assist in healing open sacral or perineal wound in the incontinent patient
- Intraoperative monitoring of urinary output during surgery or large volumes of fluid or diuretics anticipated
- Prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fractures)

<http://www.cdc.gov/nchs/data/brb/brb040102.htm> (Source: USA CDC guidelines, last visited 2009)

## Indications for long-term catheter use

- Intractable **urinary retention** for those who cannot manage an intermittent catheter (and no caregiver to do it)
- **Bladder outlet obstruction**, not surgically treated
- Improving comfort for **end-of-life care** if needed
- **Alternatives to consider:** toileting schedule (when no retention), intermittent catheter, condom/sheath catheter (for cooperative males without obstructed urine or persistent retention )

(USA CDC guidelines, Gould et al. 2009)

## Short & long-term **catheter use** defined:

- **Short term-** less than 1 months' expected use
  - Can be longer, failing trial without catheter
- **Long term-** over 1 months use but often extends over many years.
  - "Indefinite use" would be more accurate term, but no agreement on terminology.
- Both "catheter types" and "catheter use" for expected time of catheterization are called short and long-term, causing confusion. (Cominsky et al. 2014)

## Short term catheter types

- Short term use—less than 14 days' expected use
  - Latex or plastic, but caution related to latex allergy.
- Coated catheters (silver alloy, nitrofurazone or minocycline/rifampicin) for up to two weeks
  - Can decrease bacteriuria but do not prevent symptomatic UTI & evidence is weak.
  - Can be uncomfortable and are more expensive. (Lam et al., 2014)
- Long term catheter types also can be used. (Catherine et al., 2013)

## Long term catheter types

- Can be used for 28 days and up to 12 weeks, dependent on local policy.
- Latex coated poly-tetrafluoro-ethylene (PTFE or Teflon)
- Silicone elastomer-coated latex or 100% silicone (harder surface but wider lumen). Balloon water can evaporate quicker in pure silicone catheters. Take care to prevent traction as erosion of penis has occurred with silicone.
- Hydrogel polymer-coated latex (softer which can be of benefit). Hydrogel less likely to form suprapubic catheter "deflation cuff". (Peters, 2002; Jahn et al., 2012; Catherine et al., 2013)

## Catheter sizes

**Catheter sizes** (Fr= French which is the same as Charrière or Ch) **Use the smallest size that permits flow and to prevent potential trauma to urethra and sphincter.**

- 12-16 Fr for men and 12-14 Fr for women.
- Children: 5-6 Fr for newborns ; 5-10 Fr toddlers to children to age 12

**Balloons** 5-10 mL (30mL only for postoperative bleeding), 2.5-5mL for children

(BROCK, Inserting Urinary Catheters, Best Practices for OB/GYN, 2009; Catheters of 4, 2013)

ICS Teaching Module

## Catheter insertion

- Long term catheters often changed every 4 weeks. People with frequent blockage can need it every 2-3 weeks or more often. Can extend to 6-8 weeks if no problems.
- Observe several changes for "catheter life pattern." (Waffle, 2004)
- Good lighting, and help of another if spasticity in legs
- Use sterile gloves.
- Lubricate catheter well, especially for males.
- **For Males:**
  - Insert all the way to Y (bifurcation) to prevent catheter being inflated within the urethra.
  - If resistance is felt, encourage deep breaths and distraction.
- **For females:** Urethra can be short, especially in older women.
  - Insert 1" further than point of urine flow
  - Fill balloon all the way to 10mL.

(ANA CLUT) November, 2013  
<http://www.gwnet.org/ANA-CLUT/>  
 (revision-100); White & Fong, 2013)

ICS Teaching Module

## Catheter securement

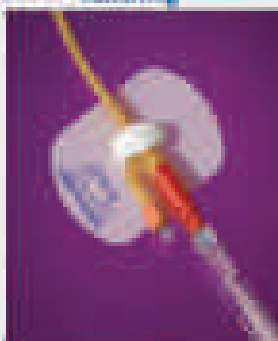
- Nurses often recommend but not use it:
  - Of 82 nurses (8 continence specialists), 98% recommended but only 4% used it. (Weges, 2010)
  - 18% secured in acute care in one day point-prevalence study (N= 8 of 44) (Alsaad et al. 2013)
- Securement could prevent dislodgement and urethral/bladder neck traumas
  - **Adhesive**—good for those likely to dislodge but irritating to skin
  - **Non-adhesive**—prevent constricting circulation (Wilde & Feng, 2013)

## Securement examples

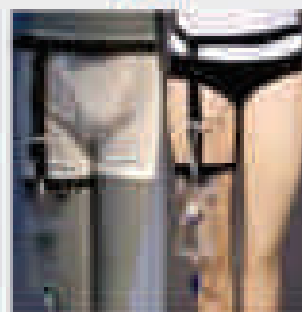
- **Non-adhering**



- **Adhering**



- **Holster**



## General catheter care

- **Hand hygiene** before and after catheter care. In home, teach family.
- If **breaks in the closed system** (e.g., disconnection, cracked tubing), **replace** the catheter and tubing.
- Perform **perineal hygiene** at a minimum daily, per facility protocol/procedure and as needed. Soap and water is all that is needed most often.
- Use **fecal containment device** when appropriate for fecal incontinence.

ANA/CNA/ITP presentation, 2019 <http://www.aanacna.org/ANA-CNA/ITP/presentation/>

ICS: Teaching Module

## Drainage bags

- **Closed drainage essential in acute care, short term use.**
  - It is the only proven method of decreasing UTI. **Blum & RICHMOND, 1986**
- **Types:**
  - Overnight (2000-4000mL)
  - Leg bags (270-1000 mL)
  - Belly bag (with normal bladder pressure) **WICK, 2006**
- **Prevent kinks/twists in tubing:** Blocked urine flow can contribute to damage to the kidneys **Deeray et al. 2015**
- **Keep bag at least 12" below the level of the bladder and off the floor to prevent suction of the catheter eyes on the bladder mucosa.** **Blum et al. 1986**

ICS: Teaching Module

## Care for drainage bags

- Empty the drainage bag regularly using a **separate, clean collecting container for each patient**; avoid splashing, and prevent contact of the drainage spout. (<https://www.cdc.gov/nhs.uk/CAUTI-Prevention-Tool/>)
- Empty when **1/3 to 1/2 full**.
- For long-term catheter users, replace drainage bags weekly.
- No evidence that connecting a catheter to a leg bag continuously & then hooking up an overnight bag is beneficial. (Cattamanchi et al. 2013)

© ICS: Teaching Module

## Cleaning & reuse of drainage bags

- **Systematic review revealed need for research in this area.**
  - Conflicting guidelines and research virtually lacking since 1990s. (White, Foster et al. 2013)
- In a U.S. study of 202 long-term catheter users, most switched between leg and night bag
  - 54% cleaned leg bags & 59% night bags. (White, McDermott et al. 2013)
  - Rehabilitation nurses have used mild bleach (1 part household bleach to 10 parts water). (Dile & Kirschner, 1993; Dile et al. 1993)
- In home care **in the past**, vinegar was recommended (1 part vinegar to 4 parts water). (White, 1998)

© ICS: Teaching Module



## Irrigation (also called flushing or washouts)

- Irrigation not recommended. Sometimes used in hospitals to remove blood clots post operatively.
- In one U.S. study of 202 long term catheter users , 42% irrigated and 18% once or more a day.
  - Solutions were saline (76%) and sterile water (23%).
  - Surprising, 9% used plain tap water, which could have bacteria or other impurities in it.
  - 4% used Renacidin –not readily available in the US and made fresh in a pharmacy. (Woods, McInerney et al 2013)

## Irrigation sachets

- Irrigation sachets (Suby G and Suby R, called catheter maintenance solutions) are available in the United Kingdom, and in some other countries, **to dissolve encrustations if change is not appropriate**. These solutions are not available in every country.
  - Saline or sterile water is not effective in breaking up encrustations.
  - Research in Canada testing saline, no irrigation and Suby G showed no difference in decreasing time to change but underpowered. (Moore et al., 2009)
  - There is a desperate need for irrigation solutions which are effective, easily obtained and used, inexpensive, and safe.

## Symptoms CAUTI- short term catheter users

- In acute care diagnosis of CAUTI, catheter in place 2+ days:
- 1. At least **one symptom below with no other recognized cause**:
  - fever ( $>38.0^{\circ}\text{C}$ ) • suprapubic tenderness • costovertebral angle pain or tenderness • urinary urgency • urinary frequency • dysuria
- 2. **AND urine culture with no more than two microorganism  $\geq 10^3$  CFU/ml**
  - <http://www.cdc.gov/nhsn/pdfs/pscManual/7pscCAUTICurrent.pdf>
- **Differential diagnosis not simple** to identify source of infection
  - Fever— without other possible source, comorbidities confound
  - Bacteriuria (Lo et al., 2014)

## Symptoms CAUTI—long term catheters

- **Urine Changes**:
  - Color – Discolored, cloudy, dark, blood stained
  - Odor – Foul smelling, change in smell from usual
  - Sediment (grit) – Increased amount
- **Temperature** – Fever, chills
- **Pain and/or pressure** in bladder area or back (Burning possible, not common)
- **Early, mild symptoms of autonomic dysreflexia** (e.g., goosebumps, headaches, sweats) mainly in people with spinal cord injury
- **General Symptoms** Blahs!, feeling sick
  - **Functioning or mental changes** – weakness, spasticity, change in the level of alertness (Witt, McDonald et al., 2013)

## CAUTI prevention

- Do not insert indwelling catheter if bladder management is possible any other way, e.g. condom catheter (sheath, external) or intermittent catheter (including caregiver performing or assisting).
- Remove catheter as soon as possible.
- Track CAUTI rate systematically:  

$$\frac{\text{Events of symptomatic UTI}}{\text{Catheter days' use (number of persons \times days catheter used)}} \times 1000$$
- Encourage staff and celebrate when CAUTI rate & usage of catheters decreases.
- In acute care, a daily order for catheter continued use is recommended.
- In community, assess regularly whether indwelling is still needed.
- Check out this important document from the USA, American Nurses' Association: ANA CAUTI prevention, 2013 <https://www.nursingworld.org/ANA/CAUTI/Prevention.pdf>

ICS Teaching Module

## References

- Appah, T., Hunter, K. P., & Moore, K. N. (2015). Securement of the indwelling urinary catheter: A prevalence study. *Journal of Wound, Ostomy, and Continence Nursing* doi:10.1097/WON.0000000000000576
- Cameron AR, Wallner LP, Tate DG, Sarma AV, Rodriguez GM, Clemens JG. Bladder management after spinal cord injury in the United States, 1972 to 2005. *J Urol*. 2010 Jul;184(1):213-7. doi: 10.1016/j.juro.2010.03.008.
- Cottenden, A., Bliem, D., Buddley, E., Foder, M., Gartley, C., Hayer, D., Ostaszewicz, J., Pieters, R., & Wilde, M.H. (2013). Management using continence products. in P. Abrams, L. Cardozo, I. Khoury, & A. Wein A. (Eds.), *Incontinence: 5th international consultation on incontinence* (pp. 1552-1786). Aachen, The Netherlands: ICS-FAU Publishers.
- Dille, C. A., Kirchhoff, K. T., Sullivan, J. J., & Larson, E. (1993). Increasing the wearing time of vinyl urinary drainage bags by decontamination with bleach. *Arch Phys Med Rehabil*, 74(4), 431-7.

ICS Teaching Module

- Dille, C. M., & Kirshhoff, K. T. (1993). Decontamination of vinyl urinary drainage bags with bleach. *Rehabil Nurs*, 18(5), 292-5. doi:10.1002/14651858.CD004013.pub4
- Fisher, E., Gillies, K., & MacLennan, S. (2014). Types of indwelling urethral catheters for short-term catheterisation in hospitalised adults. *The Cochrane Database of Systematic Reviews*, 9, CD004013.
- Feneley, R. C., Hopley, J. B., & Wells, P. N. (2015). Urinary catheters: History, current status, adverse events and research agenda. *Journal of Medical Engineering & Technology*, 1-12.
- Gerlitta, K. A. (1994). The characteristics and management of patients with recurrent blockage of long-term urinary catheters. *J Adv Nurs*, 20(1), 140-9.
- Glahn, B. E., Brandstrup, O., & Giesen, H. P. (1988). Influence of drainage conditions on mucosal bladder damage by indwelling catheters. II. histological study. *Scand J Urol Nephrol*, 22(2), 93-9.

• ICS: Teaching Module

- Glynn A, Ward V, Wilson L, et al. 1997. *Hospital Acquired Infection: Surveillance Policies and Practice: A Report of a Study of the Control of Hospital Acquired Infection in 19 Hospitals in England and Wales*. London: Public Health Laboratory Service.
- Gould, C. V., Umscheid, C. A., Agarwal, R. K., Kuntz, G., Pegues, D. A., & and the Healthcare Infection Control Practices Advisory Committee (HICPAC). (2009). *Guideline for prevention of catheter-associated urinary tract infections 2009*. Atlanta, GA: Centers for Disease Control and Prevention.
- John, R., Beutner, K., & Lange, G. (2012). Types of indwelling urinary catheters for long-term bladder drainage in adults. *The Cochrane Database of Systematic Reviews*, 10, CD004997. doi:10.1002/14651858.CD004997.pub3 [doi]
- Kunin, C. M., & McCormack, R. C. (1966). Prevention of catheter-induced urinary-tract infections by sterile closed drainage. *The New England Journal of Medicine*, 274(21), 1155-1161. doi:10.1056/NEJM196605262742101

• ICS: Teaching Module

- Lo, E., Nicolle, L. E., Coffin, S. E., Gould, C., Maragakis, L. L., Meddings, J., ... Yokoe, D. S. (2014). Strategies to prevent catheter-associated urinary tract infections in acute care hospitals: 2014 update. *Infection Control and Hospital Epidemiology*, 35 Suppl 2, S32-47.
- Lam, T. B., Omar, M. I., Fisher, E., Gillies, K., & MacLennan, S. (2014). Types of indwelling urethral catheters for short-term catheterisation in hospitalised adults. *The Cochrane Database of Systematic Reviews*, 9, CD004013. doi:10.1002/14651858.CD004013.pub4 [doi]
- Moore, K.N., Hunter, K.F., McGinnis, R., Puttagunta, L., Chobanak, J., Bascu, C., Fader M., & Voaklander, D. (2009). Do catheter washouts extend patency time in long term urethral catheters? A randomized controlled trial of acidic washout solution, normal saline washout, or standard care. *Journal of Wound, Ostomy and Continence Nursing*, 36, 82-90.

ICS Teaching Module

- Parkin, J., Scanlan, J., Woolley, M., Grover, D., Evans, A., & Feneley, R. C. (2002). Urinary catheter 'deflation cuff' formation: Clinical audit and quantitative in vitro analysis. *BJU Int*, 90(7), 666-71.
- Siegel, T. J. (2006). Do registered nurses perceive the anchoring of indwelling urinary catheters as a necessary aspect of nursing care? A pilot study. *J Wound Ostomy Continence Nurs*, 33(2), 140-4.
- Wilde, M. H. (1986). Living with a Foley. *American Journal of Nursing*, 86(10), 1121-3.
- Wilde, M. H., Brasch, J., Getliffe, K., Brown, K. A., McMahon, J. M., Smith, J. A., ... Tu, X. (2010). Study on the use of long-term urinary catheters in community-dwelling individuals. *Journal of Wound, Ostomy, and Continence Nursing*, 37(3), 301-310. doi:10.1097/WON.0b013e3181d73ac4
- Wilde, M. H., Fader, M., Ostaszewicz, J., Prieto, J., & Moore, K. (2013). Urinary bag decontamination for long-term use: A systematic review. *Journal of Wound, Ostomy, and Continence Nursing*, 40(3), 299-308. doi:10.1097/WON.0b013e3182800305 [doi]

ICS Teaching Module

- Wilde, M. H., McDonald, M. V., Brasch, J., McMahon, J. M., Fairbanks, E., Shah, S., . . . Scheid, E. (2013). Long-term urinary catheter users self-care practices and problems. *Journal of Clinical Nursing*, 22(3-4), 356-367.
- Wilde, M. H., & Zhang, F. (2013). Best practices in managing the indwelling urinary catheter for the homecare patient. *Perspectives*, 10, 1-7-12.
- Wilde, M. H., Zhang, F., Fairbanks, E., Shah, S., McDonald, M. V., & Brasch, J. (2013). Perceived value of a urinary catheter self-management program in the home. *Home Healthcare Nurse*, 31(9), 465-473. doi: 10.1097/NHH.0b013e3182a89791
- WOCN Society Clinical Practice Continence subcommittee. (2009). *Indwelling urinary catheters: Best practice for clinicians*. Wound Ostomy and Continence Nursing Society.



## **GUIDELINE FOR PREVENTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS 2009**

Carolyn V. Gould, MD, MSCR <sup>1</sup>; Craig A. Umscheid, MD, MSCE <sup>2</sup>; Rajender K. Agarwal, MD, MPH <sup>2</sup>; Gretchen Kuntz, MSW, MSLIS <sup>2</sup>; David A. Pegues, MD <sup>3</sup> and the Healthcare Infection Control Practices Advisory Committee (HICPAC) <sup>4</sup>

<sup>1</sup> Division of Healthcare Quality Promotion  
Centers for Disease Control and Prevention  
Atlanta, GA

<sup>2</sup> Center for Evidence-based Practice  
University of Pennsylvania Health System  
Philadelphia, PA

<sup>3</sup> Division of Infectious Diseases  
David Geffen School of Medicine at UCLA  
Los Angeles, CA





#### **4Healthcare Infection Control Practices Advisory Committee**

##### **(HICPAC)**

###### **Chair**

BRENNAN, Patrick J., MD  
Chief Medical Officer  
Division of Infectious Diseases  
University of Pennsylvania Health System

Department of Pathology  
University of Florida Health Science  
Center-Jacksonville

MURPHY, Denise M., MPH, RN, CIC  
Vice President, Safety and Quality  
Barnes-Jewish Hospital at Washington  
University Medical Center

###### **Executive Secretary**

BELL, Michael R., MD  
Associate Director for Infection Control  
Division of Healthcare Quality Promotion  
National Center for Infectious Diseases  
Centers for Disease Control and  
Prevention

OLMSTED, Russell N., MPH  
Epidemiologist  
Infection Control Services  
St. Joseph Mercy Health System

###### **Members**

BURNS, Lillian A., MPH  
Infection Control Coordinator  
Infectious Diseases Department,  
Greenwich Hospital

PEGUES, David Alexander, MD  
Professor of Medicine, Hospital Epidemiologist  
David Geffen School of Medicine at  
UCLA

ELWARD, Alexis, MD, MPH  
Medical Director of Infection Control  
Assistant Professor, Pediatric Infectious  
Diseases  
Washington University School of Medicine

RAMSEY, Keith M., MD  
Professor of Medicine  
Medical Director of Infection Control  
Pitt County Memorial

ENGEL, Jeffrey, MD  
Chief, Epidemiology Section, North  
Carolina Division of Public Health  
North Carolina State Epidemiologist

SINGH, Nalini, MD, MPH  
Professor of Pediatrics  
Epidemiology and International Health  
George Washington University  
Children's National Medical Center

LUNDSTROM, Tammy, MD, JD  
Chief Medical Officer  
Providence Hospital

SOULE, Barbara M., RN, MPA, CIC  
Practice Leader  
Infection Prevention Services  
Joint Commission Resources/Joint  
Commission International

GORDON, Steven M., MD  
Chairman, Department of Infectious  
Diseases  
Hospital Epidemiologist  
Cleveland Clinic Foundation

SCHECTER, William, P., MD  
Department of Surgery, Ward 3A 17  
San Francisco General Hospital

MCCARTER, Yvette S., PhD  
Director, Clinical Microbiology  
Laboratory

STEVENSON, Kurt Brown, MD, MPH  
Division of Infectious Diseases  
Department of Internal Medicine  
The Ohio State University Medical Center

### **Ex-officio Members**

#### Agency for Healthcare Research and Quality Ex-Officio

BAINE, William B., MD  
Senior Medical Advisor  
Center for Outcomes and Evidence  
Agency for Healthcare Research and Quality

#### National Institute of Health Ex-Officio

HENDERSON, David, MD  
Deputy Director for Clinical Care  
National Institute of Health

#### Health Resources and Services Administration Ex-Officio

JAY, Lorine J., MPH, RN, CPHQ  
Regional Coordinator

#### Food and Drug Administration Ex-Officio

MURPHEY, Sheila A., MD  
Chief, Infection Control Devices Branch  
Division of Anesthesiology, General Hospital  
Infection Control and Dental Devices  
Center for Devices and Radiology Health  
Food and Drug Administration

#### Center for Medicare & Medicaid Services (CMS) Ex-Officio

MILLER, Jeannie RN, MPH  
Deputy Director, Office of Clinical  
Standards and Quality/ Clinical Standards  
Group

#### Department of Veterans Affairs (VA)

ROSELLE, Gary A., MD  
National Program Director, Infectious  
Diseases  
VA Central Office  
Cincinnati VA Medical Center

### **Liaisons**

#### Association of Professionals of Infection Control and Epidemiology, Inc.

BJERKE, Nancy BSN, RN, MPH, CIC

#### Council of State and Territorial Epidemiologists

KAINER, Marion MD, MPH  
Medical Epidemiologist/Infections  
Diseases Physician Director, Hospital  
Infections and Antimicrobial Resistance  
Program, Tennessee Department of Health

Infection Control Consultant  
Infection Control Associates

#### American Health Care Association

FITZLER, Sandra L., RN  
Senior Director of Clinical Services  
American Health Care Association

#### American College of Occupational and Environmental Medicine

RUSSE, Mark, MD, MPH  
American College of Occupational and  
Environmental Medicine

#### Advisory Council for the Elimination of Tuberculosis STRICOF, Rachel L., MPH

New York State Department of Health

#### American Hospital Association

SCHULMAN, Roslyne, MHA, MBA  
Senior Associate Director, Policy  
Development

#### Association of periOperative Registered Nurses

BLANCHARD, Joan C., RN, BSN,  
MSS, CNOR, CIC  
Association of periOperative Registered  
Nurses

#### Society for Healthcare Epidemiology of America

MARAGAKIS, Lisa, MD  
Assistant Professor of Medicine  
Johns Hopkins Medical Institutions

#### Joint Commission on Accreditation of Healthcare Organizations

WISE, Robert A., MD  
Division of Standards & Survey  
Methods  
Joint Commission on Accreditation of  
Healthcare Organizations

#### Consumers Union

Senior Policy Analyst on  
MCGIFFERT, Lisa  
Health Issues, Project Director  
Stop Hospital Infections Organization

### **Acknowledgement**

HICPAC thanks the following members who served on the HICPAC CAUTI Guideline subcommittee during the guideline development process: Russell N. Olmsted, MPH, Yvette S. McCarter, PhD, Barbara M. Soule, RN, MPA, CIC, and Nalini Singh, MD, MPH.

HICPAC thanks the following outside experts for reviewing a draft of this guideline: Edward S. Wong, MD, Lindsay E. Nicolle, MD, Anthony J. Schaeffer, MD, and Harriett M. Pitt, RN, MS, CIC. The opinions of the reviewers might not be reflected in all the recommendations contained in this document.

HICPAC would also like to thank the many individuals and organizations who provided valuable feedback on the guideline during the public comment period.

### **Disclosure of Financial Interests and Relationships**

The authors C.V.G., C.A.U., R.K.A., and G.K. report no actual or potential conflicts of interest. D.A.P. is on the Speakers Bureau of Merck, Pfizer, Schering, and Cubist and is a consultant for Dow Pharmaceuticals, DaVita, and Vasonova. C.A.U. and R.K.A. received funding from the CDC to support the guideline development process.

**Table of Contents**

*Abbreviations* ..... 6

I. Executive Summary ..... 8

II. Summary of Recommendations ..... 10

III. Implementation and Audit ..... 18

IV. Recommendations for Further Research ..... 20

V. Background ..... 22

VI. Scope and Purpose ..... 25

VII. Methods ..... 26

VIII. Evidence Review ..... 34

References ..... 49

## **Abbreviations**

ADL	Activities of daily living
APACHE II	Acute Physiology and Chronic Health Evaluation II
ASA	American Society of Anesthesiologists
ASB	Asymptomatic bacteriuria
BUN	Blood urea nitrogen
CAUTI	Catheter-associated urinary tract infection
CDC	Centers for Disease Control and Prevention
CFU	Colony-forming units
CI	Confidence interval
CIC	Clean intermittent catheterization
CICU	Coronary intensive care unit
COPD	Chronic obstructive pulmonary disease
ED	Emergency department
F/U	Follow-up
GRADE	Grading of Recommendations Assessment, Development, and Evaluation system
Hb	Hemoglobin concentration
HICPAC	Healthcare Infection Control Practices Advisory Committee
H/O	History of
HPF	High power field
HR	Hazard ratio
ICU	Intensive care unit
IDR	Incidence-density ratio
LOS	Length of stay
MDR	Multi-drug resistant
MICU	Medical intensive care unit
NHSN	National Healthcare Safety Network
NIH	National Institutes of Health
NS	Not significant
OBS	Observational controlled study
OR	Odds ratio
P	P value
PACU	Post-anesthesia care unit
PVC	Polyvinyl chloride

RCT	Randomized controlled trial
RD	Risk difference
RH	Relative hazard
RR	Relative risk
SAPS II	Simplified Acute Physiology Score II
SICU	Surgical intensive care unit
SR	Systematic review
SUTI	Symptomatic urinary tract infection
TMP/SMX	Trimethoprim/sulfamethoxazole
TURP	Transurethral resection of prostate
UTI	Urinary tract infection
VAS	Visual analog scale
WMD	Weighted mean difference

## **I. Executive Summary**

This guideline updates and expands the original Centers for Disease Control and Prevention (CDC) Guideline for Prevention of Catheter-associated Urinary Tract Infections (CAUTI) published in 1981. Several developments necessitated revision of the 1981 guideline, including new research and technological advancements for preventing CAUTI, increasing need to address patients in non-acute care settings and patients requiring long-term urinary catheterization, and greater emphasis on prevention initiatives as well as better defined goals and metrics for outcomes and process measures. In addition to updating the previous guideline, this revised guideline reviews the available evidence on CAUTI prevention for patients requiring chronic indwelling catheters and individuals who can be managed with alternative methods of urinary drainage (e.g., intermittent catheterization). The revised guideline also includes specific recommendations for implementation, performance measurement, and surveillance. Although the general principles of CAUTI prevention have not changed from the previous version, the revised guideline provides clarification and more specific guidance based on a defined, systematic review of the literature through July 2007. For areas where knowledge gaps exist, recommendations for further research are listed. Finally, the revised guideline outlines high-priority recommendations for CAUTI prevention in order to offer guidance for implementation.

This document is intended for use by infection prevention staff, healthcare epidemiologists, healthcare administrators, nurses, other healthcare providers, and persons responsible for developing, implementing, and evaluating infection prevention and control programs for healthcare settings across the continuum of care. The guideline can also be used as a resource for societies or organizations that wish to develop more detailed implementation guidance for prevention of CAUTI.

Our goal was to develop a guideline based on a targeted systematic review of the best available evidence, with explicit links between the evidence and recommendations. To accomplish this, we used an adapted GRADE system approach for evaluating quality of evidence and determining strength of recommendations. The methodology, structure, and components of this guideline are approved by HICPAC and will be used for subsequent guidelines issued by HICPAC. A more detailed description of our approach is available in the [Methods](#) section.

To evaluate the evidence on preventing CAUTI, we examined data addressing three key questions and related subquestions:

1. Who should receive urinary catheters?
  - A. When is urinary catheterization necessary?
  - B. What are the risk factors for CAUTI?
  - C. What populations are at highest risk of mortality related to urinary catheters?
2. For those who may require urinary catheters, what are the best practices?
 

Specifically, what are the risks and benefits associated with:

  - A. Different approaches to catheterization?
  - B. Different catheters or collecting systems?
  - C. Different catheter management techniques?
  - D. Different systems interventions (i.e., quality improvement programs)?
3. What are the best practices for preventing CAUTI associated with obstructed urinary catheters?

Evidence addressing the key questions was used to formulate recommendations, and explicit links between the evidence and recommendations are available in the [Evidence Review](#) in the body of the guideline and [Evidence Tables](#) and [GRADE Tables](#) in the [Appendices](#). **It is important to note that Category I recommendations are all considered strong recommendations and should be equally implemented;** it is only the *quality* of the evidence underlying the recommendation that distinguishes between levels A and B. Category IC recommendations are required by state or federal regulation and may have any level of supporting evidence.

The categorization scheme used in this guideline is presented in Table 1 in the [Summary of Recommendations](#) and described further in the [Methods section](#).

The [Summary of Recommendations](#) is organized as follows: 1) recommendations for who should receive indwelling urinary catheters (or, for certain populations, alternatives to indwelling catheters); 2) recommendations for catheter insertion; 3) recommendations for catheter maintenance; 4) quality improvement programs to achieve appropriate placement, care, and removal of catheters; 5) administrative infrastructure required; and 6) surveillance strategies.

The [Implementation and Audit](#) section includes a prioritization of recommendations (i.e., high-priority recommendations that are essential for every healthcare facility), organized by modules, in order to provide facilities more guidance on implementation of these guidelines. A list of recommended performance measures that can potentially be used for internal reporting purposes is also included.

Areas in need of further research identified during the evidence review are outlined in the [Recommendations for Further Research](#). This section includes guidance for specific methodological approaches that should be used in future studies.

Readers who wish to examine the primary evidence underlying the recommendations are referred to the [Evidence Review](#) in the body of the guideline, and the [Evidence Tables](#) and [GRADE Tables](#) in the [Appendices](#). The [Evidence Review](#) includes narrative summaries of the data presented in the [Evidence Tables](#) and [GRADE Tables](#). The [Evidence Tables](#) include all study-level data used in the guideline, and the [GRADE Tables](#) assess the overall quality of evidence for each question. The [Appendices](#) also contain a clearly delineated search strategy that will be used for periodic updates to ensure that the guideline remains a timely resource as new information becomes available.



## II. Summary of Recommendations

**Table 1. Modified HICPAC Categorization Scheme\* for Recommendations**

Category IA	A strong recommendation supported by high to moderate quality† evidence suggesting net clinical benefits or harms
Category IB	A strong recommendation supported by low quality evidence suggesting net clinical benefits or harms or an accepted practice (e.g., aseptic technique) supported by low to very low quality evidence
Category IC	A strong recommendation required by state or federal regulation.
Category II	A weak recommendation supported by any quality evidence suggesting a trade off between clinical benefits and harms
No recommendation/unresolved issue	Unresolved issue for which there is low to very low quality evidence with uncertain trade offs between benefits and harms

\* Please refer to Methods (p.32) for implications of Category designations

†Please refer to Methods (p. 29-30) for process used to grade quality of evidence

### I. Appropriate Urinary Catheter Use

- A. Insert catheters only for appropriate indications (see Table 2 for guidance), and leave in place only as long as needed. **(Category IB)** (Key Questions 1B and 2C)
  1. Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI or mortality from catheterization such as women, the elderly, and patients with impaired immunity. **(Category IB)** (Key Questions 1B and 1C)
  2. Avoid use of urinary catheters in patients and nursing home residents for management of incontinence. **(Category IB)** (Key Question 1A)
    - a. Further research is needed on periodic (e.g., nighttime) use of external catheters (e.g., condom catheters) in incontinent patients or residents and the use of catheters to prevent skin breakdown. **(No recommendation/unresolved issue)** (Key Question 1A)
  3. Use urinary catheters in operative patients only as necessary, rather than routinely. **(Category IB)** (Key Question 1A)
  4. For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use. **(Category IB)** (Key Questions 2A and 2C)

<b>Table 2.</b>
<b>A. Examples of Appropriate Indications for Indwelling Urethral Catheter Use</b> <sup>1-4</sup>
Patient has acute urinary retention or bladder outlet obstruction
Need for accurate measurements of urinary output in critically ill patients
Perioperative use for selected surgical procedures: <ul style="list-style-type: none"> <li>• Patients undergoing urologic surgery or other surgery on contiguous structures of the genitourinary tract</li> <li>• Anticipated prolonged duration of surgery (catheters inserted for this reason should be removed in PACU)</li> <li>• Patients anticipated to receive large-volume infusions or diuretics during surgery</li> <li>• Need for intraoperative monitoring of urinary output</li> </ul>
To assist in healing of open sacral or perineal wounds in incontinent patients
Patient requires prolonged immobilization (e.g., potentially unstable thoracic or lumbar spine, multiple traumatic injuries such as pelvic fractures)
To improve comfort for end of life care if needed
<b>B. Examples of Inappropriate Uses of Indwelling Catheters</b>
As a substitute for nursing care of the patient or resident with incontinence
As a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void
For prolonged postoperative duration without appropriate indications (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anaesthesia, etc.)

Note: These indications are based primarily on expert consensus.

B. Consider using alternatives to indwelling urethral catheterization in selected patients when appropriate.

1. Consider using external catheters as an alternative to indwelling urethral catheters in cooperative male patients without urinary retention or bladder outlet obstruction. **(Category II)** (Key Question 2A)
2. Consider alternatives to chronic indwelling catheters, such as intermittent catheterization, in spinal cord injury patients. **(Category II)** (Key Question 1A)
3. Intermittent catheterization is preferable to indwelling urethral or suprapubic catheters in patients with bladder emptying dysfunction. **(Category II)** (Key Question 2A)
4. Consider intermittent catheterization in children with myelomeningocele and neurogenic bladder to reduce the risk of urinary tract deterioration. **(Category II)** (Key Question 1A)
5. Further research is needed on the benefit of using a urethral stent as an alternative to an indwelling catheter in selected patients with bladder outlet obstruction. **(No recommendation/unresolved issue)** (Key Question 1A)
6. Further research is needed on the risks and benefits of suprapubic catheters as an alternative to indwelling urethral catheters in selected patients requiring short- or long-term catheterization, particularly with respect to complications related to catheter insertion or the catheter site. **(No recommendation/unresolved issue)** (Key Question 2A)

## II. Proper Techniques for Urinary Catheter Insertion

- A. Perform hand hygiene immediately before and after insertion or any manipulation of the catheter device or site. **(Category IB)** (Key Question 2D)
- B. Ensure that only properly trained persons (e.g., hospital personnel, family members, or patients themselves) who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility. **(Category IB)** (Key Question 1B)
- C. In the acute care hospital setting, insert urinary catheters using aseptic technique and sterile equipment. **(Category IB)**
  - 1. Use sterile gloves, drape, sponges, an appropriate antiseptic or sterile solution for periurethral cleaning, and a single-use packet of lubricant jelly for insertion. **(Category IB)**
  - 2. Routine use of antiseptic lubricants is not necessary. **(Category II)** (Key Question 2C)
  - 3. Further research is needed on the use of antiseptic solutions vs. sterile water or saline for periurethral cleaning prior to catheter insertion. **(No recommendation/unresolved issue)** (Key Question 2C)
- D. In the non-acute care setting, clean (i.e., non-sterile) technique for intermittent catheterization is an acceptable and more practical alternative to sterile technique for patients requiring chronic intermittent catheterization. **(Category IA)** (Key Question 2A)
  - 1. Further research is needed on optimal cleaning and storage methods for catheters used for clean intermittent catheterization. **(No recommendation/unresolved issue)** (Key Question 2C)
- E. Properly secure indwelling catheters after insertion to prevent movement and urethral traction. **(Category IB)**
- F. Unless otherwise clinically indicated, consider using the smallest bore catheter possible, consistent with good drainage, to minimize bladder neck and urethral trauma. **(Category II)**
- G. If intermittent catheterization is used, perform it at regular intervals to prevent bladder overdistension. **(Category IB)** (Key Question 2A)
- H. Consider using a portable ultrasound device to assess urine volume in patients undergoing intermittent catheterization to assess urine volume and reduce unnecessary catheter insertions. **(Category II)** (Key Question 2C)
  - 1. If ultrasound bladder scanners are used, ensure that indications for use are clearly stated, nursing staff are trained in their use, and equipment is adequately cleaned and disinfected in between patients. **(Category IB)**

### III. Proper Techniques for Urinary Catheter Maintenance

- A. Following aseptic insertion of the urinary catheter, maintain a closed drainage system **(Category IB)** (Key Question 1B and 2B)
  1. If breaks in aseptic technique, disconnection, or leakage occur, replace the catheter and collecting system using aseptic technique and sterile equipment. **(Category IB)**
  2. Consider using urinary catheter systems with preconnected, sealed catheter-tubing junctions. **(Category II)** (Key Question 2B)
- B. Maintain unobstructed urine flow. **(Category IB)** (Key Questions 1B and 2D)
  1. Keep the catheter and collecting tube free from kinking. **(Category IB)**
  2. Keep the collecting bag below the level of the bladder at all times. Do not rest the bag on the floor. **(Category IB)**
  3. Empty the collecting bag regularly using a separate, clean collecting container for each patient; avoid splashing, and prevent contact of the drainage spigot with the nonsterile collecting container. **(Category IB)**
- C. Use Standard Precautions, including the use of gloves and gown as appropriate, during any manipulation of the catheter or collecting system. **(Category IB)**
- D. Complex urinary drainage systems (utilizing mechanisms for reducing bacterial entry such as antiseptic-release cartridges in the drain port) are not necessary for routine use. **(Category II)** (Key Question 2B)
- E. Changing indwelling catheters or drainage bags at routine, fixed intervals is not recommended. Rather, it is suggested to change catheters and drainage bags based on clinical indications such as infection, obstruction, or when the closed system is compromised. **(Category II)** (Key Question 2C)
- F. Unless clinical indications exist (e.g., in patients with bacteriuria upon catheter removal post urologic surgery), do not use systemic antimicrobials routinely to prevent CAUTI in patients requiring either short or long-term catheterization. **(Category IB)** (Key Question 2C)
  1. Further research is needed on the use of urinary antiseptics (e.g., methenamine) to prevent UTI in patients requiring short-term catheterization. **(No recommendation/unresolved issue)** (Key Question 2C)
- G. Do not clean the periurethral area with antiseptics to prevent CAUTI while the catheter is in place. Routine hygiene (e.g., cleansing of the meatal surface during daily bathing or showering) is appropriate. **(Category IB)** (Key Question 2C)
- H. Unless obstruction is anticipated (e.g., as might occur with bleeding after prostatic or bladder surgery) bladder irrigation is not recommended. **(Category II)** (Key Question 2C)

1. If obstruction is anticipated, closed continuous irrigation is suggested to prevent obstruction. **(Category II)**
- I. Routine irrigation of the bladder with antimicrobials is not recommended. **(Category II)** (Key Question 2C)
- J. Routine instillation of antiseptic or antimicrobial solutions into urinary drainage bags is not recommended. **(Category II)** (Key Question 2C)
- K. Clamping indwelling catheters prior to removal is not necessary. **(Category II)** (Key Question 2C)
- L. Further research is needed on the use of bacterial interference (i.e., bladder inoculation with a nonpathogenic bacterial strain) to prevent UTI in patients requiring chronic urinary catheterization. **(No recommendation/unresolved issue)** (Key Question 2C)

#### *Catheter Materials*

- M. If the CAUTI rate is not decreasing after implementing a comprehensive strategy to reduce rates of CAUTI, consider using antimicrobial/antiseptic-impregnated catheters. The comprehensive strategy should include, at a minimum, the high priority recommendations for urinary catheter use, aseptic insertion, and maintenance (see Section III. Implementation and Audit). **(Category IB)** (Key Question 2B)
  1. Further research is needed on the effect of antimicrobial/antiseptic-impregnated catheters in reducing the risk of symptomatic UTI, their inclusion among the primary interventions, and the patient populations most likely to benefit from these catheters. **(No recommendation/unresolved issue)** (Key Question 2B)
- N. Hydrophilic catheters might be preferable to standard catheters for patients requiring intermittent catheterization. **(Category II)** (Key Question 2B)
- O. Silicone might be preferable to other catheter materials to reduce the risk of encrustation in long-term catheterized patients who have frequent obstruction. **(Category II)** (Key Question 3)
- P. Further research is needed to clarify the benefit of catheter valves in reducing the risk of CAUTI and other urinary complications. **(No recommendation/unresolved issue)** (Key Question 2B)

#### *Management of Obstruction*

- Q. If obstruction occurs and it is likely that the catheter material is contributing to obstruction, change the catheter. **(Category IB)**
- R. Further research is needed on the benefit of irrigating the catheter with acidifying solutions or use of oral urease inhibitors in long-term catheterized patients who have frequent catheter obstruction. **(No recommendation/unresolved issue)** (Key Question 3)

- S. Further research is needed on the use of a portable ultrasound device to evaluate for obstruction in patients with indwelling catheters and low urine output. **(No recommendation/unresolved issue)** (Key Question 2C)
- T. Further research is needed on the use of methenamine to prevent encrustation in patients requiring chronic indwelling catheters who are at high risk for obstruction. **(No recommendation/unresolved issue)** (Key Question 2C)

#### *Specimen Collection*

- U. Obtain urine samples aseptically. **(Category IB)**
  - 1. If a small volume of fresh urine is needed for examination (i.e., urinalysis or culture), aspirate the urine from the needleless sampling port with a sterile syringe/cannula adapter after cleansing the port with a disinfectant. **(Category IB)**
  - 2. Obtain large volumes of urine for special analyses (not culture) aseptically from the drainage bag. **(Category IB)**

#### *Spatial Separation of Catheterized Patients*

- V. Further research is needed on the benefit of spatial separation of patients with urinary catheters to prevent transmission of pathogens colonizing urinary drainage systems. **(No recommendation/unresolved issue)** (Key Question 2D)

### **IV. Quality Improvement Programs**

- A. Implement quality improvement (QI) programs or strategies to enhance appropriate use of indwelling catheters and to reduce the risk of CAUTI based on a facility risk assessment. **(Category IB)** (Key Question 2D)

The purposes of QI programs should be: 1) to assure appropriate utilization of catheters 2) to identify and remove catheters that are no longer needed (e.g., daily review of their continued need) and 3) to ensure adherence to hand hygiene and proper care of catheters. Examples of programs that have been demonstrated to be effective include:

- 1. A system of alerts or reminders to identify all patients with urinary catheters and assess the need for continued catheterization
- 2. Guidelines and protocols for nurse-directed removal of unnecessary urinary catheters
- 3. Education and performance feedback regarding appropriate use, hand hygiene, and catheter care
- 4. Guidelines and algorithms for appropriate peri-operative catheter management, such as:

- a. Procedure-specific guidelines for catheter placement and postoperative catheter removal
- b. Protocols for management of postoperative urinary retention, such as nurse-directed use of intermittent catheterization and use of bladder ultrasound scanners

## V. Administrative Infrastructure

### A. Provision of guidelines

- 1. Provide and implement evidence-based guidelines that address catheter use, insertion, and maintenance. **(Category IB)**
  - a. Consider monitoring adherence to facility-based criteria for acceptable indications for indwelling urinary catheter use. **(Category II)**

### B. Education and Training

- 1. Ensure that healthcare personnel and others who take care of catheters are given periodic in-service training regarding techniques and procedures for urinary catheter insertion, maintenance, and removal. Provide education about CAUTI, other complications of urinary catheterization, and alternatives to indwelling catheters. **(Category IB)**
- 2. When feasible, consider providing performance feedback to these personnel on what proportion of catheters they have placed meet facility-based criteria and other aspects related to catheter care and maintenance. **(Category II)**

### C. Supplies

- 1. Ensure that supplies necessary for aseptic technique for catheter insertion are readily available. **(Category IB)**

### D. System of documentation

- 1. Consider implementing a system for documenting the following in the patient record: indications for catheter insertion, date and time of catheter insertion, individual who inserted catheter, and date and time of catheter removal. **(Category II)**
  - a. Ensuring that documentation is accessible in the patient record and recorded in a standard format for data collection and quality improvement purposes is suggested. Electronic documentation that is searchable is preferable. **(Category II)**

### E. Surveillance resources

- 1. If surveillance for CAUTI is performed, ensure that there are sufficient trained personnel and technology resources to support surveillance for urinary catheter use and outcomes. **(Category IB)**

## VI. Surveillance

- A. Consider surveillance for CAUTI when indicated by facility-based risk assessment. **(Category II)**
  1. Identify the patient groups or units on which to conduct surveillance based on frequency of catheter use and potential risk of CAUTI.
- B. Use standardized methodology for performing CAUTI surveillance. **(Category IB)**
  1. Examples of metrics that should be used for CAUTI surveillance include:
    - a. Number of CAUTI per 1000 catheter-days
    - b. Number of bloodstream infections secondary to CAUTI per 1000 catheter-days
    - c. Catheter utilization ratio: (urinary catheter days/patient days) x 100
  2. Use CDC/NHSN criteria for identifying patients who have symptomatic UTI (SUTI) (numerator data) (see NHSN Patient Safety Manual: <http://www.cdc.gov/nhsn/library.html>).
  3. For more information on metrics, please see the U.S. Department of Health & Human Services (HHS) Action Plan to Prevent Healthcare-Associated Infections: <http://www.hhs.gov/ophs/initiatives/hai/infection.html>.
- C. Routine screening of catheterized patients for asymptomatic bacteriuria (ASB) is not recommended. **(Category II)** (Key Question 2D)
- D. When performing surveillance for CAUTI, consider providing regular (e.g., quarterly) feedback of unit-specific CAUTI rates to nursing staff and other appropriate clinical care staff. **(Category II)** (Key Question 2D)



### **III. Implementation and Audit**

#### **Prioritization of Recommendations**

In this section, the recommendations considered essential for *all* healthcare facilities caring for patients requiring urinary catheterization are organized into modules in order to provide more guidance to facilities on implementation of these guidelines. The high-priority recommendations were chosen by a consensus of experts based on strength of recommendation as well as on the likely impact of the strategy in preventing CAUTI. The administrative functions and infrastructure listed above in the summary of recommendations are necessary to accomplish the high priority recommendations and are therefore critical to the success of a prevention program. In addition, quality improvement programs should be implemented as an active approach to accomplishing these recommendations and when process and outcome measure goals are not being met based on internal reporting.

#### **Priority Recommendations for Appropriate Urinary Catheter Use (Module 1)**

- Insert catheters only for appropriate indications (see Table 2), and leave in place only as long as needed. **(Category IB)**
  - Avoid use of urinary catheters in patients and nursing home residents for management of incontinence. **(Category IB)**
  - For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use. **(Category IB)**

#### **Priority Recommendations for Aseptic Insertion of Urinary Catheters (Module 2)**

- Ensure that only properly trained persons (e.g., hospital personnel, family members, or patients themselves) who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility. **(Category IB)**
- In the acute care hospital setting, insert catheters using aseptic technique and sterile equipment. **(Category IB)**

#### **Priority Recommendations for Proper Urinary Catheter Maintenance (Module 3)**

- Following aseptic insertion of the urinary catheter, maintain a closed drainage system **(Category IB)**
- Maintain unobstructed urine flow. **(Category IB)**

#### **Performance Measures**

- A. Internal Reporting. Consider reporting both process and outcome measures to senior administrative, medical, and nursing leadership and clinicians who care for patients at risk for CAUTI. **(Category II)**
  1. Examples of process measures:
    - a) Compliance with educational program: Calculate percent of personnel who have proper training:
      - Numerator: number of personnel who insert urinary catheters and who have proper training
      - Denominator: number of personnel who insert urinary catheters
      - Standardization factor: 100 (i.e., multiply by 100 so that measure is expressed as a percentage)

- b) Compliance with documentation of catheter insertion and removal dates: Conduct random audits of selected units and calculate compliance rate:
      - Numerator: number of patients on unit with catheters with proper documentation of insertion and removal dates
      - Denominator: number of patients on the unit with a catheter in place at some point during admission
      - Standardization factor: 100 (i.e., multiply by 100 so that measure is expressed as a percentage)
    - c) Compliance with documentation of indication for catheter placement: Conduct random audits of selected units and calculate compliance rate
      - Numerator: number of patients on unit with catheters with proper documentation of indication
      - Denominator: number of patients on the unit with catheter in place
      - Standardization factor: 100 (i.e., multiply by 100 so that measure is expressed as a percentage)
  - 2. Recommended outcome measures:
    - a) Rates of CAUTI: Use NHSN definitions (see <http://www.cdc.gov/nhsn/library.html>). Measurement of rates allows an individual facility to gauge the longitudinal impact of implementation of prevention strategies:
      - Numerator: number of CAUTIs in each location monitored
      - Denominator: total number of urinary catheter-days for all patients that have an indwelling urinary catheter in each location monitored
      - Standardization factor: Multiply by 1000 so that the measure is expressed as cases per 1000 catheter-days
    - b) Rate of bloodstream infections secondary to CAUTI: Use NHSN definitions for laboratory-confirmed bloodstream infection, available at <http://www.cdc.gov/nhsn/library.html>.
      - Numerator: number of episodes of bloodstream infections secondary to CAUTI
      - Denominator: total number of urinary catheter-days for all patients that have an indwelling urinary catheter in each location monitored
      - Standardization factor: Multiply by 1000 so that the measure is expressed as cases per 1000 catheter-days
- B. External Reporting. Current NHSN definitions for CAUTI were developed for monitoring of rates within a facility; however, reporting of CAUTI rates for facility-to-facility comparison might be requested by state requirements and external quality initiatives.

#### **IV. Recommendations for Further Research**

Our literature review revealed that many of the studies addressing strategies to prevent CAUTI were not of sufficient quality to allow firm conclusions regarding the benefit of certain interventions. Future studies of CAUTI prevention should:

- 1) Be primary analytic research (i.e. systematic reviews, meta-analyses, interventional studies, and observational studies [cohort, case-control, analytic cross-sectional studies])
- 2) Evaluate clinically relevant outcomes (e.g., SUTI, bloodstream infections secondary to CAUTI)
- 3) Adjust for confounders as needed using multivariable analyses
- 4) Stratify outcomes by patient populations at risk for CAUTI
- 5) Ensure adequate statistical power to detect differences

The following is a compilation of recommendations for further research:

1. Catheter materials
  - a. Antimicrobial and antiseptic-impregnated catheters
    - i. Effect of catheters on reducing the risk of SUTI and other clinically significant outcomes
    - ii. Patient populations most likely to benefit
    - iii. Incidence of antimicrobial resistance in urinary pathogens
    - iv. Role of bacterial biofilms in the pathogenesis of CAUTI
  - b. Standard catheters
    - i. Optimal materials for reducing the risk of CAUTI and other urethral complications
2. Appropriate urinary catheter use
  - a. Incontinent patients
    - i. Risks and benefits of periodic (e.g., nighttime) use of external catheters
    - ii. Risk of local complications (e.g., skin maceration, phimosis) with the use of external catheters
    - iii. Appropriate use of urinary catheters to manage sacral or perineal wounds
  - b. Appropriate indications for continued use in postoperative patients and associated risks
3. Antiseptics
  - a. Use of antiseptic vs. sterile solutions for periurethral cleaning prior to catheter insertion
  - b. Use of antiseptics (e.g., methenamine) to prevent CAUTI
4. Alternatives to indwelling urethral catheters and bag drainage
  - a. Risks and benefits of suprapubic catheters as an alternative to chronic indwelling urethral catheters
  - b. Use of a urethral stent as an alternative to an indwelling catheter in selected patients with bladder outlet obstruction
  - c. Use of catheter valves in reducing the risk of CAUTI and other urinary complications
  - d. Other alternative methods of urinary drainage

5. Optimal methods for preventing encrustation in long-term catheterized patients who have frequent obstruction
  - a. Optimal catheter materials
  - b. Irrigation with acidifying solutions or oral urease inhibitors
  - c. Use of methenamine
6. Other prevention measures
  - a. Use of portable ultrasound in patients with low-urine output to reduce unnecessary catheter insertions or irrigations (in catheterized patients)
  - b. Use of new prevention strategies such as bacterial interference in patients requiring chronic catheterization
  - c. Optimal cleaning and storage procedures (e.g., wet vs. dry storage) for catheters used for clean intermittent catheterization
7. Prevention of transmission
  - a. Spatial separation of patients with urinary catheters (in the absence of epidemic spread or frequent cross-infection) to prevent transmission of pathogens colonizing urinary drainage systems

## **V. Background**

Urinary tract infections are the most common type of healthcare-associated infection, accounting for more than 30% of infections reported by acute care hospitals.<sup>19</sup> Virtually all healthcare-associated UTIs are caused by instrumentation of the urinary tract. Catheter-associated urinary tract infection (CAUTI) has been associated with increased morbidity, mortality, hospital cost, and length of stay.<sup>6-9</sup> In addition, bacteriuria commonly leads to unnecessary antimicrobial use, and urinary drainage systems are often reservoirs for multidrug-resistant bacteria and a source of transmission to other patients.<sup>10,11</sup>

### **Definitions**

An indwelling urinary catheter is a drainage tube that is inserted into the urinary bladder through the urethra, is left in place, and is connected to a closed collection system. Alternative methods of urinary drainage may be employed in some patients. Intermittent (“in-and-out”) catheterization involves brief insertion of a catheter into the bladder through the urethra to drain urine at intervals. An external catheter is a urine containment device that fits over or adheres to the genitalia and is attached to a urinary drainage bag. The most commonly used external catheter is a soft flexible sheath that fits over the penis (“condom” catheter). A suprapubic catheter is surgically inserted into the bladder through an incision above the pubis.

Although UTIs associated with alternative urinary drainage systems are considered device-associated, CAUTI rates reported to the National Healthcare Safety Network (NHSN) only refer to those associated with indwelling urinary catheters. NHSN has recently revised the UTI surveillance definition criteria. Among the changes are removal of the asymptomatic bacteriuria (ASB) criterion and refinement of the criteria for defining symptomatic UTI (SUTI). The time period for follow-up surveillance after catheter removal also has been shortened from 7 days to 48 hours to align with other device-associated infections. The new UTI criteria, which took effect in January 2009, can be found in the NHSN Patient Safety Manual (<http://www.cdc.gov/nhsn/library.html>).

The limitations and heterogeneity of definitions of CAUTI used in various studies present major challenges in appraising the quality of evidence in the CAUTI literature. Study investigators have used numerous different definitions for CAUTI outcomes, ranging from simple bacteriuria at a range of concentrations to, less commonly, symptomatic infection defined by combinations of bacteriuria and various signs and symptoms. Furthermore, most studies that used CDC/NHSN definitions for CAUTI did not distinguish between SUTI and ASB in their analyses.<sup>30</sup> The heterogeneity of definitions used for CAUTI may reduce the quality of evidence for a given intervention and often precludes meta-analyses.

The clinical significance of ASB in catheterized patients is undefined. Approximately 75% to 90% of patients with ASB do not develop a systemic inflammatory response or other signs or symptoms to suggest infection.<sup>6,31</sup> Monitoring and treatment of ASB is also not an effective prevention measure for SUTI, as most cases of SUTI are not preceded by bacteriuria for more than a day.<sup>25</sup> Treatment of ASB has not been shown to be clinically beneficial and is associated with the selection of antimicrobial-resistant organisms.

## Epidemiology

Between 15% and 25% of hospitalized patients may receive short-term indwelling urinary catheters.<sup>12,13</sup> In many cases, catheters are placed for inappropriate indications, and healthcare providers are often unaware that their patients have catheters, leading to prolonged, unnecessary use.<sup>14-16</sup> In acute care hospitals reporting to NHSN in 2006, pooled mean urinary catheter utilization ratios in ICU and non-ICU areas ranged from 0.23-0.91 urinary catheter-days/patient-days.<sup>17</sup> While the numbers of units reporting were small, the highest ratios were in trauma ICUs and the lowest in inpatient medical/surgical wards. The overall prevalence of long-term indwelling urethral catheterization use is unknown. The prevalence of urinary catheter use in residents in long-term care facilities in the United States is on the order of 5%, representing approximately 50,000 residents with catheters at any given time.<sup>18</sup> This number appears to be declining over time, likely because of federally mandated nursing home quality measures. However, the high prevalence of urinary catheters in patients transferred to skilled nursing facilities suggests that acute care hospitals should focus more efforts on removing unnecessary catheters prior to transfer.<sup>18</sup>

Reported rates of UTI among patients with urinary catheters vary substantially. National data from NHSN acute care hospitals in 2006 showed a range of pooled mean CAUTI rates of 3.1-7.5 infections per 1000 catheter-days.<sup>17</sup> The highest rates were in burn ICUs, followed by inpatient medical wards and neurosurgical ICUs, although these sites also had the fewest numbers of locations reporting. The lowest rates were in medical/surgical ICUs.

Although morbidity and mortality from CAUTI is considered to be relatively low compared to other HAIs, the high prevalence of urinary catheter use leads to a large cumulative burden of infections with resulting infectious complications and deaths. An estimate of annual incidence of HAIs and mortality in 2002, based on a broad survey of US hospitals, found that urinary tract infections made up the highest number of infections (> 560,000) compared to other HAIs, and attributable deaths from UTI were estimated to be over 13,000 (mortality rate 2.3%).<sup>19</sup> And while fewer than 5% of bacteriuric cases develop bacteremia,<sup>6</sup> CAUTI is the leading cause of secondary nosocomial bloodstream infections; about 17% of hospital-acquired bacteremias are from a urinary source, with an associated mortality of approximately 10%.<sup>20</sup> In the nursing home setting, bacteremias are most commonly caused by UTIs, the majority of which are catheter-related.<sup>21</sup>

An estimated 17% to 69% of CAUTI may be preventable with recommended infection control measures, which means that up to 380,000 infections and 9000 deaths related to CAUTI per year could be prevented.<sup>22</sup>

## Pathogenesis and Microbiology

The source of microorganisms causing CAUTI can be endogenous, typically via meatal, rectal, or vaginal colonization, or exogenous, such as via contaminated hands of healthcare personnel or equipment. Microbial pathogens can enter the urinary tract either by the extraluminal route, via migration along the outside of the catheter in the periurethral mucous sheath, or by the intraluminal route, via movement along the internal lumen of the catheter from a contaminated collection bag or catheter-drainage tube junction. The relative contribution of each route in the pathogenesis of CAUTI is not well known. The marked reduction in risk of bacteriuria with the introduction of the sterile, closed urinary drainage system in the 1960's<sup>23</sup> suggests the importance of the intraluminal route. However, even with the closed drainage system,

bacteriuria inevitably occurs over time either via breaks in the sterile system or via the extraluminal route.<sup>24</sup> The daily risk of bacteriuria with catheterization is 3% to 10%,<sup>25,26</sup> approaching 100% after 30 days, which is considered the delineation between short and long-term catheterization.<sup>27</sup>

Formation of biofilms by urinary pathogens on the surface of the catheter and drainage system occurs universally with prolonged duration of catheterization.<sup>28</sup> Over time, the urinary catheter becomes colonized with microorganisms living in a sessile state within the biofilm, rendering them resistant to antimicrobials and host defenses and virtually impossible to eradicate without removing the catheter. The role of bacteria within biofilms in the pathogenesis of CAUTI is unknown and is an area requiring further research.

The most frequent pathogens associated with CAUTI (combining both ASB and SUTI) in hospitals reporting to NHSN between 2006-2007 were *Escherichia coli* (21.4%) and *Candida* spp (21.0%), followed by *Enterococcus* spp (14.9%), *Pseudomonas aeruginosa* (10.0%), *Klebsiella pneumoniae* (7.7%), and *Enterobacter* spp (4.1%). A smaller proportion was caused by other gram-negative bacteria and *Staphylococcus* spp.<sup>5</sup>

Antimicrobial resistance among urinary pathogens is an ever increasing problem. About a quarter of *E. coli* isolates and one third of *P. aeruginosa* isolates from CAUTI cases were fluoroquinolone-resistant. Resistance of gram-negative pathogens to other agents, including third-generation cephalosporins and carbapenems, was also substantial.<sup>5</sup> The proportion of organisms that were multidrug-resistant, defined by non-susceptibility to all agents in 4 classes, was 4% of *P. aeruginosa*, 9% of *K. pneumoniae*, and 21% of *Acinetobacter baumannii*.<sup>29</sup>

## **VI. Scope and Purpose**

This guideline updates and expands the original CDC Guideline for Prevention of CAUTI published in 1981. The revised guideline addresses the prevention of CAUTI for patients in need of either short- or long-term (i.e., > 30 days) urinary catheterization in any type of healthcare facility and evaluates evidence for alternative methods of urinary drainage, including intermittent catheterization, external catheters, and suprapubic catheters. The guideline also includes specific recommendations for implementation, performance measurement, and surveillance. Recommendations for further research are also provided to address the knowledge gaps in CAUTI prevention identified during the literature review.

To evaluate the evidence on preventing CAUTI, we examined data addressing three key questions and related subquestions:

1. Who should receive urinary catheters?
  - A. When is urinary catheterization necessary?
  - B. What are the risk factors for CAUTI?
  - C. What populations are at highest risk of mortality from catheters?
2. For those who may require urinary catheters, what are the best practices? Specifically, what are the risks and benefits associated with:
  - A. Different approaches to catheterization?
  - B. Different catheters or collecting systems?
  - C. Different catheter management techniques?
  - D. Different systems interventions (i.e., quality improvement programs)?
3. What are the best practices for preventing UTI associated with obstructed urinary catheters?

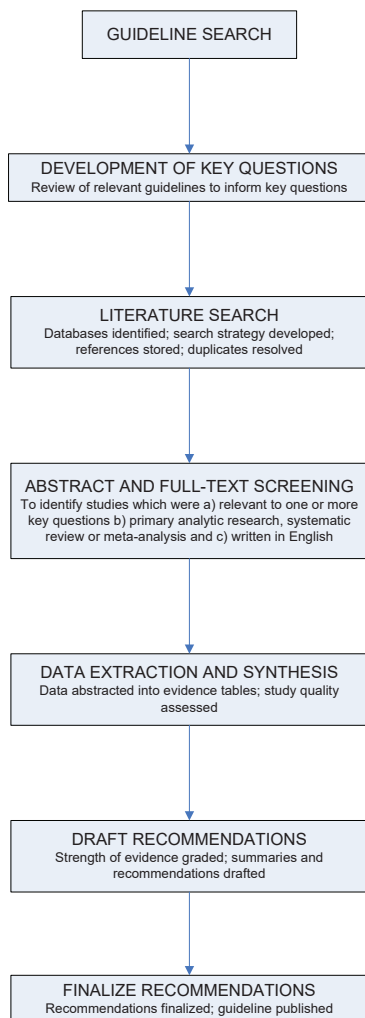
This document is intended for use by infection prevention staff, healthcare epidemiologists, healthcare administrators, nurses, other healthcare providers, and persons responsible for developing, implementing, and evaluating infection prevention and control programs for healthcare settings across the continuum of care. The guideline can also be used as a resource for societies or organizations that wish to develop more detailed implementation guidance for prevention of CAUTI.



## VII. Methods

This guideline was based on a targeted systematic review of the best available evidence on CAUTI prevention. We used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach<sup>32-34</sup> to provide explicit links between the available evidence and the resulting recommendations. Our guideline development process is outlined in *Figure 1*.

**Figure 1. The Guideline Development Process**



## Development of Key Questions

We first conducted an electronic search of the National Guideline Clearinghouse® (Agency for Healthcare Research and Quality), Medline® (National Library of Medicine) using the Ovid® Platform (Ovid Technologies, Wolters Kluwer, New York, NY), the Cochrane® Health Technology Assessment Database (Cochrane Collaboration, Oxford, UK), the NIH Consensus Development Program, and the United States Preventive Services Task Force database for existing national and international guidelines relevant to CAUTI. The strategy used for the guideline search and the search results can be found in [Appendix 1A](#). A preliminary list of key questions was developed from a review of the relevant guidelines identified in the search.<sup>1,35,36</sup> Key questions were finalized after vetting them with a panel of content experts and HICPAC members.

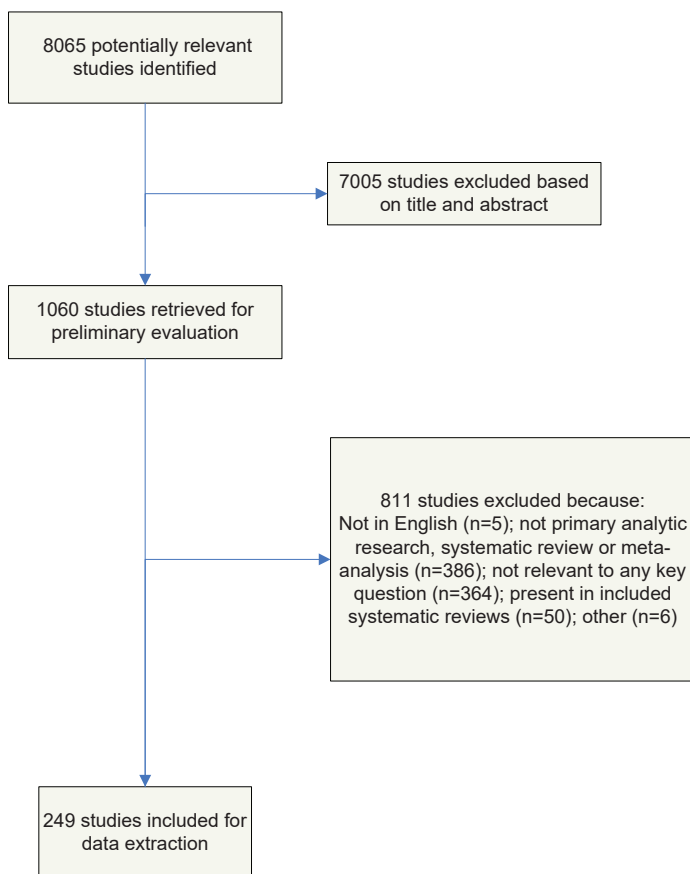
## Literature Search

Following the development of the key questions, search terms were developed for identifying literature relevant to the key questions. For the purposes of quality assurance, we compared these terms to those used in relevant seminal studies and guidelines. These search terms were then incorporated into search strategies for the relevant electronic databases. Searches were performed in Medline® (National Library of Medicine) using the Ovid® Platform (Ovid Technologies, Wolters Kluwer, New York, NY), EMBASE® (Elsevier BV, Amsterdam, Netherlands), CINAHL® (Ebsco Publishing, Ipswich, MA) and Cochrane® (Cochrane Collaboration, Oxford, UK) (all databases were searched in July 2007), and the resulting references were imported into a reference manager, where duplicates were resolved. For Cochrane reviews ultimately included in our guideline, we checked for updates in July 2008. The detailed search strategy used for identifying primary literature and the results of the search can be found in [Appendix 1B](#).

## Study Selection

Titles and abstracts from references were screened by a single author (C.V.G, R.K.A., or D.A.P.) and the full text articles were retrieved if they were 1) relevant to one or more key questions, 2) primary analytic research, systematic reviews or meta-analyses, and 3) written in English. Likewise, the full-text articles were screened by a single author (C.V.G. or D.A.P.) using the same criteria, and included studies underwent a second review for inclusion by another author (R.K.A.). Disagreements were resolved by the remaining authors. The results of this process are depicted in *Figure 2*.

**Figure 2: Results of the Study Selection Process**



## Data Extraction and Synthesis

Data on the study author, year, design, objective, population, setting, sample size, power, follow-up, and definitions and results of clinically relevant outcomes were extracted into evidence tables ([Appendix 2](#)). Three evidence tables were developed, each of which represented one of our key questions. Studies were extracted into the most relevant evidence table. Then, studies were organized by the common themes that emerged within each evidence table. Data were extracted by one author (R.K.A.) and cross-checked by another (C.V.G.). Disagreements were resolved by the remaining authors. Data and analyses were extracted as originally presented in the included studies. Meta-analyses were performed only where their use was deemed critical to a recommendation, and only in circumstances where multiple studies with sufficiently homogenous populations, interventions, and outcomes could be analyzed. Systematic reviews were included in our review. To avoid duplication of data, we excluded primary studies if they were also included in a systematic review captured by our search. The only exception to this was if the primary study also addressed a relevant question that was outside the scope of the included systematic review. Before exclusion, data from the primary studies that we originally captured were abstracted into the evidence tables and reviewed. We also excluded systematic reviews that analyzed primary studies that were fully captured in a more recent systematic review. The only exception to this was if the older systematic review also addressed a relevant question that was outside the scope of the newer systematic review. To ensure that all relevant studies were captured in the search, the bibliography was vetted by a panel of clinical experts.

## Grading of Evidence

First, the quality of each study was assessed using scales adapted from existing methodology checklists, and scores were recorded in the evidence tables. [Appendix 3](#) includes the sets of questions we used to assess the quality of each of the major study designs. Next, the quality of the evidence base was assessed using methods adapted from the GRADE Working Group.<sup>32</sup> Briefly, GRADE tables were developed for each of the interventions or questions addressed within the evidence tables. Included in the GRADE tables were the intervention of interest, any outcomes listed in the evidence tables that were judged to be clinically important, the quantity and type of evidence for each outcome, the relevant findings, and the GRADE of evidence for each outcome, as well as an overall GRADE of the evidence base for the given intervention or question. The initial GRADE of evidence for each outcome was deemed high if the evidence base included a randomized controlled trial (RCT) or a systematic review of RCTs, low if the evidence base included only observational studies, or very low if the evidence base consisted only of uncontrolled studies. The initial GRADE could then be modified by eight criteria.<sup>34</sup> Criteria which could decrease the GRADE of an evidence base included quality, consistency, directness, precision, and publication bias. Criteria that could increase the GRADE included a large magnitude of effect, a dose-response gradient, or inclusion of unmeasured confounders that would increase the magnitude of effect ([Table 3](#)). GRADE definitions are as follows:

1. High - further research is very unlikely to change confidence in the estimate of effect
2. Moderate - further research is likely to affect confidence in the estimate of effect and may change the estimate
3. Low - further research is very likely to affect confidence in the estimate of effect and is likely to change the estimate
4. Very low - any estimate of effect is very uncertain

After determining the GRADE of the evidence base for each outcome of a given intervention or question, we calculated the overall GRADE of the evidence base for that intervention or question. The overall GRADE was based on the lowest GRADE for the outcomes deemed critical to making a recommendation.

**Table 3. Rating the Quality of Evidence Using the GRADE Approach**

Type of Evidence	Initial Grade	Criteria to Decrease Grade	Criteria to Increase Grade	Overall Quality Grade
RCT	High	<u>Quality</u> Serious (-1 grade) or very serious (-2 grades) limitation to study quality	<u>Strong association</u> Strong (+1 grade) or very strong evidence of association (+2 grades)	High Moderate
Observational study	Low	<u>Consistency</u> Important inconsistency (-1 grade)	<u>Dose-response</u> Evidence of a dose-response gradient (+1 grade)	Low
Any other evidence (e.g., expert opinion)	Very low	<u>Directness</u> Some (-1 grade) or major (-2 grades) uncertainty about directness  <u>Precision</u> Imprecise or sparse data (-1 grade)  <u>Publication bias</u> High risk of bias (-1 grade)	<u>Unmeasured Confounders</u> Inclusion of unmeasured confounders increases the magnitude of effect (+1 grade)	Very low

## Formulating Recommendations

Narrative evidence summaries were then drafted by the working group using the evidence and GRADE tables. One summary was written for each theme that emerged under each key question. The working group then used the narrative evidence summaries to develop guideline recommendations. Factors determining the strength of a recommendation included 1) the values and preferences used to determine which outcomes were "critical," 2) the harms and benefits that result from weighing the "critical" outcomes, and 3) the overall GRADE of the evidence base for the given intervention or question (Table 4).<sup>33</sup> If weighing the "critical outcomes" for a given intervention or question resulted in a "net benefit" or a "net harm," then a "Category I Recommendation" was formulated to strongly recommend for or against the given intervention respectively. If weighing the "critical outcomes" for a given intervention or question resulted in a "trade off" between benefits and harms, then a "Category II Recommendation" was formulated to recommend that providers or institutions consider the intervention when deemed appropriate. If weighing the "critical outcomes" for a given intervention or question resulted in

an "uncertain trade off" between benefits and harms, then a "No Recommendation" was formulated to reflect this uncertainty.

<b>Table 4. Formulating Recommendations</b>		
<b>HICPAC Recommendation</b>	<b>Weighing Benefits and Harms for Critical Outcomes</b>	<b>Quality of Evidence</b>
STRONG (I)	Interventions with net benefits or net harms	IA – High to Moderate IB – Low or Very Low (Accepted Practice) IC – High to Very Low (Regulatory)
WEAK (II)	Interventions with trade offs between benefits and harms	High to Very Low
No recommendation/unresolved issue	Uncertain trade offs between benefits and harms	Low to Very Low

For Category I recommendations, levels A and B represent the quality of the evidence underlying the recommendation, with A representing high to moderate quality evidence and B representing low quality evidence or, in the case of an established standard (e.g., aseptic technique, education and training), very low quality to no evidence based on our literature review. For IB recommendations, although there may be low to very low quality or even no available evidence directly supporting the benefits of the intervention, the theoretical benefits are clear, and the theoretical risks are marginal. Level C represents practices required by state or federal regulation, regardless of the quality of evidence. It is important to note that the strength of a Category IA recommendation is equivalent to that of a Category IB or IC recommendation; it is only the quality of the evidence underlying the IA recommendation that makes it different from a IB.

In some instances, multiple recommendations emerged from a single narrative evidence summary. The new HICPAC categorization scheme for recommendations is provided in [Table 1](#), which is reproduced below.

<b>Table 1. Modified HICPAC Categorization Scheme for Recommendations</b>	
Category IA	A strong recommendation supported by high to moderate quality evidence suggesting net clinical benefits or harms
Category IB	A strong recommendation supported by low quality evidence suggesting net clinical benefits or harms or an accepted practice (e.g., aseptic technique) supported by low to very low quality evidence
Category IC	A strong recommendation required by state or federal regulation.
Category II	A weak recommendation supported by any quality evidence suggesting a trade off between clinical benefits and harms
No recommendation/unresolved issue	Unresolved issue for which there is low to very low quality evidence with uncertain trade offs between benefits and harms

Category I recommendations are defined as strong recommendations with the following implications:

1. For patients: Most people in the patient's situation would want the recommended course of action and only a small proportion would not; request discussion if the intervention is not offered.
2. For clinicians: Most patients should receive the recommended course of action.
3. For policymakers: The recommendation may be adopted as a policy.

Category II recommendations are defined as weak recommendations with the following implications:

1. For patients: Most people in the patient's situation would want the recommended course of action, but many would not.
2. For clinicians: Different choices will be appropriate for different patients, and clinicians must help each patient to arrive at a management decision consistent with her or his values and preferences.
3. For policymakers: Policy making will require substantial debate and involvement of many stakeholders.

It should be noted that Category II recommendations are discretionary for the individual institution and are not intended to be enforced.

The wording of each recommendation was carefully selected to reflect the recommendation's strength. In most cases, we used the active voice when writing Category I recommendations - the strong recommendations. Phrases like "do" or "do not" and verbs without auxiliaries or conditionals were used to convey certainty. We used a more passive voice when writing Category II recommendations - the weak recommendations. Words like "consider" and phrases like "is preferable," "is suggested," "is not suggested," or "is not recommended" were chosen to reflect the lesser certainty of the Category II recommendations. Rather than a simple statement of fact, each recommendation is actionable, describing precisely a proposed action to take.

The category "No recommendation/unresolved issue" was most commonly applied to situations where either 1) the overall quality of the evidence base for a given intervention was low to very low and there was no consensus on the benefit of the intervention or 2) there was no published evidence on outcomes deemed critical to weighing the risks and benefits of a given intervention. If the latter was the case, those critical outcomes will be noted at the end of the relevant evidence summary.

Our evidence-based recommendations were cross-checked with those from guidelines identified in our original systematic search. Recommendations from previous guidelines for topics not directly addressed by our systematic review of the evidence were included in our "Summary of Recommendations" if they were deemed critical to the target users of this guideline. Unlike recommendations informed by our literature search, these recommendations are not linked to a key question. These recommendations were agreed upon by expert consensus and are designated either IB if they represent a strong recommendation based on accepted practices (e.g., aseptic technique) or II if they are a suggestion based on a probable net benefit despite limited evidence.

All recommendations were approved by HICPAC. Recommendations focused only on efficacy, effectiveness, and safety. The optimal use of these guidelines should include a consideration of the costs relevant to the local setting of guideline users.

## **Reviewing and Finalizing the Guideline**

After a draft of the tables, narrative summaries, and recommendations was completed, the working group shared the draft with the expert panel for in-depth review. While the expert panel was reviewing this draft, the working group completed the remaining sections of the guideline, including the executive summary, background, scope and purpose, methods, summary of recommendations, and recommendations for guideline implementation, audit, and further research. The working group then made revisions to the draft based on feedback from members of the expert panel and presented the entire draft guideline to HICPAC for review. The guideline was then posted on the Federal Register for public comment. After a period of public comment, the guideline was revised accordingly, and the changes were reviewed and voted on by HICPAC. The final guideline was cleared internally by CDC and published and posted on the HICPAC website.

### **Updating the Guideline**

Future revisions to this guideline will be dictated by new research and technological advancements for preventing CAUTI and will occur at the request of HICPAC.



## **VIII. Evidence Review**

### **Q1. Who should receive urinary catheters?**

To answer this question, we focused on three subquestions: A) When is urinary catheterization necessary? B) What are the risk factors for CAUTI? and C) What populations are at highest risk of mortality from urinary catheters?

#### ***Q1A. When is urinary catheterization necessary?***

The available data examined five main populations. In all populations, we considered CAUTI outcomes as well as other outcomes we deemed critical to weighing the risks and benefits of catheterization. The evidence for this question consists of 1 systematic review,<sup>37</sup> 9 RCTs,<sup>38-46</sup> and 12 observational studies.<sup>47-58</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 1A.

For *operative patients*, low-quality evidence suggested a benefit of avoiding urinary catheterization.<sup>37-44,47-49</sup> This was based on a decreased risk of bacteriuria/unspecified UTI, no effect on bladder injury, and increased risk of urinary retention in patients without catheters. Urinary retention in patients without catheters was specifically seen following urogenital surgeries. The most common surgeries studied were urogenital, gynecological, laparoscopic, and orthopedic surgeries. Our search did not reveal data on the impact of catheterization on peri-operative hemodynamic management.

For *incontinent patients*, low-quality evidence suggested a benefit of avoiding urinary catheterization.<sup>45,50-52</sup> This was based on a decreased risk of both SUTI and bacteriuria/unspecified UTI in male nursing home residents without urinary catheters compared to those with continuous condom catheters. We found no difference in the risk of UTI between having a condom catheter only at night and having no catheter. Our search did not reveal data on the impact of catheterization on skin breakdown.

For *patients with bladder outlet obstruction*, very low-quality evidence suggested a benefit of a urethral stent over an indwelling catheter.<sup>53</sup> This was based on a reduced risk of bacteriuria in those receiving a urethral stent. Our search did not reveal data on the impact of catheterization versus stent placement on urinary complications.

For *patients with spinal cord injury*, very low-quality evidence suggested a benefit of avoiding indwelling urinary catheters.<sup>54,56</sup> This was based on a decreased risk of SUTI and bacteriuria in those without indwelling catheters (including patients managed with spontaneous voiding, clean intermittent catheterization [CIC], and external striated sphincterotomy with condom catheter drainage), as well as a lower risk of urinary complications, including hematuria, stones, and urethral injury (fistula, erosion, stricture).

For *children with myelomeningocele and neurogenic bladder*, very low-quality evidence suggested a benefit of CIC compared to urinary diversion or self voiding.<sup>46,57,58</sup> This was based on a decreased risk of bacteriuria/unspecified UTI in patients receiving CIC compared to urinary diversion, and a lower risk of urinary tract deterioration (defined by febrile urinary tract infection, vesicoureteral reflux, hydronephrosis, or increases in BUN or serum creatinine) compared to self-voiding and in those receiving CIC early (< 1 year of age) versus late (> 3 years of age).

Evidence Review Table 1A. When is urinary catheterization necessary?
1A.1. Use urinary catheters in operative patients only as necessary, rather than routinely. <b>(Category IB)</b>
1A.2. Avoid use of urinary catheters in patients and nursing home residents for management of incontinence. <b>(Category IB)</b>
1A.2.a. Further research is needed on periodic (e.g., nighttime) use of external catheters in incontinent patients or residents and the use of catheters to prevent skin breakdown. <b>(No recommendation/unresolved issue)</b>
1A.3. Further research is needed on the benefit of using a urethral stent as an alternative to an indwelling catheter in selected patients with bladder outlet obstruction. <b>(No recommendation/unresolved issue)</b>
1A.4. Consider alternatives to chronic indwelling catheters, such as intermittent catheterization, in spinal cord injury patients. <b>(Category II)</b>
1A.5. Consider intermittent catheterization in children with myelomeningocele and neurogenic bladder to reduce the risk of urinary tract deterioration. <b>(Category II)</b>

**Q1B. What are the risk factors for CAUTI?**

To answer this question, we reviewed the quality of evidence for those risk factors examined in more than one study. We considered the critical outcomes for decision-making to be SUTI and bacteriuria. The evidence for this question consists of 11 RCTs<sup>59-69</sup> and 37 observational studies.<sup>9,50,54,70-103</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 1B.

For *SUTI*,<sup>50,54,61,62,74,75,79,83,102,103</sup> low-quality evidence suggested that female sex, older age, prolonged catheterization, impaired immunity, and lack of antimicrobial exposure are risk factors. Very low quality evidence suggested that catheter blockage and low albumin level are also risk factors. For *bacteriuria*,<sup>9,59-61,63-68,72,73,76-78,82,84-86,89-94,96-100</sup> multiple risk factors were identified; there was high quality evidence for prolonged catheterization and moderate quality evidence for female sex, positive meatal cultures, and lack of antimicrobial exposure. Low-quality evidence also implicated the following risk factors for bacteriuria: older age, disconnection of the drainage system, diabetes, renal dysfunction, higher severity of illness, impaired immunity, placement of the catheter outside of the operating room, lower professional training of the person inserting the catheter, incontinence, and being on an orthopaedic or neurology service. Our search did not reveal data on adverse events and antimicrobial resistance associated with antimicrobial use, although one observational study found that the protective effect of antimicrobials lasted only for the first four days of catheterization, and that antimicrobial exposure led to changes in the epidemiology of bacterial flora in the urine.

**Evidence Review Table 1B. What are the risk factors for CAUTI?**

1B.1. Following aseptic insertion of the urinary catheter, maintain a closed drainage system. **(Category IB)<sup>a</sup>**

1B.2. Insert catheters only for appropriate indications, and leave in place only as long as needed. **(Category IB)<sup>b</sup>**

1B.3. Minimize urinary catheter use and duration of use in all patients, particularly those at higher risk for CAUTI such as women, the elderly, and patients with impaired immunity. **(Category IB)**

1B.4. Ensure that only properly trained persons (e.g., hospital personnel, family members, or patients themselves) who know the correct technique of aseptic catheter insertion and maintenance are given this responsibility. **(Category IB)**

1B.5. Maintain unobstructed urine flow. **(Category IB)<sup>c</sup>**

<sup>a</sup> More data are available under Question 2B.

<sup>b</sup> More data are available under Question 2C.

<sup>c</sup> More data are available under Question 2D.

**Q1C. What populations are at highest risk of mortality from urinary catheters?**

To answer this question, we reviewed the quality of evidence for those risk factors examined in more than one study. The evidence for this question consists of 2 observational studies.<sup>7,74</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 1C.

Low-quality evidence suggested that older age, higher severity of illness, and being on an internal medicine service compared to a surgical service were independent risk factors for mortality in patients with indwelling urinary catheters. Both studies evaluating these risk factors found the highest risk of mortality in patients over 70 years of age. Low-quality evidence also suggested that CAUTI was a risk factor for mortality in patients with catheters.

**Evidence Review Table 1C. What populations are at highest risk of mortality from catheters?**

1C.1. Minimize urinary catheter use and duration in all patients, particularly those who may be at higher risk for mortality due to catheterization, such as the elderly and patients with severe illness. **(Category IB)**

**Q2. For those who may require urinary catheters, what are the best practices?**

To answer this question, we focused on four subquestions: A) What are the risks and benefits associated with different approaches to catheterization?, B) What are the risks and benefits associated with different types of catheters or collecting systems?, C) What are the risks and benefits associated with different catheter management techniques, and D) What are the risks and benefits associated with different systems interventions?

## **Q2A. What are the risks and benefits associated with different approaches to catheterization?**

The available data examined the following comparisons of different catheterization approaches:

- 1) External versus indwelling urethral
- 2) Intermittent versus indwelling urethral
- 3) Intermittent versus suprapubic
- 4) Suprapubic versus indwelling urethral
- 5) Clean intermittent versus sterile intermittent

For all comparisons, we considered SUTI, bacteriuria/unspecified UTI, or combinations of these outcomes depending on availability, as well as other outcomes critical to weighing the risks and benefits of different catheterization approaches. The evidence for this question consists of 6 systematic reviews,<sup>37,104-108</sup> 16 RCTs,<sup>62,63,109-122</sup> and 18 observational studies.<sup>54,73,81,84,123-136</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 2A

### **Q2A.1. External versus indwelling urethral**

Low-quality evidence suggested a benefit of using external catheters over indwelling urethral catheters in male patients who require a urinary collection device but do not have an indication for an indwelling catheter such as urinary retention or bladder outlet obstruction.<sup>81,109,123</sup> This was based on a decreased risk of a composite outcome of SUTI, bacteriuria, or death as well as increased patient satisfaction with condom catheters. Differences were most pronounced in men without dementia. Statistically significant differences were not found or reported for the individual CAUTI outcomes or death. Our search did not reveal data on differences in local complications such as skin maceration or phimosis.

### **Q2A.2. Intermittent versus indwelling urethral**

Low-quality evidence suggested a benefit of using intermittent catheterization over indwelling urethral catheters in selected populations.<sup>84,104-106,110-114,124-126,135,136</sup> This was based on a decreased risk of SUTI and bacteriuria/unspecified UTI but an increased risk of urinary retention in postoperative patients with intermittent catheterization. In one study, urinary retention and bladder distension were avoided by performing catheterization at regular intervals (every 6-8 hrs) until return of voiding. Studies of patients with neurogenic bladder most consistently found a decreased risk of CAUTI with intermittent catheterization. Studies in operative patients whose catheters were removed within 24 hrs of surgery found no differences in bacteriuria with intermittent vs. indwelling catheterization, while studies where catheters were left in for longer durations had mixed results. Our search did not reveal data on differences in patient satisfaction.

### **Q2A.3. Intermittent versus suprapubic**

Very low-quality evidence suggested a benefit of intermittent over suprapubic catheterization in selected populations<sup>115,116,134-136</sup> based on increased patient acceptability and decreased risk of urinary complications (bladder calculi, vesicoureteral reflux, and upper tract abnormalities). Although we found a decreased risk of bacteriuria/unspecified UTI with suprapubic catheterization, there were no differences in SUTI. The populations studied included women undergoing urogynecologic surgery and spinal cord injury patients.

#### Q2A.4. *Suprapubic versus indwelling urethral*

Low-quality evidence suggested a benefit of suprapubic catheters over indwelling urethral catheters in selected populations.<sup>37,62,104,107,108,128-133,135,136</sup> This was based on a decreased risk of bacteriuria/unspecified UTI, recatheterization, and urethral stricture, and increased patient comfort and satisfaction. However, there were no differences in SUTI and an increased risk of longer duration of catheterization with suprapubic catheters. Studies involved primarily postoperative and spinal cord injury patients. Our search did not reveal data on differences in complications related to catheter insertion or the catheter site.

#### Q2A.5. *Clean intermittent versus sterile intermittent*

Moderate-quality evidence suggested no benefit of using sterile over clean technique for intermittent catheterization.<sup>63,73,105,117-122</sup> No differences were found in the risk of SUTI or bacteriuria/unspecified UTI. Study populations included nursing home residents and adults and children with neurogenic bladder/spinal cord injury.

### **Evidence Review Table 2A. What are the risks and benefits associated with different approaches to catheterization?**

2A.1. Consider using external catheters as an alternative to indwelling urethral catheters in cooperative male patients without urinary retention or bladder outlet obstruction. **(Category II)**

2A.2. Intermittent catheterization is preferable to indwelling urethral or suprapubic catheters in patients with bladder emptying dysfunction. **(Category II)**

2A.3. If intermittent catheterization is used, perform it at regular intervals to prevent bladder overdistension. **(Category IB)**

2A.4. For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use. **(Category IB)\***

2A.5. Further research is needed on the risks and benefits of suprapubic catheters as an alternative to indwelling urethral catheters in selected patients requiring short- or long-term catheterization, particularly with respect to complications related to catheter insertion or the catheter site. **(No recommendation/unresolved issue)**

2A.6. In the non-acute care setting, clean (i.e., non-sterile) technique for intermittent catheterization is an acceptable and more practical alternative to sterile technique for patients requiring chronic intermittent catheterization. **(Category IA)**

\* More data are available under Question 2C

## **Q2B. What are the risks and benefits associated with different catheters or collecting systems?**

The available data examined the following comparisons between different types of catheters and drainage systems:

1. Antimicrobial/antiseptic catheters vs. standard catheters
  - a. Silver-coated catheters vs. standard catheters
  - b. Nitrofurazone-impregnated catheters vs. standard catheters
2. Hydrophilic catheters vs. standard catheters
3. Closed vs. open drainage systems
4. Complex vs. simple drainage systems
5. Preconnected/sealed junction catheters vs. standard catheters
6. Catheter valves vs. catheter bags

For all comparisons, we considered CAUTI outcomes as well as other outcomes critical to weighing the risks and benefits of different types of catheters or collecting systems. The evidence for this question consists of 5 systematic reviews,<sup>37,137-140</sup> 17 RCTs,<sup>64,143-158</sup> 23 observational studies,<sup>82,86,89,97,159-163, 165-178</sup> and 3 economic analyses.<sup>179,180,181</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 2B.

### **Q2B.1.a. Silver-coated catheters vs. standard catheters**

Low-quality evidence suggested a benefit of silver-coated catheters over standard latex catheters.<sup>37,82,86,137-139,143,159-163, 165,166</sup> This was based on a decreased risk of bacteriuria/unspecified UTI with silver-coated catheters and no evidence of increased urethral irritation or antimicrobial resistance in studies that reported data on microbiological outcomes. Differences were significant for silver alloy-coated catheters but not silver oxide-coated catheters. In a meta-analysis of randomized controlled trials (see [Appendix](#)), silver alloy-coated catheters reduced the risk of asymptomatic bacteriuria compared to standard latex catheters (control latex catheters were either uncoated or coated with hydrogel, Teflon®, or silicone), whereas there were no differences when compared to standard, all silicone catheters. The effect of silver alloy catheters compared to latex catheters was more pronounced when used in patients catheterized <1 week. The results were robust to inclusion or exclusion of non peer-reviewed studies. Only one observational study found a decrease in SUTI with silver alloy-coated catheters.<sup>166</sup> The setting was a burn referral center, where the control catheters were latex, and patients in the intervention group had new catheters placed on admission, whereas the control group did not. Recent observational studies in hospitalized patients found mixed results for bacteriuria/unspecified UTI.

### **Q2B.1.b. Nitrofurazone-impregnated catheters vs. standard catheters**

Low-quality evidence suggested a benefit of nitrofurazone-impregnated catheters in patients catheterized for short periods of time.<sup>137,138</sup> This was based on a decreased risk of bacteriuria and no evidence of increased antimicrobial resistance in studies that reported microbiological outcomes. Differences were significant in a meta-analysis of three studies examining nitrofurazone-impregnated catheters (only one individual study significant) when duration of catheterization was <1 week. No differences were seen when duration of catheterization was >1 week, although the meta-analysis was borderline significant.

### *Q2B.2. Hydrophilic catheters vs. standard catheters*

Very low-quality evidence suggested a benefit of hydrophilic catheters over standard non-hydrophilic catheters in specific populations undergoing clean intermittent catheterization.<sup>137,144-148,169</sup> This was based on a decreased risk of SUTI, bacteriuria, hematuria, and pain during insertion, and increased patient satisfaction. Differences in CAUTI outcomes were limited to one study of spinal cord injury patients and one study of patients receiving intravesical immunochemoprophylaxis for bladder cancer, while multiple other studies found no significant differences.

### *Q2B.3. Closed vs. open drainage systems*

Very low-quality evidence suggested a benefit of using a closed rather than open urinary drainage system.<sup>89,171</sup> This was based on a decreased risk of bacteriuria with a closed drainage system. One study also found a suggestion of a decreased risk of SUTI, bacteremia, and UTI-related mortality associated with closed drainage systems, but differences were not statistically significant. Sterile, continuously closed drainage systems became the standard of care based on an uncontrolled study published in 1966 demonstrating a dramatic reduction in the risk of infection in short-term catheterized patients with the use of a closed system.<sup>23</sup> Recent data also include the finding that disconnection of the drainage system is a risk factor for bacteriuria (Q1B).

### *Q2B.4. Complex vs. simple drainage systems*

Low-quality evidence suggested no benefit of complex closed urinary drainage systems over simple closed urinary drainage systems.<sup>150-152,154,172,176,177</sup> Although there was a decreased risk of bacteriuria with the complex systems, differences were found only in studies published before 1990, and not in more recent studies. The complex drainage systems studied included various mechanisms for reducing bacterial entry, such as antiseptic-releasing cartridges at the drain port of the urine collection bag; see evidence table for systems evaluated.

### *Q2B.5. Preconnected/sealed junction catheters vs. standard catheters*

Low-quality evidence suggested a benefit of using preconnected catheters with junction seals over catheters with unsealed junctions to reduce the risk of disconnections.<sup>64,153,156,175</sup> This was based on a decreased risk of SUTI and bacteriuria with preconnected sealed catheters. Studies that found differences had higher rates of CAUTI in the control group than studies that did not find an effect.

### *Q2B.6. Catheter valves vs. drainage bags*

Moderate-quality evidence suggested a benefit of catheter valves over drainage bags in selected patients with indwelling urinary catheters.<sup>140</sup> Catheter valves led to greater patient satisfaction but no differences in bacteriuria/unspecified UTI or pain/bladder spasms. Details regarding the setting for recruitment and follow-up of the patients in the studies were unclear, and the majority of subjects were men. Our search did not reveal data on the effect of catheter valves on bladder function, bladder/urethral trauma, or catheter blockage.

**Evidence Review Table 2B. What are the risks and benefits associated with different catheters or collecting systems?**

2B.1. If the CAUTI rate is not decreasing after implementing a comprehensive strategy to reduce rates of CAUTI, consider using antimicrobial/antiseptic-impregnated catheters. The comprehensive strategy should include, at a minimum, the high priority recommendations for urinary catheter use, aseptic insertion, and maintenance (see Section III. Implementation and Audit). **(Category IB)**

2B.1.a. Further research is needed on the effect of antimicrobial/antiseptic-impregnated catheters in reducing the risk of symptomatic UTI, their inclusion among the primary interventions, and the patient populations most likely to benefit from these catheters. **(No recommendation/unresolved issue)**

2B.2. Hydrophilic catheters might be preferable to standard catheters for patients requiring intermittent catheterization. **(Category II)**

2B.3. Following aseptic insertion of the urinary catheter, maintain a closed drainage system. **(Category IB)**

2B.4. Complex urinary drainage systems (utilizing mechanisms for reducing bacterial entry such as antiseptic-release cartridges in the drain port) are not necessary for routine use. **(Category II)**

2B.5. Urinary catheter systems with preconnected, sealed catheter-tubing junctions are suggested for use. **(Category II)**

2B.6. Further research is needed to clarify the benefit of catheter valves in reducing the risk of CAUTI and other urinary complications. **(No recommendation/unresolved issue)**

**Q2C. What are the risks and benefits associated with different catheter management techniques?**

The available data examined the following catheter management techniques:

1. Antimicrobial prophylaxis
2. Urinary antiseptics (i.e., methanamine)
3. Bladder irrigation
4. Antiseptic instillation in the drainage bag
5. Periurethral care
6. Routine catheter or bag change
7. Catheter lubricants
8. Securing devices
9. Bacterial interference
10. Catheter cleansing
11. Catheter removal strategies (clamping vs. free drainage prior to removal, postoperative duration of catheterization)
12. Assessment of urine volumes



For all comparisons, we considered CAUTI outcomes as well as other outcomes critical to weighing the risks and benefits of different catheter management techniques. The evidence for this question consists of 6 systematic reviews,<sup>37,105,106,182-184</sup> 56 RCTs,<sup>60,61,65-69,143,158,185-231</sup> 34 observational studies,<sup>83,85,88,90,96,102,133,167,178,232-258</sup> and 1 economic analysis.<sup>180</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 2C.

#### Q2C.1. Antimicrobial prophylaxis

Low-quality evidence suggested no benefit of antimicrobial prophylaxis in patients undergoing short-term catheterization.<sup>37,60,61,83,85,133,158,178,182,185,186,189-191,232-234</sup> This was based on heterogeneous results for SUTI and bacteriuria/unspecified UTI and no adverse events related to antimicrobials. Lack of consistency in specific factors, such as patient population, antimicrobial agents, timing of administration, and duration of follow-up, did not allow for a summary of evidence of the effect of antimicrobial prophylaxis on CAUTI in patients undergoing short term catheterization. Only two studies evaluated adverse events related to antimicrobials. Our search did not reveal data on antimicrobial resistance or *Clostridium difficile* infection.

Low-quality evidence suggested no benefit of antimicrobial prophylaxis in patients undergoing long-term catheterization (indwelling and clean intermittent catheterization).<sup>106,183,192,194,235,238</sup> This was based on a decreased risk of bacteriuria, heterogeneous results for SUTI, and no differences reported for catheter encrustation or adverse events, although data were sparse. One systematic review suggested an increase in antimicrobial resistance with antimicrobial use.

#### Q2C.2. Urinary antiseptics

Low-quality evidence suggested a benefit of methenamine for short-term catheterized patients.<sup>196,197</sup> This was based on a reduced risk of SUTI and bacteriuria and no differences in adverse events. Evidence was limited to two studies of patients following gynecological surgery in Norway and Sweden.

Very low-quality evidence suggested a benefit of methanamine for long-term catheterized patients.<sup>106,236-239</sup> This was based on a reduced risk of encrustation but no differences in risk of SUTI or bacteriuria. Data on encrustation was limited to one study. Studies involved primarily elderly and spinal cord injury patients with chronic indwelling catheters

#### Q2C.3. Bladder irrigation

Low-quality evidence suggested no benefit of bladder irrigation in patients with indwelling or intermittent catheters.<sup>66,69,199-206,240-242</sup> This was based on no differences in SUTI and heterogeneous findings for bacteriuria.

#### Q2C.4. Antiseptic instillation in the drainage bag

Low-quality evidence suggested no benefit of antiseptic instillation in urinary drainage bags.<sup>90,207-211,243-245</sup> This was based on no differences in SUTI and heterogeneous results for bacteriuria.

#### Q2C.5. Periurethral care

Low-quality evidence suggested no benefit of antiseptic meatal cleaning regimens before or during catheterization to prevent CAUTI.<sup>65,67,68,88,158,212-216,246,247</sup> This was based on no difference in the risk of bacteriuria in patients receiving periurethral care regimens compared to those not receiving them. One study found a higher risk of bacteriuria with cleaning of the urethral meatus-catheter junction (either twice daily application of povidine-iodine or once daily cleaning with a non-antiseptic solution of green soap and water) in a subgroup of women with positive meatal cultures and in patients not receiving antimicrobials. Periurethral cleaning with chlorhexidine before catheter insertion did not have an effect in two studies.

#### *Q2C.6. Routine catheter or bag change*

Low-quality evidence suggested no benefit of routine catheter or drainage bag changes to prevent CAUTI.<sup>102,217-219,248,249</sup> This was based on no difference or an increased risk of SUTI and no difference in bacteriuria with routine compared to as-needed changes or with more frequent changing intervals. One study in nursing home residents found no differences in SUTI with routine monthly catheter changes compared to changing only for obstruction or infection, but the study was underpowered to detect a difference. Another study in home care patients found an increased risk of SUTI when catheters were changed more frequently than monthly.

#### *Q2C.7. Catheter lubricants*

Very low-quality evidence suggested a benefit of using lubricants for catheter insertion.<sup>167,220-223,250-254</sup> This was based on a decreased risk of SUTI and bacteriuria with the use of a pre-lubricated catheter compared to a catheter lubricated by the patient and a decreased risk of bacteriuria with use of a lubricant versus no lubricant. Studies were heterogeneous both in the interventions and outcomes studied. Several studies comparing antiseptic lubricants to non-antiseptic lubricants found no significant differences.

#### *Q2C.8. Securing devices*

Low-quality evidence suggested no benefit of using catheter securing devices to prevent CAUTI.<sup>224</sup> This was based on no significant difference in the risk of SUTI or meatal erosion. The only study in this category looked at one particular product.

#### *Q2C.9. Bacterial interference*

Moderate-quality evidence suggested a benefit of using bacterial interference in catheterized patients.<sup>225</sup> In the one study evaluating this intervention, urinary colonization with a non-pathogenic *Escherichia coli* was associated with a decreased risk of SUTI in adults with spinal cord injury and a history of frequent CAUTI.

#### *Q2C.10. Catheter cleansing*

Very low-quality evidence suggested a benefit of wet versus dry storage procedures for catheters used in clean intermittent catheterization.<sup>255</sup> This was based on a decreased risk of SUTI with a wet storage procedure in one study of spinal cord injury patients undergoing clean intermittent catheterization compared to a dry storage procedure where the catheter was left to air dry after washing. In the wet procedure, the catheter was stored in a dilute povidone-iodine solution after washing with soap and water.

#### *Q2C.11. Catheter removal strategies*

#### a. Clamping vs. free drainage prior to removal

Low-quality evidence suggested no benefit of clamping versus free drainage before catheter removal.<sup>37,184</sup> This was based on no difference in risk of bacteriuria, urinary retention, or recatheterization between the two strategies. One study comparing a clamp and release strategy to free drainage over 72 hours found a greater risk of bacteriuria in the clamping group.

#### b. Postoperative duration of catheterization

Moderate-quality evidence suggested a benefit of shorter versus longer postoperative durations of catheterization.<sup>37,184,227,228</sup> This was based on a decreased risk of bacteriuria/unspecified UTI, decreased time to ambulation and length of stay, no differences in urinary retention and SUTI, and increased risk of recatheterization. Significant decreases in bacteriuria/unspecified UTI were found specifically for comparisons of 1 day versus 3 or 5 days of postoperative catheterization. Recatheterization risk was greater in only one study comparing immediate removal to removal 6 or 12 hours after hysterectomy.

#### *Q2C.12. Assessment of urine volumes*

Low-quality evidence suggested a benefit of using portable ultrasound to assess urine volume in patients undergoing intermittent catheterization.<sup>229,230</sup> This was based on fewer catheterizations but no reported differences in risk of unspecified UTI. Patients studied were adults with neurogenic bladder in inpatient rehabilitation centers. Our search did not reveal data on the use of ultrasound in catheterized patients in other settings.

#### **Evidence Review Table 2C. What are the risks and benefits associated with different catheter management techniques?**

2C.1. Unless clinical indications exist (e.g., in patients with bacteriuria upon catheter removal post urologic surgery), do not use systemic antimicrobials routinely as prophylaxis for UTI in patients requiring either short or long-term catheterization. **(Category IB)**

2C.2.a. Further research is needed on the use of urinary antiseptics (e.g., methanamine) to prevent UTI in patients requiring short-term catheterization. **(No recommendation/unresolved issue)**

2C.2.b. Further research is needed on the use of methanamine to prevent encrustation in patients requiring chronic indwelling catheters who are at high risk for obstruction. **(No recommendation/unresolved issue)**

2C.3.a. Unless obstruction is anticipated (e.g., as might occur with bleeding after prostatic or bladder surgery), bladder irrigation is not recommended. **(Category II)**

2C.3.b. Routine irrigation of the bladder with antimicrobials is not recommended. **(Category II)**

2C.4. Routine instillation of antiseptic or antimicrobial solutions into urinary drainage bags is not recommended. **(Category II)**

2C.5.a. Do not clean the periurethral area with antiseptics to prevent CAUTI while the catheter is in place. Routine hygiene (e.g., cleansing of the meatal surface during daily bathing) is

appropriate. **(Category IB)**

2C.5.b. Further research is needed on the use of antiseptic solutions vs. sterile water or saline for periurethral cleaning prior to catheter insertion. **(No recommendation/unresolved issue)**

2C.6. Changing indwelling catheters or drainage bags at routine, fixed intervals is not recommended. Rather, catheters and drainage bags should be changed based on clinical indications such as infection, obstruction, or when the closed system is compromised. **(Category II)**

2C.7.a. Use a sterile, single-use packet of lubricant jelly for catheter insertion. **(Category IB)**

2C.7.b. Routine use of antiseptic lubricants is not necessary. **(Category II)**

2C.8. Further research is needed on the use of bacterial interference to prevent UTI in patients requiring chronic urinary catheterization. **(No recommendation/unresolved issue)**

2C.9. Further research is needed on optimal cleaning and storage methods for catheters used for clean intermittent catheterization. **(No recommendation/unresolved issue)**

2C.10.a. Clamping indwelling catheters prior to removal is not necessary. **(Category II)**

2C.10.b. Insert catheters only for appropriate indications, and leave in place only as long as needed. **(Category IB)**

2C.10.c. For operative patients who have an indication for an indwelling catheter, remove the catheter as soon as possible postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use. **(Category IB)**

2C.11.a. Consider using a portable ultrasound device to assess urine volume in patients undergoing intermittent catheterization to assess urine volume and reduce unnecessary catheter insertions. **(Category II)**

2C.11.b. Further research is needed on the use of a portable ultrasound device to evaluate for obstruction in patients with indwelling catheters and low urine output. **(No recommendation/unresolved issue)**

## ***Q2D. What are the risks and benefits associated with different systems interventions?***

The available data examined the following systems interventions:

1. Infection control/quality improvement programs (multifaceted)
2. Catheter reminders
3. Bacteriologic monitoring
4. Hand hygiene
5. Patient placement
6. Catheter team versus self-catheterization
7. Feedback
8. Nurse-directed catheter removal

We considered CAUTI outcomes, duration of catheterization, recatheterization, and transmission of pathogens when weighing the risks and benefits of different systems interventions. The evidence for this question consists of 1 RCT<sup>259</sup> and 19 observational

studies.<sup>3,25,260-276</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 2D.

#### *Q2D.1. Multifaceted infection control/quality improvement programs*

Low-quality evidence suggested a benefit of multifaceted infection control/quality improvement programs to reduce the risk of CAUTI.<sup>3,260-267</sup> This was based on a decreased risk of SUTI, bacteriuria/unspecified UTI, and duration of catheter use with implementation of such programs. Studies evaluated various multifaceted interventions. The studies with significant findings included: 1) education and performance feedback regarding compliance with catheter care, emphasizing hand hygiene, and maintaining unobstructed urine flow; 2) computerized alerts to physicians, nurse-driven protocols to remove catheters, and use of handheld bladder scanners to assess for urinary retention; 3) guidelines and education focusing on perioperative catheter management; and 4) a multifaceted infection control program including guidelines for catheter insertion and maintenance. A program using a checklist and algorithm for appropriate catheter use also suggested a decrease in unspecified UTI and catheter duration, but statistical differences were not reported.

#### *Q2D.2. Reminders*

Very low-quality evidence suggested a benefit of using urinary catheter reminders to prevent CAUTI.<sup>268-270</sup> This was based on a decreased risk of bacteriuria and duration of catheterization and no differences in recatheterization or SUTI when reminders were used. Reminders to physicians included both computerized and non-computerized alerts about the presence of urinary catheters and the need to remove unnecessary catheters.

#### *Q2D.3. Bacteriologic monitoring*

Very low-quality evidence suggested no benefit of bacteriologic monitoring to prevent CAUTI.<sup>25,271</sup> Although one study found a decreased risk of bacteriuria during a period of bacteriologic monitoring and feedback, only 2% of SUTI episodes were considered potentially preventable with the use of bacteriologic monitoring.

#### *Q2D.4. Hand hygiene*

Very low-quality evidence suggested a benefit of using alcohol hand sanitizer in reducing CAUTI. This was based on one study in a rehabilitation facility that found a decrease in unspecified UTI, although no statistical differences were reported.<sup>272</sup> A separate multifaceted study that included education and performance feedback on compliance with catheter care and hand hygiene showed a decrease in risk of SUTI.<sup>265</sup>

#### *Q2D.5. Patient placement*

Very low-quality evidence suggested a benefit of spatially separating patients to prevent transmission of urinary pathogens.<sup>273</sup> This was based on a decreased risk of transmission of urinary bacterial pathogens in nursing home residents in separate rooms compared to residents in the same rooms.

#### *Q2D.6. Catheter team versus self-catheterization*

Very low-quality evidence suggested no benefit of a catheter team to prevent CAUTI among patients requiring intermittent catheterization.<sup>274</sup> This was based on one study showing no difference in unspecified UTI between use of a catheter care team and self-catheterization for intermittent catheterization in paraplegic patients.

#### *Q2D.7. Feedback*

Very low-quality evidence suggested a benefit of using nursing feedback to prevent CAUTI.<sup>275</sup> This was based on a decreased risk of unspecified UTI during an intervention where nursing staff were provided with regular reports of unit-specific rates of CAUTI.

#### *Q2D.8. Nurse-directed catheter removal*

Very low-quality evidence suggested a benefit of a nurse-directed catheter removal program to prevent CAUTI.<sup>276</sup> This was based on a decreased risk of unspecified UTI during an intervention where criteria were developed that allowed a registered nurse to remove a catheter without a physician's order when no longer medically necessary. Of the three intensive care units where the intervention was implemented, differences were significant only in the coronary intensive care unit.

### **Evidence Review Table 2D. What are the risks and benefits associated with different systems interventions?**

2D.1.a. Ensure that healthcare personnel and others who take care of catheters are given periodic in-service training stressing the correct techniques and procedures for urinary catheter insertion, maintenance, and removal. **(Category IB)**

2D.1.b. Implement quality improvement (QI) programs or strategies to enhance appropriate use of indwelling catheters and to reduce the risk of CAUTI based on a facility risk assessment. **(Category IB)**

Examples of programs that have been demonstrated to be effective include:

1. A system of alerts or reminders to identify all patients with urinary catheters and assess the need for continued catheterization
2. Guidelines and protocols for nurse-directed removal of unnecessary urinary catheters
3. Education and performance feedback regarding appropriate use, hand hygiene, and catheter care
4. Guidelines and algorithms for appropriate peri-operative catheter management, such as:
  - a. Procedure-specific guidelines for catheter placement and postoperative catheter removal
  - b. Protocols for management of postoperative urinary retention, such as nurse-directed use of intermittent catheterization and use of ultrasound bladder scanners

2D.2. Routine screening of catheterized patients for asymptomatic bacteriuria is not recommended. **(Category II)**

2D.3. Perform hand hygiene immediately before and after insertion or any manipulation of the catheter site or device. **(Category IB)**

2D.5. Maintain unobstructed urine flow. **(Category IB)**

2D.6. Further research is needed on the benefit of spatial separation of patients with urinary catheters to prevent transmission of pathogens colonizing urinary drainage systems. **(No recommendation/unresolved issue)**

2D.7. When performing surveillance for CAUTI, consider providing regular (e.g., quarterly) feedback of unit-specific CAUTI rates to nursing staff and other appropriate clinical care staff. **(Category II)**

### **Q3: What are the best practices for preventing UTI associated with obstructed urinary catheters?**

The available data examined the following practices:

1. Methods to prevent/reduce encrustations or blockage
2. Catheter materials preventing blockage

For this question, available relevant outcomes included blockage/encrustation. We did not find data on the outcomes of CAUTI. The evidence for this question consists of 1 systematic review,<sup>277</sup> 2 RCTs,<sup>278,279</sup> and 2 observational studies.<sup>280,281</sup> The findings of the evidence review and the grades for all important outcomes are shown in Evidence Review Table 3.

#### *Q3.1. Methods to prevent/reduce encrustations or blockage*

Low-quality evidence suggested a benefit of acidifying solutions or oral acetohydroxamic acid in preventing or reducing catheter encrustations and blockage in long-term catheterized patients.<sup>277,278,280,281</sup> No differences were seen with daily catheter irrigation with normal saline.

#### *Q3.2. Catheter materials preventing blockage*

Low-quality evidence suggested a benefit of silicone over latex or Teflon-coated catheters in prevention or reducing catheter encrustations in long-term catheterized patients who were prone to blockage. No differences were seen with different materials in patients considered “non-blockers.”<sup>279</sup>

#### **Evidence Review Table 3. What are the best practices for preventing UTI associated with obstructed urinary catheters?**

3.1.a. Further research is needed on the benefit of irrigating the catheter with acidifying solutions or use of oral urease inhibitors in long-term catheterized patients who have frequent catheter obstruction. **(No recommendation/unresolved issue)**

3.2.a. Silicone might be preferable to other materials to reduce the risk of encrustation in long-term catheterized patients who have frequent obstruction. **(Category II)**

## References

1. Wong ES. Guideline for prevention of catheter-associated urinary tract infections. *Am J Infect Control*. 1983;11(1):28-36.
2. Lo E, Nicolle L, Classen D, et al. Strategies to prevent catheter-associated urinary tract infections in acute care hospitals. *Infect Control Hosp Epidemiol*. 2008;29:S41-S50.
3. Stephan F, Sax H, Wachsmuth M, Hoffmeyer P, Clergue F, Pittet D. Reduction of urinary tract infection and antibiotic use after surgery: A controlled, prospective, before-after intervention study. *Clin Infect Dis*. 2006;42(11):1544-1551.
4. Dolin SJ, Cashman JN. Tolerability of acute postoperative pain management: Nausea, vomiting, sedation, pruritis, and urinary retention. evidence from published data. *Br J Anaesth*. 2005;95(5):584-591.
5. Hidron AI, Edwards JR, Patel J, et al. NHSN annual update: Antimicrobial-resistant pathogens associated with healthcare-associated infections: Annual summary of data reported to the national healthcare safety network at the centers for disease control and prevention, 2006-2007. *Infect Control Hosp Epidemiol*. 2008;29(11):996-1011.
6. Saint S. Clinical and economic consequences of nosocomial catheter-related bacteriuria. *Am J Infect Control*. 2000;28(1):68-75.
7. Platt R, Polk BF, Murdock B, Rosner B. Mortality associated with nosocomial urinary-tract infection. *N Engl J Med*. 1982;307(11):637-642.
8. Givens CD, Wenzel RP. Catheter-associated urinary tract infections in surgical patients: A controlled study on the excess morbidity and costs. *J Urol*. 1980;124(5):646-648.
9. Tambyah PA, Knasinski V, Maki DG. The direct costs of nosocomial catheter-associated urinary tract infection in the era of managed care. *Infect Control Hosp Epidemiol*. 2002;23(1):27-31.
10. Schaberg DR, Weinstein RA, Stamm WE. Epidemics of nosocomial urinary tract infection caused by multiply resistant gram-negative bacilli: Epidemiology and control. *J Infect Dis*. 1976;133(3):363-366.
11. Yoon HJ, Choi JY, Park YS, et al. Outbreaks of *serratia marcescens* bacteriuria in a neurosurgical intensive care unit of a tertiary care teaching hospital: A clinical, epidemiologic, and laboratory perspective. *Am J Infect Control*. 2005;33(10):595-601.
12. Warren JW. Catheter-associated urinary tract infections. *Int J Antimicrob Agents*. 2001;17(4):299-303.
13. Weinstein JW, Mazon D, Pantelick E, Reagan-Cirincione P, Demby LM, Hierholzer WJ, Jr. A decade of prevalence surveys in a tertiary-care center: Trends in nosocomial infection rates, device utilization, and patient acuity. *Infect Control Hosp Epidemiol*. 1999;20(8):543-548.
14. Munasinghe RL, Yazdani H, Siddique M, Hafeez W. Appropriateness of use of indwelling urinary catheters in patients admitted to the medical service. *Infect Control Hosp Epidemiol*. 2001;22(10):647-649.



15. Jain P, Parada JP, David A, Smith LG. Overuse of the indwelling urinary tract catheter in hospitalized medical patients. *Arch Intern Med.* 1995;155(13):1425-1429.
16. Saint S, Wiese J, Amory JK, et al. Are physicians aware of which of their patients have indwelling urinary catheters? *Am J Med.* 2000;109(6):476-480.
17. Edwards JR, Peterson KD, Andrus ML, et al. National healthcare safety network (NHSN) report, data summary for 2006, issued june 2007. *Am J Infect Control.* 2007;35(5):290-301.
18. Rogers MA, Mody L, Kaufman SR, Fries BE, McMahon LF, Jr, Saint S. Use of urinary collection devices in skilled nursing facilities in five states. *J Am Geriatr Soc.* 2008;56(5):854-861.
19. Klevens RM, Edwards JR, Richards CL, Jr, et al. Estimating health care-associated infections and deaths in U.S. hospitals, 2002. *Public Health Rep.* 2007;122(2):160-166.
20. Weinstein MP, Towns ML, Quartey SM, et al. The clinical significance of positive blood cultures in the 1990s: A prospective comprehensive evaluation of the microbiology, epidemiology, and outcome of bacteremia and fungemia in adults. *Clin Infect Dis.* 1997;24(4):584-602.
21. Muder RR, Brennen C, Wagener MM, Goetz AM. Bacteremia in a long-term-care facility: A five-year prospective study of 163 consecutive episodes. *Clin Infect Dis.* 1992;14(3):647-654.
22. Umscheid C, Mitchell M, Agarwal R, Williams K, Brennan P. Mortality from reasonably-preventable hospital acquired infections. included in written testimony by the society of healthcare epidemiology of america for the committee on oversight and government reform hearing on healthcare-associated infections: A preventable epidemic, chaired by henry A. waxman, april 16, 2008, washington, DC. [congressional testimony]. .
23. Kunin CM, McCormack RC. Prevention of catheter-induced urinary-tract infections by sterile closed drainage. *N Engl J Med.* 1966;274(21):1155-1161.
24. Tambyah PA, Halvorson KT, Maki DG. A prospective study of pathogenesis of catheter-associated urinary tract infections. *Mayo Clin Proc.* 1999;74(2):131-136.
25. Garibaldi RA, Mooney BR, Epstein BJ, Britt MR. An evaluation of daily bacteriologic monitoring to identify preventable episodes of catheter-associated urinary tract infection. *Infect Control.* 1982;3(6):466-470.
26. Saint S, Lipsky BA, Goold SD. Indwelling urinary catheters: A one-point restraint? *Ann Intern Med.* 2002;137(2):125-127.
27. Warren JW, Tenney JH, Hoopes JM, Muncie HL, Anthony WC. A prospective microbiologic study of bacteriuria in patients with chronic indwelling urethral catheters. *J Infect Dis.* 1982;146(6):719-723.
28. Saint S, Chenoweth CE. Biofilms and catheter-associated urinary tract infections. *Infect Dis Clin North Am.* 2003;17(2):411-432.

29. Kallen AJ, Hidron AI, Edwards JR, Patel J, Srinivasan A. Antibiotic resistance among important gram-negative pathogens causing healthcare-associated infections reported to the national healthcare safety network, 2006-2007 [abstract 376] in: Program and abstracts of the 18th annual scientific meeting of the society for healthcare epidemiology of america, orlando, FL, apr 5-8, 2008. .
30. Horan TC, Gaynes RP. Surveillance of nosocomial infections. In: Mayhall CG, ed. *Hospital Epidemiology and Infection Control*. 3rd ed. Philadelphia: Lippincott Williams & Wilkins; 2004:1659-1702.
31. Tambyah PA, Maki DG. Catheter-associated urinary tract infection is rarely symptomatic: A prospective study of 1,497 catheterized patients. *Arch Intern Med*. 2000;160(5):678-682.
32. Atkins D, Best D, Briss PA, et al. Grading quality of evidence and strength of recommendations. *BMJ*. 2004;328(7454):1490.
33. Guyatt GH, Oxman AD, Kunz R, et al. Going from evidence to recommendations. *BMJ*. 2008;336(7652):1049-1051.
34. Guyatt GH, Oxman AD, Kunz R, et al. What is "quality of evidence" and why is it important to clinicians? *BMJ*. 2008;336(7651):995-998.
35. Pratt RJ, Pellowe CM, Wilson JA, et al. epic2: National evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in england. *J Hosp Infect*. 2007;65(Suppl 1):S1-64.
36. Pellowe CM, Pratt RJ, Harper P, et al. Evidence-based guidelines for preventing healthcare-associated infections in primary and community care in england. *J Hosp Infect*. 2003;55(Suppl 2):S2-127.
37. Phipps S, Lim YN, McClinton S, Barry C, Rane A, N'Dow J. Short term urinary catheter policies following urogenital surgery in adults. *Cochrane Database Syst Rev*. 2006(2):CD004374.
38. Tang KK, Wong CK, Lo SF, Ng TK. Is it necessary to catheterise the bladder routinely before gynaecological laparoscopic surgery? *Aust N Z J Obstet Gynaecol*. 2005;45(5):380-383.
39. Iorio R, Healy WL, Patch DA, Appleby D. The role of bladder catheterization in total knee arthroplasty. *Clin Orthop*. 2000(380):80-84.
40. Liu SK, Rassai H, Krasner C, Braun J, Matolo NM. Urinary catheter in laparoscopic cholecystectomy: Is it necessary? *Surg Laparosc Endosc Percutan Tech*. 1999;9(3):184-186.
41. Normelli H, Aaro S, Hedlund R, Svensson O, Stromberg L. Urethral catheterization in spinal surgery: A randomized prospective study. *Eur Spine J*. 1993;2(3):132-135.
42. Carpinello VL, Cendron M, Altman HG, Malloy TR, Booth R. Treatment of urinary complications after total joint replacement in elderly females. *Urology*. 1988;32(3):186-188.
43. Akhtar MS, Beere DM, Wright JT, MacRae KD. Is bladder catheterization really necessary before laparoscopy? *Br J Obstet Gynaecol*. 1985;92(11):1176-1178.

44. Chaudhuri P, Vengadasalam D. Urinary tract infection following abdominal delivery--second thought on indwelling catheter. *Singapore Med J.* 1983;24(4):224-226.
45. McMurdo ME, Davey PG, Elder MA, Miller RM, Old DC, Malek M. A cost-effectiveness study of the management of intractable urinary incontinence by urinary catheterisation or incontinence pads. *J Epidemiol Community Health.* 1992;46(3):222-226.
46. Geraniotis E, Koff SA, Enrile B. The prophylactic use of clean intermittent catheterization in the treatment of infants and young children with myelomeningocele and neurogenic bladder dysfunction. *J Urol.* 1988;139(1):85-86.
47. Kumar P, Mannan K, Chowdhury AM, Kong KC, Pati J. Urinary retention and the role of indwelling catheterization following total knee arthroplasty. *Int Braz J Urol.* 2006;32(1):31-34.
48. Miskry T, Cumbis A, Apostolidis P, Eleftheriou M, Magos A. Do not catheterize the bladder at operative laparoscopy. *Gynaecol Endosc.* 2001;10(1):29-32.
49. Barnes JS. Is it better to avoid urethral catheterization at hysterectomy and caesarean section? *Aust N Z J Obstet Gynaecol.* 1998;38(3):315-316.
50. Ouslander JG, Greengold B, Chen S. External catheter use and urinary tract infections among incontinent male nursing home patients. *J Am Geriatr Soc.* 1987;35(12):1063-1070.
51. Rannikko S, Kyllastinen M, Granqvist B. Comparison of long-term indwelling catheters and bed-pads in the treatment of urinary incontinence in elderly patients. *J Infect.* 1986;12(3):221-227.
52. Nordqvist P, Ekelund P, Edouard L, Svensson ML, Brandberg A, Seeberg S. Catheter-free geriatric care. routines and consequences for clinical infection, care and economy. *J Hosp Infect.* 1984;5(3):298-304.
53. Egilmez T, Aridogan IA, Yachia D, Hassin D. Comparison of nitinol urethral stent infections with indwelling catheter-associated urinary-tract infections. *J Endourol.* 2006;20(4):272-277.
54. Ruz ED, Garcia Leoni E, Herruzo Cabrera R. Epidemiology and risk factors for urinary tract infection in patients with spinal cord injury. *J Urol.* 2000;164(4):1285-1289.
55. Donovan WH, Stolov WC, Clowers DE, et al. Bacteriuria during intermittent catheterization following spinal cord injury. *Arch Phys Med Rehabil.* 1978;59(8):351-357.
56. Larsen LD, Chamberlin DA, Khonsari F, Ahlering TE. Retrospective analysis of urologic complications in male patients with spinal cord injury managed with and without indwelling urinary catheters. *Urology.* 1997;50(3):418-422.
57. Kochakarn W, Ratana-Olarn K, Lertsithichai P, Roongreungsilp U. Follow-up of long-term treatment with clean intermittent catheterization for neurogenic bladder in children. *Asian J.* 2004;27(2):134-136.

58. Ehrlich O, Brem AS. A prospective comparison of urinary tract infections in patients treated with either clean intermittent catheterization or urinary diversion. *Pediatrics*. 1982;70(5):665-669.
59. Darouiche RO, Smith JA, Jr., Hanna H, et al. Efficacy of antimicrobial-impregnated bladder catheters in reducing catheter-associated bacteriuria: A prospective, randomized, multicenter clinical trial. *Urology*. 1999;54(6):976-981.
60. Stricker PD, Grant AB. Relative value of antibiotics and catheter care in the prevention of urinary tract infection after transurethral prostatic resection. *Br J Urol*. 1988;61(6):494-497.
61. Rogers RG, Kammerer-Doak D, Olsen A, et al. A randomized, double-blind, placebo-controlled comparison of the effect of nitrofurantoin monohydrate macrocrystals on the development of urinary tract infections after surgery for pelvic organ prolapse and/or stress urinary incontinence with suprapubic catheterization. *Obstet Gynecol*. 2004;191(1):182-187.
62. Baan AH, Vermeulen H, van der Meulen, J., Bossuyt P, Olszyna D, Gouma DJ. The effect of suprapubic catheterization versus transurethral catheterization after abdominal surgery on urinary tract infection: A randomized controlled trial. *Dig Surg*. 2003;20(4):290-295.
63. Carapeti EA, Andrews SM, Bentley PG. Randomised study of sterile versus non-sterile urethral catheterisation.[erratum appears in ann R coll surg engl 1996 may;78(3 pt 1):167]. *Ann R Coll Surg Engl*. 1996;78(1):59-60.
64. Huth TS, Burke JP, Larsen RA, Classen DC, Stevens LE. Clinical trial of junction seals for the prevention of urinary catheter-associated bacteriuria. *Arch Intern Med*. 1992;152(4):807-812.
65. Huth TS, Burke JP, Larsen RA, Classen DC, Stevens LE. Randomized trial of meatal care with silver sulfadiazine cream for the prevention of catheter-associated bacteriuria. *J Infect Dis*. 1992;165(1):14-18.
66. Schneeberger PM, Vreede RW, Bogdanowicz JF, van Dijk, W. C. A randomized study on the effect of bladder irrigation with povidone-iodine before removal of an indwelling catheter. *J Hosp Infect*. 1992;21(3):223-229.
67. Burke JP, Jacobson JA, Garibaldi RA, Conti MT, Alling DW. Evaluation of daily meatal care with poly-antibiotic ointment in prevention of urinary catheter-associated bacteriuria. *J Urol*. 1983;129(2):331-334.
68. Classen DC, Larsen RA, Burke JP, Alling DW, Stevens LE. Daily meatal care for prevention of catheter-associated bacteriuria: Results using frequent applications of polyan antibiotic cream. *Infect Control Hosp Epidemiol*. 1991;12(3):157-162.
69. Warren JW, Platt R, Thomas RJ, Rosner B, Kass EH. Antibiotic irrigation and catheter-associated urinary-tract infections. *N Engl J Med*. 1978;299(11):570-573.
70. Seki N, Masuda K, Kinukawa N, Senoh K, Naito S. Risk factors for febrile urinary tract infection in children with myelodysplasia treated by clean intermittent catheterization. *Int J Urol*. 2004;11(11):973-977.

71. Kelleher RE, Meeropol E, Parks D. Factors influencing the development of symptomatic bacteriuria in children on clean intermittent catheterization. *J Urol Nurs*. 1996;15(2):1256-1265.
72. Waites KB, Canupp KC, DeVivo MJ. Epidemiology and risk factors for urinary tract infection following spinal cord injury. *Arch Phys Med Rehabil*. 1993;74(7):691-695.
73. Anderson RU. Non-sterile intermittent catheterization with antibiotic prophylaxis in the acute spinal cord injured male patient. *J Urol*. 1980;124(3):392-394.
74. Van Der Kooi, T. I. I., De Boer, A. S., Mannien J, et al. Incidence and risk factors of device-associated infections and associated mortality at the intensive care in the dutch surveillance system. *Intensive Care Med*. 2007;33(2):271-278.
75. Bochicchio GV, Joshi M, Shih D, Bochicchio K, Tracy K, Scalea TM. Reclassification of urinary tract infections in critically ill trauma patients: A time-dependent analysis. *Surg Infect*. 2003;4(4):379-385.
76. Leone M, Albanese J, Garnier F, et al. Risk factors of nosocomial catheter-associated urinary tract infection in a polyvalent intensive care unit. *Intensive Care Med*. 2003;29(7):1077-1080.
77. Tissot E, Limat S, Cornette C, Capellier G. Risk factors for catheter-associated bacteriuria in a medical intensive care unit. *Eur J Clin Microbiol Infect Dis*. 2001;20(4):260-262.
78. Colau A, Lucet JC, Rufat P, Botto H, Benoit G, Jardin A. Incidence and risk factors of bacteriuria after transurethral resection of the prostate. *Eur Urol*. 2001;39(3):272-276.
79. Ouslander JG, Greengold B, Chen S. Complications of chronic indwelling urinary catheters among male nursing home patients: A prospective study. *J Urol*. 1987;138(5):1191-1195.
80. Hazelett SE, Tsai M, Gareri M, Allen K. The association between indwelling urinary catheter use in the elderly and urinary tract infection in acute care. *BMC geriatr*. 2006;6:15.
81. Saint S, Kaufman SR, Rogers MAM, Bakers PD, Boyko EJ, Lipsky BA. Risk factors for nosocomial urinary tract-related bacteremia: A case-control study. *Am J Infect Control*. 2006;34(7):401-407.
82. Srinivasan A, Karchmer T, Richards A, Song X, Perl TM. A prospective trial of a novel, silicone-based, silver-coated foley catheter for the prevention of nosocomial urinary tract infections. *Infect Control Hosp Epidemiol*. 2006;27(1):38-43.
83. Cardosi RJ, Cardosi RP, Grendys EC, Jr., Fiorica JV, Hoffman MS. Infectious urinary tract morbidity with prolonged bladder catheterization after radical hysterectomy... includes discussion. *Obstet Gynecol*. 2003;189(2):380-384.
84. Johansson I, Athlin E, Frykholm L, Bolinder H, Larsson G. Intermittent versus indwelling catheters for older patients with hip fractures. *J Clin Nurs*. 2002;11(5):651-656.

85. Hustinx WN, Mintjes-de Groot, Verkooyen RP, Verbrugh HA. Impact of concurrent antimicrobial therapy on catheter-associated urinary tract infection.[see comment]. *J Hosp Infect.* 1991;18(1):45-56.
86. Johnson JR, Roberts PL, Olsen RJ, Moyer KA, Stamm WE. Prevention of catheter-associated urinary tract infection with a silver oxide-coated urinary catheter: Clinical and microbiologic correlates. *J Infect Dis.* 1990;162(5):1145-1150.
87. Lima NL, Guerrant RL, Kaiser DL, Germanson T, Farr BM. A retrospective cohort study of nosocomial diarrhea as a risk factor for nosocomial infection. *J Infect Dis.* 1990;161(5):948-952.
88. Jacono JJ, Talamelli CL. Nosocomial urinary tract infection in catheterized patients. *Infect Control Can.* 1988;3(1):16-20.
89. Lanara V, Plati C, Paniara O, et al. The prevalence of urinary tract infection in patients related to type of drainage bag. *Scand J Caring Sci.* 1988;2(4):163-170.
90. Holliman R, Seal DV, Archer H, Doman S. Controlled trial of chemical disinfection of urinary drainage bags. reduction in hospital-acquired catheter-associated infection. *Br J Urol.* 1987;60(5):419-422.
91. Mulhall AB, Chapman RG, Crow RA. Bacteriuria during indwelling urethral catheterization. *J Hosp Infect.* 1988;11(3):253-262.
92. Pien FD, Landers JQ, Jr. Indwelling urinary catheter infections in small community hospital. role of urinary drainage bag. *Urology.* 1983;22(3):255-258.
93. Shapiro M, Simchen E, Izraeli S, Sacks TG. A multivariate analysis of risk factors for acquiring bacteriuria in patients with indwelling urinary catheters for longer than 24 hours. *Infect Control.* 1984;5(11):525-532.
94. Platt R, Polk BF, Murdock B, Rosner B. Risk factors for nosocomial urinary tract infection. *Am J Epidemiol.* 1986;124(6):977-985.
95. Burke JP, Larsen RA, Stevens LE. Nosocomial bacteriuria: Estimating the potential for prevention by closed sterile urinary drainage. *Infect Control.* 1986;7(2):96-99.
96. Saramma PP. Catheter-associated urinary tract infection: A follow-up study in prevention. *Nurs J India.* 1987;78(10):257-259.
97. Islam AK, Chapman J. Closed catheter drainage and urinary infection--a comparison of two methods of catheter drainage. *Br J Urol.* 1977;49(3):215-220.
98. Hartstein AI, Garber SB, Ward TT, Jones SR, Morthland VH. Nosocomial urinary tract infection: A prospective evaluation of 108 catheterized patients. *Infect Control.* 1981;2(5):380-386.
99. Garibaldi RA, Burke JP, Britt MR, Miller MA, Smith CB. Meatal colonization and catheter-associated bacteriuria. *N Engl J Med.* 1980;303(6):316-318.
100. Garibaldi RA, Burke JP, Dickman ML, Smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterization. *N Engl J Med.* 1974;291(5):215-219.

101. Hirsh DD, Fainstein V, Musher DM. Do condom catheter collecting systems cause urinary tract infection? *JAMA*. 1979;242(4):340-341.
102. White MC, Ragland KE. Urinary catheter-related infections among home care patients. *J Wound Ostomy Continence Nurs*. 1995;22(6):286-290.
103. Wilde MH, Carrigan MJ. A chart audit of factors related to urine flow and urinary tract infection. *J Adv Nurs*. 2003;43(3):254-262.
104. Niel-Weise BS, van den Broek, P. J. Urinary catheter policies for short-term bladder drainage in adults. *Cochrane Libr*. 2006;4.
105. Shekelle PG, Morton SC, Clark KA, Pathak M, Vickrey BG. Systematic review of risk factors for urinary tract infection in adults with spinal cord dysfunction. *J Spinal Cord Med*. 1999;22(4):258-272.
106. Vickrey BG, Shekelle P, Morton S, Clark K, Pathak M, Kamberg C. Prevention and management of urinary tract infections in paralyzed persons. *Evid Rep Technol Assess*. 1999(6):1-3.
107. Branagan GW, Moran BJ. Published evidence favors the use of suprapubic catheters in pelvic colorectal surgery. *Dis Colon Rectum*. 2002;45(8):1104-1108.
108. McPhail MJ, Abu-Hilal M, Johnson CD. A meta-analysis comparing suprapubic and transurethral catheterization for bladder drainage after abdominal surgery. *Br J Surg*. 2006;93(9):1038-1044.
109. Saint S, Kaufman SR, Rogers MA, Baker PD, Ossenkop K, Lipsky BA. Condom versus indwelling urinary catheters: A randomized trial. *J Am Geriatr Soc*. 2006;54(7):1055-1061.
110. Michelson JD, Lotke PA, Steinberg ME. Urinary-bladder management after total joint-replacement surgery. *N Engl J Med*. 1988;319(6):321-326.
111. Tang MW, Kwok TC, Hui E, Woo J. Intermittent versus indwelling urinary catheterization in older female patients. *Maturitas*. 2006;53(3):274-281.
112. Turi MH, Hanif S, Fasih Q, Shaikh MA. Proportion of complications in patients practicing clean intermittent self-catheterization (CISC) vs indwelling catheter. *J Pak Med Assoc*. 2006;56(9):401-404.
113. Tangtrakul S, Taechaiya S, Suthutvoravut S, Linasmita V. Post-cesarean section urinary tract infection: A comparison between intermittent and indwelling catheterization. *J Med Assoc Thai*. 1994;77(5):244-248.
114. Skelly JM, Guyatt GH, Kalbfleisch R, Singer J, Winter L. Management of urinary retention after surgical repair of hip fracture. *Can Med Assoc J*. 1992;146(7):1185-1189.
115. Jannelli ML, Wu JM, Plunkett LW, Williams KS, Visco AG. A randomized controlled trial of clean intermittent self-catheterization versus suprapubic catheterization after urogynecologic surgery. *Am J Obstet Gynecol*. 2007;197(1).
116. Roberts K, Naik R. Catheterization options following radical surgery for cervical cancer. *Br J Nurs*. 2006;15(19):1038-1044.

117. Duffy LM, Cleary J, Ahern S, et al. Clean intermittent catheterization: Safe, cost-effective bladder management for male residents of VA nursing homes. *J Am Geriatr Soc*. 1995;43(8):865-870.
118. Moore KN, Burt J, Voaklander DC. Intermittent catheterization in the rehabilitation setting: A comparison of clean and sterile technique. *Clin Rehabil*. 2006;20(6):461-468.
119. Moore KN, Kelm M, Sinclair O, Cadrain G. Bacteriuria in intermittent catheterization users: The effect of sterile versus clean reused catheters. *Rehabil Nurs*. 1993;18(5):306-309.
120. Prieto-Fingerhut T, Banovac K, Lynne CM. A study comparing sterile and nonsterile urethral catheterization in patients with spinal cord injury. *Rehabil Nurs*. 1997;22(6):299-302.
121. Schlager TA, Clark M, Anderson S. Effect of a single-use sterile catheter for each void on the frequency of bacteriuria in children with neurogenic bladder on intermittent catheterization for bladder emptying. *Pediatrics*. 2001;108(4):E71.
122. Joseph C, Jacobson C, Strausbaugh L, Maxwell M, French M, Colling J. Sterile vs clean urinary catheterization. *J Am Geriatr Soc*. 1991;39(10):1042-1043.
123. Saint S, Lipsky BA, Baker PD, McDonald LL, Ossenkop K. Urinary catheters: What type do men and their nurses prefer? *J Am Geriatr Soc*. 1999;47(12):1453-1457.
124. Ritter MA, Faris PM, Keating EM. Urinary tract catheterization protocols following total joint arthroplasty. *Orthopedics*. 1989;12(8):1085-1087.
125. Oishi CS, Williams VJ, Hanson PB, Schneider JE, Colwell CW, Jr., Walker RH. Perioperative bladder management after primary total hip arthroplasty. *J Arthroplasty*. 1995;10(6):732-736.
126. Furuhashi A, Ogawa K, Saito K, Yamaguchi T. Preoperative intermittent catheterization in patients with prostatic hypertrophy. *Clin Ther*. 1988;10 Spec No:47-51.
127. Alli MO, Singh B, Moodley J, Shaik AS. Prospective evaluation of combined suprapubic and urethral catheterization to urethral drainage alone for intraperitoneal bladder injuries. *Journal of Trauma-Injury Infection & Critical Care*. 2003;55(6):1152-1154.
128. Dunn TS, Figge J, Wolf D. A comparison of outcomes of transurethral versus suprapubic catheterization after burch cystourethropy. *Int Urogynecol J Pelvic Floor Dysfunct*. 2005;16(1):60-2; discussion 62.
129. Dinneen MD, Wetter LA, May AR. Urethral strictures and aortic surgery. suprapubic rather than urethral catheters. *Eur J Vasc Surg*. 1990;4(5):535-538.
130. Horgan AF, Prasad B, Waldron DJ, O'Sullivan DC. Acute urinary retention. comparison of suprapubic and urethral catheterisation. *Br J Urol*. 1992;70(2):149-151.
131. Hofmeister FJ, Martens WE, Strebel RL. Foley catheter or suprapubic tube? *Obstet Gynecol*. 1970;107(5):767-779.



132. Van Nagell, JR, Penny RM, Roddick JW. Suprapubic bladder drainage following radical hysterectomy. *Obstet Gynecol.* 1972;113(6):849-850.
133. Verbrugh HA, Mintjes-de Groot, Andriess R, Hamersma K, van Dijk A. Postoperative prophylaxis with norfloxacin in patients requiring bladder catheters. *Eur J Clin Microbiol Infect Dis.* 1988;7(4):490-494.
134. Noll F, Russe O, Kling E, Botel U, Schreiter F. Intermittent catheterisation versus percutaneous suprapubic cystostomy in the early management of traumatic spinal cord lesions. *Paraplegia.* 1988;26(1):4-9.
135. Weld KJ, Dmochowski RR, Foster HE, Jr. Effect of bladder management on urological complications in spinal cord injured patients. *J Urol.* 2000;163(3):768-772.
136. Lloyd LK, Kuhlemeier KV, Fine PR, Stover SL. Initial bladder management in spinal cord injury: Does it make a difference? *J Urol.* 1986;135(3):523-527.
137. Schumm K, Lam TB. Types of urethral catheters for management of short-term voiding problems in hospitalised adults.[update of cochrane database syst rev. 2004;(1):CD004013; PMID: 14974052]. *Cochrane Database Syst Rev.* 2008(2):004013.
138. Johnson JR, Kuskowski MA, Wilt TJ. Systematic review: Antimicrobial urinary catheters to prevent catheter-associated urinary tract infection in hospitalized patients. *Ann Intern Med.* 2006;144(2):116-126.
139. Niel-Weise BS, Arend SM, van den Broek, PJ. Is there evidence for recommending silver-coated urinary catheters in guidelines? *J Hosp Infect.* 2002;52(2):81-87.
140. van den Eijkel, E., Griffiths P. Catheter valves for indwelling urinary catheters: A systematic review. *Br J Community Nurs.* 2006;11(3):111-2, 114.
141. Crnich CJ, Drinka PJ. Does the composition of urinary catheters influence clinical outcomes and the results of research studies? *Infect Control Hosp Epidemiol.* 2007;28(1):102-103.
142. Reiche T, Lisby G, Jorgensen S, Christensen AB, Nordling J. A prospective, controlled, randomized study of the effect of a slow-release silver device on the frequency of urinary tract infection in newly catheterized patients. *BJU Int.* 2000;85(1):54-59.
143. Schaeffer AJ, Story KO, Johnson SM. Effect of silver oxide/trichloroisocyanuric acid antimicrobial urinary drainage system on catheter-associated bacteriuria. *J Urol.* 1988;139(1):69-73.
144. De Ridder, D. J., Everaert K, Fernandez LG, et al. Intermittent catheterisation with hydrophilic-coated catheters (SpeediCath) reduces the risk of clinical urinary tract infection in spinal cord injured patients: A prospective randomised parallel comparative trial. *Eur Urol.* 2005;48(6):991-995.
145. Cindolo L, Palmieri EA, Autorino R, Salzano L, Altieri V. Standard versus hydrophilic catheterization in the adjuvant treatment of patients with superficial bladder cancer. *Urol Int.* 2004;73(1):19-22.
146. Stensballe J, Looms D, Nielsen PN, Tvede M. Hydrophilic-coated catheters for intermittent catheterisation reduce urethral micro trauma: A prospective, randomised, participant-blinded, crossover study of three different types of catheters. *Eur Urol.* 2005;48(6):978-983.

147. Vapnek JM, Maynard FM, Kim J, Vapnek JM, Maynard FM, Kim J. A prospective randomized trial of the LoFric hydrophilic coated catheter versus conventional plastic catheter for clean intermittent catheterization. *J Urol*. 2003;169(3):994-998.
148. Monson T, Kunin CM. Evaluation of a polymer-coated indwelling catheter in prevention of infection. *J Urol*. 1974;111(2):220-222.
149. Shafik A. The electrified catheter. role in sterilizing urine and decreasing bacteriuria. *World J Urol*. 1993;11(3):183-185.
150. Leone M, Garnier F, Antonini F, Bimar MC, Albanese J, Martin C. Comparison of effectiveness of two urinary drainage systems in intensive care unit: A prospective, randomized clinical trial. *Intensive Care Med*. 2003;29(4):551-554.
151. Classen DC, Larsen RA, Burke JP, Stevens LE. Prevention of catheter-associated bacteriuria: Clinical trial of methods to block three known pathways of infection. *Am J Infect Control*. 1991;19(3):136-142.
152. al-Juburi AZ, Cicmanec J. New apparatus to reduce urinary drainage associated with urinary tract infections. *Urology*. 1989;33(2):97-101.
153. DeGroot-Kosolcharoen J, Guse R, Jones JM. Evaluation of a urinary catheter with a preconnected closed drainage bag. *Infect Control Hosp Epidemiol*. 1988;9(2):72-76.
154. Klarskov P, Bischoff N, Bremmelgaard A, Hald T. Catheter-associated bacteriuria. A controlled trial with bardex(TM) urinary drainage system. *Acta Obstet Gynecol Scand*. 1986;65(4):295-299.
155. Keys TF, Maker MD, Segura JW. Bacteriuria during closed urinary drainage: An evaluation of top-vented versus bag-vented systems. *J Urol*. 1979;122(1):49-51.
156. Platt R, Polk BF, Murdock B, Rosner B. Reduction of mortality associated with nosocomial urinary tract infection. *Lancet*. 1983;1(8330):893-897.
157. Monson TP, Macalalad FV, Hamman JW, Kunin CM. Evaluation of a vented drainage system in prevention of bacteriuria. *J Urol*. 1977;117(2):216-219.
158. Cleland V, Cox F, Berggren H, MacInnis MR. Prevention of bacteriuria in female patients with welling catheters. *Nurs Res*. 1971;20(4):309-318.
159. Seymour C. Audit of catheter-associated UTI using silver alloy-coated foley catheters. *Br J Nurs*. 2006;15(11):598-603.
160. Gentry H, Cope S. Using silver to reduce catheter-associated urinary tract infections. *Nurs Stand*. 2005;19(50):51-54.
161. Madeo M, Davies D, Johnson G, Owen E, Wadsworth P, Martin CR. The impact of using silver alloy urinary catheters in reducing the incidence of urinary tract infections in the critical care setting. *Br J Infect Control*. 2004;5(1):21-24.
162. Rupp ME, Fitzgerald T, Marion N, et al. Effect of silver-coated urinary catheters: Efficacy, cost-effectiveness, and antimicrobial resistance. *Am J Infect Control*. 2004;32(8):445-450.

163. Lai KK, Fontecchio SA, Lai KK, Fontecchio SA. Use of silver-hydrogel urinary catheters on the incidence of catheter-associated urinary tract infections in hospitalized patients. *Am J Infect Control*. 2002;30(4):221-225.
164. Akiyama H, Okamoto S. Prophylaxis of indwelling urethral catheter infection: Clinical experience with a modified foley catheter and drainage system. *J Urol*. 1979;121(1):40-42.
165. Bologna RA, Tu LM, Polansky M, Frainow HD, Gordon DA, Whitmore KE. Hydrogel/silver ion-coated urinary catheter reduces nosocomial urinary tract infection rates in intensive care unit patients: A multicenter study. *Urology*. 1999;54(6):982-987.
166. Newton T, Still JM, Law E. A comparison of the effect of early insertion of standard latex and silver-impregnated latex foley catheters on urinary tract infections in burn patients. *Infect Control Hosp Epidemiol*. 2002;23(4):217-218.
167. Butler HK, Kunin CM. Evaluation of polymyxin catheter lubricant and impregnated catheters. *J Urol*. 1968;100(4):560-566.
168. Mooro H, Kamel M. Prevention of catheter fever by the use of furacin urethral inserts. *J Egypt Med Assoc*. 1966;49(8):550-553.
169. Pachler J, Frimodt-Moller C. A comparison of prelubricated hydrophilic and non-hydrophilic polyvinyl chloride catheters for urethral catheterization. *BJU Int*. 1999;83(7):767-769.
170. Chen TY, Ponsot Y, Carmel M, Bouffard N, Kennelly MJ, Tu LM. Multi-centre study of intraurethral valve-pump catheter in women with a hypocontractile or acontractile bladder. *Eur Urol*. 2005;48(4):628-633.
171. Danchaivijitr S, Chokeloidkaew S, Prutsachativuthi S, Trakulsomboon S. Should the open urinary drainage system be continued? *J Med Assoc Thai*. 1988;71 Suppl 3:14-18.
172. Wille JC, Blusse van Oud Alblas, A., Thewessen EA. Nosocomial catheter-associated bacteriuria: A clinical trial comparing two closed urinary drainage systems. *J Hosp Infect*. 1993;25(3):191-198.
173. Hardyck C, Petrino L. Reducing urinary tract infections in catheterized patients. *Ostomy Wound*. 1998;44(12):36-8, 40, 42-3.
174. Montagnino BA, Gonzales ET, Jr., Roth DR. Open catheter drainage after urethral surgery. *J Urol*. 1988;140(5):1250-1252.
175. Madeo M, Barr B, Owen E. A study to determine whether the use of a pre-connect urinary catheter system reduces the incidence of nosocomial urinary tract infections. *Br J Infect Control*. 2005;6(4):22-25.
176. Leone M, Garnier F, Dubuc M, Bimar MC, Martin C. Prevention of nosocomial urinary tract infection in ICU patients: Comparison of effectiveness of two urinary drainage systems. *Chest*. 2001;120(1):220-224.
177. Blenkharn JJ. Prevention of bacteriuria during urinary catheterization of patients in an intensive care unit: Evaluation of the 'ureofix 500' closed drainage system. *J Hosp Infect*. 1985;6(2):187-193.

178. Drach GW, Lacy SS, Cox CE, 2<sup>nd</sup>. Prevention of catheter-induced post-prostatectomy infection. effects of systemic cephaloridine and local irrigation with neomycin-polymyxin through closed-drainage catheter system. *J Urol*. 1971;105(6):840-842.
179. Plowman R, Graves N, Esquivel J, Roberts JA. An economic model to assess the cost and benefits of the routine use of silver alloy coated urinary catheters to reduce the risk of urinary tract infections in catheterized patients. *J Hosp Infect*. 2001;48(1):33-42.
180. Platt R, Polk BF, Murdock B, Rosner B. Prevention of catheter-associated urinary tract infection: A cost-benefit analysis. *Infect Control Hosp Epidemiol*. 1989;10(2):60-64.
181. Saint S, Veenstra DL, Sullivan SD, Chenoweth C, Fendrick AM. The potential clinical and economic benefits of silver alloy urinary catheters in preventing urinary tract infection. *Arch Intern Med*. 2000;160(17):2670-2675.
182. Niel-Weise BS, van den Broek, P. J. Antibiotic policies for short-term catheter bladder drainage in adults. *Cochrane Libr*. 2006;4.
183. Niel-Weise BS, van den Broek, P. J. Urinary catheter policies for long-term bladder drainage. *Cochrane Libr*. 2006;4.
184. Griffiths R, Fernandez R. Strategies for the removal of short-term indwelling urethral catheters in adults. *Cochrane Libr*. 2007(2).
185. Esposito S, Noviello S, Leone S, Marvaso A, Drago L, Marchetti F, The LSG. A pilot study on prevention of catheter-related urinary tract infections with fluoroquinolones. *J Chemother*. 2006;18(5):494-501.
186. Wazait HD, Patel HR, Van Der Meulen, J. H. P., et al. A pilot randomized double-blind placebo-controlled trial on the use of antibiotics on urinary catheter removal to reduce the rate of urinary tract infection: The pitfalls of ciprofloxacin. *BJU Int*. 2004;94(7):1048-1050.
187. Lukkarinen O, Hellstrom P, Leppilahti M, Kontturi M, Tammela T. Antibiotic prophylaxis in patients with urinary retention undergoing transurethral prostatectomy. *Ann Chir Gynaecol*. 1997;86(3):239-242.
188. Lukkarinen O, Hellstrom P, Leppilahti M, Kontturi M, Tammela T. Prospective randomized open study between ciprofloxacin and a combination of sulfadiazine and trimethoprim in antibiotic prophylaxis in connection with transurethral prostatectomy. *Scand J Urol Nephrol*. 1996;30(1):33-36.
189. Vollaard EJ, Clasener HA, Zambon JV, Joosten HJ, van Griethuysen, AJ. Prevention of catheter-associated gram-negative bacilluria with norfloxacin by selective decontamination of the bowel and high urinary concentration. *J Antimicrob Chemother*. 1989;23(6):915-922.
190. Grabe M, Forsgren A, Hellsten S. A short antibiotic course given in conjunction with and after catheter removal consecutive to transurethral prostatic resection. *Scand J Urol Nephrol*. 1984;18(3):193-199.
191. Little PJ, Pearson S, Peddie BA, Greenslade NF, Utley WL. Amoxicillin in the prevention of catheter-induced urinary infection. *J Infect Dis*. 1974;129(0):suppl:S241-2.
192. Clarke SA, Samuel M, Boddy SA. Are prophylactic antibiotics necessary with clean intermittent catheterization? A randomized controlled trial. *J Pediatr Surg*. 2005;40(3):568-571.

193. Waites KB, Canupp KC, Armstrong S, DeVivo MJ. Effect of cranberry extract on bacteriuria and pyuria in persons with neurogenic bladder secondary to spinal cord injury. *J Spinal Cord Med*. 2004;27(1):35-40.
194. Firestein M, Mendelson G, Gronich D, Granot E, Ben-Israel J, Raz R. Can antibiotic use during routine replacement of long-term urinary catheter prevent bacteriuria? *Infectious Diseases in Clinical Practice*. 2001;10(3):133-135.
195. Schlager TA, Anderson S, Trudell J, Hendley JO. Effect of cranberry juice on bacteriuria in children with neurogenic bladder receiving intermittent catheterization. *J Pediatr*. 1999;135(6):698-702.
196. Schiotz HA, Guttu K. Value of urinary prophylaxis with methenamine in gynecologic surgery. *Acta Obstet Gynecol Scand*. 2002;81(8):743-746.
197. Tyreman NO, Andersson PO, Kroon L, Orstam S. Urinary tract infection after vaginal surgery. effect of prophylactic treatment with methenamine hippurate. *Acta Obstet Gynecol Scand*. 1986;65(7):731-733.
198. Pearman JW, Bailey M, Harper WE, Pearman JW, Bailey M, Harper WE. Comparison of the efficacy of "trisdine" and kanamycin-colistin bladder instillations in reducing bacteriuria during intermittent catheterisation of patients with acute spinal cord trauma. *Br J Urol*. 1988;62(2):140-144.
199. Pearman JW, Bailey M, Riley LP. Bladder instillations of trisdine compared with catheter introducer for reduction of bacteriuria during intermittent catheterisation of patients with acute spinal cord trauma. *Br J Urol*. 1991;67(5):483-490.
200. Adesanya AA, Osegbe DN, Amaku EO. The use of intermittent chlorhexidine bladder irrigation in the prevention of post-prostatectomy infective complications. *Int Urol Nephrol*. 1993;25(4):359-367.
201. Ball AJ, Carr TW, Gillespie WA, Kelly M, Simpson RA, Smith PJ. Bladder irrigation with chlorhexidine for the prevention of urinary infection after transurethral operations: A prospective controlled study.[see comment]. *J Urol*. 1987;138(3):491-494.
202. van den Broek, P. J., Daha TJ, Mouton RP. Bladder irrigation with povidone-iodine in prevention of urinary-tract infections associated with intermittent urethral catheterisation. *Lancet*. 1985;1(8428):563-565.
203. Savage JE, Phillips B, Lifshitz S, et al. Bacteriuria in closed bladder drainage versus continuous irrigation in patients undergoing intracavitary radium for treatment of gynecologic cancer. *Gynecol Oncol*. 1982;13(1):26-30.
204. Kirk D, Dunn M, Bullock DW, Mitchell JP, Hobbs SJ. Hibitane bladder irrigation in the prevention of catheter-associated urinary infection. *Br J Urol*. 1979;51(6):528-531.
205. Chamberlain G, Holt E. Automatic bladder irrigation after vaginal surgery. *Br J Urol*. 1975;47(6):641-643.
206. Clark LW. Neomycin in the prevention of postcatheterization bacteriuria. *Med J Aust*. 1973;1(21):1034-1036.
207. Washington EA. Instillation of 3% hydrogen peroxide or distilled vinegar in urethral catheter drainage bag to decrease catheter-associated bacteriuria. *Biol Res Nurs*. 2001;3(2):78-87.

208. Sweet DE, Goodpasture HC, Holl K, Smart S, Alexander H, Hedari A. Evaluation of H<sub>2</sub>O<sub>2</sub> prophylaxis of bacteriuria in patients with long-term indwelling foley catheters: A randomized controlled study. *Infect Control*. 1985;6(7):263-266.
209. Thompson RL, Haley CE, Searcy MA, et al. Catheter-associated bacteriuria. failure to reduce attack rates using periodic instillations of a disinfectant into urinary drainage systems. *JAMA*. 1984;251(6):747-751.
210. Gillespie WA, Simpson RA, Jones JE, Nashef L, Teasdale C, Speller DC. Does the addition of disinfectant to urine drainage bags prevent infection in catheterised patients? *Lancet*. 1983;1(8332):1037-1039.
211. Maizels M, Schaeffer AJ. Decreased incidence of bacteriuria associated with periodic instillations of hydrogen peroxide into the urethral catheter drainage bag. *J Urol*. 1980;123(6):841-845.
212. Webster J, Hood RH, Burrig CA, Doidge ML, Phillips CM, George N. Water or antiseptic for periurethral cleaning before urinary catheterization: A randomized controlled trial. *Am J Infect Control*. 2001;29(6):389-394.
213. Bardwell TA. Comparing meatal cleansing. *Aust Nurs J*. 1999;7(2):30-31.
214. Sanderson PJ, Weissler S. A comparison of the effect of chlorhexidine antiseptics, soap and antibiotics on bacteriuria, perineal colonization and environmental contamination in spinally injured patients. *J Hosp Infect*. 1990;15(3):235-243.
215. Burke JP, Garibaldi RA, Britt MR, Jacobson JA, Conti M, Alling DW. Prevention of catheter-associated urinary tract infections. efficacy of daily meatal care regimens. *Am J Med*. 1981;70(3):655-658.
216. Ross PW, Smylie HG. A comparison of two regimes of catheterisation in the prophylaxis of urinary tract infection in gynaecological patients. *Br J Urol*. 1966;38(2):194-198.
217. Keerasuntonpong A, Thearawiboon W, Panthawan A, et al. Incidence of urinary tract infections in patients with short-term indwelling urethral catheters: A comparison between a 3-day urinary drainage bag change and no change regimens. *Am J Infect Control*. 2003;31(1):9-12.
218. Dille CA, Kirchhoff KT, Sullivan JJ, Larson E. Increasing the wearing time of vinyl urinary drainage bags by decontamination with bleach. *Arch Phys Med Rehabil*. 1993;74(4):431-437.
219. Priefer BA, Duthie EH, Jr., Gambert SR. Frequency of urinary catheter change and clinical urinary tract infection. study in hospital-based, skilled nursing home. *Urology*. 1982;20(2):141-142.
220. Fera P, Glashan RQ, Bruschini H, Lelis MAS, Baretta MCC, Srougi M. Lubricated urethral catheters with lidocaine versus gentamycin for clean intermittent catheterization. *International Braz J Urol*. 2002;28(1):50-56.
221. Giannantoni A, Di Stasi SM., Scivoletto G, Virgili G, Dolci S, Porena M. Intermittent catheterization with a prelubricated catheter in spinal cord injured patients: A prospective randomized crossover study. *J Urol*. 2001;166(1):130-133.

222. Cohen A. A microbiological comparison of a povidone-iodine lubricating gel and a control as catheter lubricants. *J Hosp Infect.* 1985;6 Suppl A:155-161.
223. Kunin CM, Finkelberg Z. Evaluation of an intraurethral lubricating catheter in prevention of catheter-induced urinary tract infections. *J Urol.* 1971;106(6):928-930.
224. Darouiche RO, Goetz L, Kaldis T, Cerra-Stewart C, AlSharif A, Priebe M. Impact of StatLock securing device on symptomatic catheter-related urinary tract infection: A prospective, randomized, multicenter clinical trial. *Am J Infect Control.* 2006;34(9):555-560.
225. Darouiche RO, Thornby JL, Cerra-Stewart C, Donovan WH, Hull RA. Bacterial interference for prevention of urinary tract infection: A prospective, randomized, placebo-controlled, double-blind pilot trial. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America.* 2005;41(10):1531-1534.
226. Moore KN. Two methods for cleaning catheters used for intermittent catheterization: Sunlight(TM) liquid detergent and cetrimide 1:30 (savlon(TM)). *Canadian Journal of Rehabilitation.* 1990;4(2):87-92.
227. Alessandri F, Mistrangelo E, Lijoi D, Ferrero S, Ragni N. A prospective, randomized trial comparing immediate versus delayed catheter removal following hysterectomy. *Acta Obstet Gynecol Scand.* 2006;85(6):716-720.
228. Schiotz HA. Comparison of 1 and 3 days' transurethral foley catheterization after vaginal plastic surgery. *International Urogynecology Journal.* 1995;6(3):158-161.
229. Polliack T, Bluvshstein V, Philo O, et al. Clinical and economic consequences of volume- or time-dependent intermittent catheterization in patients with spinal cord lesions and neuropathic bladder (structured abstract). *Spinal Cord.* 2005;43(10):615-619.
230. Anton HA, Chambers K, Clifton J, Tasaka J. Clinical utility of a portable ultrasound device in intermittent catheterization. *Archives of Physical Medicine & Rehabilitation.* 1998;79(2):172-175.
231. Moyad RH, Persky L. Vesical irrigation and urosepsis. *Invest Urol.* 1968;6(1):21-25.
232. Shohet I, Alagam M, Shafir R, Tsur H, Cohen B. Postoperative catheterization and prophylactic antimicrobials in children with hypospadias. *Urology.* 1983;22(4):391-393.
233. Anonymous. Evaluation of aseptic techniques and chlorhexidine on the rate of catheter-associated urinary-tract infection. southampton infection control team. *Lancet.* 1982;1(8263):89-91.
234. Cafferkey MT, Conneely B, Falkiner FR, Gillespie WA, Murphy D. Post-operative urinary infection and septicaemia in urology. *J Hosp Infect.* 1980;1(4):315-320.
235. Salomon J, Denys P, Merle C, et al. Prevention of urinary tract infection in spinal cord-injured patients: Safety and efficacy of a weekly oral cyclic antibiotic (WOCA) programme with a 2 year follow-up - an observational prospective study. *J Antimicrob Chemother.* 2006;57(4):784-788.

236. Wibell L, Scheynius A, Norrman K. Methenamine-hippurate and bacteriuria in the geriatric patient with a catheter. *Acta Med Scand*. 1980;207(6):469-473.
237. Kostiala AA, Nyren P, Jokinen EJ, Runeberg L. Prospective study on the appearance of antibody-coated bacteria in patients with an indwelling urinary catheter. *Nephron*. 1982;30(3):279-285.
238. Nyren P, Runeberg L, Kostiala AI, Renkonen OV, Roine R. Prophylactic methenamine hippurate or nitrofurantoin in patients with an indwelling urinary catheter. *Ann Clin Res*. 1981;13(1):16-21.
239. Norrman K, Wibell L. Treatment with methenamine hippurate in the patient with a catheter. *J Int Med Res*. 1976;4(2):115-117.
240. Pearman JW. The value of kanamycin-colistin bladder instillations in reducing bacteriuria during intermittent catheterisation of patients with acute spinal cord injury. *Br J Urol*. 1979;51(5):367-374.
241. Cox F, Smith RF, Elliott JP, Quinn EL. Neomycin-polymyxin prophylaxis of urinary-tract infection associated with indwelling catheters. *Antimicrob Agents Chemother*. 1966;6:165-168.
242. Thornton GF, Lytton B, Andriole VT. Bacteriuria during indwelling catheter drainage. effect of constant bladder rinse. *JAMA*. 1966;195(3):179-183.
243. Wongsatanapong W. Prevention of urinary tract infection by instillation of chlorhexidine into urinary drainage bags. *J Med Assoc Thai*. 1988;71 Suppl 3:19-21.
244. Sujka SK, Petrelli NJ, Herrera L. Incidence of urinary tract infections in patients requiring long-term catheterization after abdominoperineal resection for rectal carcinoma: Does betadine(TM) in the foley drainage bag make a difference? *European Journal of Surgical Oncology*. 1987;13(4):341-343.
245. Samuels P, Fisher P. The use of hydrogen peroxide in catheter drainage units. *AUAA J*. 1983;3(3):5-9.
246. Koskeroglu N, Durmaz G, Bahar M, Kural M, Yelken B. The role of meatal disinfection in preventing catheter-related bacteriuria in an intensive care unit: A pilot study in turkey. *J Hosp Infect*. 2004;56(3):236-238.
247. Matsumoto T, Sakumoto M, Takahashi K, Kumazawa J. Prevention of catheter-associated urinary tract infection by meatal disinfection. *Dermatology*. 1997;195 Suppl 2:73-77.
248. Stelling JD, Hale AM. Protocol for changing condom catheters in males with spinal cord injury. *SCI Nurs*. 1996;13(2):28-34.
249. Reid RI, Webster O, Pead PJ, Maskell R. Comparison of urine bag-changing regimens in elderly catheterised patients. *Lancet*. 1982;2(8301):754-756.
250. Kambal C, Chance J, Cope S, Beck J. Catheter-associated UTIs in patients after major gynaecological surgery. *Prof Nurse*. 2004;19(9):515-518.
251. Schiotz HA. Antiseptic catheter gel and urinary tract infection after short-term postoperative catheterization in women. *Arch Gynecol Obstet*. 1996;258(2):97-100.
252. Harrison LH. Comparison of a microbicidal povidone-iodine gel and a placebo gel as catheter lubricants. *J Urol*. 1980;124(3):347-349.



253. Chavigny KH. The use of polymixin B as a urethral lubricant to reduce the post-instrumental incidence of bacteriuria in females. an exploratory study. *Int J Nurs Stud.* 1975;12(1):33-42.
254. Nooyen RL. Prophylaxis of catheter-induced urinary tract infection in obstetric patients. *J Am Osteopath Assoc.* 1966;66(3):324-326.
255. Sims L, Ballard N. A comparison of two methods of catheter cleansing and storage used with clean intermittent catheterization. *Rehabil Nurs Res.* 1993;2(2):87-92.
256. Wald H, Epstein A, Kramer A. Extended use of indwelling urinary catheters in postoperative hip fracture patients. *Med Care.* 2005;43(10):1009-1017.
257. Wyatt TD, Timoney R. The effect of introducing a policy for catheter care on the catheter infection rate in a small hospital. *J Hosp Infect.* 1987;9(3):230-234.
258. Hoy WE, Kissel SM, Freeman RB, Sterling WA, Jr. Altered patterns of posttransplant urinary tract infections associated with perioperative antibiotics and curtailed catheterization. *Am J Kidney Dis.* 1985;6(4):212-216.
259. Pickard WG, Grundy DJ. A comparison of two methods of sterile urethral catheterisation in spinal cord injured adults. *Paraplegia.* 1996;34(1):30-33.
260. Jain M, Miller L, Belt D, King D, Berwick DM. Decline in ICU adverse events, nosocomial infections and cost through a quality improvement initiative focusing on teamwork and culture change. *Qual Saf Health Care.* 2006;15(4):235-239.
261. Reilly L, Sullivan P, Ninni S, Fochesto D, Williams K, Fetherman B. Reducing foley catheter device days in an intensive care unit: Using the evidence to change practice. *AACN Adv Crit Care.* 2006;17(3):272-283.
262. Verdier R, Parer S, Jean-Pierre H, Dujols P, Picot MC. Impact of an infection control program in an intensive care unit in france. *Infect Control Hosp Epidemiol.* 2006;27(1):60-66.
263. Topal J, Conklin S, Camp K, Morris V, Balcezak T, Herbert P. Prevention of nosocomial catheter-associated urinary tract infections through computerized feedback to physicians and a nurse-directed protocol. *Am J Med Qual.* 2005;20(3):121-126.
264. Misset B, Timsit JF, Dumay MF, et al. A continuous quality-improvement program reduces nosocomial infection rates in the ICU. *Intensive Care Med.* 2004;30(3):395-400.
265. Rosenthal VD, Guzman S, Safdar N. Effect of education and performance feedback on rates of catheter-associated urinary tract infection in intensive care units in argentina. *Infect Control Hosp Epidemiol.* 2004;25(1):47-50.
266. Berg DE, Hershow RC, Ramirez CA, Weinstein RA. Control of nosocomial infections in an intensive care unit in guatemala city. *Clin Infect Dis.* 1995;21(3):588-593.
267. Cools HJ, van der Meer JW. Infection control in a skilled nursing facility: A 6-year survey. *J Hosp Infect.* 1988;12(2):117-124.

268. Saint S, Kaufman SR, Thompson M, Rogers MA, Chenoweth CE. A reminder reduces urinary catheterization in hospitalized patients. *Jt Comm J Qual Patient Saf.* 2005;31(8):455-462.
269. Huang WC, Wann SR, Lin SL, et al. Catheter-associated urinary tract infections in intensive care units can be reduced by prompting physicians to remove unnecessary catheters. *Infect Control Hosp Epidemiol.* 2004;25(11):974-978.
270. Cornia PB, Amory JK, Fraser S, Saint S, Lipsky BA. Computer-based order entry decreases duration of indwelling urinary catheterization in hospitalized patients. *Am J Med.* 2003;114(5):404-407.
271. Jacobson JA, Burke JP, Kasworm E. Effect of bacteriologic monitoring of urinary catheters on recognition and treatment of hospital-acquired urinary tract infections. *Infect Control.* 1981;2(3):227-232.
272. Fendler EJ, Ali Y, Hammond BS, Lyons MK, Kelley MB, Vowell NA. The impact of alcohol and sanitizer use on infection rates in an extended care facility. *Am J Infect Control.* 2002;30(4):226-233.
273. Fryklund B, Haeggman S, Burman LG. Transmission of urinary bacterial strains between patients with indwelling catheters - nursing in the same room and in separate rooms compared. *J Hosp Infect.* 1997;36(2):147-153.
274. Wyndaele JJ, De Taeye N. Early intermittent self-catheterisation after spinal cord injury. *Paraplegia.* 1990;28(2):76-80.
275. Goetz AM, Kedzuf S, Wagener M, Muder RR. Feedback to nursing staff as an intervention to reduce catheter-associated urinary tract infections. *Am J Infect Control.* 1999;27(5):402-404.
276. Dumigan DG, Kohan CA, Reed CR, Jekel JF, Fikrig MK. Utilizing national nosocomial infection surveillance system data to improve urinary tract infection rates in three intensive-care units. *Clin Perform Qual Health Care.* 1998;6(4):172-178.
277. Mayes J, Bliss J, Griffiths P. Preventing blockage of long-term indwelling catheters in adults: Are citric acid solutions effective? *Br J Community Nurs.* 2003;8(4):172-175.
278. Muncie HL, Jr., Hoopes JM, Damron DJ, Tenney JH, Warren JW. Once-daily irrigation of long-term urethral catheters with normal saline. lack of benefit. *Arch Intern Med.* 1989;149(2):441-443.
279. Kunin CM, Chin QF, Chambers S. Formation of encrustations on indwelling urinary catheters in the elderly: A comparison of different types of catheter materials in "blockers" and "nonblockers". *J Urol.* 1987;138(4):899-902.
280. Burns JR, Gauthier JF. Prevention of urinary catheter incrustations by acetohydroxamic acid. *J Urol.* 1984;132(3):455-456.
281. Ruwaldt MM. Irrigation of indwelling urinary catheters. *Urology.* 1983;21(2):127-129.

# ICS teaching module: Clinical stress test for urinary incontinence

ML Guralnick, X Fritel, T Tarcan, M Espuna-Pons,  
PFWM Rosier

*The ICS grants permission to use the PowerPoint slide set in educational environment with the proviso that the set remains unchanged, the ICS branding remains and is for non-commercial use. The ICS does not need prior approval for use of this slide set.*

*For commercial use please contact the ICS Office.*



**International Continence Society**  
Educational Module

## Clinical Testing For SUI – Cough Stress Test (CST)

*International Consultation Incontinence*  
(ICS Standard Terminology 2002)

- The stress test involves observation for urine loss with coughing or Valsalva manoeuvre ...
- Can be used to help make the diagnosis of SUI (objective test done in clinic) especially prior to surgical management
- Can be used as objective outcome measure when reporting treatment effects.

## Endorsed By Many Societies

- French College of Gynaecologists and Obstetricians (CNGOF)

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- International Federation of Gynecology and Obstetrics (FIGO)

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- International Urogynecological Association (IUGA)

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- American College of Obstetricians and Gynecologists (ACOG)

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

## Reliability of CST (UDS as gold standard)

- CST combined with the symptom of SUI:

- PPV 98-99%

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- CST with simple bladder filling:

- Sensitivity 88%
- Specificity 77%
- PPV 82%
- NPV 84%

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- Agreement between CST and UDS:

- 88% ( $\kappa=0.81$ )

“The ICS Education Module is a valuable tool for the education of gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians. It is a must-read for all gynaecologists and obstetricians.”

- Agreement between CST and 24 hr pad test:

- 87% ( $\kappa=0.76$ )

## No Standardization of Performance/Reporting of CST

- Variables to consider:
  - Patient position (supine/lithotomy/seated/standing)
  - Bladder volume and method of determination
  - Number of coughs
  - Method of SUI detection

## Many Reports Fail to Describe How The CST Was Done



- position includes: supine/lithotomy, semi-lithotomy, seated, standing
- \*\* bladder volumes include: "empty", "comfortably/comfortably full", "full, 100-300ml"
- \*\*\* natural/blow-ingrade 40-60ml/min (coughs done during ICS)
- number of coughs ranged from 1-10 or reported as "a series of coughs"
- visual observation of incontinence or just feeling

## ICS Uniform Cough Stress Test (ICS-UCST)

Provisional (consensus)

- To standardise performance/reporting of CST to allow for easier, more consistent interpretation
- Recommendations of ICS working group based on review of more than 200 articles that have some mention of stress test
- To be done during uro-gynecological examination

### Inform patient:

- ... there are diverse causes of urinary incontinence
- ... physical effort as one of the causes will be tested
- ... through a forceful cough during the clinical examination
  - vaginal inspection
- ... not pleasant, nor elegant, but helps select the best management

## ICS-UCST Variables

(Evidence base in accompanying manuscript)

- Patient Position:
  - Supine/lithotomy
- Bladder volume:
  - 200-400mL
- Method of bladder filling:
  - Natural:
    - Patient allowed to present with comfortably full bladder
    - Use ultrasound or voided volume + PEF after ICS-UCST to determine
  - Retrograde:
    - Specific volume instilled by examiner

## ICS-UCST Variables:

- Number of coughs (up to 4):
  - Patient coughs forcefully x 1
  - If no SUI, patient then coughs 3 more times
    - If SUI noted after 1 cough, additional coughs not needed
- Method of SUI detection:
  - Examiner spreads labia and directly visualizes leakage of urine per urethral meatus

## Interpretation ICS-UCST:

- ICS-UCST is **positive** when urine (fluid) is observed, leaving the meatus *coincident/simultaneous* to one or more of the coughs
- ICS-UCST is **negative** when there is no urine (fluid) lost or leakage of urine (fluid) lasts longer than the cough/delayed from the cough (cough induced detrusor overactivity)
  - Report: '... incontinence is not demonstrated during ICS-UCST.'

## Other Tests (Accessory Stress Tests):

- 'Stress tests-variants'
  - In other positions or with alternate provocation
    - Standing / seated
      - Generally recommended that upright CST be done if supine CST is negative in patient with complaint of SLB
    - Strain / Valsalva
  - Other bladder volumes:
    - Empty (Supine Empty Stress Test: SEST) – may help identify potential intrinsic sphincter deficiency
    - 'Full bladder' (>400ml)
- Cystometry [e.g. LPP testing]:
  - Confirming or refuting ICSUI



## Scientific Reporting

- Report proportion (%) of patients (recruited or included) with:
  - Positive ICS-UCST
  - Positive accessory tests (specify)
  - Cystometry

## Conclusion:

- ICS-Uniform Cough Stress Test is presented
  - ICS-UCST:
    - Supine/lithotomy position
    - Bladder volume 200-400mL
    - 1-4 forceful coughs
    - Incontinence seen coincident/simultaneous to the cough(s)
- Accessory stress tests may be used when ICS-UCST negative to further clarify diagnosis
  - Not standardized

## Future

- Validity of ICS-UCST should be determined/quantified:
  - Specificity
  - Sensitivity (compare with accessory tests; UDS)
  - Predictive value towards outcome of management

# Thank you!

*The ICS grants permission to use the PowerPoint slide set in educational environment with the proviso that the set remains unchanged, the ICS branding remains and is for non-commercial use. The ICS does not need prior approval for use of this slide set.*

*For commercial use please contact the ICS Office.*





# ICS Educational Module: Cough stress test in the evaluation of female urinary incontinence: Introducing the ICS-Uniform Cough Stress Test

Michael L. Guralnick<sup>1</sup> | Xavier Fritel<sup>2</sup> | Tufan Tarcan<sup>3</sup> |  
Montserrat Espuna-Pons<sup>4</sup> | Peter F. W. M. Rosier<sup>5</sup>

<sup>1</sup> Medical College of Wisconsin,  
Milwaukee, Wisconsin

<sup>2</sup> Faculté de Médecine et Pharmacie,  
Université de Poitiers, Poitiers, France

<sup>3</sup> Marmara University School of Medicine,  
Istanbul, Turkey

<sup>4</sup> ICGON, Hospital Clínic., University of  
Barcelona, Barcelona, Spain

<sup>5</sup> University Medical Center Utrecht,  
Utrecht, The Netherlands

## Correspondence

Michael L. Guralnick, MD, FRCSC,  
Medical College of Wisconsin, Milwaukee,  
WI 53226.  
Email: mguralni@mcw.edu

**Introduction:** A cough stress test (CST) is recommended in the evaluation of the uncomplicated female patient with the complaint of stress urinary incontinence (SUI) to identify the sign of SUI, and is often used as an outcome measure following SUI treatment. However, there has been no standardization of the performance or reporting of CST. A working group of the International Continence Society (ICS) has developed an educational module, comprising a Powerpoint™ presentation and evidence base manuscript, to instruct on the performance, interpretation, and reporting of the CST in a standardized manner: the ICS-Uniform Cough Stress Test (ICS-UCST).

**Methods:** The working group performed a PUBMED literature search of articles (observational/experimental and reviews) published prior to 2017 that mentioned a CST. The evidence base examined various variables in performing a CST as well as sensitivity/specificity and positive/negative predictive values of CST.

**Results:** The variables involved in performing/interpreting an ICS-UCST include: patient positioning, degree of bladder filling, number, and forcefulness of coughs, and method of SUI detection. For the ICS-UCST it is recommended that the patient be in a supine/lithotomy position with 200-400 mL of fluid in the bladder. She coughs forcefully 1-4 times and the examiner directly visualizes the urethral meatus for the presence of leakage. Leakage of fluid from the urethral meatus coincident with/simultaneous to the cough(s) is considered a positive test.

**Conclusion:** This module provides instructions to educate a uniform CST (the ICS-UCST), with the aim of improving the clinical practice of cough stress testing in female patients with urinary incontinence.

## KEYWORDS

cough stress test, stress urinary incontinence

## 1 | INTRODUCTION

Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

The cough stress test (CST) is a clinical test used in the evaluation of urinary incontinence (UI). The patient coughs

and the visualization of urine loss synchronous with the cough confirms the presence of stress urinary incontinence (SUI).<sup>1</sup> CST is used to objectively make the diagnosis of SUI<sup>2</sup> and assess the outcome of treatment for SUI.<sup>3,4</sup> Its use in the evaluation of UI (when symptoms of SUI are expressed; the SUI syndrome: SUI-S<sup>5</sup>) has been endorsed by several societies including the French College of Gynecologists and Obstetricians; International Federation of Gynecology and Obstetrics (FIGO); International Urogynecological Association (IUGA), and American College of Obstetricians and Gynecologists.<sup>2,6–8</sup> Although the European Association of Urology guideline is brief about this test, the recent American Urological Association guideline considers it a sine qua non for the diagnosis of SUI.<sup>9,10</sup> Based on their review, the FIGO working group recommended all patients being evaluated for SUI-S should have a CST (Grade A)<sup>8</sup> and in a research context, CST has been the most commonly used measure for evaluating the outcome of SUI surgery.<sup>3,4</sup> Despite the support for the CST, standardization of how to perform a CST does not exist. The ICS Urodynamics Committee presents the teaching module “Cough stress test in the evaluation of female urinary incontinence” to serve as a standard for educating a CST for the evaluation of female UI and/or SUI-S.

A new ICS term for the CST is introduced: ICS Uniform Cough Stress Test (ICS-UCST) because the secondary aim of this module is to uniformize, by teaching, CST for clinical routine and research. This manuscript provides the evidence base for the ICS educational PowerPoint™ presentation that accompanies this module as well as the arguments for the uniformization. The aim of this module is to educate the utilization and interpretation of the CST which will hopefully improve and facilitate the clinical diagnosis of SUI and the assessment/reporting of SUI treatment outcomes.

## 2 | METHODS

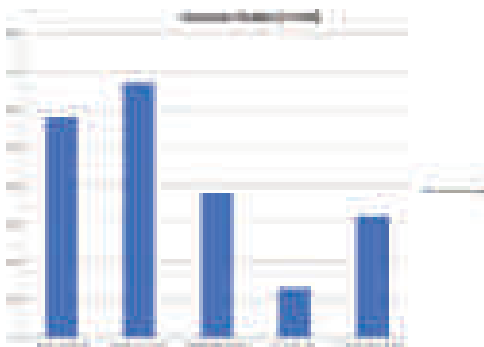
The working group for this module did an extensive literature review of more than 200 articles published prior to 2017 that mention a cough stress test, via a PUBMED online search using the terms “cough and stress test and incontinence.” These included observational/experimental studies as well as review articles. References used specifically for this manuscript are provided at the end and a full references list in an accessory file on the publisher's website.

### 2.1 | The evidence base for standardization of CST

There is general consensus that the CST in combination with the SUI-S is reliable in confirming that the pathophysiology of the UI is SUI.<sup>11–18</sup> In a review of the

literature to determine the predictive value of the clinical evaluation of SUI (history, physical exam with CST) using multichannel UDS as the comparator, it was found that for the diagnosis of genuine SUI, the CST alone had sensitivity (sens:) 57%, specificity (spec:) 71%, positive predictive value (PPV) of 55% and negative predictive value (NPV) of 73%.<sup>15</sup> However, when other UDS diagnoses (eg, mixed incontinence) were included, the PPV was 91%, indicating that CST had been demonstrating UI but not “uncomplicated SUI” in all patients. When combined with the symptoms of SUI-S, the CST had a PPV of 78–97%.<sup>15</sup> A randomized trial of UDS prior to SUI surgery observed that an office evaluation including a CST correctly identified 97% of women found to have SUI on UDS and the demonstration of SUI during UDS subsequent to a positive CST did not improve the treatment success of SUI surgery.<sup>12</sup> In a prospective study, when CST was compared to multichannel UDS and 24 h pad testing the agreement between UDS and CST was 89% ( $k = 0.51$ ), whereas agreement between UDS and 24 h pad test was only 60% ( $k = 0.08$ ) and agreement between the CST and 24 h pad test was only 67% ( $k = 0.26$ ).<sup>16</sup> Using UDS as the reference, the sens, spec, PPV and NPV of the CST were 90%, 80%, 98%, and 44% respectively. CST during single channel cystometry was compared to CST during multichannel UDS in another prospective study<sup>13</sup> that alternated the gold standard for diagnosing SUI (a cough UPP during multichannel UDS versus CST and simple CMG). No significant difference between the two methods was seen with both having sens, spec, PPV, and NPV between 80% and 87%. In a similar study, when CST with simple bladder filling was compared to CST during multichannel UDS (using CST during UDS as the gold standard),<sup>14</sup> for the diagnosis of SUI the CST with simple bladder filling had a sens 88%, spec 77%; PPV 82% and NPV 84%. It was concluded that CST with simple bladder filling is a reliable method of diagnosing SUI and can replace complex UDS which is in keeping with an assessment of AHCPR criteria for predicting SUI clinically (using UDS as the gold standard) that found that the most helpful criterion was the CST which had sens 93%; spec 56%; PPV 68% and NPV 89%.<sup>17</sup>

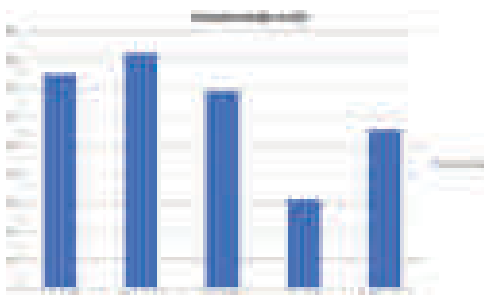
Despite the evidence supporting the use of CST there has not been any standardization of the performance or reporting of CST. In fact, in reviewing 208 studies that make mention of a CST (outcome assessment studies, test evaluation studies) we found that only 62% specified the patient positioning, 71% the bladder volume, 45% the method of filling, 17% the number of coughs and 38% the method of SUI determination (Figures 1 and 2). The lack of standardization makes every statement about the predictive value of (history and) clinical examination (and CST) on the outcome of management for UI difficult to evaluate and/or impossible to extrapolate.



**FIGURE 1** Studies assessing the outcome of a treatment intervention that mentioned using a CST (references online). \*Positioning included: supine/lithotomy, semi-lithotomy, seated, standing. \*\*Bladder volumes included “empty,” “comfortably/symptomatically full,” “full,” 100-700 mL. \*\*\*Natural fill or retrograde fill via catheter (often done during UDS). ^Number of coughs ranged from 1 to 10 or reported as “a series of coughs.” ^^Direct visualization of incontinence or pad testing

## 2.2 | Educating the ICS-UCST

From the available evidence we have selected the elements of CST: (1) preparation for the test; (2) performing the test: (a) patient positioning; (b) bladder volume; (c) number of coughs; (d) leakage detection; and (3) interpretation and reporting of the test. On the basis of our review of the evidence, we propose, to educate the elements of the CST to be performed in a standard manner, the ICS-UCST (Figure 3).



**FIGURE 2** Studies looking at the evaluation of incontinence (e.g. studies assessing clinical factors contributing to incontinence, studies evaluating the performance of UDS, that mentioned using a CST (references online). \*Positioning included: supine/lithotomy, semi-lithotomy, seated, standing. \*\*Bladder volumes included “empty,” “comfortably/symptomatically full,” “full,” 100-700 mL. \*\*\*Natural fill or retrograde fill via catheter (often done during UDS). ^Number of coughs ranged from 1 to 10 or reported as “a series of coughs.” ^^Direct visualization of incontinence or pad testing

The education of the ICS-Uniform Cough Stress Test includes the explanation of the instructions:	
<b>The physician should:</b>	
• Explain to the patient before or during clinical exam in lithotomy position that the ICS-UCST is one of the tests that is used to unravel the nature/origin of the urinary incontinence	
• That the test may be embarrassing, however considered valuable and necessary	
• Ask the patient about bladder fullness (see below)	
• Be aware of the usual voided volumes (and frequency)	
<b>The physician:</b>	
• Has instructed the patient to be in supine/lithotomy position and is able to observe the meatus	
• Considers likelihood that the present intravesical volume, during the test, is representative for this patient and between 200 and 400mL	
• Asks the patient to cough as forceful as possible and if no leakage is observed, asks to cough 3 more times, as forceful as possible	
<b>The physician:</b>	
• Objectively determines what the intravesical volume is or has been during the CST	
• Reports that the ICS-UCST has been 'positive with ***mL' or 'negative'	
• Considers repeating CST (up to 4 coughs) in standing position and reports the standing accessory CST to be positive or negative	
• Considers complimentary or accessory evaluation to determine the pathophysiology as the cause of the UI*	
* In a patient with UI or more specifically with SUI-S, a negative ICS-UCST and a negative accessory CST, an ICS standard pad test <sup>19</sup> and/or (full) urodynamic testing may be considered to evaluate the complete lower urinary tract function, as per current practice guidelines.	

**FIGURE 3** Educating the ICS-UCST

### 2.2.1 | Preparation

A cough stress test is typically performed during the physical examination of the patient in the outpatient clinic, but can be done at the time of a procedure or during urodynamic testing. The last being a urodynamic stress test and/or leak point pressure (LPP) determination. Practice and validity of (UDS-) LPP testing are not further discussed but are summarized, for example, in the ICI-consultation report.<sup>18</sup>

We believe that before the ICS-UCST the patient should be informed about the relevance and rationale for performing the test and also the potential embarrassing nature of the test. Apart from undressing the lower part of the body and some issues mentioned below, the patient does not have to prepare herself specifically for the test.

### 2.2.2 | Technique

#### Patient position

A CST can be performed in the supine, semi supine, standing, sitting, or lithotomy positions. In the supine position (using pads to measure the leakage), it was noted that only 49% of women leaked during the cough stress test (when floor and trampoline jumping were used as the comparator).<sup>19</sup> In addition, CST was negative when done in a semi-supine position in 14% of patients who complain of SUI in another study on the effects of a UDS catheter on the diagnosis of SUI.<sup>20</sup> Furthermore, it has been noted that during LPP testing (done during CMG with a catheter in place), both Valsalva LPP and CLPP are significantly lower when the patient is standing versus supine.<sup>21</sup>

However, probably the most convenient time to do a CST is when the patient is undergoing a vaginal exam in the supine/lithotomy position (legs either in stirrups or abducted in a “frog-leg” position), when one assesses vaginal anatomy and pelvic floor function. This positioning allows for relatively easy visualization of the urethral meatus for the occurrence of urine leakage.

Because of the observed potential for a false negative in the supine position, reported in some cohort studies, it has been recommended that patients undergo a CST in the upright position, especially if they had a negative test in the supine position.<sup>7,8</sup> However, having the patient stand for the CST requires more effort on the examiner's part to expose the urethral meatus for visualization of the leakage. As well, not all patients are able to stand on their own, and testing in the standing position may therefore be less relevant and/or representative in these patients. Furthermore, it is currently unknown if the pathophysiology of a patient who has a positive CST in the upright position but negative in the supine/lithotomy position is comparable to a patient who has a positive CST in the supine position.

Conclusion for the purposes of uniformized practice of the ICS-UCST, we recommend that the CST be done in the supine/lithotomy position at the time of vaginal examination (LoE 1b, GoR A). If the test is negative (ie, no leakage detected), then accessory stress testing such as repeating the test in the upright position should be considered. When reporting the results of an ICS-UCST, it can be assumed that the test was done in the supine/lithotomy position. A patient with a negative test in the supine/lithotomy position and a positive accessory stress test in the upright position should be reported as: “ICS-UCST negative, accessory (upright CST) positive.”

### Bladder volume

A spectrum of CST bladder volumes has been used in the literature from empty to 700 mL, including a “comfortably full” or a “symptomatically full” bladder. No consensus exists regarding the bladder volume for CST and to our knowledge no one has evaluated CST at differing bladder volumes in the same patient. The effect of differing bladder volumes has been evaluated in the context of LPP testing during UDS: Valsalva LPP was lower when bladder volumes were larger and the detection of SUI on LPP testing increased with increased bladder volumes.<sup>22–25</sup> During (cystometry-) LPP testing in women with SUI-S, leakage was not detected in any patient with a bladder volume <100 mL while leakage was detected in 19% of patients with a volume of 150 mL, 58% with a volume of 200 mL and 95% with a volume of 250 mL.<sup>26</sup> It seems reasonable to extrapolate this to the CST done in the clinic: a larger bladder volume may be more likely to elicit a positive test. On the other hand, one wants to avoid overfilling the bladder and elicit results that are not

representative. Some patients may not routinely store more than 250–300 mL and it may be unrealistic for them to be filled to a larger volume. The use of a “comfortably full bladder might remedy this because one presumes that the patient's bladder volume will be close to their functional capacity but this reported sensation may be affected by anxiety level. Basing the CST volume on a percentage of the patient's bladder (maximum) capacity seems logical and this concept was used in the context of pad weight testing using a bladder filled to a volume of 50% of cystometric capacity.<sup>27</sup> It was concluded that this type of standardization reduced test retest variation in the quantifying of UI volume. However, determining cystometric capacity requires the patient undergo UDS first. Another option is to base the CST volume on a percentage of the capacity/maximum voided volume on a frequency-volume chart, or use the “usual/average voided volume” avoiding the need for urethral instrumentation/UDS. To our knowledge this has not been studied in the context of a CST and therefore requires additional evaluation. For the purposes of standardization for the ICS-UCST, we recommend that the patient has a bladder volume in the range of 200–400 mL, and to ensure that this volume is not exceptional (far too low or far too high) for this patient (LoE 2, GoR B).

How one achieves/determines the bladder volume is also up for debate. Natural bladder filling or retrograde filling with a catheter can be used. Retrograde bladder filling allows for filling to a preset amount independent of patient activity. This requires catheterization which carries a small risk for infection and a potential to irritate/injure the urethral mucosa which could affect the results.<sup>28</sup> Natural bladder filling avoids urethral instrumentation albeit with lesser control over the actual bladder volume. One may determine the patient's bladder volume at the time of CST via an ultrasound bladder scan prior to or immediately after a CST or one could do a CST then have the patient void and add the voided volume to the postvoid residual volume (via bladder scanner or catheterization) to calculate the bladder volume retroactively.

For the ICS-UCST we recommend the patient be asked about their sense of bladder fullness and the time since the last micturition to get an idea of the degree of fullness with natural filling. We propose the test be performed in a target range of bladder volumes between 200 and 400 mL with the frequency volume chart serving as a guide for usual normal desire to void. We recommend furthermore that a more precise determination of the bladder volume during the test, using one of the aforementioned methods, be reported (in mL) when reporting the results of the ICS-UCST. (eg, “ICS-UCST 380 mL positive”)

### Number/Forcefulness of coughs

The goal of a CST is to reproduce the patient's UI or at least to determine the likelihood that SUI is a cause of the UI. The CST, therefore, should ideally reproduce the kinds of

provocative maneuvers that are experienced by the patient on a day to day basis. In addition, the test must be easy to perform and interpret (ie, it should be of minimal burden to the patient and provide clear, easy to interpret results). While it has been demonstrated that with greater exertional effort (eg, jumping), SUI will be more likely to be elicited,<sup>19,29</sup> many women do not routinely subject themselves to such exertion and furthermore, it may be unrealistic, or too risky, to expect women to do such strenuous maneuvers in the clinic. Hence, on the basis of the available evidence as well as practicality, we propose that coughing be the provocative maneuver within the ICS-UCST.

In many reports that used a CST there was no mention of the number of times the patient was asked to cough (Figures 1 and 2). There is some evidence that, during UDS, multiple coughs are more likely to elicit leakage as was demonstrated during a “1-3-5” cough test.<sup>30</sup> The patient initially coughs once and if no SUI is noted then coughs three times and again if no SUI is noted then coughs five times. The “severity” of SUI was graded based on the occurrence of SUI after fewer coughs (more severe) versus many coughs (more mild). When compared with patient-perception questionnaires (eg, ICIQ-FLUTS, King's Health Questionnaire, UDI-6, and UIQ-7), statistically significant associations of higher grades of SUI (based on the 1-3-5 CST) with higher scores of incontinence domains on the questionnaires were noted. Others have speculated that (pelvic) muscular fatigue may have a role in SUI and its diagnosis: by having patients cough repeatedly (up to seven times), a greater than 20% decrease in MUCP was measured in almost a quarter of patients with SUI-S.<sup>31</sup>

While standardization of cough effort/force has been attempted using an audiometer as a gauge (to measure audible cough strength),<sup>32</sup> it has been suggested that it is rather difficult to achieve reliable standardization of coughing force/effort<sup>33</sup> and for the purposes of a routine office visit it is impractical. Rather, the recommendation of three coughs “as hard as possible” seems reasonable.<sup>34</sup>

Taking all of this together, we recommend that for the ICS-UCST: The patient should cough as forceful as possible. If no leakage is seen after the first cough, coughing should be repeated three more times (ie, total of four coughs) before calling the test negative (LoE 2, GoR B). If no leakage is seen after four forceful coughs, accessory stress testing (eg, greater number of coughs; upright testing; alternative provocations; ICS standard pad testing or UDS) can be performed, with no evidence based preference for any of these. We recommend this however to be reported specifically, especially for scientific purposes.

#### Determination of SUI/Interpretation

Most reports that describe the method of CST use direct visualization of incontinence that occurs simultaneous with a

cough as the definition of a positive CST.<sup>7,8,34</sup> Incontinence occurring subsequent to a cough (ie, after a brief delay) or incontinence that persists after the cough has subsided is reported to be indicative of a concurrent detrusor contraction and usually referred to as cough induced DO<sup>2</sup> or cough associated DO.<sup>35</sup>

While some have used pads to capture the incontinence, avoiding the need for direct visualization of the incontinence,<sup>29,32</sup> the lack of direct visualization of the moment of the incontinence could call into doubt whether one is dealing with actual SUI versus cough associated DO. For the ICS-UCST therefore, we recommend that a positive test requires direct visualization of the efflux of urine from the urethral meatus synchronous with the cough.

### 2.2.3 | Accessory stress tests

#### Upright CST

As previously noted, a negative CST in the supine/lithotomy position does not necessarily rule out the presence of SUI. It has therefore been recommended that a patient with the complaint of SUI who has a negative CST in the supine/lithotomy position undergo a repeat test in the upright position.<sup>7</sup> This can be done in the same fashion as the standard ICS-UCST (bladder volume of 200-400 mL), up to four forceful coughs. If the upright CST is positive and the ICS-UCST (supine/lithotomy) is negative, the patient should be reported as having ICS-UCST negative, accessory (upright CST) positive.

#### Supine empty stress test (SEST)

A positive CST performed in the supine position with an “empty” bladder (volume <100 mL) has been suggested to indicate the presence of intrinsic sphincter deficiency (ISD). In a prospective series it was noted that a positive SEST was associated with a lower MUCP (mean, 20 vs 36 cm H<sub>2</sub>O) and SEST had sens: 65-70% and spec: 67-76% for predicting ISD using low MUCP to diagnose ISD.<sup>36</sup> A positive SEST was also associated with a low LPP (40% of women with a positive SEST had a LPP of 60 cm H<sub>2</sub>O or less versus 10% with negative SEST) with sens: 93.5%, spec: 90%, PPV 96.7% and NPV 81.8% for detecting ISD using ALPP to define ISD.<sup>37</sup> The IUGA suggests that SEST could be used as a simple test to be reasonably assured that ISD is not present (without resorting to multichannel UDS)<sup>2</sup> If a SEST is done as an accessory to (or preceding) an ICS-UCST, the results of each should be specified and reported.

In a patient with UI or more specifically with SUI-S, a negative ICS-UCST and a negative accessory CST, an ICS standard pad test<sup>38</sup> and/or (full) urodynamic testing may be considered to evaluate the complete lower urinary tract function, as per current practice guidelines.



### 3 | CONCLUSION

This module has introduced and provided the evidence base for the International Continence Society-Uniform Cough Stress Test (ICS-UCST) to standardize the performance and reporting of the cough stress test used in the clinical and outcomes assessment of women with urinary incontinence.

#### ORCID

Michael L. Guralnick  <http://orcid.org/0000-0001-9869-3076>

Peter F. W. M. Rosier  <http://orcid.org/0000-0003-0445-4563>

#### REFERENCES

- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) Joint Report on the Terminology for Female Pelvic Floor Dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
- Ghoniem G, Stanford E, Kenton K, et al. Evaluation and outcome measures in the treatment of female urinary stress incontinence: International Urogynecological Association (IUGA) guidelines for research and clinical practice. *Int Urogynecol J Pelvic Floor Dysfunct* 2008;19:5–33.
- Castillo PA, Espallat-Rijo LM, Davila GW. Outcome measures and definition of cure in female stress urinary incontinence surgery: a survey of recent publications. *Int Urogynecol J*. 2010;21:343–348.
- Zimmern P, Kobashi K, Lemack G. Outcome measure for stress urinary incontinence treatment (OMIT): results of two society of urodynamics and female urology (SUFU) surveys. *Neurourol Urodyn*. 2010;29:715–718.
- Rosier PF, Giarenis I, Valentini FA, Wein A, Cardozo L. Do patients with symptoms and signs of lower urinary tract dysfunction need a urodynamic diagnosis? ICI-RS 2013. *Neurourol Urodyn*. 2014;33:581–586.
- Fritel X, Fauconnier A, Bader G, et al. Diagnosis and management of adult female stress urinary incontinence: guidelines for clinical practice from the French College of Gynaecologists and Obstetricians. *Eur J Obstet Gynecol Reprod Biol*. 2010;151:14–19.
- Evaluation of uncomplicated stress urinary incontinence in women before surgical treatment. Committee Opinion No. 603 The American College of Obstetricians and Gynecologists. *Obstet Gynecol* 2014;123:1403–1407.
- Medina CA, Costantini E, Petri E, et al. Evaluation and surgery for stress urinary incontinence: a FIGO working group report. *Neurourol Urodyn*. 2017;36:518–528.
- Lucas MG, Bosch RJ, Burkhard FC, et al. EAU guidelines on assessment and nonsurgical management of urinary incontinence. *Eur Urol*. 2012;62:1130–1142. Epub 2012 Aug 31. Erratum in: *Eur Urol*. 2013 Jul;64(1):e20. PubMed PMID: 22985745.
- Kobashi KC, Albo ME, Dmochowski RR, et al. Surgical treatment of female stress urinary incontinence: AUA/SUFU Guideline. *J Urol*. 2017;198:875–883. Epub 2017 Jun 15. PubMed PMID: 28625508.
- Swift SE, Ostergard DR. Evaluation of current urodynamic test methods in the diagnosis of genuine stress incontinence. *Obstet Gynecol* 1995;86:85–91.
- Nager CW, Brubaker L, Litman HJ, et al. A randomized trial of urodynamic testing before stress-incontinence surgery. *N Engl J Med*. 2012;366:1987–1997.
- Scotti RJ, Myers DL. A comparison of the cough stress test and single-channel cystometry with multichannel urodynamic evaluation in genuine stress incontinence. *Obstet Gynecol*. 1993;81:430–433. PubMed PMID: 8437800.
- Wall LL, Wiskind AK, Taylor PA. Simple bladder filling with a cough stress test compared with subtracted cystometry for the diagnosis of urinary incontinence. *Am J Obstet Gynecol*. 1994;171:1472–1477. discussion 1477–9. PubMed PMID: 7802056.
- Harvey MA, Versi E. Predictive value of clinical evaluation of stress urinary incontinence: a summary of the published literature. *Int Urogynecol J* 2001;12:31–37.
- Price DM, Noblett K. Comparison of the cough stress test and 24-h pad test in the assessment of stress urinary incontinence. *Int Urogynecol J*. 2012;23:429–433. Epub 2011 Nov 16. PMID: 22086265.
- Weidner AC, Myers ER, Visco AG, Cundiff GW, Bump RC. Which women with stress incontinence require urodynamic evaluation? *Am J Obstet Gynecol*. 2001;184:20–27.
- Rosier PFW, Kuo H-C, Finazzi Agro E, et al. Urodynamic testing. In: Abrams P, Cardozo L, Wagg A, Wein A, eds. *Incontinence 6th Edition. ICI-ICS. International Continence Society*. Bristol, UK; 2017:599–670. ISBN: 978-0956960733.
- Rimstad L, Larsen ES, Schiøtz HA, Kulseng-Hanssen S. Pad stress tests with increasing load for the diagnosis of stress urinary incontinence. *Neurourol Urodyn*. 2014;33:1135–1139.
- Türker P, Kilic G, Tarcan T. The presence of transurethral cystometry catheter and type of stress test affect the measurement of abdominal leak point pressure (ALPP) in women with stress urinary incontinence (SUI). *Neurourol Urodyn*. 2010;29:536–539.
- Nguyen JK, Gunn GC, Bhatia NN. The effect of patient position on leak-point pressure measurements in women with genuine stress incontinence. *Int Urogynecol J Pelvic Floor Dysfunct*. 2002;13:9–14.
- Bump RC, Elser DM, Theofrastous JP, McClish DK. Valsalva leak point pressures in women with genuine stress incontinence: reproducibility, effect of catheter caliber, and correlations with other measures of urethral resistance. Continence Program for Women Research Group. *Am J Obstet Gynecol*. 1995;173:551–557.
- McLennan MT, Melick CF, Bent AE. Leak-point pressure: clinical application of values at two different volumes. *Int Urogynecol J Pelvic Floor Dysfunct*. 2000;11:136–141.
- Miklos JR, Sze EH, Karram MM. A critical appraisal of the methods of measuring leak-point pressures in women with stress incontinence. *Obstet Gynecol*. 1995;86:349–352.
- Seo YH, Kim SO, Yu HS, Kwon D. Leak point pressure at different bladder volumes in stress urinary incontinence in women: comparison between Valsalva and cough-induced leak point pressure. *Can Urol Assoc J*. 2016;10:E23–E27.
- Faerber GJ, Vashi AR. Variations in valsalva leak point pressure with increasing vesical volume. *J Urol*. 1998;159:1909–1911.
- Lose G, Rosenkilde P, Gammelgaard J, Schroeder T. Pad-weighing test performed with standardized bladder volume. *Urology*. 1988;32:78–80.



28. Wu WY, Sheu BC, Lin HH. Comparison of 20-minute pad test versus 1-hour pad test in women with stress urinary incontinence. *Urology*. 2006;68:764–768.
29. Papa Petros PE, Ulmsten U. An analysis of rapid pad testing and the history for the diagnosis of stress incontinence. *Acta Obstet Gynecol Scand*. 1992;71:529–536.
30. Grigoriadis T, Giannoulis G, Zacharakis D, Protopapas A, Cardozo L, Athanasiou S. The “1-3-5 cough test”: comparing the severity of urodynamic stress incontinence with severity measures of subjective perception of stress urinary incontinence. *Int Urogynecol J*. 2016;27:419–425. PMID: 26239956.
31. Deffieux X, Hubeaux K, Dick J, Ismael SS, Raibaut P, Amarenco G. Urine leakage related to physical fatigue in women with urinary stress incontinence. *J Obstet Gynaecol Res*. 2009;35:738–745. PMID: 19751336.
32. Norton PA, Baker JE. Postural changes can reduce leakage in women with stress urinary incontinence. *Obstet Gynecol*. 1994;84:770–774. PubMed PMID: 7936510.
33. Luginbuehl H, Baeyens JP, Kuhn A, et al. Pelvic floor muscle reflex activity during coughing – an exploratory and reliability study. *Ann Phys Rehabil Med*. 2016;59:302–307. Epub 2016 Jun 2. PMID: 27265846.
34. Yalcin I, Versi E, Benson JT, Schäfer W, Bump RC. Validation of a clinical algorithm to diagnose stress urinary incontinence for large studies. *J Urol*. 2004;171:2321–2325. PubMed PMID: 15126813.
35. Rosier PFWM, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260. Epub 2016 Dec 5. Review. PubMed PMID: 27917521.
36. Lobel RW, Sand PK. The empty stress test as a predictor of intrinsic urethral sphincter dysfunction. *Obstet Gynecol*. 1996;88:128–132.
37. McLennan MT, Bent AE. Supine empty stress test as a predictor of low Valsalva leak point pressure. *Neurourol Urodyn*. 1998;17:121–127.
38. Krhut J, Zachoval R, Smith PP, et al. Pad weight testing in the evaluation of urinary incontinence. *Neurourol Urodyn*. 2014;33:507–510. Epub 2013 Jun 24. Review. PubMed PMID: 23797972.

**How to cite this article:** Guralnick ML, Fritel X, Tarcan T, Espuna-Pons M, Rosier PFWM. ICS Educational Module: Cough stress test in the evaluation of female urinary incontinence: Introducing the ICS-Uniform Cough Stress Test. *Neurourology and Urodynamics*. 2018;1–7. <https://doi.org/10.1002/nau.23519>

# Detrusor Leak Point Pressures (DLPP) in Patients with Relevant Neurological Abnormalities

Tufan Tarcan\*, Oktay Demirkesen\*,  
Mauricio Plata\*\*, David Castro-Diaz\*\*\*

Istanbul-Turkey\*, Bogotá-Colombia\*\*, Canary Islands-Spain\*\*\*

*The ICS grants permission to use the PowerPoint slide set in educational environment with the proviso that the set remains unchanged, the ICS branding remains and is for non-commercial use. The ICS does not need prior approval for use of this slide set.*

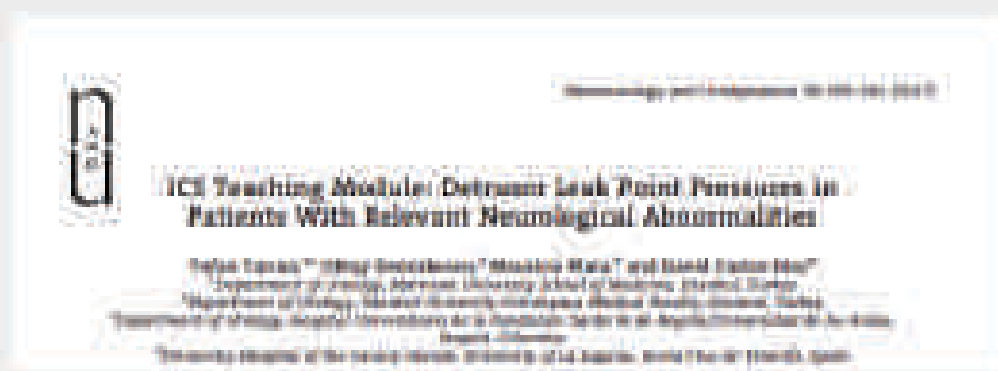
*For commercial use please contact the ICS Office.*



**International Continence Society**  
Educational Module

1

## Publication



**ICS** Educational Module

## Background

- McGuire, 1981
  - Observations of videourodynamic studies of children with MMC and UI secondary to impaired bladder compliance
  - DLPP was found to predict the upper urinary tract deterioration (UUTD)\*
- Further applied to different etiologies of neurogenic lower urinary tract dysfunction (N-LUTD) in adults

\*McGuire BL, Benson PL, Hedges JR. Upper urinary tract deterioration in patients with neurogenic and idiopathic dysfunction: a follow-up study. *J Urol* 1988;139:833-8

## The ICS definition of DLPP

- The lowest detrusor pressure at which urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure\*

\*Hayden P, Gershlag J, Falt M, Goffin G, Jones R. Update on urodynamic definitions. Report of the International Continence Society. The Standardization of Terminology of Lower Urinary Tract Function. Report from the Standardization Subcommittee of the International Continence Society. Neurourol Urolog. 2002;21:107-16

## Controversies

- The exact value of DLPP to predict UUTD is debatable
- Measuring DLPP lacks standardization and carries pitfalls
- A common mistake:
  - Using DLPP in N-LUTD during detrusor contractions (neurogenic detrusor overactivity) instead of reduced bladder compliance

## The ICS Urodynamics Committee Teaching Module

- Aim
  - To standardize and improve the method of DLPP measurement in patients with N-LUTD to minimize performer- and patient dependent variations
  - To review the clinical implications
- Methods
  - Literature search; key word: Detrusor Leak Point Pressure

## Preparation and Technique: DLPP is a cystometric finding

- Should be in accordance with:
  - ICS reports on Good Urodynamic Practices (GUP) and urodynamic equipment performance\*
  - The International Children's Continence Society (ICCS) report on the standardization of terminology of LUT function\*\*

\*Standardization of terminology of urodynamic procedures (GUP) – ICS, 2002. <http://www.ics.internationalcontinence.org/ICSpublications/gup/gup.htm>.  
 \*\*Standardization of terminology of urodynamic procedures in children and adolescents – report from the International Children's Continence Society, 2006. <http://www.ics.internationalcontinence.org/ICSpublications/gup/gup.htm>.

 ICS Educational Module

## Technique I

- Standard urodynamic equipment
- Patients in supine position with empty bladder
- ICS recommends sitting position in suitable patients (grade II)\*
- No evidence for the influence of specific positioning of patients with N-LUTD on the DLPP

\*Grade II LUTD: ICS, 2002. The ICS, 2002. <http://www.ics.internationalcontinence.org/ICSpublications/gup/gup.htm>.  
 \*\*Standardization of terminology of urodynamic procedures in children and adolescents – report from the International Children's Continence Society, 2006. <http://www.ics.internationalcontinence.org/ICSpublications/gup/gup.htm>.

 ICS Educational Module

## Technique III: Filling rate

- Not standardized in the ICS GUP
- Usually done with a rate dependent on age (from 20ml/min in children to 30-60 ml/min in adults)
  - Detrusor adaptation to volume (compliance) may be challenged in high filling rates
- Classified as physiologic and non-physiologic by ICS rather than slow-medium-rapid\*

\*Assaad F, Cardozo L, Fakhri G, Gilling D, Haefliger C, van Herpepeere P, Ismail A, Ismail A. Standardized Sub-committee of the International Continence Society. The classification of terminology of lower urinary tract function. Report from the Standardization Subcommittee of the International Continence Society. Neurourology and Urology. 2012;33:167-76.

## Technique III: Filling rate (cont'd)

- Day-to-day bladder capacity by using voiding or catheterization diary volumes
- 5-10% of known or predicted capacity may be used in children\*
- Slow filling rate needed in adult neurogenic patients with a known hypocompliant bladder [LO]

\*Schafer T, van Ginkel P, van der Pijl A, Hadders B, Boven G, Boven W, Janssen JTM, Kijgy B, Koolen A, Meijer JHM, (2016a) (2). The representation of knowledge of lower urinary tract function in clinical and educational equipment for the International Committee of the International Children's Continence Society. *Urology*. 2016;100:100-104.

 ICS EducationalModule

## Technique IV: Pump and filling

- Infusion pump devices rather than gravity-type infusion systems
  - Avoid iatrogenic bladder pressure increases
- The influence of fluid temperature on DLPP is never studied
- More accurate representation of bladder activity with natural fill (ambulatory) cystometry in children\*

\*Schafer T, van Ginkel P, van der Pijl A, Hadders B, Boven G, Boven W, Janssen JTM, Kijgy B, Koolen A, Meijer JHM, (2016b) (2). The representation of knowledge of lower urinary tract function in clinical and educational equipment for the International Committee of the International Children's Continence Society. *Urology*. 2016;100:100-104.

 ICS EducationalModule

## Technique V: Detection of urinary leakage

- One person observing for leakage and another observing the recording and marking pressures
- In video-UDS, fluoroscopic visualisation of contrast around the catheter may be more accurate
  - Sato TM, Shah PL. Leak point pressures. BJU Int 2000;85:943-8.

## Technique VI: When to stop?

- Cystometry may be stopped when<sup>7</sup>;
  - Pdet exceeds 40 cmH<sub>2</sub>O
  - Maximum bladder volume at intermittent catheterization is reached
  - A detrusor contraction occurs



## Technique VII: Other definitions

- End filling pressure (EFP)
  - When the cystometry is ended without leakage
- Neurogenic Detrusor Overactivity Leak Point Pressure (N-DO LPP)\*
  - If leakage occurs with an episode of neurogenic detrusor overactivity (N-DO) any time during filling cystometry
- Detrusor Overactivity Leak Point Pressure (DO LPP)\*\*
  - In non-neurogenic women with urgency

\*Proposed term not being adopted yet, but suggested by the authors of this module

\*\*Detrusor LPP, also known as Urgency LPP, is the pressure at which leakage occurs in women with urgency, irrespective of whether or not there is evidence of neurogenic detrusor overactivity. It is proposed to be DO LPP.

## Basic Pathophysiology related to DLPP

- DLPP is the pressure which overwhelms the bladder outlet resistance and causes urinary leakage.
- Reflection of the resistance of the bladder outlet or external sphincter.
- DLPP may estimate how much and how long the urinary tract will be exposed to high pressure in-between bladder emptying periods (with or without CIC).

## The treatment of patients with a high DLPP aims:

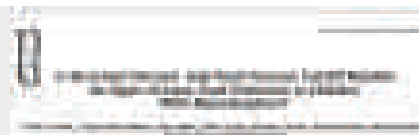
- Reduction of outlet resistance is proposed to improve safe bladder storage and preserve upper tracts
  - remains unproven and leads to incontinence
- The treatment of patients with a high DLPP who are on CIC should aim:
  - Improving bladder compliance

\*International U.I. Symposium, Boston 1984. Higher values than previously reported in patients with neurologically well defined lesions. A follow-up study (1984-1991) showed

## Which cut off for DLPP?

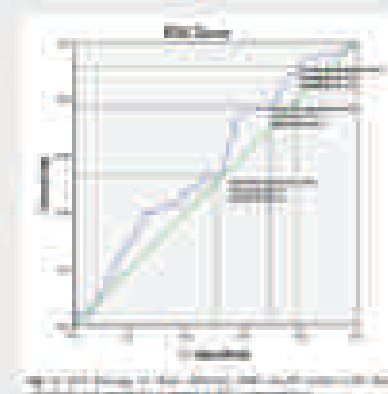
- The absolute values of DLPP are unreliable
  - No UUT deterioration of several patients with DLPP's of >40 cmH<sub>2</sub>O in the long term follow-up\*

\*European Society of Urology Symposium for urology education and research, Stockholm 1994. 1994-1998, 1994-1998



- Higher sensitivity of 20 cm H<sub>2</sub>O DLPP cutoff to predict the risk group for UUT deterioration in children with MMC

Group	No. (percentage) of patients with UUT deterioration by	P-value
Unoperated	2/10 (20%)	0.001
Unoperated	4/10 (40%)	0.001
Unoperated	4/10 (40%)	0.001
Unoperated	4/10 (40%)	0.001



ICS Educational Module

## N- DO is also a risk factor for UUT

- Significant association with hydronephrosis in patients with N-DO >75 cmH<sub>2</sub>O\*
- The total duration of N-DO contractions\*\*
- The only statistically significant urodynamic variable for upper tract dilatation or VUR in spinal cord lesion patients

\*Giles JJ, Gnanapavan S, Datta A, Gupta N, Gnanapavan S, Gnanapavan S, et al. (2013) N-DO is a risk factor for UUT deterioration in patients with MMC. *Journal of Urology* 189: 1000-1004.

\*\*Gnanapavan S, Gupta N, Gnanapavan S, Gnanapavan S, Gnanapavan S, Gnanapavan S, et al. (2013) The impact of urodynamic parameters on the upper tract of patients with MMC. *Journal of Urology* 189: 1005-1009.

ICS Educational Module

## Conclusions and recommendations I

- DLPP
  - A part of cystometric evaluation of children and adults with N-LUTD to help predicting (and preventing) UUTD (Grade B/C)
- Recommendations of ICS and ICCS should be followed for cystometric equipment and for the measurement technique

## Conclusions and recommendations II

- Discrimination of high risk (for UUTD) patients on the basis of DLPP (Grade B/C)
- Not to be used as the sole parameter to decide on invasive therapies, e.g.
  - Bladder augmentation and sphincterotomy

## Conclusions and recommendations III

- Other factors to predict UUTD in N-LUTD
  - Bladder compliance
  - Volume where leakage occurs
  - Duration and amplitude of detrusor contractions
  - Volume which obtained by CIC
- Low sensitivity of traditional cutoff  $>40$  cmH<sub>2</sub>O for the prediction of UUTD

## Conclusions and recommendations IV

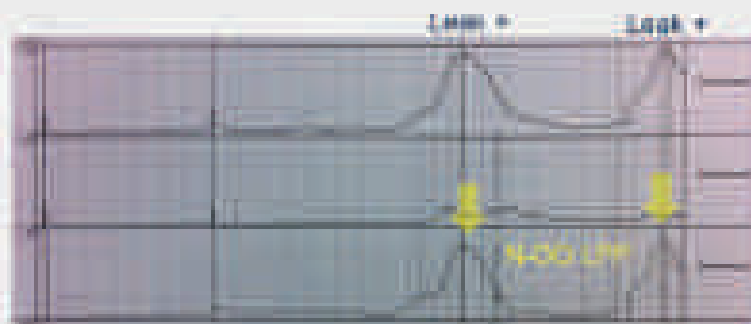
- Future research to standardize the technique and better classify DLPP cutoffs in N-LUTD
- The predictive value of LPP may differ according to underlying etiology of N-LUTD such as MMC, MS or SCI.

## Conclusions and recommendations V

- Cystometric readings should be sub-classified and differentiated according to the presence of N-DO

## Conclusions and recommendations V (cont'd)

- N-DO LPP refers to the detrusor pressure that belongs to a spontaneous N-DO leading to leakage during cystometry



## Conclusions and recommendations VI

- EFP should be taken into consideration if the leakage does not occur during cystometry however, the clinical relevance of EFP is unclear.

Thank you



## ICS Teaching Module: Detrusor Leak Point Pressures in Patients With Relevant Neurological Abnormalities

Tufan Tarcan,<sup>1\*</sup> Oktay Demirkesen,<sup>2</sup> Mauricio Plata,<sup>3</sup> and David Castro-Diaz<sup>4</sup>

<sup>1</sup>Department of Urology, Marmara University School of Medicine, Istanbul, Turkey

<sup>2</sup>Department of Urology, Istanbul University Cerrahpaşa Medical Faculty, Istanbul, Turkey

<sup>3</sup>Department of Urology, Hospital Universitario de la Fundación Santa Fé de Bogotá/Universidad de los Andes, Bogotá, Colombia

<sup>4</sup>University Hospital of the Canary Islands, University of La Laguna, Santa Cruz de Tenerife, Spain

**Aims:** This manuscript serves as a scientific background review; the evidence base, for the presentation made available on ICS website to summarize current knowledge and recommendations for the measurement and use of the DLPP.

**Methods:** This review has been prepared by a Working Group of The ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel. **Results:** DLPP has been recommended and utilized in the urodynamic evaluation of N-LUTD for many years, but it lacks standardization and there are numerous pitfalls in its measurement. EFP and LPP associated with N-DO are frequently and mistakenly reported as DLPP. The information that high DLPP predicts UUTD originates from retrospective cohort studies of a low level of evidence (LoE 3). Existing data confirm that patients with lower DLPP do better than patients with higher DLPP in terms of their upper urinary tract. However, there appears to be no reliable 'safe/no safe' cut-off for DLPP since there are other urodynamic factors that influence UUTD such as bladder compliance and more. **Conclusion:** Although higher DLPP is associated with a greater risk of UUTD, there is no reliable cut-off level to undoubtedly discriminate the risky group, including the traditional cut-off level of 40 cm H<sub>2</sub>O. Therefore, DLPP should not be used as the sole urodynamic parameter. Future research should be directed to standardization of the technique and better classification of DLPP cut-offs in N-LUTD. *Neurol. Urodynam.*

© 2015 Wiley Periodicals, Inc.

**Key words:** detrusor leak point pressure; neurogenic bladder; urodynamics

### INTRODUCTION

Detrusor leak-point pressure (DLPP) testing originates from observations of videourodynamic studies of children with myelomeningocele (MMC) and urinary incontinence secondary to impaired bladder compliance. McGuire retrospectively evaluated this group of children with the aim of finding predictors for upper urinary tract deterioration (UUTD).<sup>1–3</sup> This concept has been further applied to different etiologies of neurogenic lower urinary tract dysfunction (N-LUTD) in adults.<sup>4</sup> The International Continence Society (ICS) defines the DLPP as the lowest detrusor pressure at which urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure.<sup>5</sup> The value of DLPP to predict UUTD is not known very precisely, and the measurement of DLPP lacks standardization and carries pitfalls. For example, although DLPP measurement has been recommended in neurological patients with reduced bladder compliance, some authors measure DLPP during involuntary detrusor contractions.<sup>5</sup>

The ICS Urodynamics Committee presents the teaching module “detrusor leak point pressures in patients with relevant neurological abnormalities” to serve as a standard education of good urodynamic practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, for those caring for patients with N-LUTD. The teaching module consists of a web-casted presentation, in combination with this manuscript, which is available on the ICS website. The presentation explains testing requirements, clinical workup, and analysis. The presentation and this manuscript contain experts’ opinion where evidence is

unavailable, especially for the clinical practice aspects, and is marked with: “EO” (expert’s opinion).

This module reviews the value of DLPP measurement in predicting UUTD in N-LUTD in light of the existing literature. Our purpose is to standardize and improve the method of DLPP measurement in patients with N-LUTD to minimize performer- and patient-dependent variations.

### MATERIALS AND METHODS

All the requirements and instructions for the measurement of DLPP described in this section follow the ICS reports on Good Urodynamic Practices (GUP)<sup>6</sup> and urodynamic equipment performance.<sup>7</sup> The International Children’s Continence Society (ICCS) report on the standardization of terminology of lower urinary tract function in children and adolescents has been taken into consideration for the measurement of DLPP in children.<sup>8</sup> DLPP is obtained during a standard cystometry and no specific other equipment or specific patient preparation is needed to determine DLPP. DLPP uses detrusor pressure;

Prof. Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Nothing to disclose.

\*Correspondence to: Tufan Tarcan, MD, PhD, Professor of Urology, Department of Urology, Marmara University School of Medicine, Fevzi Çakmak Mah., Muhsin Yazicioglu Cad. No:10 Ust Kaynarca, Pendik, Istanbul, Turkey. E-mail: tufan@marmara.edu.tr

Received 25 November 2015; Accepted 25 November 2015

Published online in Wiley Online Library

(wileyonlinelibrary.com).

DOI 10.1002/nau.22947

© 2015 Wiley Periodicals, Inc.



## 2 Tarcan et al.

consequently, it cannot be obtained via a single channel cystometry and, therefore, both vesical and intra-abdominal pressure must be recorded.

### Technique

The measurement of DLPP is a part of cystometric evaluation in patients with N-LUTD. Traditionally, the patient is positioned supine and the bladder emptied. A small cystometry catheter ( $\leq 10$  F) is inserted into the urethra and standard urodynamic equipment used to measure vesical pressure via a pressure transducer with a rectal probe to monitor intra-abdominal pressure changes.<sup>9</sup>

In suitable patients, the study can also be performed in the sitting position according to ICI recommendations, because this is reported to have a higher sensitivity for the diagnosis of filling phase abnormalities (recommendation Grade B).<sup>10</sup> No evidence is available on the influence of positioning of patients with N-LUTD on the DLPP. The size of the catheter has an influence on the DLPP and it has been shown that using progressively larger catheters increases DLPP.<sup>11</sup> According to the ICI 2013, there is evidence of level 3 that, in general, flow rate during voiding is reduced with a urodynamic catheter in the urethra and that this reduction is partially caused by the size of the catheter. Use of, as thin as possible, "one-catheter systems" (dual lumen if fluid filled) for filling and pressure recording during urodynamic testing is recommended with a level of evidence 4.<sup>10</sup> This recommendation may correspond to 5–8 F double lumen cystometry catheters during water cystometry. The consequence of this recommendation is that DLPP is also done with a 5–8 F transurethral catheter. Another consequence is that when cystometry is performed via a suprapubic catheter, the DLPP will theoretically be underestimated if compared with published data, as this can also indirectly be deduced from a study where catheters were removed and reinserted during cystometry.<sup>13</sup>

A cystometry filling rate is not standardized in the ICS GUP but is usually done with a rate dependent on age (from 20 ml/min in children to 30–60 ml/min in adults).<sup>6</sup> There is some evidence that fluid temperature may not be relevant for the outcome of cystometry; however, the influence on DLPP has not been studied.<sup>14,15</sup>

Detrusor adaptation to volume (compliance) may however, be challenged if relatively high filling rates are used.<sup>9</sup> The ICS classifies infusion rates as physiologic and non-physiologic and no longer wishes to divide the filling rates as slow if  $< 10$  ml/min, medium if 10–100 ml/min, or rapid if  $> 100$  ml/min, although almost all investigations are performed using medium filling rates within a wide range.<sup>5</sup> It is advised to learn the day-to-day bladder capacity by using voiding (or catheterization) diary volumes before the study, although particularly large or small capacities might affect the desired filling rates. For this reason, we recommend a slow filling rate in adult neurogenic patients with a known hypocompliant bladder (EO).

According to the ICCS, filling rates (per minute) of 5–10% of known or predicted capacity may be used in children. Infusion pump devices rather than gravity-type infusion systems are recommended to avoid iatrogenic bladder pressure increases during filling and inaccurate interpretation by pressure transducers.<sup>9–11</sup> The ICCS also reports that the use of natural fill (ambulatory) cystometry provides a true physiological filling rate and offers a more accurate representation of bladder activity than traditional cystometry in children and may be the technique of choice in pediatric urodynamics if time and equipment are available.<sup>8</sup>

According to an expert review, urinary leakage (in the absence of fluoroscopy) is best detected by having one person

observing for leakage and another observing the recording and marking pressures using an event marker. However, the authors also stated that fluoroscopy visualization of contrast around the catheter is more accurate than observing the meatus or observing urine falling onto a sheet.<sup>9</sup>

It is suggested that the cystometry for patients with N-LUTD may be stopped when  $P_{det}$  exceeds 40 cm H<sub>2</sub>O or the maximum volume recovered at intermittent catheterization is reached or if a detrusor contraction occurs.<sup>3</sup> When cystometry ends without leakage, the end filling pressure (EFP) should be noted. If leakage occurs with an episode of neurogenic detrusor overactivity (N-DO) any time during filling cystometry, we suggest that it should be noted as N-DO LPP. A similar definition in non-neurogenic patients has recently been proposed as the "detrusor overactivity leak point pressure" in women with urgency incontinence.<sup>16</sup> The bladder volume at which leak occurs should also be noted, as it may be important for a particular patient to organize their clean intermittent self-catheterization (CIC) regimen.

### Basic Pathophysiology and Clinical Implications of DLPP in Patients With N-LUTD

DLPP is the pressure that overwhelms bladder outlet resistance, causing urinary leakage. DLPP is a reflection of the resistance of the bladder outlet or external sphincter.<sup>1</sup> McGuire's pioneering work has stated that patients with MMC and a LPP  $> 40$  cm were at risk of developing UUTD and this cutoff has been traditionally accepted without a high level of evidence.<sup>2</sup> It was shown in another study that reduction of outlet resistance may improve bladder storage in the long-term and may preserve the upper tracts.<sup>12</sup> Combs et al., however, reported that several of their patients with DLPPs of  $> 40$  cm H<sub>2</sub>O (followed over a long period) showed no deterioration in their upper tracts, while by contrast some individuals undergoing successful bladder augmentation required an artificial urinary sphincter, despite apparently good outlet resistance before surgery.<sup>13</sup> These authors suggested that absolute values of DLPP reported previously were unreliable because the technique lacked standardization. Another retrospective study has challenged the single cutoff level of 40 cm H<sub>2</sub>O<sup>17</sup> showing that UUT involvement rates are 18% in children with a DLPP below 20 cm H<sub>2</sub>O; 38% between 20 and 40 cm H<sub>2</sub>O; and 28% above 40 cm H<sub>2</sub>O, respectively. The authors concluded that determining the cut-off value of the DLPP as 20 cm H<sub>2</sub>O instead of 40 cm H<sub>2</sub>O showed a higher sensitivity to predict the risk group for UUT deterioration (Table I). They also suggested that children with MMC and a DLPP between 20 and 40 cm H<sub>2</sub>O should be closely monitored, since 38.4% of children in their study had UUT deterioration at the age of 3.<sup>17</sup>

In spite of the ICS definition, DLPP is sometimes referred to as the elevation of the detrusor pressure during contractions leading to leakage. In fact, this is not DLPP but is N-DO LPP. However, the (clinical) significance of N-DO LPP versus DLPP in

TABLE I. UUT Involvement According to Different DLPP Cut-Off Values<sup>17</sup>

DLPP	Percentage of patients with upper tract involvement	Sensitivity (ROC analysis)
$> 40$ cm H <sub>2</sub> O	18/64 (28.1%)	51.4%
$> 30$ cm H <sub>2</sub> O	24/88 (27.3%)	68.6%
$> 20$ cm H <sub>2</sub> O	33/102 (32.3%)	91.4%

**TABLE II. Recommendations of the ICS Teaching Module for the Measurement, Clinical Utilization, and Future Research on DLPP**

- (1) Measuring and reporting of DLPP should be a part of cystometric evaluation of children and adults with N-LUTD to help predict (and prevent) UUTD (Grade B/C)
  - a. The recommendations of the ICS and the ICCS should be followed for cystometric equipment and technique
- (2) Discrimination of high-risk (UUTD) patients is, however, not very precisely possible on the basis of DLPP (Grade B/C)
- (3) DLPP should not be used as the sole parameter to decide on invasive therapies such as bladder augmentation and sphincterotomy
  - a. UUTD in N-LUTD does not only depend on DLPP but will also depend on other factors such as bladder compliance; volume where leakage occurs; and detrusor contraction duration and amplitude, with all of these related to CIC obtained volumes. On the other hand, the resistance of the bladder outlet to the involuntary rise in detrusor pressure is another important parameter for deterioration
  - b. The traditional cut-off for DLPP of 40 cm H<sub>2</sub>O may have too low a sensitivity for the prediction of UUTD
- (4) Future research should be directed to standardization of the technique and better classification of DLPP cut-offs in N-LUTD
  - a. The predictive value of LPP may differ according to underlying etiology of N-LUTD such as MMC, MS, or SCI
  - b. Cystometric readings should be sub-classified according to the presence of neurogenic DO (overactive detrusor contractions with or without leakage)
  - c. EFP should be taken into consideration if the leakage does not occur during cystometry, however, the clinical relevance of EFP is unclear

N-LUTD has not been investigated. Frequent DO episodes with high LPP are plausibly a similar risk for future upper tract changes. The duration of the bladder contraction during an N-DO episode and DLPP >75 mmH<sub>2</sub>O is reported to have a significant association with hydronephrosis.<sup>4,18</sup> In a study with spinal cord lesion patients, the total duration of DO contractions appeared as the only statistically significant urodynamic variable that correlated with upper tract dilatation or with vesicoureteral reflux.<sup>18</sup> Although DLPP is a measure of outlet resistance, treatment of patients with a high DLPP is directed toward reducing the vesical pressures and increasing the bladder capacity. Reducing the number and amplitude of overactive detrusor contractions and improving bladder compliance, for example, with antimuscarinics, botulinum neurotoxin, or bladder augmentation is the mainstay of treatment. The clinical implication of DLPP is to help estimating how much and how long the urinary tract system will be exposed to high pressure in-between bladder emptying periods (with or without CIC) in the patient's daily life.

#### End Filling Pressure (EFP)

Another problem with the utilization of DLPP is that a significant number of patients with N-LUTD do not leak during studies. It is generally accepted that the filling phase finishes when the detrusor pressure remains over 40 cm H<sub>2</sub>O without leakage. In a recent study of 80 children with MMC and a median age of 7 years (range 2–17), the majority of children with MMC did not leak during urodynamics but bladder wall thickness as well as urinary levels of TGF- $\beta$  1, NGF, and TIMP-2 were found to be significantly increased when DLPP or EFP was greater than 40 cm H<sub>2</sub>O in this cohort.<sup>19</sup> Alternative methods, such as biomarkers, may become available to predict UUTD.

A recent study has challenged the predictive value of EFP in predicting UUTD in a cohort of children who underwent bladder neck surgery (different types of slings) without augmentation for neurogenic incontinence.<sup>20</sup> Seventeen children with sustained EFP >40 cm for more than 1 year despite anticholinergics were included in the study. During a mean follow-up of 39 months, new hydronephrosis or VUR developed in six (35%), whereas all new hydronephrosis resolved with medical treatment, as did two out of three new VUR cases. The other patient with VUR had successful suburethral injection.

The authors concluded that despite a sustained EFP >40 cm, upper tract changes developed in only 35% of patients, and resolved with medical management or minimally invasive interventions, and suggested that EFP should not be used as an independent indication for augmentation.

*Neurourology and Urodynamics* DOI 10.1002/nau

#### CONCLUSION

Although the causative relationship between the pressure within the urinary tract and UUTD has been acknowledged for a long time, there are still many caveats regarding the standardization of urodynamic measurements and their predictive roles. According to the fifth International Consultation on Incontinence, DLPP in patients with N-LUTD is considered a relevant parameter with the recommendations of grade B/C.<sup>10</sup> It has been stated that DLPP is not consistently defined throughout the literature and that lack of standardization is hindering comparison of studies.

Using a single “safe-unsafe” cut-off at 40 cm H<sub>2</sub>O may not reflect clinical reality and as McGuire suggested, a clinical management approach with an “as low as” reasonably achievable detrusor pressure over the entire daily volume range is advisable.<sup>21</sup>

The clinical recommendations on the basis of this review of DLPP are summarized in Table II. Better standardization of DLPP measurements as well as better definition of urodynamic capacity where leakage occurs and of EFP as well as of leak point pressure at overactive detrusor contraction will be helpful. The bladder volume at which leakage occurs is very important in order to adapt patients to CIC. Furthermore, EFP and N-DO LPP should be separated from DLPP in urodynamic investigations, and the definition should include the difference between these terms in order to prevent any confusion. Prospective follow-up studies in patients with N-LUTD to evaluate the predictive value of these parameters for upper tract deterioration are recommended. This manuscript has summarized the practice and interpretation of DLPP from a clinical perspective.

#### ACKNOWLEDGMENT

We would like to thank the members of the ICS Urodynamics Committee core panel for establishing the teaching module and reviewing the manuscript.

#### REFERENCES

1. McGuire EJ, Woodside JR, Borden TA, et al. Prognostic value of urodynamic testing in myelodysplastic patients. *J Urol* 1981;126:205–9.
2. McGuire EJ, Woodside JR, Borden TA. Upper urinary tract deterioration in patients with myelodysplasia and detrusor hypertonia: A followup study. *J Urol* 1983;129:823–6.
3. McGuire EJ, Cespedes RD, O'Connell HE. Leak-point pressures. *Urol Clin North Am* 1996;23:253–62.
4. Ozkan B, Demirkesen O, Durak H, et al. Which factors predict upper urinary tract deterioration in overactive neurogenic bladder dysfunction? *Urology* 2005;66:99–104.
5. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: Report from the standardisation sub-

## 4 Tarcn et al.

- committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
6. Schäfer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002;21:261–74.
  7. Gammie A, Clarkson B, Constantinou C, et al. International Continence Society guidelines on urodynamic equipment performance. *Neurourol Urodyn* 2014;33:370–9.
  8. Nevéus T, von Gontard A, Hoebeke P, et al. The standardization of terminology of lower urinary tract function in children and adolescents: Report from the standardisation committee of the International Children's Continence Society. *J Urol* 2006;176:314–24.
  9. Lane TM, Shah PJ. Leak-point pressures. *BJU Int* 2000;86:942–9.
  10. Rosier PFWM, Kuo H-C, De Gennaro M, et al. In: Abrams Paul, Cardozo Linda, Khoury Saad, Wein Alan, editors. *Urodynamic testing*. 5th Edition. Paris: 5th International Consultation on Incontinence; 2013.
  11. Decter RM, Harpster L. Pitfalls in determination of leak point pressure. *J Urol* 1992;148:588–91.
  12. Bloom DA, Knetchel JM, McGuire EJ. Urethral dilatation improves bladder compliance in children with myelomeningocele and high leak point pressures. *J Urol* 1990;144:430–3.
  13. Combs AJ, Horowitz M. A new technique for assessing detrusor leak point pressure in patients with spina bifida. *J Urol* 1996;156:757–60.
  14. Chin-Peuckert I, Rennick JE, Jednak R, et al. Should warm infusion solution be used for urodynamic studies in children? A prospective randomized study. *J Urol* 2004;172:1657–61.
  15. Gehrich AP, Hill MJ, McWilliams GD, et al. Comparison of urodynamic volume measurements using room and body temperature saline: A double-blinded randomized crossover study design. *Female Pelvic Med Reconstr Surg* 2012;18:170–4.
  16. Smith AL, Jaffe WI, Wang M, et al. Detrusor overactivity leak point pressure in women with urgency incontinence. *Int Urogynecol J* 2012;23:443–6.
  17. Tarcn T, Tinay I, Sekerci CA, et al. Is 40 cm H<sub>2</sub>O detrusor leak point pressure (DLPP) cut-off really reliable for upper urinary tract (UUT) protection in children with myelodysplasia? *J Urol* 2009;181(Suppl 4):312.
  18. Linsenmyer TA, Bagaria SP, Gendron B, et al. The impact of urodynamic parameters on the upper tracts of spinal cord injured men who void reflexly. *J Spinal Cord Med* 1998;21:15–20.
  19. Sekerci CA, İşbilen B, İşman F, et al. Urinary NGF, TGF  $\beta$ -1, TIMP-2 and bladder wall thickness predict neuro-urological findings in children with myelodysplasia. *J Urol* 2014;191:199–205.
  20. Snodgrass W, Villaneuva C, Jacobs M, et al. Upper tract changes in patients with neurogenic bladder and sustained pressures >40 cm following bladder neck surgery without augmentation. *J Pediatr Urol* 2014;10:744–8.
  21. McGuire EJ. Urodynamics of the neurogenic bladder. *Urol Clin North Am* 2010;37:507–16.

# ICS Educational Module: Electromyography in the assessment and therapy of lower urinary tract dysfunction in adults

J. Krhut, Ostrava, Czech Republic

P.F.W.M. Rosier, Utrecht, The Netherlands

B. Shelly, Moline, IL, USA

R. Zachoval, Prague, Czech Republic

P. Zvara, Burlington, VT, USA



**International Continence Society**  
Educational Module

1

## ICS Educational module

- This slide set should be used together with manuscript

„ICS educational module: Electromyography in the assessment  
and therapy of lower urinary tract dysfunction in adults.  
NeuroUrol Urodyn. 2018;37: 27-32“.

which provides the scientific background and the evidence base  
for use of EMG in urology as well as references.

## Principle of EMG

- Recording of the electrical activity from (isolated) muscle with electrodes, to assess function and innervation.

2 methods:

**Needle EMG = Needle electrode(s)** inside muscle = motor unit.

- Positive: - allows assessment of single action potentials
- Negative: - invasive  
- complex expertise in EMG required

**Surface EMG = Surface (patch) electrode(s)** On muscle – 'whole' muscle.

- Positive: - non-invasive, less time- and money-consuming
- Negative: - less specific, less 'detail'  
- does not allow assessment of single action potentials

## EMG tests in adult urology

- Needle EMG of external anal sphincter (EAS)
- Needle EMG of external urethral sphincter (EUS)
  - Monopolar
  - Bipolar (concurrent)
  - Wire(s)
- Surface EMG of external anal sphincter (EAS)
- Surface EMG and sacral reflexes conductivity testing
- Surface EMG and biofeedback
- Surface EMG with cystometry and pressure/flow
- Surface EMG = 'physiological EMG' with pair (or array) of electrodes over muscle



## Needle EMG of external anal sphincter (EAS)

### Principle:

- Recording of electrical activity of EAS
- Elements of muscle activity of the pelvic floor

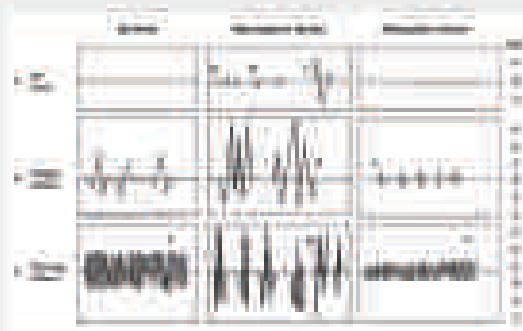
### Technique:

- Patient in lateral decubitus or lithotomy position
- EAS: Needle electrodes inserted bilaterally, approximately 0.5 cm lateral to the anus
- Assessment during maximal relaxation, during slight pelvic floor contraction, during maximal voluntary contraction and/or during artificial bladder filling

## Needle EMG of external anal sphincter (EAS)

### Evidence:

- Potentially useful to detect disturbances in neuroregulation of the pelvic floor muscles in patients with:
  - lower motor neuron lesion
  - demyelinating diseases
  - with Parkinson disease
  - Multiple System Atrophy



Sakuma Y, et al. Transl Neurosci Physiol 2013; 23: 111-120

# Needle EMG of external urethral sphincter (EUS)

## Principle:

- Direct recording of electrical activity of EUS

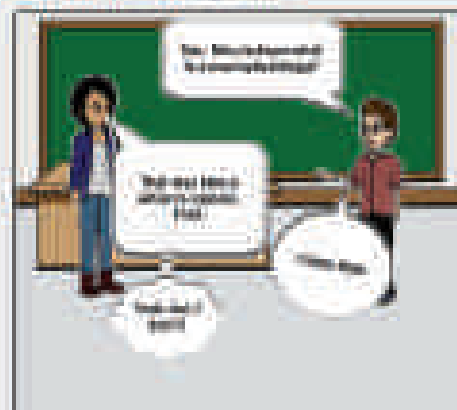
## Technique:

- Patient in lateral decubitus or lithotomy position
- Needle electrodes inserted transperineally (⚡) or transvaginally (💡) or transurethrally – via catheter
- Assessment during maximal relaxation, during slight pelvic floor contraction, during maximal voluntary contraction and/or during artificial bladder filling

# Needle EMG of external urethral sphincter (EUS)

## Evidence:

- Limited evidence for role in clinical setting for EUS–EMG
- Some role in Fowler's (⚡ retention) syndrome
- Potentially useful in direct detection of electrical activity while bladder filling



## Surface EMG of external anal sphincter (EAS)

### Principle:

- Recording of muscle activity using surface (patch) electrodes or electrodes on cone or plug

### Technique:

- Degreasing of the perianal skin
- 2 "active" electrodes adjusted bilaterally to the mucocutaneous line + ground electrode
- Assessment of activity rest vs. contraction

### Evidence:

- Tool to detect pelvic floor muscle activity or relaxation

## Surface EMG and Sacral reflexes conductivity testing

### Principle:

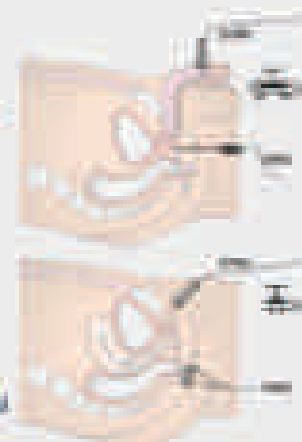
- Stimulation of the pudendal nerve to induce pelvic floor contraction to evaluate of bulbocavernosus (Bulbo-cavernosus) reflex

### Technique:

- Stimulation using electrode dorsal at the base on the penis (♂) or on clitoris (♀)
- The response recorded with surface or needle electrodes from the region of anal sphincter or bulbocavernosus muscle

### Evidence:

- Absence or delay in response, suggest lower-motor-neuron impairment
- No relevant recent study which could support the role of this examination in the daily clinical work-up was found





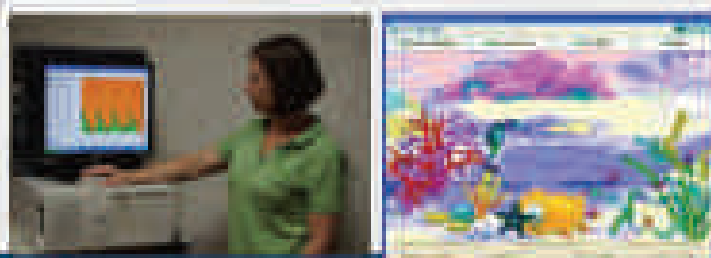
# Surface EMG and biofeedback

## • Principle:

- Detect the pelvic floor muscle activity and transform it into a visual and/or acoustic display in order to convey the information to the patient

## • Technique:

- Surface electrodes are placed close to the anal sphincter or on an anal or intravaginal plug
- Recorded signal transformed into apparent sound or visual cue
- Allows the patient to better understand the functional status of the pelvic floor



# Surface EMG and biofeedback

## Clinical observations:

- Baseline between contractions – inconsistent and evading
- Resting baseline – varies widely from session to session, especially when pain exists
- Erratic tracing without artifact or noise
- Patient has symptoms of overactive PFM – obstructed urination, defecation, pain
- Return to baseline after startle or frightening – overactive PFM is slow
- 2/3 of dysfunctional muscles will have normal resting baseline

## Surface EMG and biofeedback

### Evidence:

- Potentially useful for conservative treatment (PFM training) of stress urinary incontinence and QAB
- Little evidence regarding the use of EMG biofeedback as tool to help relax the pelvic floor muscles during micturition in adults

Reynolds L, et al. *Neurourology and Urology*. 2002;23(2):223-31. Wess KP, et al. *Urology*. 2004;64(2):210-5.

## Surface EMG with cystometry

### Principle:

- Recording of pelvic floor muscle activity during filling of the bladder.

### Technique:

- Surface EMG (as on earlier slides)

### Evidence:

- Introduced on the basis of expert opinion/plausibility
- No (comparative) evidence
- Surface EMG may fail to reflect urethral (continence) function

# Surface EMG with pressure flow studies

## Principle and technique

- Identical to surface EMG

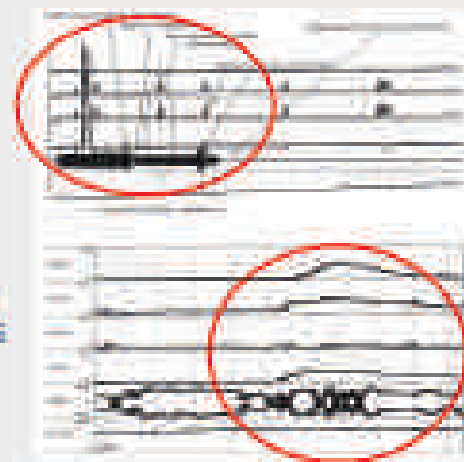
## Evidence

- Introduced on the basis of expert opinion/ plausibility
- No (comparative) evidence
- Expert series demonstrating plausible results
- However: Large ( $n=655$ ) prospective cohort <sup>8</sup> with EMG revised:
  - Many (51%) were not interpretable (but also)...
  - ...surface EMG failed to reflect EUS relaxation

Education in Neurourology 2014; 3(1): 678-686

# Surface EMG (adult)

- May be not interpretable
  - (technical) artefacts
- May give not plausible results
  - Not reflect relevant (EUS) activity
  - Smooth flow-rate and bizarre EMG



## sEMG with urodynamic tests (adult)

### Linking practice standards for:

- Display: envelope; linear envelope; full wave; half wave
- Time scale
- Sampling: ... Hz; Filtering: moving average; root mean square
- Placing of active electrodes ( $\otimes$  /  $\otimes$ )
- Impedance checks (cleaning of skin):  $<5$  (or  $<10$ ) k $\Omega$
- Reference electrode - neutral (Not on another muscle); trochanter; pelvic rim; sacrum
- Technical and clinical quality checks
- Analysis, interpretation and reporting

## sEMG with urodynamic tests (adult)

- Not very invasive
- Not very time and cost consuming
- Without standard
- Without certainty of relevance
- May add confusion if artefacts are not acknowledged
- May be of help in (pelvic) muscle strength and control training and learning to relax

## EMG tests in adult urology

- The concept of use of EMG methods in functional urology/urogynaecology and physiotherapy is supported by good theoretical basis
- Current value of EMG in diagnosis is however limited
- Currently EMG practice can only rarely play a decision-making role in diagnostics of LUT partially due to lack of standards

## A long way ahead.....



# ICS Educational Module: Electromyography in the assessment and therapy of lower urinary tract dysfunction in adults

Jan Krhut<sup>1</sup> | Roman Zachoval<sup>2</sup>  | Peter F. W. M. Rosier<sup>3</sup> | Beth Shelly<sup>4</sup> | Peter Zvara<sup>5</sup>

<sup>1</sup> Department of Urology, Ostrava University, University Hospital, Ostrava, Czech Republic

<sup>2</sup> Department of Urology, Thomayer Hospital and 1st and 3rd Faculty of Medicine of Charles University, Prague, Czech Republic

<sup>3</sup> Department of Urology, University Medical Center Utrecht, Utrecht, The Netherlands

<sup>4</sup> Beth Shelly Physical Therapy, Moline, Illinois

<sup>5</sup> Department of Urology and Biomedical Laboratory, University of Southern Denmark, Odense, Denmark

## Correspondence

Roman Zachoval, MD, PhD, Department of Urology, Thomayer Hospital, Vídeňská 800, 140 59 Praha 4.  
 Email: roman.zachoval@ftn.cz

**Aim:** To present the teaching module “Electromyography in the assessment and therapy of lower urinary tract dysfunction in adults.” This teaching module embodies a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base made available on ICS website to summarize current knowledge and recommendations.

**Methods:** This review has been prepared by a Working Group of The ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel.

**Results:** Electromyography (EMG) is a method to record spontaneous or artificially induced electrical activity of the nerve-muscle unit or to test nerve conductivity. EMG of the anal sphincter using surface electrode is most widely used screening technique to detect detrusor-sphincter dyssynergia in urology. It is non-invasive and easy to perform. EMG methods using needle electrodes are reserved for diagnostics in well selected group of mainly neurogenic patients. These methods require expertise in the field of general EMG and are usually performed by neurologist and neuro-physiologist. The evidence in many aspects of use of EMG in urology remains sparse.

**Conclusions:** Currently EMG methods rarely play a decision making role in selecting proper treatment of lower urinary tract dysfunction. With the current efforts to improve phenotyping of these patients in order to provide individualized treatment, the role of EMG could increase.

## KEYWORDS

bio-feedback, diagnostics, electrode, electromyography, ICS teaching module, urinary incontinence

## 1 | INTRODUCTION

The role of electromyography (EMG) is to record spontaneous or artificially induced electrical activity of the nerve-muscle unit or to test nerve conductivity. It is a component of the comprehensive urodynamic evaluation, however, the current

use of this method is limited. The aim of this communication is to summarize the current evidence regarding the use of EMG in adult urology and provide some suggestions for future research which could lead to further development of this diagnostic and therapeutic method in urology. This paper was prepared by a Working Group of The ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group,

Roman Zachoval led the review process.

and review by members of the ICS Urodynamics Committee core panel. Literature review was performed according to the modified PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) methodology in March 2016.<sup>1</sup> Following Medical Subject Heading (MeSH) were used for electronic search on MEDLINE database: (a) electromyography; (b) neurofeedback; (c) lower urinary tract symptoms; (d) urodynamics; (e) pelvic floor disorders. Terms (a) and (b) were subsequently crossed with (c); (d); and (e). Total 1576 publications were identified. After removing duplications ( $1576 - 355 = 1221$ ), all articles published before 1986 ( $1221 - 302 = 919$ ) and all articles in other than English language were excluded ( $919 - 132 = 787$ ). We identified 81 relevant papers which served as a evidence base for preparation of this manuscript and slide set. The ICS Urodynamics Committee presents this teaching module to serve as a standard education tool for professionals involved in diagnostics and treatment of lower urinary tract dysfunctions. The teaching module consists of a ICS Power Point Presentation, available via <http://www.icsoffice.org/eLearning/> and this paper which serves as a scientific background review. The presentation and this manuscript contain experts' opinion where evidence is, especially for the clinical practice aspects, unavailable and is marked with: "eo" (expert opinion).

### 1.1 | History

EMG is the oldest and most widely used electrophysiological assessment method. The first records of EMG use involved examination of skeletal muscles and it dates back to 19th century. The first sphincter EMG was described by Beck in 1930.<sup>2</sup> The EMG of the anal sphincter was first used in clinical setting by Bailey in 1968.<sup>3</sup> He used EMG as a part of complex neuro-urological evaluation of 184 incontinent children with neurogenic bladder. He also proposed that EMG could be used in adults with neurogenic bladder. Chantrain was the first to conduct comparative studies of skeletal muscle and anal sphincter EMG.<sup>4</sup> In 1979, Mayo included EMG of the anal sphincter into the urodynamic assessment.<sup>5</sup> The future steps in the development of this diagnostic method were marked by neural conductivity studies looking at sacral reflex pathways in 1970s and finally introduction of sensory and motor evoked potentials testing which was first published in 1982.<sup>6,7</sup>

### 1.2 | Electrophysiology

An intact and functioning motor unit (MU) is the basic component required for adequate function of any muscle. MU consists of a single  $\alpha$ -motoneuron residing in the anterior horn of the spinal cord, axon nerve fiber and corresponding muscle fiber. Neurons conduct electrical impulses—action

potentials. Action potentials are waves of cell membrane depolarization which travels toward the periphery. The transmission of neural action potential to a respective muscle, which leads to its contraction, takes place at the neuromuscular junction. The action potentials are associated with changes in extracellular and intracellular currents, which could be recorded and processed for their quantitative (frequency and amplitude of action potential) and qualitative (pattern of action potential) characteristics. Simultaneous activation of multiple motor units leads to contraction of a single muscle. Voluntary contraction force is modulated by the number of recruited MU and changes in the activation frequency. The number of recruited MU and their mean discharge frequency of excitation determines the electrical activity, which could be recorded using EMG. There is a direct relationship between the EMG and the muscle force.

### 1.3 | Technical aspects of EMG

Most clinical EMG devices use a differential amplifier to enhance the display of information. This includes two or more active electrodes placed in proximity to the target muscle or muscle fibers and a common electrode placed equidistant from the active electrodes or on a neutral tissue. The differential amplifier compares the information in all electrodes and discards any information that is the same in all electrodes. This represents the background electrical noise of the body. The remaining information (the target muscle) is then amplified to reduce the influence of artifact or environmental noise on the signal.

Technical parameters of the EMG unit play crucial role in validity of the obtained information. The quality of units used in urology differs significantly. A minimal technical requirement for EMG unit for use in urology should include: Bandwidth: 30 Hz–10 kHz; Time scale: 10–100 ms; Sensitivity: 0.1–2.0 mV; 5p DIN connector; 1.5 mm touch-proof connector for common electrode; EMG processing average rectified curve, raw EMG curve, and audio EMG.

### 1.4 | Electrodes

In general electrodes are used for recording changes in the algebraic sum of motor unit action potentials, or for neural stimulation. The recording unit consists of two or more active electrode and a ground electrode. The size of the electrode determines the specificity of the recording. Larger electrodes are used to record large muscle areas such as the activity of the entire pelvic floor muscle contraction. Smaller electrodes are used to evaluate single motor units. According to their design, technical characteristics and purpose (recording vs stimulation) electrodes are divided in several groups:

Needle electrodes are inserted into the recording muscle and are designed to record single fiber action potentials or action potentials from a small number of units.

#### 1.4.1 | Coaxial needle electrode

Is the most widely used type of needle electrode used in myography performed by neurologists. It consists of the platinum wire (active electrode) which is wrapped in a steel sheet (reference/common electrode). The electrode records the differences in a single action potential between the tip of the platinum wire and the conductive sheet.

#### 1.4.2 | Bipolar needle electrode

Consists of two platinum wires embedded in the sheet and records the difference between action potentials recorded by the two active wires.

#### 1.4.3 | Monopolar needle electrodes

Measure activity recorded by a conically shaped tip of the needle which is embedded in the unconducting sheet. Compared to coaxial needles, it has a larger recording surface, and a wider pick-up field, resulting in higher amplitudes of recorded potentials. This does not allow for recording of action potential from a single muscle fiber and is therefore less specific.

#### 1.4.4 | Surface electrodes

Surface electrodes are placed on the skin overlaying the muscle of interest. This includes both external patch and internal vaginal or rectal probe electrodes. They consist of silver chloride conductive discs or bars. They have a larger reception field, which means that they display a summary of the entire muscle not single action potential. They are however, easy to use and not associated with needle insertion, therefore, despite their low sensitivity they are the most widely used electrodes in urodynamic evaluation.

#### 1.4.5 | Stimulation electrodes

Their principal use is to provoke action potential remotely, which is then picked up by the recording electrode for the purpose of assessing the nerve conductivity and neuromuscular transmission. They could be designed as both needle or surface electrodes of different shapes according to the type of use (clip electrodes, band electrodes).

## 2 | EMG METHODS USED IN UROLOGY

### 2.1 | Needle EMG of anal sphincter

#### 2.1.1 | Principle

External anal sphincter is the component of the pelvic floor which is easiest to identify and target using a needle electrode. Due to close anatomical location and shared innervation, its activity could implicate the activity of other anatomical structures of the pelvic floor. It is therefore used as a tool for indirect evaluation of the urethral closing mechanism.

#### 2.1.2 | Technique

With the patient in the lateral decubitus or lithotomy position, under digital rectal control, needle electrodes are inserted bilaterally, approximately 0.5 cm lateral to the anus. The depth of insertion is 3-8 cm, depending on patient's constitution.

First, we assess the EMG during maximal relaxation, then during slight pelvic floor muscle contraction or during slow artificial bladder filling. Subsequently we assess the sphincter activity during maximal voluntary contraction of the anal sphincter. To obtain reproducible results it is necessary to record at least 10-20 single action potentials in every phase of the assessment.<sup>8</sup> This assessment is challenging for the patient, time consuming, requiring skills, and expertise.

#### 2.1.3 | Evidence

Anal sphincter EMG using needle electrodes allows the physician to detect disturbances in neuroregulation of the pelvic floor muscles, which could be due to spinal cord injury, lower motor neuron lesion, demyelinating diseases, and Parkinson disease. It could indirectly detect detrusor-sphincter dyssynergia (*eo*).

However, no systematic study or meta-analysis has been published during last two decades with the topic of the use of needle EMG of the anal sphincter in urology. Currently, only limited evidence based on single center expert opinion is available (*eo*).

### 2.2 | Needle EMG of urethral sphincter

#### 2.2.1 | Principle

Direct detection of the activity of the striated external urethral sphincter.



### 2.2.2 | Technique

In male patients the needles are inserted into the perineum 0.5 cm lateral to the midline at the point of projection of the urethral bulb. The needle tip is directed toward the apex of the prostate and the depth of insertion is controlled by digital rectal examination (DRE) and by acoustic and visual evidence of activity recorded by the EMG equipment. In female patients the electrodes are inserted transvaginal, after the bladder neck is identified with help of a urethral Foley catheter. The recording technique is identical to that of the anal sphincter.

### 2.2.3 | Evidence

Allows direct recording of the urethral sphincter, however, due to its invasive nature and technical difficulty is used only used in a limited number of carefully selected cases, most often in research studies.<sup>9</sup> Basic work describing the use of needle EMG of the urethral sphincter can be dated back to 1984.<sup>10</sup> More recently Mahajan confirmed the superiority of needle urethral sphincter electrodes compared to surface electrodes.<sup>11</sup> However, only limited evidence based on single center expert opinion is available.

## 2.3 | EMG of anal sphincter using surface electrodes

### 2.3.1 | Principle

Non-invasive detection of activity of the entire pelvic floor muscles which is routinely used in urology in course of uroflowmetry or invasive urodynamics.

### 2.3.2 | Technique

Surface patch electrodes are attached adjacent to the mucocutaneous line of anus bilaterally. The impedance of the skin is reduced using careful degreasing. In some cases a careful epidermis abrasion is required. Excessive hair and adipose tissue around the anal sphincter decrease accuracy of the EMG reading. The electrode wires need to be positioned away from the urine stream. Practitioners are also cautioned not to place the electrodes too lateral in which case the gluteus muscles are being recorded. The common electrode can be placed on the thigh or trochanter. The proper attachment of the electrodes is subsequently tested by recording increased activity during the voluntary pelvic floor contractions.

### 2.3.3 | Evidence

Evidence for using EMG diagnosis of anal sphincter dysfunction using surface electrodes in adults remains weak. This modality is used for screening purposes to detect detrusor-

sphincter dyssynergia in patients with neurogenic bladder and impaired pelvic floor muscle relaxation in patients with dysfunctional voiding. Recently it has been documented that anal sphincter EMG using surface electrodes did not document pelvic floor muscle relaxation during voiding in the majority of a large cohort of patients, suggesting the low sensitivity of this evaluation.<sup>12</sup> However, in pediatric urology literature evidence has been published in support of the beneficial role of simultaneous uroflowmetry and EMG to detect dysfunctional voiding. The argument is that abnormal voiding pattern, that is, staccato and interrupted/fractionated voiding observed on uroflowmetry alone, can lead to overdiagnosis of dysfunctional voiding or detrusor underactivity and that adding simultaneous EMG could significantly improve the diagnostic accuracy.<sup>13</sup> In addition, evidence of usefulness of EMG lag time has been reported in children. EMG lag time is a uroflow/EMG measurement of the time interval between the moment that relaxation of the pelvic floor EMG takes place and the moment urine flow begins. When the lag time is short it is supportive of the diagnosis of detrusor overactivity, while prolongation supports the diagnosis of primary bladder neck dysfunction, especially when they appear in combination with certain LUTS and uroflow patterns.<sup>14</sup> These data should stimulate future studies exploring the role of simultaneous uroflow and EMG in adults.

## 2.4 | Sacral reflex conductivity testing

### 2.4.1 | Principle

Stimulation of the pudendal nerve to induce pelvic floor muscle contraction. The presence or absence of response of pelvic floor muscles is evaluated together with recording for latency interval between the stimulus and the response. The goal is to assess the peripheral limb of the micturition reflex.

### 2.4.2 | Technique

Neurostimulation is performed with surface electrodes attached at the dorsal aspect close to the base of the penis in men and to small labia in women. The response could be recorded by both surface or needle electrodes from the region of anal sphincter or bulbocavernous muscle.

### 2.4.3 | Evidence

This modality is potentially useful for evaluation of bulbocavernosus and anorectal reflexes.

Absence or delay in response, suggest lower motor neuron impairment. No relevant recent study which could support the role of this examination in daily clinical work-up was found.

## 2.5 | EMG biofeedback

### 2.5.1 | Principle

Detect the pelvic floor muscle activity and transform it into a visual and/or acoustic display in order to convey the information to the patient. This is subsequently used for biofeedback training.

### 2.5.2 | Technique

Surface electrodes are placed close to the anal sphincter (as described above) or inside the vaginal or rectal canal. The recording signal is transformed into sound or visual clue and used to guide the patient to better understand the functional status of the pelvic floor muscles.

### 2.5.3 | Evidence

This technique is widely used in conservative treatment of incontinence. Acoustic or visual clues help patients to improved awareness of their pelvic floor muscles and to improve their ability to selectively contract the appropriate group of muscles. EMG biofeedback seems to be effective in the conservative treatment of stress urinary incontinence as well as overactive bladder.<sup>15,16</sup> However, there is only limited number of well designed randomized controlled studies to support this observation.

On the other hand, in dysfunctional voiders, EMG biofeedback is used as a tool to help relax the pelvic floor muscles during micturition. While being a well established method in the treatment of voiding dysfunctions in the pediatric population, where combination of acoustic and visual biofeedback plays an important role, evidence in adults is lacking.<sup>17,18(eo)</sup>.

## 2.6 | Patients perspective

Electromyography does not require any specific patient preparation. Patients must be properly instructed that insertion of EMG needles is associated with a certain degree of pain. Surface EMG is non-invasive and painless. However, the patient must be informed that hair removal, skin defatting and, in some cases, epidermis abrasion is required before placing electrodes. In all cases, but especially for EMG used for biofeedback, patients should be physically and mentally capable of following instructions given by the health care professional (eg, contraction or relaxation of the pelvic floor muscles).

## 2.7 | Standards for reporting EMG data

The “Standards for Reporting EMG Data” endorsed by the International Society of Electrophysiology and Kinesiology have

been written by Dr. Roberto Merletti.<sup>19</sup> This document summarizes technical information that has to be included for each type of electrode, necessary data on detection mode, amplification, rectification of signal and its computer processing. In addition it provides guidelines on EMG amplitude and frequency processing, normalization, EMG processing for estimation of muscle fiber conduction velocity and EMG crosstalk. Every medical professional using EMG, especially in research, should follow these guidelines.

## 2.8 | Suggestions for future research

There is a clear lack of evidence in many aspects of the use of EMG in urology. High quality trials are required especially in following topics:

1. EMG pattern of the pelvic floor muscle under physiological and pathological conditions.
2. Role of the EMG in the comprehensive urodynamic evaluation.
3. Role of EMG in the phenotypisation of the patients suffering from LUTS.
4. Role of the pelvic floor muscle EMG as a biofeedback tool in LUT dysfunctions.
5. Role of audio monitoring during EMG in adults.
6. Role of simultaneous uroflowmetry and EMG in detection of voiding dysfunctions, detrusor overactivity, and detrusor underactivity in adults.

## 3 | CONCLUSIONS

The concept of the use of electrophysiological methods in urology is supported by good theoretical basis. However, the evidence supporting the value of EMG techniques in diagnostics is limited. With the current efforts to improve phenotyping of these patients in order to provide individualized treatment, the role of EMG could increase. In contrary evidence in support of EMG biofeedback exists and should be considered an integral part of conservative treatment of incontinence, OAB, and dysfunctional voiding.

## REFERENCES

1. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med*. 2009;151:264–269.
2. Beck A. Elektromyographische untersuchungen am sphincter ani. (Ein beitrag zur tonusfrage). *Pflugers Arch*. 1930;224:278.
3. Bailey J, Powers J, Walonis G. A clinical evaluation of electromyography of the anal sphincter. *Arch Phys Med*. 1970;7:402–408.
4. Chantraine A. Electromyographie des sphincters stries ureteral et anal humains. *Rev Neurol*. 1966;115:396–403.

5. Mayo ME. The value of sphincter electromyography in urodynamics. *J Urol.* 1979;122:357–360.
6. Rushworth G. Diagnostic value of electromyographic study of reflex activity in man. *Electroenceph Clin Neurophysiol.* 1967; (Supl 25):65–73.
7. Badr GA, Fall M, Carlsson CA, et al. Cortical evoked potentials following the stimulation of the urinary bladder in man. *Electroenceph Clin Neurophysiol.* 1982;54:494–498.
8. Chantraine A. EMG examination of the anal and urethral sphincters. In: Desmedt JE: *New developments in electromyography and clinical neurophysiology.* Basel: Karger; 1973.
9. Vereecken RL, Derluyn J, Verduyn H. Electromyography of the perineal striated muscles during cystometry. *Urol Int.* 1975;30:92–98.
10. Fowler CJ, Kirby RS, Harrison MJG, et al. Individual motor unit analysis in the diagnosis of disorders of urethral sphincter innervations. *J Neurol Neurosurg Psychiatry.* 1984;47:637–641.
11. Mahajan ST, Fitzgerald MP, Kenton K, et al. Concentric needle electrodes are superior to perineal surface-patch electrodes for electromyographic documentation of urethral sphincter relaxation during voiding. *BJU Int.* 2006;97:117–120.
12. Kirby AC, Nager CW, Litman HJ, et al. Perineal surface electromyography does not typically demonstrate expected relaxation during normal voiding. *Neurol Urodyn.* 2011;30:1591–1596.
13. Wenske S, Combs AJ, Van Batavia JP, et al. Can staccato and interrupted/fractionated uroflow patterns alone correctly identify the underlying lower urinary tract condition? *J Urol.* 2012;187:2188–2193.
14. Combs AJ, Van Batavia JP, Horowitz M, et al. Short pelvic floor electromyographic lag time: a novel noninvasive approach to document detrusor overactivity in children with lower urinary tract symptoms. *J Urol.* 2013;189:2282–2286.
15. Dannecker C, Wolf V, Raab R, et al. EMG-biofeedback assisted pelvic floor muscle training is an effective therapy of stress urinary or mixed incontinence: a 7-year experience with 390 patients. *Arch Gynecol Obstet.* 2005;273:93–97.
16. Wang AC, Wang YY, Chen MC. Single-blind, randomized trial of pelvic floor muscle training, biofeedback-assisted pelvic floor muscle training, and electrical stimulation in the management of overactive bladder. *Urology.* 2004;63:61–66.
17. Koenig JF, McKenna PH. Biofeedback therapy for dysfunctional voiding in children. *Curr Urol Rep.* 2011;12:144–152.
18. Combs AJ, Glassberg AD, Gerdes D, et al. Biofeedback therapy for children with dysfunctional voiding. *Urology.* 1998;52:312–315.
19. Merletti R. Standards for reporting EMG data. *JEK.* 2015;25:1–2.

## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

**How to cite this article:** Krhut J, Zachoval R, Rosier PFWM, Shelly B, Zvara P. ICS Educational Module: Electromyography in the assessment and therapy of lower urinary tract dysfunction in adults. *Neurourology and Urodynamics.* 2018;37:27–32. <https://doi.org/10.1002/nau.23278>

# Filling Cystometry

Carlos D'Ancona, Mario João Gomes, Peter F.W.M. Rosier

ICS Education Module

8

## Cystometry - Definition

- Transurethral or suprapubic continuous fluid filling of the bladder, and measurement of vesical and abdominal pressures.....
- „Cystometry ends with ‘permission to void’ or with incontinence (involuntary loss) of the (total) bladder content.

ICS Education Module

## Cystometry: Aims

- To diagnose lower urinary tract reservoir function and find an explanation for the patients' complaints
- To evaluate lower urinary tract reservoir function for research purposes

## Cystometry (clinical relevance)

- Demonstrate the reservoir function of the bladder relevant to the symptoms and signs that the patient perceives

### What should be known before starting?

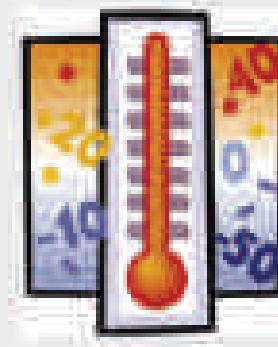
- Patient's perceived (LUT-) symptoms and signs
  - Symptoms questionnaire (preferable)
  - Voiding diary ('usual' volumes voided)
    - 'Predict'-estimated- cystometric capacity
  - Free uroflowmetry
  - Post void residual urine

## ICS Standard:

- Fluid filled: saline solution
- External pressure transducers
- Reference = pressure at the level of the symphysis
- Patient in standing position
- Fill until strong desire to void
- Medium fill-rate (e.g. 10% of expected capacity /minute)
- Indicate end of cystometry on trace
  - Stopping of the pump (and /or)
  - 'Permission to void'

## Solution infused

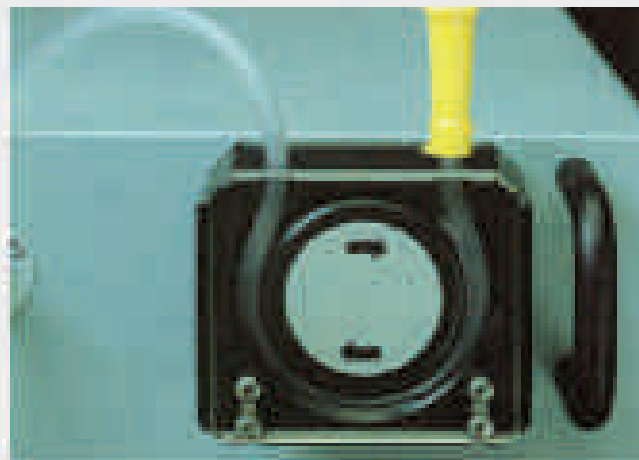
- Saline solution
  - Or contrast
- Temperature
  - Room temperature



## Patient position during cystometry

- Sitting (standing) position is more provocative for abnormal detrusor activity (ex. overactivity) than the supine position.  
At some point in the test, filling might desirably take place with the patient standing.
- Patients unable to sit or stand → supine position.

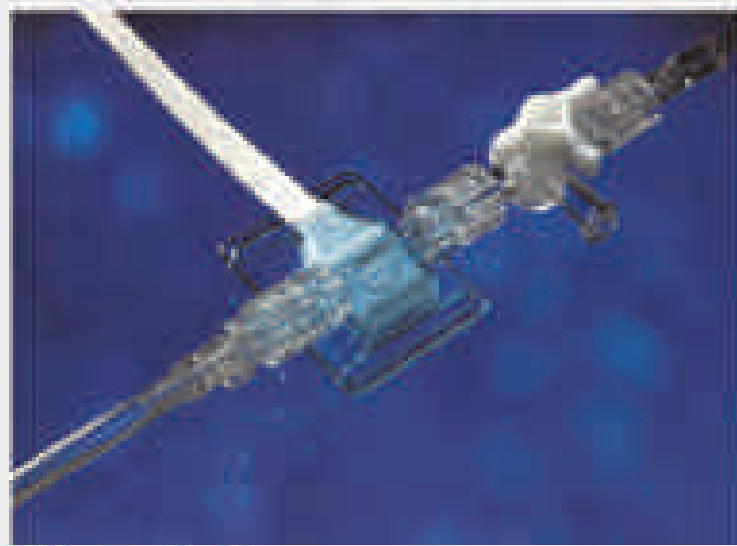
## Infusion Pump



- Usually lithotomy position
- Sterile catheters
  - Vesical: double lumen (or separate)
  - 6-7F
  - Rectal: catheter with a punctured balloon
- Fix the catheters adjacent to the meatus
- Patient in comfortable position
- Cover the patient - es. with a towel



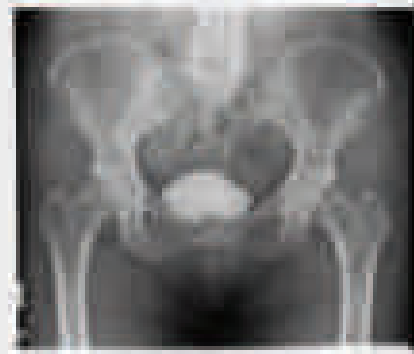
## Transducer



ICS Educational Module

## Position of the Transducer

- External transducer measured at the level of the symphysis pubis
- Equals: Base of the bladder
- Intra rectal and intravesical pressures are assumed to be measured at identical levels



ICS Educational Module

## Filling cystometry

- Initial resting pressure
  - Supine 5 -20cmH<sub>2</sub>O
  - Sitting 15-40cmH<sub>2</sub>O
  - Standing 30-50cmH<sub>2</sub>O

Wagman S, Heumann M & Unsley S 2012, 11: 1104-1117

**ICS** Education Module

## Bladder sensation - classification

- **Normal bladder sensation**
  - can be judged by three defined points noted during filling cystometry and evaluation relative to the bladder volume at that moment and in relation to the patient's symptomatic complaints.
- **First sensation of bladder filling**
  - is the feeling the patient has, during filling cystometry, when he/she first becomes aware of the bladder filling.
  - To be separated from the sensation that the catheterisation has caused, that means it disappears after a few minutes.
- **First desire to void**
  - is defined as the feeling, that would lead the patient to pass urine at the first convenient moment, but voiding can be delayed if necessary.
- **Strong desire to void**
  - is defined as a persistent desire to void without the fear of leakage.
- **Urgency**
  - during filling cystometry, is a sudden compelling desire to void.

**ICS** Education Module

- **Increased bladder sensation**
  - is defined, as an early first sensation of bladder filling (or an early desire to void) and/or an early strong desire to void, which occurs at low bladder volumes and which persists.
- **Reduced bladder sensation**
  - is defined, as diminished sensation throughout bladder filling.
- **Absent bladder sensation**
  - means that, during filling cystometry, the individual has no bladder sensation.
- **Non-specific bladder sensation,**
  - during filling cystometry, may make the individual aware of bladder filling, for example, abdominal fullness or vegetative symptoms.
- **Bladder pain,**
  - is a self-explanatory term, and is an abnormal finding.
  - Pain may increase with volume, or not, which should be reported.

## Filling cystometry - information

- **Cystometric capacity (mL)**
  - infused weight and pump speed helpful during the test.
  - And include diuresis (capacity; voided volume + PVR) after the test.
  - Measure PVR after pressure flow via the catheter
- **Bladder sensations (mL)**
  - Electronic buttons during cystometry do not exclude diuresis; correct after the test if needed

## Bladder filling sensation

- It is a subjective parameter
  - Depending on sensation communication with the patient
- Normal bladder sensation (rule of thumb) of cap.
 

• First sensation	±/- 175-250ml	33%
• First desire to void	±/- 375-450ml	66%
• Strong desire to void	±/- 425-500ml	100%

## Bladder capacity

- Cystometric capacity – bladder volume at the end of filling phase
  - Commonly there is no reason to fill more than 800ml, e.g. in the absence of sensation and/or contraction
- Maximum cystometric capacity – patient can no longer delay micturition
  - Overfilling hinders subsequent representative voiding
- Maximum anesthetic capacity – volume of bladder without urinary leakage

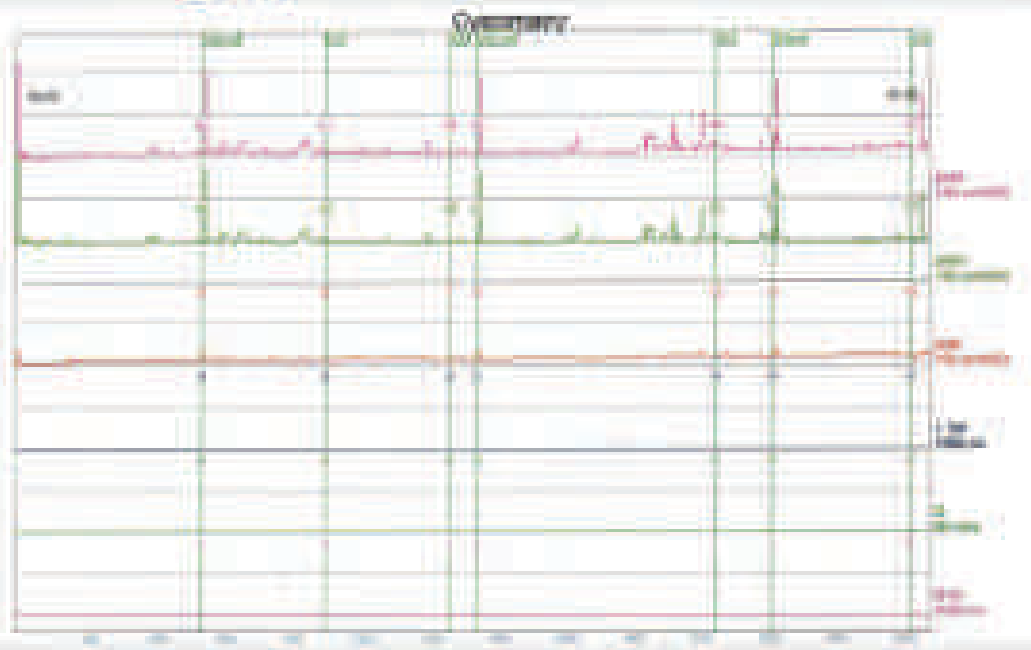
## Detrusor Pressure

$$P_{\text{det}} = P_{\text{ves}} - P_{\text{abd}}$$

Schaller W. NeuroUrology. 2012; 21: 263-74

ICS Educational Module

## Filling Cystometry



ICS Educational Module

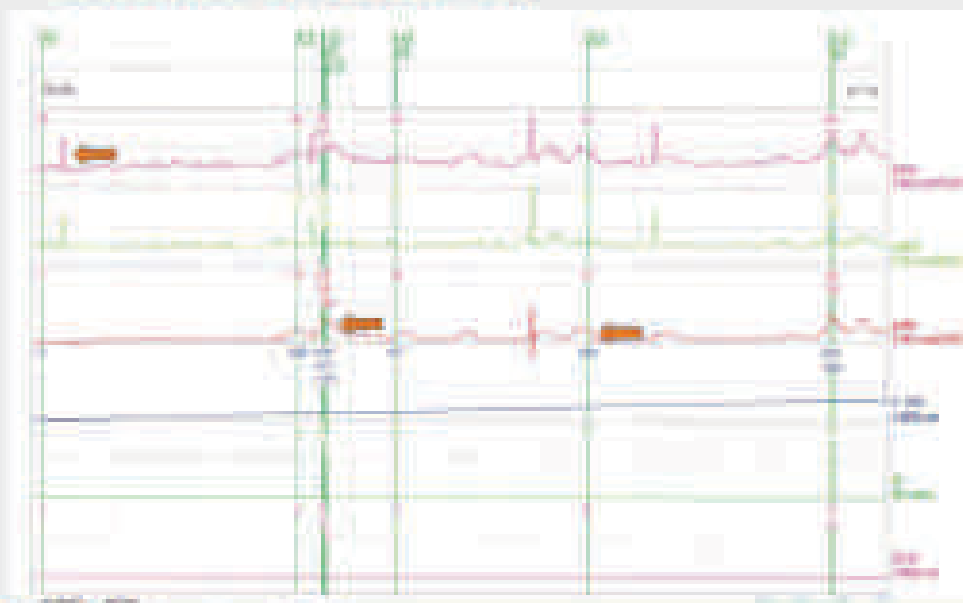
## Detrusor function

- Normal detrusor function – little or no changes in pressure
  - Detrusor overactivity – ANY amplitude of detrusor pressure rise before permission to void.
    - Neurogenic, when relevant neurological abnormalities are present
    - Idiopathic
- Cystometry patterns do not discriminate Neurogenicity: History and clinical exam.

Werner R. Urology, 2004, 61: 37-48

ICS Education Module

## Detrusor overactivity



ICS Education Module

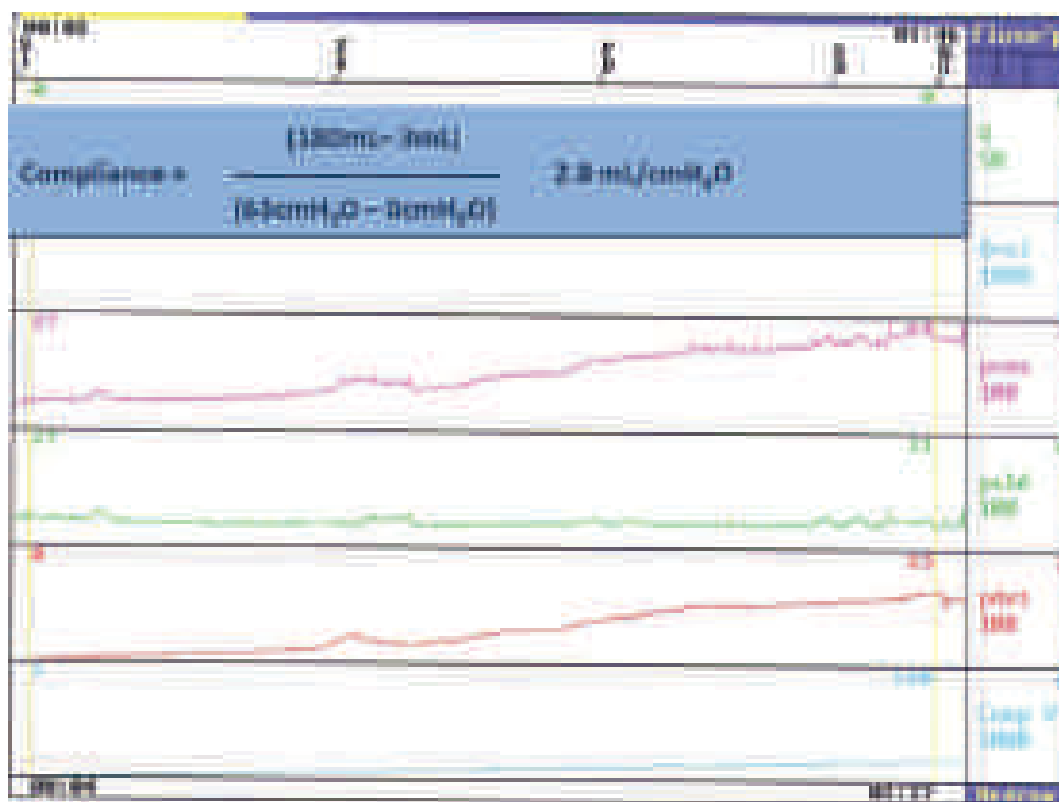
## Bladder Compliance

- Good compliance is large volume and low pressure

$$C = \frac{(V1 - V0)}{(P1 - P0)}$$

Horms J. Urology 2003; 61: 37-48

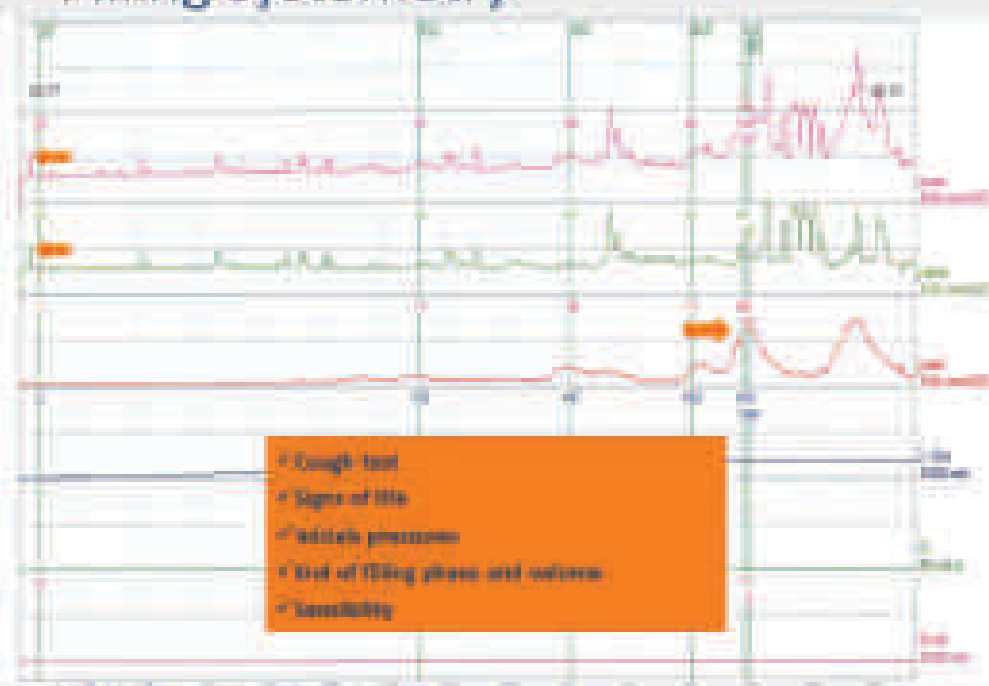
ICS Education Module



## Bladder Compliance – Normal Values

- Not well defined
- (Measuring) UT dysfunction:
  - (low) values 23 – 40 ml/cmH<sub>2</sub>O, upper tract risk
- Normal >40 ml/cmH<sub>2</sub>O
- Low <40 ml/cmH<sub>2</sub>O
  - Relation with sensation, volume and leak point

## Filling cystometry





## Cystometry

- Patient should be relaxed and trustful
- Technically adequate
- Observe the pressures 'as an engineer'
- Perform the test as representative for the usual situation as possible
- Systematically report all observations

Thank You

# ICS teaching module: Cystometry (basic module)

Carlos Arturo Levi D'Ancona<sup>1</sup> | Mario João Gomes<sup>2</sup> | Peter F.W.M. Rosier<sup>3</sup>

<sup>1</sup> Division of Urology, University of Campinas School of Medicine, Campinas, Sao Paulo, Brazil

<sup>2</sup> In remembrance: Hospital Santo Antonio, Porto, Portugal

<sup>3</sup> Department of Urology, University Medical Center Utrecht, The Netherlands

## Correspondence

Carlos Arturo Levi D'Ancona, Division of Urology, University of Campinas School of Medicine, Campinas, Sao Paulo, Brazil.  
Email: cdancona@uol.com.br

**Aims:** To summarize the evidence background for education of good urodynamic practice, especially cystometry.

**Methods:** A search was done in PubMed for the last 5 years of publications selecting only clinical studies, utilizing the following keywords: cystometry 133 articles and filling cystometry 53 articles.

**Results:** The evidence with regard to clinical setting and cystometry technique, as well as for catheters and transducers type, infused solution and patient position is presented with recommendations. Also the practice of determining bladder filling sensation and capacity and the basis of detrusor storage function diagnosis is educated.

**Conclusions:** This manuscript provides the evidence background for the practice of cystometry.

## KEYWORDS

cystometry, urodynamics

## 1 | INTRODUCTION

Cystometry is the method by which the storage function of the lower urinary tract (LUT) is measured during the filling of the bladder.<sup>1,3</sup> The aim of urodynamics is to find an objective, pathophysiological, explanation for the patient's LUT symptoms and to answer the clinical (or research) question.<sup>3–5</sup> Cystometry is an important part of invasive urodynamics as it evaluates the storage function of the bladder. Invasive urodynamics, that is, cystometry requires insertion of catheters and technical instrumentation and also depends on cooperation of the patient. Urodynamics is a replication of the LUT physiology in a laboratory situation and the interpretation should be made with specific attention to representativeness, technical details, as well as clinical relevance. Cystometry is the golden standard for LUT storage function assessment.<sup>1–5</sup>

The ICS Urodynamics Committee presents this teaching module “Cystometry” as standard education of Good Urodynamic Practice<sup>2,3</sup> for everyone involved with indicating,

performing, and analyzing urodynamic testing. The teaching module consists of a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base, for the ICS PowerPoint presentation; available via <http://www.icsoffice.org/eLearning/.....> The presentation explains normal physiology, testing requirements, practice of testing, and analysis methods.

### 1.1 | Clinical setting

Cystometry is part of invasive urodynamic investigation and contemporary guidelines recommend that a LUT symptom questionnaire, a voiding diary, clinical examination, and laboratory urine exam preceded invasive testing. Usually uroflowmetry and a post void residual urine (PVR) are also recommended before further testing. The voiding diary informs about the range of the volume of micturition and the frequency of voiding. Uroflowmetry and PVR are recommended for clinical reasons but also relevant to evaluate the representativeness of pressure flow analysis (not further discussed here). For the practice of cystometry however, PVR is also informative to be aware of the “hidden” capacity of the bladder, not visible on the voiding diary.

Dr. Alan Wein led the peer-review process as the Associate Editor responsible for the paper.

Voided volumes (including PVR) provide a clue to the urodynamic capacity that can be expected. Cystometry should result in a diagnosis of detrusor (muscle volume-adaptation) function and bladder compliance as well as diagnoses of bladder filling sensation and cystometric (bladder) capacity.<sup>1</sup> Clinical stress-testing during examination can demonstrate urine loss however cystometry allows stress (urinary incontinence) testing while intravesical volume and pressures are monitored, allowing to control for detrusor activity.<sup>6,7</sup> All this information gives the urodynamic diagnosis of storage phase function and is basis for management of patients with symptoms and signs of LUTD.<sup>5</sup> The cystometry starts (after insertion of the catheters) when the infusion begins and ends when the infusion stops under the command of the patient and/or decision of the urodynamicist.<sup>1-3</sup> Cystometry may also end with loss (incontinence) of total bladder volume.

## 1.2 | Technique of cystometry

Catheterization is performed trans-urethral however, can also be done via the suprapubic route. ICS standard requires fluid filled catheters connected to an external pressure transducer. Simultaneous recording of abdominal pressure (Pabd) is also standard and can be obtained with the use of a catheter in the rectum and connected to a pressure transducer.<sup>1-3</sup>

The external transducers are positioned at the level of the upper border of symphysis pubic and zeroed at atmospheric pressure before connecting to the catheters, or via a tree-way stopcock while connected.<sup>3</sup> Air bubbles in the connecting tubes and catheters cause dampening of the pressure transmission and should be removed from the system before insertion and measuring.

Before and during the exam, it is necessary to verify that both pressures are registering by asking the patient to cough.<sup>3</sup> The amplitude of pves and pabd should be similar. The vital signs of respiration, talking of the patient, and movement should be visible in pves and pabd throughout the entire cystometry as a sign of pressure registering quality.<sup>2,8,9</sup> Rectal contractions may occur during cystometry and should not be misinterpreted as detrusor overactivity in the pdet trace.<sup>9</sup> On the other hand classification of intensity and frequency of rectal contractions may be of relevance.<sup>10</sup>

## 1.3 | Types of catheters

A double lumen catheter, as thin as possible (usually 7-8F), is ICS good urodynamic practices standard. A double lumen catheter requires an infusion pump on the filling lumen. Using a double lumen catheter allows a smooth transition from storage to voiding and permits the exam to be repeated without reinsertion of a filling catheter.

A double lumen catheter may be considered too expensive in some health care systems and in that case a 6F catheter is

inserted together with a filling catheter (usually 8-10F) that is removed at the end of the filling to avoid excess obstruction during voiding. Abdominal pressure, surrounding the bladder in the lower pelvis, is measured with a, preferably punctured, balloon filled with a small amount of fluid to prevent clogging of the catheter by rectal content, but may also be an open fluid filled tube without balloon.<sup>2,3</sup> Vaginal placing or via a stoma are alternatives when the rectum is closed. Although this is—especially stoma placement—less reliable.

The size of the abdominal pressure catheter is preferably similar to that of the Pves so that the same sensitiveness to transfer the pressure is present.

## 1.4 | Pressure transducer

Electronic external transducer, connected to the tubing via a pressure dome is the most frequently used in ICS standard urodynamic evaluation and all pressure parameters are based on this system. New microtip or air filled transducers have the advantage of no air bubbles in the fluid system or obstruction of measuring holes, but the results obtained with these systems are not entirely identical.<sup>11</sup> New studies should elucidate the magnitude of the differences and uncover practical methods to calibrate the clinical results with the alternative systems with the available reference values obtained with fluid filled systems.

## 1.5 | Solution infused

Saline solution is the commonly used fluid for bladder filling. When videourodynamics is performed, a contrast solution is added. Body temperature fluid and room temperature fluid do not differently affect bladder sensory thresholds and do not unequally provoke DO or LUT irritation<sup>12,13</sup> but forced diuresis (without external filling) does lead to a higher incidence of DO.<sup>14</sup>

The infusion rate is, by ICS good urodynamic practices, divided into Physiological filling rate—less than predicted maximum; calculated with body weight in kg divided by four expressed in mL/min; Non-physiologic filling rate; defined as filling rate greater than the predicted maximum filling rate.<sup>1</sup> A fill rate of 10% of anticipated capacity, based on voiding diary and PVR, per minute may be an acceptable rule of thumb to select the (non-physiologic) fill rate.<sup>1-3</sup>

## 1.6 | Patient position

The ICS standard position during cystometry is sitting upright or standing in all patients able to do. The initial resting pressures, if zeroed to the ICS reference, are 15-40 cmH<sub>2</sub>O (sitting) or 30-50 cmH<sub>2</sub>O (standing), both for the vesical as well as intrarectal pressure. In the supine position, the vesical pressure will be 5-20 cmH<sub>2</sub>O and the intrarectal pressure in an individual, usually somewhat higher as a consequence of this

position.<sup>15</sup> By consequence the subtracted detrusor pressures are around zero. Small differences ( $< +$  or  $- 10$  cmH<sub>2</sub>O) can be considered to be a result from differences in catheter tip position of both catheters inside the body and are therefore acceptable.

### 1.6.1 | Bladder sensation

During the exam verbal communication is maintained with the patient so he/she can give information about the bladder sensation. This is a subjective parameter. ICS has defined three points to be evaluated: First sensation of bladder filling—is the feeling the patient has, during filling cystometry, when he/she first becomes aware of the bladder filling. First desire to void—defined as the feeling, during filling cystometry, that would lead the patient to pass urine at the next convenient moment, but voiding can be delayed if necessary. Strong desire to void—is defined, during filling cystometry, as a persistent desire to void without the fear of leakage.<sup>1,3</sup> These definitions should be put in practice as follows: First Sensation should be separated from the sensations that the catheterization has caused, that usually diminishes after the first minutes; The patient is asked “Tell me when you become aware that the bladder is not empty anymore.” Normal desire is (if no or little chronic post void residual exists) usually roughly associated with “average” FVC-BD volumes and can be asked as: “Tell me when you have the sensation that normally tells you go to the toilet, without any hurry. Strong desire is “the moment that you, without any pain, will not likely postpone the voiding any more, and or will visit the nearest restroom, eg, while shopping.” Correlating the results of cystometry volume and sensations with FVC-BD may provide background information regarding day to day sensory findings and bladder volumes. Sensation volumes are “normally” occurring at respectively  $\pm 30$  and 60% of capacity, and are also associated with the dysfunction.<sup>16,17</sup> Bladder sensation can be classified with the terms normal, absent, reduced, and increased sensations. Sensation is considered increased when the sensations, as described above, occur early, at relatively small volumes.<sup>1</sup> Bladder sensation can also be atypical, usually in patients with neurological abnormalities (not further discussed in this module).

### 1.6.2 | Bladder capacity during filling cystometry

Bladder capacity during filling cystometry is characterized by cystometric capacity and maximum cystometric capacity. Usually reported is capacity at strong desire which may be interpreted as maximum cystometric capacity that should be around 500 mL in women<sup>16,17</sup> and somewhat less in elderly men.<sup>8</sup> Filling of more than 800 mL is seldom useful.

Maximum anesthetic capacity; the volume to which the bladder can be filled under deep general or spinal anesthetic,

without urinary leakage, is rarely reported in scientific literature but may be of relevance in (ketamine) interstitial cystitis.

Cystometry is apart from urinary tract infection and urethral lesion not associated with excessive risks. In persons with a spinal cord lesion, however, autonomic dysreflexia may occur; immediate emptying of the bladder is the remedy (further discussed in specific ICS module). After cystoplasty or myectomy of the detrusor there is an increased risk of rupture of reservoir and especially in these patients (but not exclusively) the bladder should not be filled far beyond the usual volumes.<sup>18,19</sup>

### 1.6.3 | Detrusor function

Detrusor function can be normal or overactive.<sup>1</sup> Normal detrusor function—allows bladder filling with little or no change in pressure. Detrusor overactivity—is characterized by phasic detrusor pressure increments, which may be spontaneous or provoked. Examples of provocative maneuvers: non-physiological fast, for example, 100 mL/min bladder filling, change of position, stress test, and washing hands.

Detrusor overactivity should be classified as neurogenic or idiopathic. Detrusor overactivity is a urodynamic diagnosis and clinical symptoms may be urgency, urgency and incontinence, or overactive bladder syndrome.<sup>1,7</sup> When detrusor overactivity is observed in a patient with a relevant neurologic abnormality (should be diagnosed based on history and clinical examination) the detrusor overactivity is neurogenic.

### 1.6.4 | Bladder compliance

Bladder compliance represents the relationship between change in bladder volume and change in detrusor pressure and shows the capacity of the detrusor to relax and to stretch to accommodate to volume increment. Also reduced compliance may result in frequent voiding.

The module “cystometry advanced” discusses abnormalities of sensation and or detrusor function abnormalities.

## 2 | CONCLUSION

The evidence with regard to clinical setting and cystometry technique, as well as for catheters and transducers type, infused solution, and patient position is presented with recommendations. Also the practice of determining bladder filling sensation and capacity and the basis of detrusor storage function diagnosis is educated and provides the evidence background for the practice of cystometry shown in the ICS teaching module slides-set and presentation.

### 3 | POTENTIAL CONFLICTS OF INTEREST

Dr. Rosier reports grants from T-doc, grants from MMS/Laborie, grants from Astellas, outside the submitted work; Dr. D'Ancona reports grants from Astellas, outside the submitted work; Dr. Gomes has nothing to disclose.

### REFERENCES

- Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21:167–178.
- Schäfer W, Abrams P, Liao L, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
- Rosier PFWM, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016 (ICS-GUP2016): urodynamics, uroflowmetry, cystometry and pressure-Flow study. *Neurourol Urodyn*. 2016; In press.
- Abrams P, ed. *Urodynamicis*. 2nd ed. London: Springer; 1997:1.
- Rosier PF, Giarenis I, Valentini FA, Wein A, Cardozo L. Do patients with symptoms and signs of lower urinary tract dysfunction need a urodynamic diagnosis? ICI-RS 2013. *Neurourol Urodyn*. 2014;33:581–586.
- Winters JC, Dmochowski RR, Goldman HB, et al. Urodynamic studies in adults: AUA/SUFU guideline. *J Urol*. 2012;188:2464–2472.
- Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29:4–20.
- Liao L, Schaefer W. Quantitative quality control during urodynamic studies with TVRs for cystometry in men with lower urinary tract symptoms suggestive of benign prostatic hyperplasia. *Int Urol Nephrol*. 2014;46:1301–1308.
- Hogan S, Gammie A, Abrams P. Urodynamic features and artefacts. *Neurourol Urodyn*. 2012;31:1104–1117.
- Cho SY, Oh SJ. The clinical significance of rectal contractions that occur during urodynamic studies. *Neurourol Urodyn*. 2010;29:418–423.
- Cooper MA, Fletter PC, Zaszczurynski PJ, Damaser MS. Comparison of air-charged and waterfilled urodynamic pressure measurement catheters. *Neurourol Urodyn*. 2011;30:329–334.
- Gelhrich AP, Hill MJ, McWilliams GD, Larsen W, McCartin T. Comparison of urodynamic volume measurements using room and body temperature saline: a double-blinded randomized crossover study design. *Female Pelvic Med Reconstr Surg*. 2012;18:170–174.
- Klevmark B. Natural pressure-volume curves and conventional cystometry. *Scand J Urol Nephrol Suppl*. 1999;201:1–4.
- van Venrooij GE, Boon TA. Extensive urodynamic investigation: interaction among diuresis, detrusor instability, urethral relaxation, incontinence and complaints in women with a history of urge incontinence. *J Urol*. 1994;152:1535–1538.
- Sullivan JG, Swithinbank L, Abrams P. Defining achievable standards in urodynamics—a prospective study of initial resting pressures. *Neurourol Urodyn*. 2012;31:535–540.
- Mahfouz W, Al Afraa T, Campeau L, Corcos J. Normal urodynamic parameters in women. Part II—invasive urodynamics. *Int Urogynecol J*. 2012;23:269–277.
- Wyndaele JJ. Normality in urodynamics studied in healthy adults. *J Urol*. 1999;161:899–902.
- Blok BF, Al Zahrani A, Capolicchio JP, Bilodeau C, Corcos J. Post-augmentation bladder perforation during urodynamic investigation. *Neurourol Urodyn*. 2007;26:540–542.
- Ehdaie B, Mason MD, Gray M, Peters CA, Corbett ST. Bladder perforation in augmentation cystoplasty during urodynamic investigation: a case report and review of the literature. *J Pediatr Urol*. 2013;9:102–106.

**How to cite this article:** D'Ancona CAL, Gomes MJ, Rosier PF. ICS teaching module: Cystometry (basic module). *Neurourology and Urodynamics*. 2017;36:1673–1676. <https://doi.org/10.1002/nau.23181>

# ICS Teaching Module: Measurement of Post-Void Residual Urine


A D Asimakopoulos, C De Nunzio, E Kocjancic, A  
Tubaro, P Rosier & E Finazzi-Agro



**International Continence Society**  
Education Module

1

## Definitions

 **ICS** Education Module

2

## PVR

*“The amount of residual urine in the bladder after a voluntary void”*

Kaplan SA et al. J Urol. 2008 Jul;180(1):47-54.

Increased in pts with:

1. BOO (BPH, poor sphincter relaxation, urethral/meatal stricture or bladder stones)
2. Detrusor underactivity
3. Bladder diverticulum
4. Large volume vesicourethral reflux → “pseudoresidual”

## PVR and BOO

### Limits

- I. Can be due to detrusor underactivity
- II. 1/3 of male patients with BPH and bladder outlet obstruction do NOT present PVR

*More useful if used in combination with uroflowmetry or other parameters.*

*Belal M, Abrams P: J Urol 2006*

## PVR

- *Threshold values delineating what constitutes an abnormal PVR are poorly defined.*
- *Most urologists agree that volumes of 50-100 mL constitute the lower threshold to define an abnormal PVR.*

*Abrams PH et al . Br Med J 1978; 2: 1258.*

## Measurement



## PVR measurement

- Urethral catheterization has been accepted as the gold standard for PVR measurements, but this may cause discomfort for patients and carries a risk of urinary tract infection and trauma.

Schaeffer AJ, et al. J Urol 1983;130:1096--9.

- Non-invasive ultrasound bladder volume measurement has been used as an alternative to urethral catheterization, as a good compromise between accuracy and patients safety/comfort.

Griffiths CJ, et al. J Urol 1986;136:808-812

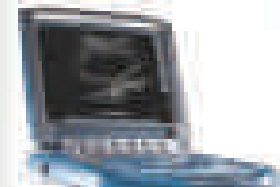
## PVR measurement by US



Ultrasound bladder volume estimation can be performed in two ways:

1. By a real-time ultrasound to directly visualize the bladder.

Griffiths CJ, et al. J Urol 1986;136:808-812



2. By using a portable bladder scanner to calculate the volume automatically without directly visualizing the bladder.

Harbeck GS et al. Br J Radiol 60 (1987), pp. 1063-1065.



## PVR measurement

### Bladder scanner advantages:

1. easy to use;
2. requires only basic training;
3. can be carried out on the ward.

Reliability? (Better with additional real-time pre-scan imaging?)

Park YH: Neurourol Urodyn 2011; 30:335–8.

## Significance

## Significance of PVR

### PVR and acute or chronic urinary retention

Chronic urinary retention has been widely accepted as corresponding to a PVR of more than 300 mL (nevertheless variable definitions).

Abrams PH, et al. Br Med J 1978; 2: 1258.

(Chronic) PVR does not seem to be a strong predictor of acute urinary retention (AUR).

Roehrborn CG, et al. J Urol, suppl., 2005; 173: 443, abstract 1638.

## Significance of PVR

### BOO

- *It is commonly thought that the increase in PVR indicates the severity of BOO.*
- *However, abnormal measurements of free uroflowmetry or PVR can detect only voiding dysfunction without indicating BOO specifically.*
- *Nevertheless, PVR measurements are used as parameter of efficacy for medical and surgical treatments of BPO.*

Kaplan SA, et al. Eur Urol. 2007 Jun;51(6):1717-23. Epub 2007 Jan 16.

## Significance of PVR

### PVR and clinical progression of BPO

- *High PVR is associated with an increased risk of LUTS deterioration and should thus be reconsidered in practice as a predictor of BPO progression.*
- *According to the EAU guidelines on the Management of Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO) , very large PVRs may herald progression of disease and may indicate bladder dysfunction and predict a less favourable response to treatment.*

Oelke M, et al EAU Guidelines on the Management of Male LUTS, incl. BPO

## Significance of PVR

### PVR and clinical progression of BPO

- However, residual urine is not a contraindication to watchful waiting or medical therapy and no level of residual urine mandates invasive therapy and no PVR "cut-point" is yet established for decision-making.

Oelke M, et al EAU Guidelines on the Management of Male LUTS, incl. BPO

## Significance of PVR

### PVR and Antimuscarinics in men

- It is common belief that antimuscarinics should not be used in men with BOO for a potential of AUR.
- Some placebo controlled clinical trial data suggest that antimuscarinics (alone or in combination with an alpha-blocker) do not increase the risk of AUR and do not produce a clinically significant increase of PVR in men, even in presence of BPO.

Roehrborn CG, et al. Urology. 2008 Nov;72(5):1061-7; discussion 1067.

Athanasopoulos A, et al. Eur Urol. 2011 Jul;60(1):94-105.

*However, patients with significant PVR were excluded from these studies and the safety of antimuscarinics in men remains to be confirmed.*

## Significance of PVR

### PVR and bacteriuria

Large PVRs may be associated with UTIs, especially in persons at risk (children, patients with spinal cord injury or diabetes).

Kelly CE. Rev Urol. 2004;6 Suppl 1:S32-7.

*Other studies, however, demonstrated that elevated PVR is not correlated to bacteriuria, incontinence, immobility, impaired cognition, or neurological disease.*

## Significance of PVR

### PVR and Chronic kidney disease (CKD)

- Very large PVRs (>300 mL) may be associated with an increased risk of upper urinary tract dilation and renal insufficiency.

Kelly CE. Rev Urol. 2004;6 Suppl 1:S32-7.

- A PVR >100 mL has been associated with CKD, even if other studies do not suggest this association.

## Significance of PVR

### PVR and Female incontinence

Measurement of PVR is recommended in the management of female urinary incontinence.

Thüroff JW, et al. EAU guidelines on urinary incontinence. Eur Urol. 2011 Mar;59(3):387-400.

PVR should be measured during the assessment of women complaining of overactive bladder symptoms to exclude voiding dysfunction and anticholinergic medication should be used if PVR is low.

Milleman M, et al. J Urol. 2004 Nov;172(5 Pt 1):1911-4

## Significance of PVR PVR and Children

Assessment of PVR is mandatory in a variety of pediatric patients, such as those with voiding LUTS, UTIs, vesicoureteral reflux, posterior urethral valves or neural tube defects.

Kelly CE. Rev Urol. 2004;6 Suppl 1:S32-7.

## Recommendations and evidence summary

## PVR

### Actual recommendations

- The interval between voiding and PVR measurement should be as short as possible (eo). It is advisable to ask the patients if the voiding was similar to a typical micturition in his/her daily life (eo).
- Use preferably noninvasive ultrasound bladder volume measurement instead of urethral catheterization (LE 3).
- Measurement of PVR is recommended at the management of female urinary incontinence (LE 3).
- Assessment of PVR is considered mandatory in a variety of pediatric patients (LE 3).

## PVR

### Evidence summary

- Unrepresentative results may be obtained when voiding has to occur in unfamiliar surroundings or on command with an only partially filled or an overfilled bladder (eo).
- Portable bladder scanner may present some advantages over real-time ultrasound, especially if equipped with an additional real-time pre-scan imaging (LE 3).
- There is no universally accepted definition of a significant residual urine volume. For clinical practice, PVR <30 mL can be considered insignificant, while residual volumes persistently >50 mL could be regarded as relevant (eo).



## PVR

### Evidence summary

- Large PVR (>200–300 mL) often indicates LUTD and may predispose to unsatisfactory treatment results if invasive BOO treatment is undertaken (LE 3). Nevertheless, no level of residual urine, of itself, mandates invasive therapy and no PVR threshold is yet established for decision-making (LE 3).

## PVR

### Evidence summary

- PVR cannot be used as a robust predictor of acute urinary retention (LE 3).
- PVR can detect only voiding dysfunction without indicating BOO specifically (LE 2-3).

## PVR

### Evidence summary

- PVR is not increased significantly in patients treated with antimuscarinic drugs (LE 2). However, consider that patients with significant PVR were excluded from studies published up to now.
- PVR may be associated with UTI, especially in subjects at risk, such as children or patients with spinal cord injury or diabetes (LE 3). This association among adults is far from clear (LE 3).
- Large PVR may be associated with chronic kidney diseases (LE 3).

## PVR

### Conclusions

- Measurement of PVR is recommended in guidelines and recommendations on the management of LUTS and urinary incontinence.
- Increased PVR values may be associated with an increased risk of UTI, risk of upper urinary tract deterioration and renal failure, risk of progression in men with BPO, risk of AUR following antimuscarinic treatment and risk of poor outcome following surgery of BPO.
- Up to now, most of the ominous features associated with PVR are not evidence-based.



## Measurement of Post-Void Residual Urine

Anastasios D. Asimakopoulos,<sup>1</sup> Cosimo De Nunzio,<sup>2</sup>  
Ervin Kocjancic,<sup>3</sup> Andrea Tubaro,<sup>2</sup> Peter F. Rosier,<sup>4</sup> and Enrico Finazzi-Agrò<sup>5\*</sup>

<sup>1</sup>UOC of Urology, Department of Surgery, University of Tor Vergata, Policlinico Casilino, Rome, Italy

<sup>2</sup>Department of Urology, Sant'Andrea Hospital, Faculty of Health Sciences "La Sapienza" University of Rome, Rome, Italy

<sup>3</sup>Director division of Pelvic Health and Reconstructive Urology, Department of Urology, University of Illinois at Chicago, Chicago, Illinois

<sup>4</sup>University Medical Centre Utrecht, Department of Urology, Utrecht, The Netherlands

<sup>5</sup>Unit for Functional Urology, Policlinico Tor Vergata, Department of Experimental Medicine and Surgery, Tor Vergata University of Rome, Rome, Italy

**Aims:** To present the teaching module "Measurement of Post-void residual urine." **Methods:** This module has been prepared by a Working Group of the ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel. **Results:** In this ICS teaching module the evidence for and relevance of PVR measurement in patients with lower urinary tract dysfunction (LUTD) is summarized; in short: The interval between voiding and post-void residual (PVR) measurement should be of short duration and ultrasound bladder volume measurement is preferred to urethral catheterization. There is no universally accepted definition of a significant residual urine volume. Large PVR (>200–300 ml) may indicate marked bladder dysfunction and may predispose to unsatisfactory treatment results if for example, invasive treatment for bladder outlet obstruction (BOO) is undertaken. PVR does not seem to be a strong predictor of acute urinary retention and does not indicate presence of BOO specifically. Although the evidence base is limited, guidelines on assessment of LUTS generally include PVR measurement. **Conclusion:** Measurement of PVR is recommended in guidelines and recommendations on the management of LUTS and urinary incontinence, but the level of evidence for this measurement is not high. This manuscript summarizes the evidence and provides practice recommendations for teaching purposes in the framework of an ICS teaching module. *Neurourol. Urodynam.* 35:55–57, 2016. © 2014 Wiley Periodicals, Inc.

**Key words:** bladder outlet obstruction; measurement; post-void residual urine; urinary incontinence; urinary tract infections; urodynamics

### INTRODUCTION

The incomplete evacuation of the bladder leads to post-void residual urine (PVR). PVR is defined as the volume (ml) of urine left in the bladder at the end of micturition.<sup>1</sup>

The ICS Urodynamics Committee presents the teaching module "Measurement of post-void residual urine" to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, performing analysis of voiding. The teaching module consists of a PowerPoint presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base for the ICS PowerPoint presentation is available via <http://www.icsoffice.org/eLearning/> or via the QR code on this page. The presentation explains testing requirements, clinical workup and analysis. The presentation and this manuscript are based on the highest-level available published evidence; evidence has been graded according to the modification of the Oxford Center for Evidence-Based Medicine levels of evidence used by the 5th International Consultation on Incontinence.<sup>2</sup> Where evidence is unavailable, experts' opinion has been used and the sentence is marked as "eo" (experts' opinion).

### PATHOPHYSIOLOGY

PVR is very frequently the consequence of lower urinary tract dysfunction (LUTD), with bladder outlet obstruction (BOO) and underactive or acontractile detrusor as its most prevalent

examples. However, anatomical abnormalities for example, bladder diverticulum or large volume vesicourethral reflux may also cause PVR (in the latter case due to very early refilling of the bladder by the refluxed urine).<sup>3</sup> BOO may be a consequence of prostate enlargement (BPE), urethral or meatal stricture, or incomplete or interrupted sphincter relaxation. Rarely a bladder stone or tumor is the cause of PVR.<sup>3</sup> Underactive detrusor contraction can result from neurogenic, myogenic or psychogenic causes or be an effect or side effect of pharmacotherapy.<sup>3</sup> In any individual, especially in the elderly, or the neurologically affected, the pathophysiology of PVR may be multifactorial.<sup>3</sup> Furthermore, threshold values delineating what constitutes an abnormal PVR are poorly defined.<sup>4–7</sup>

### PREPARATION

PVR is measured after a flowmetry. However PVR can also be measured after visiting a normal toilet. No evidence exists about the reliability of PVR measurements in the last

Christopher Chapple led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Nothing to disclose.

\*Correspondence to: Enrico Finazzi Agrò, Department of Experimental Medicine and Surgery, University of Rome Tor Vergata, Rome, Italy. Email: [efinazzi@tin.it](mailto:efinazzi@tin.it)

Received 11 February 2014; Accepted 1 August 2014

Published online 22 September 2014 in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI: 10.1002/nau.22671

mentioned situation. No specific patient preparation is needed. It may be reasonable to ask the patient if the voiding was similar to a typical micturition in his/her daily life.

### TECHNIQUE

Ideally, the interval between voiding and PVR measurement is of short duration. Furthermore, unrepresentative results may be obtained when voiding has to occur in unfamiliar surroundings or on command with a partially filled or overfilled bladder. Although transurethral catheterization has been accepted as the gold standard for PVR measurements, this may cause discomfort for patients and carries a risk of urinary tract infection and trauma.<sup>8</sup> To overcome these limitations, non-invasive ultrasound bladder volume measurement has been used as an alternative to urethral catheterization since it represents a good compromise between accuracy and patients' safety/comfort.<sup>9–11,31</sup> Traditionally, ultrasound bladder volume estimation can be performed in two ways; either by using real-time ultrasound to directly visualize the bladder<sup>9–10</sup> or by using a portable bladder scanner to calculate the volume automatically without directly visualizing the bladder.<sup>11</sup> Portable bladder scanners have many advantages over real-time ultrasound. They are easy to use, require only basic training, and can be used on the ward, freeing up precious radiology department resources. Furthermore, a bladder scanner may reduce catheterizations; minimize the threat of urethral injuries and causes less patient discomfort. Recently, in an aim to improve accuracy, a portable ultrasound bladder scanner equipped with an additional real-time pre-scan imaging (RPI) has been introduced. It seems to be able to enhance accuracy, as it can provide examiners with pre-localization of the central target point as well as information on the shape of the bladder prior to actual scanning, reducing the variability of the measured values.<sup>12</sup>

### INTERPRETATION

#### PVR and Acute or Chronic Urinary Retention

Chronic post-void residual has been widely accepted as corresponding to a consistent PVR of more than 300 ml;<sup>4</sup> however, some investigators have defined it as more than 400 ml,<sup>13</sup> as 100–500 ml<sup>14</sup> or have given it no definite number at all.<sup>15</sup> On the other hand, (chronic) PVR does not seem to be a strong predictor of acute urinary retention (AUR).<sup>16</sup>

#### BOO

It is commonly thought that the increase in residual urine indicates the severity of BOO. However, abnormal measurements of free uroflowmetry or PVR can detect only a voiding dysfunction without indicating BOO specifically. Detrusor underactivity may be the only cause of a large PVR. Nevertheless, PVR measurements are used as parameter of efficacy for medical and surgical treatments for BPO.<sup>17–18</sup>

#### PVR and Clinical Progression Of BPO

High volume PVR is associated with an increased risk of LUTS deterioration and considered a predictor of BPO progression.<sup>19–20</sup> In the EAU Guidelines on the Management of Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO),<sup>21</sup> it is paraphrased that very large PVRs may herald progression of disease. However, expert

opinion prevails that very large PVR volumes (>200–300 ml) may indicate detrusor underactivity and predict a less favorable response to treatment. PVR as such is not considered a stringent contraindication for watchful waiting or medical therapy. The use of PVR measurements is considered optional in men with uncomplicated LUTS undergoing noninvasive therapy. No level of residual urine, of itself, mandates invasive therapy<sup>21</sup> and no PVR “cut-point” is yet established for decision-making.

#### PVR and Antimuscarinics in Men

Some recent placebo controlled clinical trial data suggest that anti-muscarinics (alone or in combination with tamsulosin) do not increase the risk of AUR and do not produce a clinically significant increase of PVR<sup>22–23</sup> in men, even in the presence of BPO. However, patients with significant PVR were excluded from these studies and the safety of anti-muscarinics in men with BPO remains to be confirmed in long-term trials.

#### Bacteriuria

Large and/or persistent PVRs may be associated with urinary tract infections (UTI), especially in persons at risk, such as children or patients with spinal cord injury or diabetes.<sup>24</sup> Although this association is confirmed in a pediatric population<sup>24</sup> and in patients with neurogenic dysfunction,<sup>25</sup> other studies concluded that PVR does not correlate with bacteriuria, incontinence, immobility, impaired cognition, or neurological disease.<sup>26–27</sup>

#### Chronic Kidney Disease (CKD)

Very large PVRs (>300 ml) may increase the risk of upper urinary tract dilation and renal insufficiency.<sup>24</sup> A PVR > 100 ml has been associated with CKD in elderly men with LUTS,<sup>28</sup> however, other studies do not show a significant correlation between PVR and CKD.<sup>29</sup>

#### Female Incontinence

It is currently recommended that PVR should be measured during the assessment of women with signs and symptoms of urinary incontinence and/or overactive bladder syndrome to exclude voiding dysfunction.<sup>3</sup> Although the available evidence is still limited, antimuscarinic or anticholinergic medication should generally be considered if PVR is low.<sup>30</sup> Measurement of PVR is recommended in the management of female urinary incontinence.<sup>31</sup>

#### Children

Assessment of PVR is mandatory in a variety of pediatric patients, such as those with voiding LUTS, UTIs, vesicoureteral reflux, posterior urethral valves or neural tube defects.<sup>24</sup>

### ACTUAL RECOMMENDATIONS

- The interval between voiding and PVR measurement should be as short as possible (eo). It is advisable to ask the patients if the voiding was similar to a typical micturition in his/her daily life (eo).
- Preferably use non-invasive ultrasound bladder volume measurement instead of urethral catheterization (LE 3).
- Measurement of PVR is recommended in the management of female urinary incontinence (LE 3).

- Assessment of PVR is considered mandatory in a variety of pediatric patients (LE 3).

#### EVIDENCE SUMMARY

- Unrepresentative results may be obtained when voiding has to occur in unfamiliar surroundings or on command with an only partially filled or an overfilled bladder (eo).
- A portable bladder scanner may present some advantages over real-time ultrasound (LE 3), especially if equipped with additional real-time pre-scan imaging (LE 3).
- There is no universally accepted definition of a significant residual urine volume. For clinical practice, PVR <30 ml can be considered insignificant, while residual volumes persistently >50 ml could be regarded as important (eo).
- Large PVR (>200–300 ml) often indicates LUTD and may predispose to unsatisfactory treatment results if invasive BOO treatment is undertaken (LE 3). Nevertheless, no level of residual urine, of itself, mandates invasive therapy and no PVR threshold is yet established for decision-making (LE 3).
- PVR cannot be used as a robust predictor of acute urinary retention (LE 3).
- PVR can detect only voiding dysfunction without indicating BOO specifically (LE 2–3).
- There is no evidence that PVR increases significantly in patients treated with anti-muscarinic drugs (LE 2). However, consider that patients with significant PVR were excluded from studies published up to now.
- PVR may be associated with UTI, especially in persons at risk, such as children or patients with neurogenic dysfunction (LE 3). This association among adults is far from clear (LE 3).
- Large PVR may be associated with chronic kidney diseases (LE 3).

#### CONCLUSIONS

Measurement of PVR is recommended in guidelines and recommendations on the management of LUTS and urinary incontinence. However, there is still lack of evidence on the precise associations of PVR with most of the lower urinary tract dysfunctions and, consequently, most of the ominous features associated with PVR are not evidence-based. We have reviewed the evidence and provided recommendations for ICS standard teaching purposes.

#### REFERENCES

- Abrams P, Cardozo L, Fall M, et al.; Standardisation Sub-committee of the International Continence Society. The standardisation of terminology of lower urinary tract function: Report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn* 2002;21:167–78.
- Abrams P, Cardozo L, Khoury S, et al. Incontinence (5th International Consultation on Incontinence, Paris February, 2012). ICUD-EAU 2013.
- Campbell-Walsh Urology, 9th edition. Section XIV, Chapter 57 “Pathophysiology and classification of voiding dysfunction. Abnormalities of filling/storage and emptying/voiding: Overview of pathophysiology.”
- Abrams PH, Dunn M, George N. Urodynamic findings in chronic retention of urine and their relevance to results of surgery. *Br J Med* 1978;2:1258.
- Neal DE, Styles RA, Powell PH, et al. Relationship between detrusor function and residual urine in men undergoing prostatectomy. *Br J Urol* 1987;60:560.
- Neal DE, Styles RA, Powell PH, et al. Relationship between voiding pressures, symptoms and urodynamic findings in 253 men undergoing prostatectomy. *Br J Urol* 1987;60:554.
- Ghalayini IF, Al-Ghazo MA, Pickard RS. A prospective randomized trial comparing transurethral prostatic resection and clean intermittent self-catheterization in men with chronic urinary retention. *BJU Int* 2005;96:93.
- Schaeffer AJ, Chmielewski J. Urethral meatal colonization in the pathogenesis of catheter-associated bacteriuria. *J Urol* 1983;130:1096–9.
- Griffiths CJ, Murray A, Ramsden PD. Accuracy and repeatability of bladder volume measurement using ultrasonic imaging. *J Urol* 1986;136:808–12.
- Boomes GM, Millard RJ. The accuracy of portable ultrasound scanning in the measurement of residual urine volume. *J Urol* 1994;152:2083–85.
- Hartnell GG, Kiely EA, Williams G, et al. Real-time ultrasound measurement of bladder volume: a comparative study of three methods. *Br J Radiol* 1987;60:1063–65.
- Park YH, Ku JH, Oh SJ. Accuracy of post-void residual urine volume measurement using a portable ultrasound bladder scanner with real-time pre-scan imaging. *Neurourol Urodyn* 2011;30:335–8.
- Sakakibara R, Hattori T, Yasuda K, et al. Micturitional disturbance in acute disseminated encephalomyelitis (ADEM). *J Auton Nerv Syst* 1996;60:200.
- Gallien P, Reymann JM, Amarengo G, et al. Placebo controlled, randomised, double blind study of the effects of botulinum A toxin on detrusor sphincter dyssynergia in multiple sclerosis patients. *J Neurol Neurosurg Psychiatry* 2005;76:1670.
- Thomas AW, Cannon A, Bartlett E, et al. The natural history of lower urinary tract dysfunction in men: The influence of detrusor underactivity on the outcome after transurethral resection of the prostate with a minimum 10-year urodynamic follow-up. *BJU Int* 2004;93:745.
- Roehrborn CG, Kaplan SA, Lee MW, et al. Baseline post void residual urine volume as a predictor of urinary outcomes in men with BPH in the MTOPS study. *J Urol*, suppl 2005;173:443 abstract 1638.
- Kaplan SA, Gonzalez RR, Te AE. Combination of alfuzosin and sildenafil is superior to monotherapy in treating lower urinary tract symptoms and erectile dysfunction. *Eur Urol* 2007;51:1717–23.
- Zhao Z, Zeng G, Zhong W, et al. A prospective, randomised trial comparing plasmakinetic enucleation to standard transurethral resection of the prostate for symptomatic benign prostatic hyperplasia: Three-year follow-up results. *Eur Urol* 2010;58:752–8.
- Roehrborn CG. BPH progression: Concept and key learning from MTOPS, ALTESS, COMBAT, and ALF-ONE. *BJU Int* 2008;101:17–21.
- Crawford ED, Wilson SS, McConnell JD, et al. MTOPS RESEARCH Group. Baseline factors as predictors of clinical progression of benign prostatic hyperplasia in men treated with placebo. *J Urol* 2006;175:1422–6 discussion 6–7.
- Oelke M, Bachmann A, Descazeaud A, et al. EAU Guidelines on the Management of Male Lower Urinary Tract Symptoms (LUTS), incl. Benign Prostatic Obstruction (BPO). [http://www.uroweb.org/gls/pdf/12\\_Male\\_LUTS\\_LR%20May%209th%202012.pdf](http://www.uroweb.org/gls/pdf/12_Male_LUTS_LR%20May%209th%202012.pdf)
- Roehrborn CG, Kaplan SA, Kraus SR, et al. Effects of serum PSA on efficacy of tolterodine extended release with or without tamsulosin in men with LUTS, including OAB. *Urology* 2008;72:1061–7 discussion 1067.
- Athanasopoulos A, Chapple C, Fowler C, et al. The role of antimuscarinics in the management of men with symptoms of overactive bladder associated with concomitant bladder outlet obstruction: An update. *Eur Urol* 2011;60:94–105.
- Kelly CE. Evaluation of voiding dysfunction and measurement of bladder volume. *Rev Urol* 2004;6 (Suppl 1):S32–7.
- Dromerick AW, Edwards DF. Relation of postvoid residual to urinary tract infection during stroke rehabilitation. *Arch Phys Med Rehabil* 2003;84:1369–72.
- Omli R, Skotnes LH, Mykletun A, et al. Residual urine as a risk factor for lower urinary tract infection: A 1-year follow-up study in nursing homes. *J Am Geriatr Soc* 2008;56:871–4.
- Barabas G, Mölstad S. No association between elevated post-void residual volume and bacteriuria in residents of nursing homes. *Scand J Prim Health Care* 2005;23:52–6.
- Rule AD, Jacobson DJ, Roberts RO, et al. The association between benign prostatic hyperplasia and chronic kidney disease in community-dwelling men. *Kidney Int* 2005;67:2376–82.
- Hong SK, Lee ST, Jeong SJ, et al. Chronic kidney disease among men with lower urinary tract symptoms due to benign prostatic hyperplasia. *BJU Int* 2010;105:1424–8.
- Millenman M, Langenstroer P, Guralnick ML. Post-void residual urine volume in women with overactive bladder symptoms. *J Urol* 2004;172:1911–4.
- Lucas MG, Bedretidina D, Bosch JLHR, et al. EAU Guidelines on Urinary Incontinence. [http://www.uroweb.org/gls/pdf/16052013Urinary\\_Incontinence\\_LR.pdf](http://www.uroweb.org/gls/pdf/16052013Urinary_Incontinence_LR.pdf)

# ICS Teaching Module: Pad Weight Testing in the Evaluation of Urinary Incontinence

J. Krhut, A. Martan, P. Rosiez, P. Smith, L. Valansky, R. Zachoval, & P. Zvara



International Continence Society  
Teaching Module

1

## Aims of the pad weight testing

- Qualitative assessment (continent vs incontinent)
- Quantitative assessment (how much)

## Principle of the pad weight testing

- weight of the pads before and after test
- weight gain in g = urine loss in ml

## Duration of the pad weight test

### Short term tests

- 20 min – 2 hrs
- qualitative assessment

### Long term tests

- 12 hrs – 72 hrs
- quantitative assessment

## ICS pad weight test

- Only 1 hour pad weight test is standardized<sup>2</sup>

0 - 15 min:	drinking of 500 ml sodium-free liquid, resting
15 - 45 min:	walking, including stairs climbing to one flight up and down
45 - 60 min:	standing up from sitting (10 times) coughing vigorously (10 times) running on the spot (1 min) bending to pick up small object from the floor (5 times) washing hands in running water (1 min)

<sup>2</sup>Research report on the standardization of terminology of female urinary tract disorders (ICCS) and of the standardization of terminology of female urinary tract disorders (ICCS) published in the International Continence Society Committee on Standardization of Terminology (ICCS) (1997) (reference: 24, 1997) (1997)

## Preparation of the patient

### Short term tests

- without retrograde filling
- with retrograde filling<sup>1</sup>  
(200-300 ml)  
(50-75% of the bladder capacity)

### Long term tests

- without retrograde filling





## Quantification of the incontinence severity using the pad weight test

	1-hour test	24-hour test
<i>Mild incontinence</i>	< 10 mL	< 20 mL
<i>Moderate incontinence</i>	11-50 mL	21-74 mL
<i>Severe incontinence</i>	>50 mL	>75 mL

© Williams & Wilkins, a division of Lippincott Williams & Wilkins, Inc. All rights reserved. No part of this publication may be reproduced without prior written permission. ISBN: 978-1-9751-0000-0

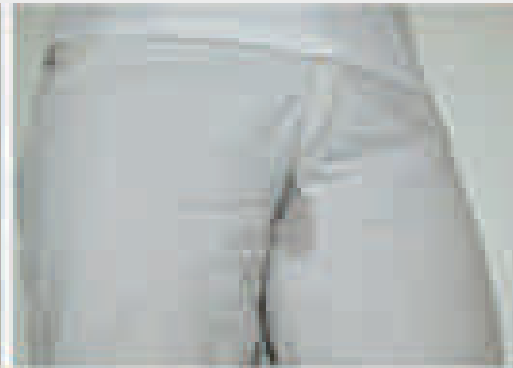
## Is leak of 1 mL significant?

1 mL of fluid = 25 drops



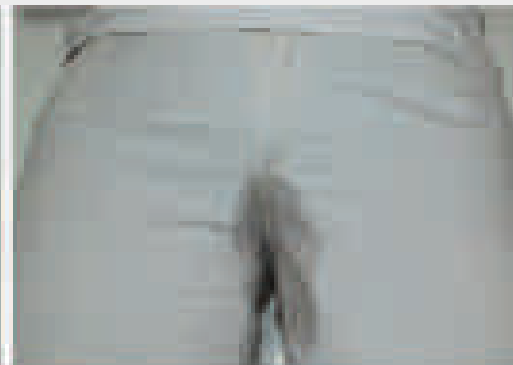
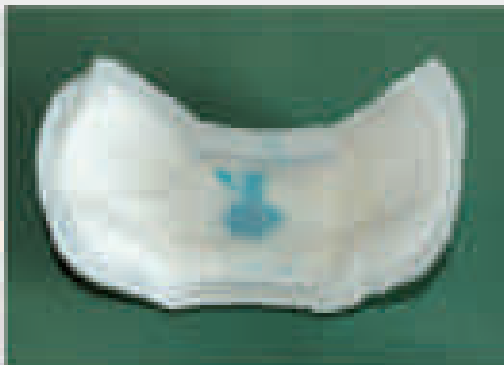
## Is leak of 1 mL of fluid significant?

- 1 mL of fluid leaked into the pad
- 1 mL of fluid leaked into the cloth



## Is leak of 5 mL of fluid significant?

- 5 mL of fluid absorbed by pad
- 5 mL of fluid leaked into the clothing



## Sensitivity and specificity

### Short term tests

- sensitivity: 34-83%<sup>1,2</sup>
- specificity: 65-89%<sup>2</sup>

### Long term tests

- sensitivity: no sufficient data
- specificity: no sufficient data

1. Hay MC, Hay ID, de Lencastre A. Urinary incontinence and fecal incontinence: an evidence-based review of tests with strong recommendations for the clinical practice with these incontinence disorders. The Clinical Evidence Supplement. (24-11), 2009

2. Gossens JC, van der Wal AC, de Leeuw FW. Urinary and fecal incontinence: how to use the tests available to evaluate these disorders. International Urogynecology Journal. 2010;21:101-109

## Limitations

- lack of standardization
- results of the long term tests may be influenced by:
  - fluid intake
  - increased voiding frequency
  - sweating
  - vaginal discharge (up to 7g/24 hrs)<sup>1</sup>
  - patient compliance
- no value in determining incontinence etiology
- weak correlation with the degree of patient's bother

1. Hay MC, de Lencastre A, Hay ID. The degree and frequency of urinary and fecal incontinence: a review of the literature. International Urogynecology Journal. 2010;21:101-109

## Clinical conclusions

- pad-test can provide additional information about degree of patient's incontinence
- easy to perform, inexpensive, risk-free
- could be influenced by many factors, therefore

Outcomes should be interpreted in context of other diagnostic instruments

## Recommendation for clinical use of the pad weight test

- detailed instruction and patient motivation are crucial
- use short term test for qualitative evaluation of incontinence
- if retrograde filling is to be used, bladder should be filled to 50-75% of bladder capacity
- use long term test for quantitative evaluation of incontinence
- interpret test results in conjunction with other relevant assessments (self-assessment, questionnaires, physical examination, etc.)
- pad weight test result doesn't always correlate with patient's bother



## Pad Weight Testing in the Evaluation of Urinary Incontinence

Jan Krhut,<sup>1</sup> Roman Zachoval,<sup>2\*</sup> Phillip P. Smith,<sup>3</sup> Peter F.W.M. Rosier,<sup>4</sup> Ladislav Valanský,<sup>5</sup> Alois Martan,<sup>6</sup> and Peter Zvara<sup>7</sup>

<sup>1</sup>Department of Urology, Ostrava University, University Hospital, Ostrava, Czech Republic

<sup>2</sup>Department of Urology, Thomayer Hospital and First Faculty of Medicine, Charles University, Prague, Czech Republic

<sup>3</sup>Department of Surgery, University of Connecticut Health Center, Farmington, Connecticut

<sup>4</sup>Department of Urology, University Medical Centre, Utrecht, The Netherlands

<sup>5</sup>Department of Urology, PIS University, Kosice, Slovak Republic

<sup>6</sup>Department of Gynecology and Obstetrics, First Faculty of Medicine, Charles University, Prague, Czech Republic

<sup>7</sup>Division of Urology, Department of Surgery, University of Vermont, Burlington, Vermont

**Aim:** To present the teaching module “Pad Weight Testing in the Evaluation of Urinary Incontinence.” This teaching module embodies a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base made available on ICS website to summarize current knowledge and recommendations. **Methods:** This review has been prepared by a Working Group of The ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel. **Results:** The pad test is a non-invasive diagnostic tool for urinary incontinence. It is an easy to perform, inexpensive test with utilization in both the daily patient care and clinical research. Despite it is clear value in initial diagnosis, selection of treatment, and follow-up evaluation, only less than 10% of urologists perform the test routinely. A number of testing protocols with varying lengths of recording time exist, however, only a 1-hr pad test has been standardized. One-hour pad tests are most suitable in establishing initial diagnosis, the 24-hr test serves most often for evaluation of treatment outcomes, and longer pad tests are used in clinical studies. **Conclusions:** The pad test is clearly underutilized. Well-designed studies providing level one evidence are lacking. Numerous variations in how the test is performed by individual urologists make the evaluation of published literature difficult. Future research goals should include randomized studies leading to establishment of optimal protocols of testing for clinical research and daily care. *Neurourol. Urodynam.* 33:507–510, 2014.

© 2014 Wiley Periodicals, Inc.

**Key words:** diagnostics; ICS teaching module; urinary incontinence; urodynamics; pad weight test

### INTRODUCTION

Pad testing is a non-invasive method of detecting and quantifying severity of urine leakage. The 4th International Consultation on Incontinence defined pad testing as “an optional test for evaluation of urinary incontinence.”<sup>1</sup> Diverse testing durations have been reported in the literature and only for the 1-hr pad test a specific test protocol has been standardized.<sup>2,3</sup> Although it is generally believed that longer tests are more reproducible, evidence on the accuracy of different methods of pad testing is inconsistent. A 24-hr test is more reproducible than a 1-hr test, but longer testing requires more preparation and a greater commitment on the part of the patient. Twenty-four-hour testing is reported to be adequate in routine clinical settings while 48- to 72-hr testing is deemed necessary for clinical research.<sup>2,4</sup>

### MATERIALS AND METHODS

This review has been prepared by a Working Group of The ICS Urodynamics Committee. The methodology used included comprehensive literature review, consensus formation by the members of the Working Group, and review by members of the ICS Urodynamics Committee core panel.

The ICS Urodynamics Committee presents the teaching module “Pad Weight Testing in the Evaluation of Urinary

Incontinence” to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing and analyzing urodynamic testing in general and more specifically, performing analysis of voiding. The teaching module consists of a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base, for the ICS Power Point presentation; available via <http://www.icsoffice.org/eLearning/> or via the QR code on this page. The presentation explains, testing requirements, clinical workup and analysis. The presentation and this manuscript contain experts’ opinion where evidence is, especially for the clinical practice aspects, unavailable and is marked” with: “eo” (experts opinion).

Heinz Koelbl led the peer-review process as the Associate Editor responsible for the paper.

Conflict of interest: none.

\*Correspondence to: Ass. Prof. Roman Zachoval, M.D., Ph.D., Department of Urology, Thomayer Hospital, Videnska 800, 140 59 Prague 4, Czech Republic. E-mail: [roman.zachoval@ftn.cz](mailto:roman.zachoval@ftn.cz)

Received 13 March 2013; Accepted 25 April 2013

Published online in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI 10.1002/nau.22436

© 2014 Wiley Periodicals, Inc.

## RESULTS

## Preparation

- (1) *Test selection*: The type of pad test selected is based on goals. A 1-hr test is usually administered during initial evaluation to select treatment and estimate prognosis for cure (*eo*). Twenty-four-hour or longer testing is necessary for quantifying the degree of urine leakage (*eo*).
- (2) *Instruction*: Detailed instruction is critical in order to elicit the full compliance of patients.
- (3) *Filling the bladder to a set starting volume*: The short duration pad test (1-hr or less) may be performed using an instilled starting bladder volume. Usually, the bladder is filled through a urethral catheter (or during cystoscopy). Most reported studies used 150–300 ml, some recommend a volume equivalent to 50–75% of the functional bladder capacity.<sup>5,6</sup> Filling to the first desire to void or sensation of fullness has also been reported.<sup>7</sup> Although studies have documented that this modification improves the quantitative value of the test, the consensus on the ideal starting volume is lacking.<sup>3</sup>

## Technique

The test is administered in a same manner to both male and female patients (*eo*).

**One-hour pad test.** The testing protocol has been standardized by International Continence Society (ICS-pad test):

- the test is started by putting one pre-weighted pad without patient voiding,
- patient drinks 500 ml of sodium-free liquid in <15 min—then sits or rests,
- patient walks for 30 min, including climbing one flight of stairs (up and down),
- patient performs the following activities: standing up from sitting (10×), coughing vigorously (10×), running on the spot for 1 min, bending to pick up an object from the floor (5×), and washing hands in running water for 1 min (this activity program may be modified according to the patient's physical fitness),
- the total amount of urine leaked is determined by weighing the pad.

If a moderately full bladder cannot be maintained through the hour (if the patient must void), the test has to be started again.

**Twenty-four-hour pad test.**

- the test should be started with an empty bladder,
- normal daily activities should be followed and recorded in a voiding diary so that the same schedule will be observed during follow-up re-testing (*eo*),
- to avoid urine loss through leakage or evaporation the pads should be worn inside waterproof underpants and exchanged every 4–6 hr during daytime,
- pads should be weighed immediately. If weighing is performed at the clinic, pads must be stored in airtight bag.

## Interpretation

The upper limit of weight increase for the 1-hr test in continent women is 1.4 g (equivalent to 1.4 ml) and 1.3–4.4 g for 24-hr test. These values may increase in situations of increased perspiration.<sup>8</sup> In the analysis of 1-hr pad test, an

increase of 1–10 g is classified as representing mild incontinence, 11–50 g moderate and >50 g severe incontinence. The values for 24-hr pad test are classified as follows: Mild (4–20 g/24 hr), moderate (21–74 g/24 hr), and severe (>75 g/24 hr) incontinence.<sup>9</sup>

A weight gain of less than 1.4 g during 1-hr test or 4.4 g for 24-hr test could be a result of sweating or vaginal discharge. If the findings are inconclusive, oral phenazopyridine which colors the urine orange could be used.<sup>10</sup> Listed cut-off values are based on studies performed in female patients. The values specific to males have not been yet determined.

The outcomes of studies which attempted to correlate the volume of leakage to the etiology (stress, urge, and mixed incontinence) showed significant variability, suggesting that the pad test is not appropriate for separating the types of incontinence based on their etiology.<sup>11,12</sup> Ryhammer et al. compared weight gain between two groups of randomly selected women, 79 of whom reported continence and 38 reported incontinence. They found no difference in the outcome of 24-hr pad test, suggesting that pad test should not be used as a screening tool.<sup>13</sup> The sensitivity and specificity of the 1-hr pad test reported in the literature varies significantly.<sup>14</sup> The 1-hr pad test was shown to have a high positive predictive value, however the false positive results can occur in more than 50% of cases.<sup>15</sup>

## Recommendations

-in the initial patient work-up, an objective measure of incontinence loss volume such as the pad test may help in treatment selection (e.g., male sling vs. artificial sphincter in the treatment of the post-prostatectomy incontinence) (Table I).<sup>16</sup>

-estimation of treatment prognosis (patients with high volume incontinence may experience lower cure rates) (*eo*),

-objective measure of treatment outcome for anti-incontinence procedures,

-the volume of leakage does not always correlate with the degree of bother (e.g., 2 g of urine leakage, which is roughly equivalent to 40 drops, produces a large spot on the clothing), therefore pad tests should be always interpreted in conjunction with history, clinical examination and self-assessment questionnaires (*eo*),

-future research goals should include determination of the optimal technique and duration of testing for both clinical and research purposes with the ultimate goal of developing an appropriate individualized testing protocol for patients and their varying circumstances (*eo*).

**One-hour pad test.**

-the 1-hr pad test, using the ICS standardized protocol is appropriate in routine evaluation of patients during initial work up,

TABLE I. Basic Characteristics and Degree of Accuracy of Individual Types of Pad Tests

	Short-term tests (qualitative assessment)	Long-term tests (quantitative assessment)
Bladder filling	No artificial filling or retrograde filling	No artificial filling
Physical activity during test	Standardized activities	Normal daily activities
Evaluation	Weight gain >1 g	Weight gain >4 g/24 hr
Sensitivity	34–83% <sup>22</sup>	Insufficient data
Specificity	65–89% <sup>22</sup>	Insufficient data

- if either the patient or physician have doubts about the accuracy of the initial test, evaluation should be extended by an additional hour or repeated,
- the test should always be interpreted in conjunction with standard self-assessment questionnaires including the bother index,
- performing the test with a known start volume might increase the accuracy, but the data supporting this assumption is inconclusive and there is no consensus on what the volume should be (*eo*).

#### Twenty-four-hour pad test.

- it is more reproducible than 1-hr test,
- highly dependent on patient compliance and therefore not suitable for all patients (*eo*),
- detailed instruction and patient motivation are important,
- the test results depend on fluid intake, physical activity levels, hormonal status, sexual activity, and environmental factors (temperature, humidity),
- the protocol should be personalized based on patient's physical status (*eo*),
- the physical activity and detailed voiding diary should be recorded so that a similar protocol is followed during the initial and all follow-up (*eo*).

### DISCUSSION

Pad weighing as a diagnostic method for incontinence was first described by James et al. in 1971.<sup>17</sup> In 1981, Sutherst et al. were the first to publicize the use of the pad test with a prescribed set of activities and exercises.<sup>18</sup> Since then, a number of published studies used various forms of the pad testing protocols. Pad testing is easy and inexpensive, yet recent surveys of the Society for Urodynamics and Female Urology members showed that only 4.5–8% of the members perform the pad test routinely in their practice.<sup>19</sup> A number of studies have documented that the longer the testing, the better the correlation between the test results and the degree of incontinence. However, 24- to 72-hr pad tests are cumbersome and require high levels of patient compliance.<sup>15,20</sup> Test outcomes are affected by many factors and therefore have to be interpreted in combination with other methods of evaluation. Caution has to be exercised especially in giving too much weight to a negative 1-hr pad test (*eo*). Repeated short term testing is recommended especially in cases where the test result does not correlate with subjective assessment provided by the patient.<sup>21</sup> Good correlation has been reported by Abdel-Fattah et al.<sup>22</sup> between the self-assessment questionnaires and the 1-hr pad test. The King's Health Questionnaire showed a 96% sensitivity and 93% specificity of a 1-hr pad test in identifying incontinent patients.<sup>22</sup> The good correlation between self-assessment questionnaires and 1-hr pad test, but not the 24-hr pad test supports the value in standardization. Good correlation with the 24-hr pad test and the International Consultation on Incontinence Questionnaire—Short Form (ICIQ-SF) has been documented.<sup>23</sup> The biggest cost associated with the pad testing is the office visit, therefore home pad tests using the mail has been proposed.<sup>24</sup> Longer testing protocols could potentially increase the sensitivity and specificity, however, they require selection of highly motivated patients. The type of pad, leak, and evaporation could affect the outcome, therefore pad should be exchanged every 4–6 hr during the 24-hr and longer pad testing.<sup>25</sup>

### CONCLUSIONS

The pad test is non-invasive and easy to perform, yet factors such as embarrassment and behavioral changes to reduce

incontinence severity (inactivity, fluid restriction) could affect the outcome significantly. The 1-hr pad test as standardized by ICS is currently the only tool with a set protocol, and we recommend using the original protocol. In the case that artificial bladder filling is used, the bladder should be filled to 50–75% of its functional capacity prior to the initiation of the test. The 24-hr test is sufficient in daily clinical practice. Performing this test in conjunction with a voiding diary, or simply recording fluid intake and frequency of incontinence episodes, will significantly increase its utility. A standard protocol for 24- to 72-hr pad testing does not exist at the present time, and we believe establishing one would be very helpful. Prescribing specific physical activity over 24–72 hr is problematic, therefore we recommend instructing the patient to follow a normal daily routine. Despite the above limitations, the pad test provides objective assessment of involuntary urine loss. Its optimal utility depends upon understanding the impact of these limitations for diagnostic and prognostic use. The correlations of specific testing protocols with subjective and objective measures must be performed so that the most appropriate testing protocol may be employed according to circumstance. We believe that standardization of testing is an important first step in improving the utilization of this simple and inexpensive testing method.

### REFERENCES

- Abrams P, Andersson KE, Birder L, et al. Fourth International Consultation on Incontinence Recommendations of the International Scientific Committee: Evaluation and treatment of urinary incontinence, pelvic organ prolapse, and fecal incontinence. *Neurourol Urodyn* 2010;29:213–40.
- Persson J, Bergqvist CE, Wolner-Hanssen P. An ultra-short perineal pad-test for evaluation of female stress urinary incontinence treatment. *Neurourol Urodyn* 2001;20:277–85.
- Andersen JT, Blaivas JG, Cardozo L, et al. Seventh report on the standardisation of terminology of lower urinary tract function: Lower urinary tract rehabilitation techniques. International Continence Society Committee on Standardisation of Terminology. *Scand J Urol Nephrol* 1992;26:99–106.
- Tennstedt S. Design of the Stress Incontinence Surgical Treatment Efficacy Trial (SISTER). *Urology* 2005;66:1213–17.
- Wu WY, Sheu BC, Lin HH. Twenty-minute pad test: Comparison of infusion of 250 ml of water with strong-desire amount in the bladder in women with stress urinary incontinence. *Eur J Obstet Gynecol Reprod Biol* 2008;136:121–5.
- Jakobsen H, Vedel P, Andersen JT. Objective assessment of urinary incontinence: An evaluation of three different pad-weighing tests. *Neurourol Urodyn* 1987;6:325–30.
- Lose G, Rosenkilde P, Gammelgaard J, et al. Pad-weighing test performed with standardized bladder volume. *Urology* 1988;32:78–80.
- Figueiredo EM, Gontijo R, Vaz CT, et al. The results of a 24-h pad test in Brazilian women. *Int Urogynecol J* 2012;23:785–9.
- O'Sullivan R, Karantanis E, Stevermuer TL, et al. Definition of mild, moderate and severe incontinence on the 24-hour pad test. *BJOG* 2004;111:859–62.
- Wall LL, Wang K, Robson I, et al. The Pyridium pad test for diagnosing urinary incontinence. A comparative study of asymptomatic and incontinent women. *J Reprod Med* 1990;35:682–4.
- Matharu GS, Assassa RP, Williams KS, et al. Objective assessment of urinary incontinence in women: Comparison of the one-hour and 24-hour pad tests. *Eur Urol* 2004;45:208–12.
- Fantl JA, Harkins SW, Wyman JF, et al. Fluid loss quantitation test in women with urinary incontinence: A test-retest analysis. *Obstet Gynecol* 1987;70:739–43.
- Ryhammer AM, Laurberg S, Djurhuus JC, et al. No relationship between subjective assessment of urinary incontinence and pad test weight gain in a random population sample of menopausal women. *J Urol* 1998;159:800–3.
- Costantini E, Lazzeri M, Bini V, et al. Sensitivity and specificity of one-hour pad test as a predictive value for female urinary incontinence. *Urol Int* 2008;81:153–9.
- Versi E, Orrego G, Hardy E, et al. Evaluation of the home pad test in the investigation of female urinary incontinence. *Br J Obstet Gynaecol* 1996;103:162–7.
- Kumar A, Litt ER, Ballert KN, et al. Artificial urinary sphincter versus male sling for post-prostatectomy incontinence—what do patients choose? *J Urol* 2009;181:1231–5.



## 510 Krhut et al.

17. James ED, Flack FC, Caldwell KP, et al. Continuous measurement of urine loss and frequency in incontinent patients. Preliminary report. *Br J Urol* 1971;43:233-7.
18. Zimmern P, Kobashi K, Lemack G. Outcome measure for stress urinary incontinence treatment (OMIT): Results of two society of urodynamics and female urology (SUFU) surveys. *Neurourol Urodyn* 2010;29:715-8.
19. Victor A, Larsson G, Asbrink AS. A simple patient-administered test for objective quantitation of the symptom of urinary incontinence. *Scand J Urol Nephrol* 1987;21:277-9.
20. Sutherst J, Brown M, Shawer M. Assessing the severity of urinary incontinence in women by weighing perineal pads. *Lancet* 1981;1:1128-30.
21. Soroka D, Drutz HP, Glazener CM, et al. Perineal pad test in evaluating outcome of treatments for female incontinence: A systematic review. *Int Urogynecol J Pelvic Floor Dysfunct* 2002;13:165-75.
22. Abdel-Fattah M, Barrington JW, Youssef M. The standard 1-hour pad test: Does it have any value in clinical practice? *Eur Urol* 2004;46:377-80.
23. Karantanis E, Fynes M, Moore KH, et al. Comparison of the ICIQ-SF and 24-hour pad test with other measures for evaluating the severity of urodynamic stress incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 2004;15:111-6.
24. Flisser AJ, Figueroa J, Bleustein CB, et al. Pad test by mail for home evaluation of urinary incontinence. *Neurourol Urodyn* 2004;23:127-9.
25. Karantanis E, O'Sullivan R, Moore KH. The 24-hour pad-test in continent women and men: Normal values and cyclical alterations. *BJOG* 2003;110:567-71.

# ICS Teaching Module: Urodynamic Artefacts 1

## Common artefacts in water-filled systems

A Gammie, C D'Ancona, H-C Kuo & P Rosier



International Continence Society  
Teaching Module

1

## International Continence Society (ICS) Guest Speaker: DISCLOSURES

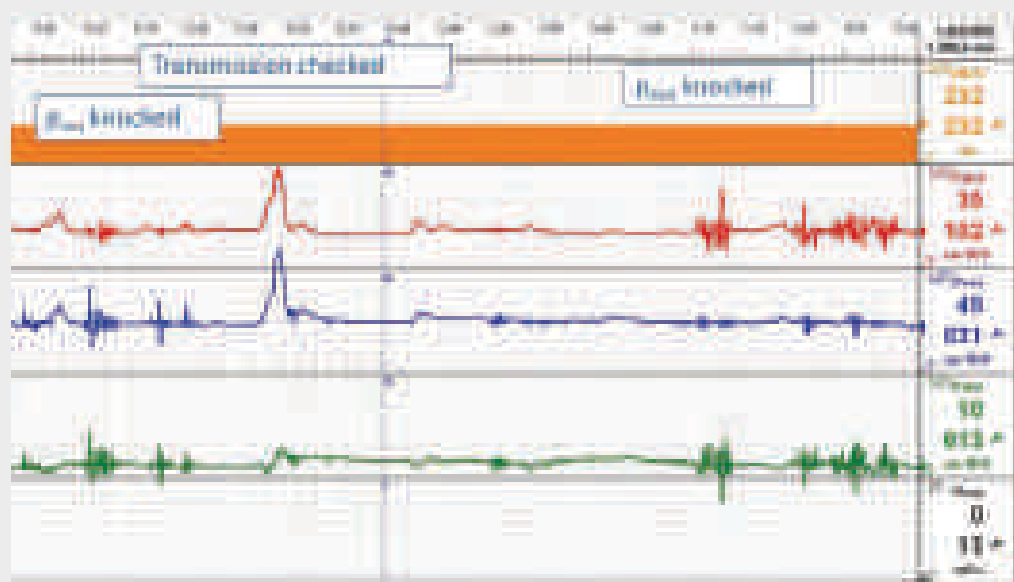
- Andromeda, Digitimer, Laborie, Mediwatch
  - Project sponsorship
- T-Doc LLC
  - Trial sponsorship
- Astellas, Ono Pharma, Vyera, Flexicare
  - Consultancy
- EZL Ltd
  - Royalties from [www.UrodynamicsTrainer.com](http://www.UrodynamicsTrainer.com)

## Common artefacts in water-filled systems

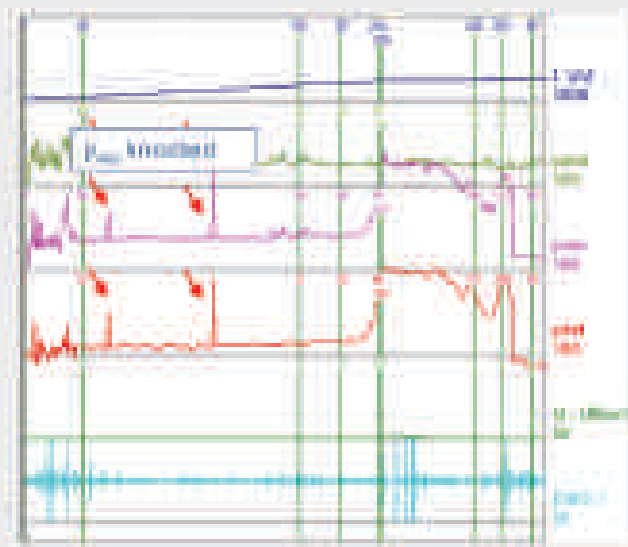
Artefact: 'Something...that is not naturally present but occurs as a result of...the procedure' (Chford)

- Movement / tube knock
- Patient position change
- Expelled vesical catheter
- Expelled rectal catheter
- Flushed catheter
- Line open to syringe
- Empty bladder (poor response)
- Empty rectal catheter
- Poor cough response

## Movement / tube knock (water)



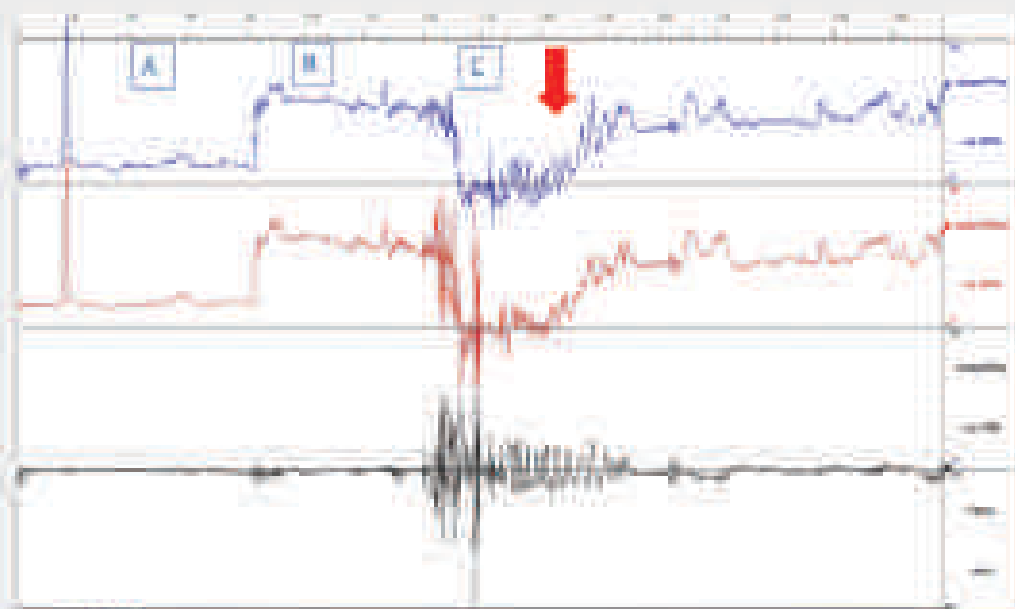
## Movement / tube knock (water)



ICS - Teaching Module

6

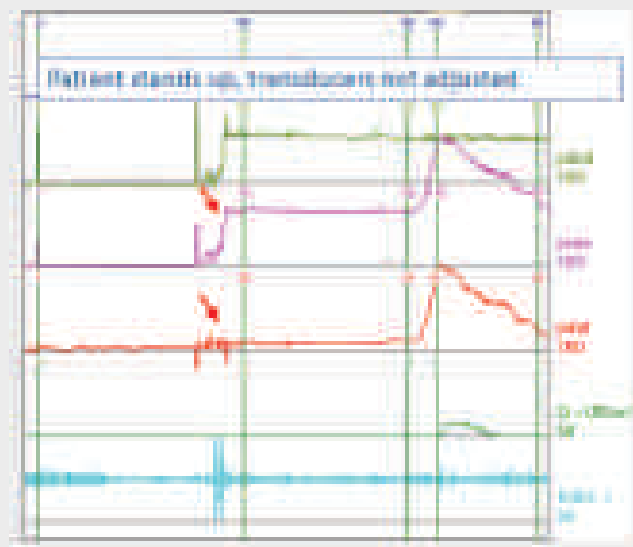
## Patient position change (water filled)



ICS - Teaching Module

6

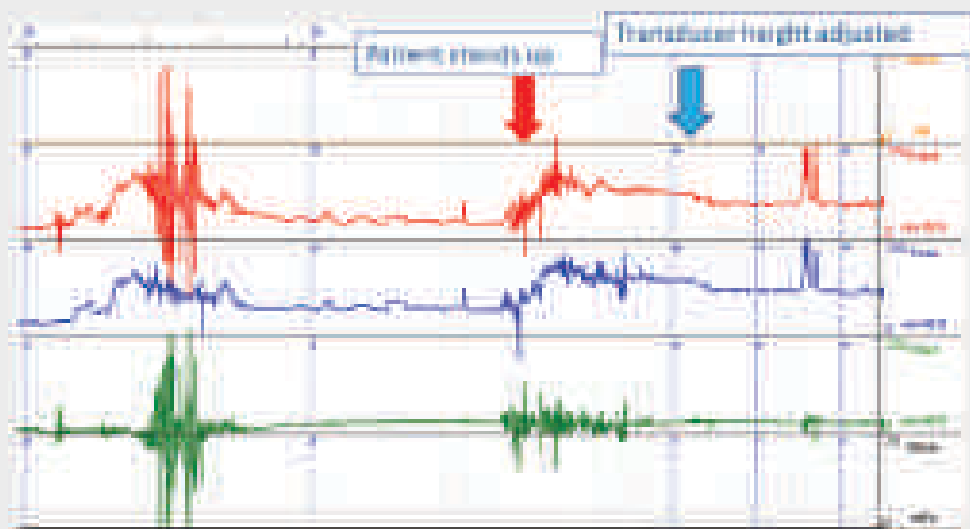
## Patient position change (water filled)



ICS Teaching Module

4

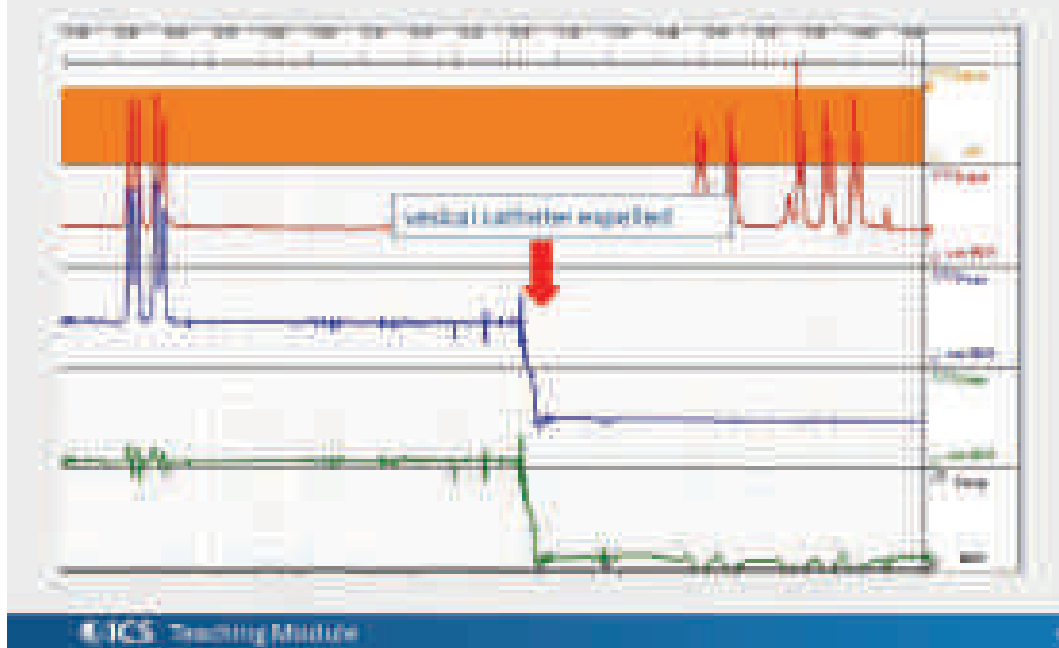
## Patient position change (water filled)



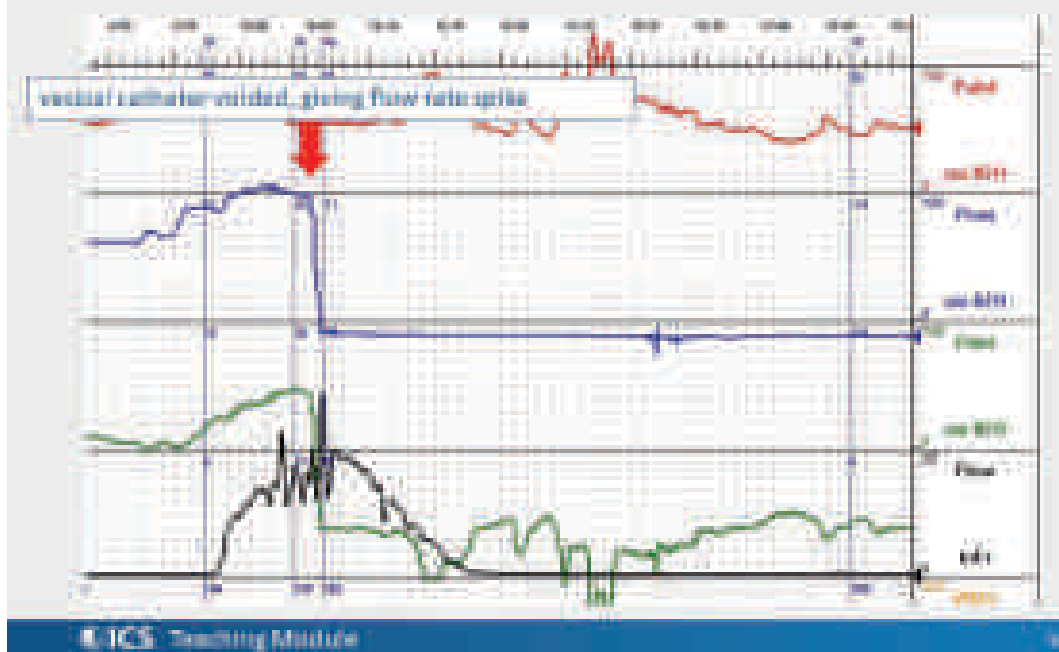
ICS Teaching Module

4

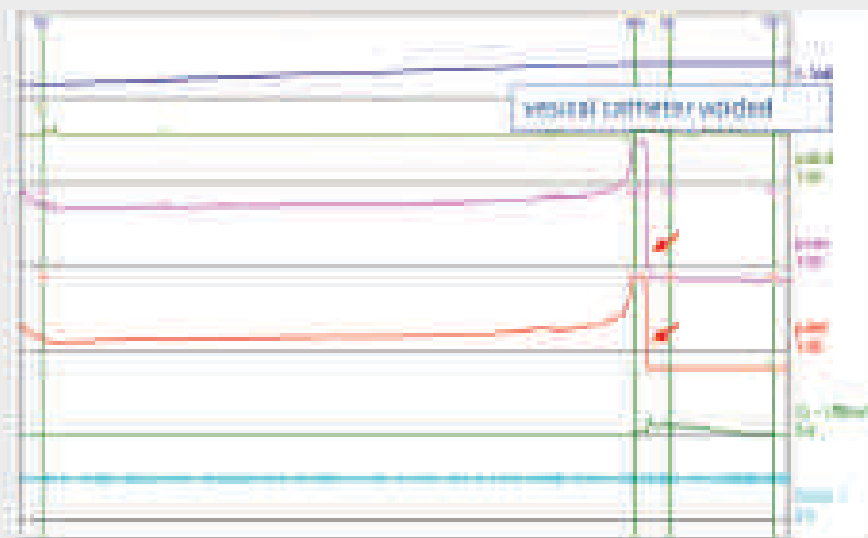
## Expelled vesical catheter



## Expelled vesical catheter



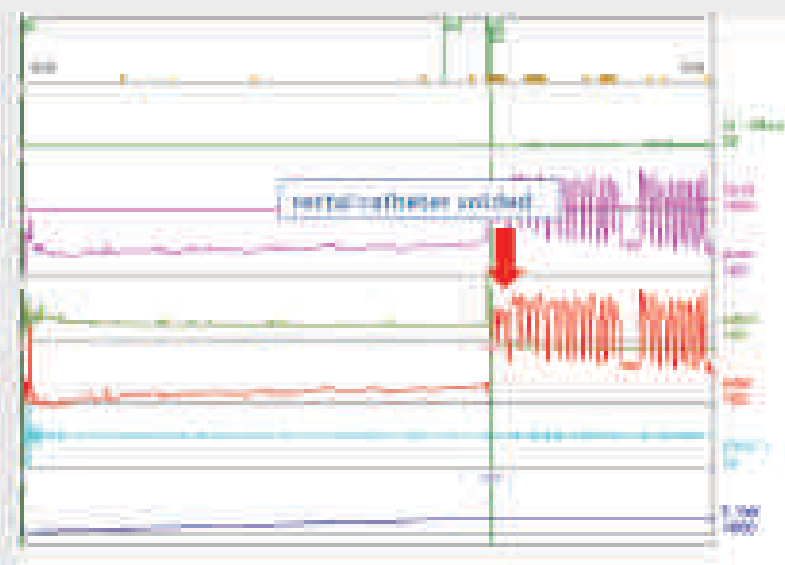
## Expelled vesical catheter



ICS Teaching Module

14

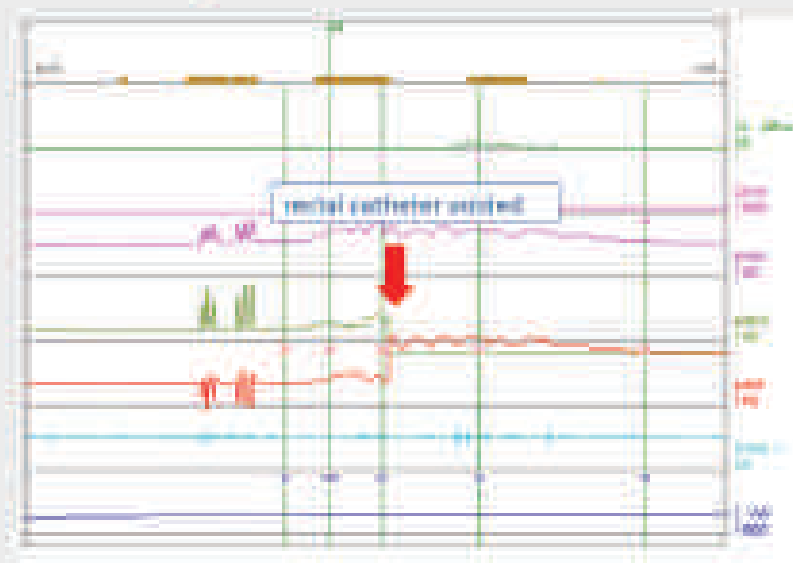
## Expelled rectal catheter



ICS Teaching Module

15

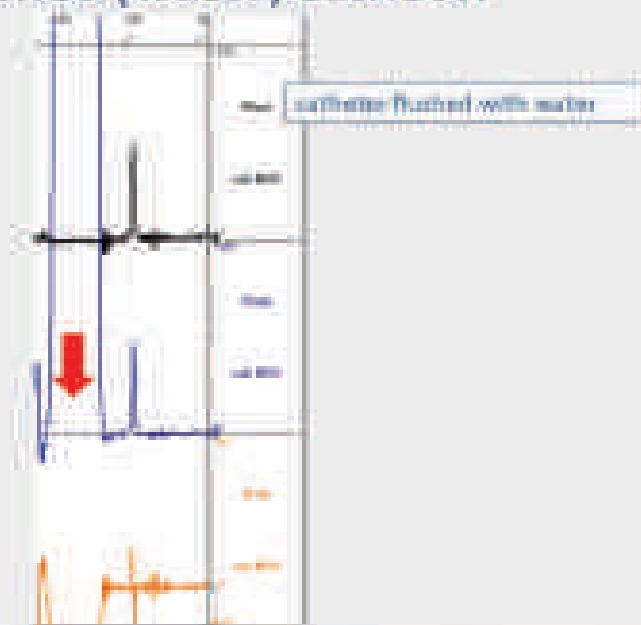
## Expelled rectal catheter



ICS Teaching Module

741

## Flushed (water) catheter

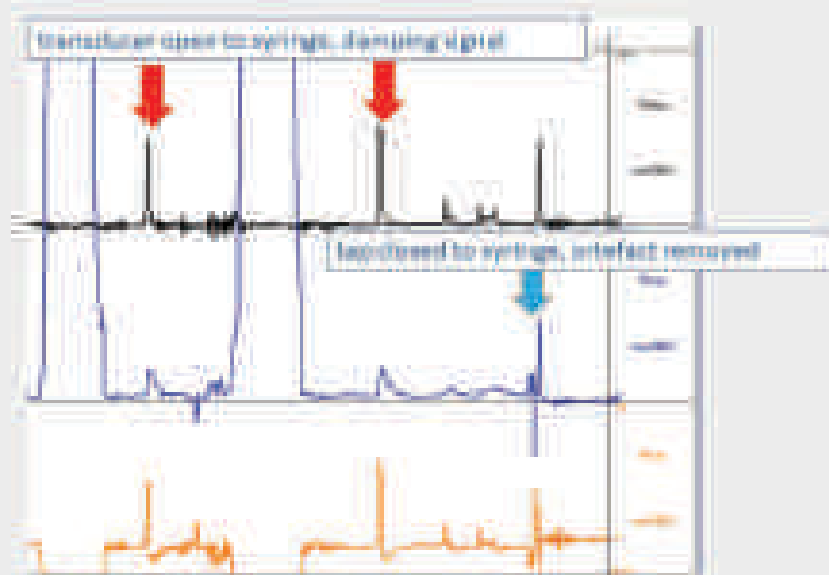


ICS Teaching Module

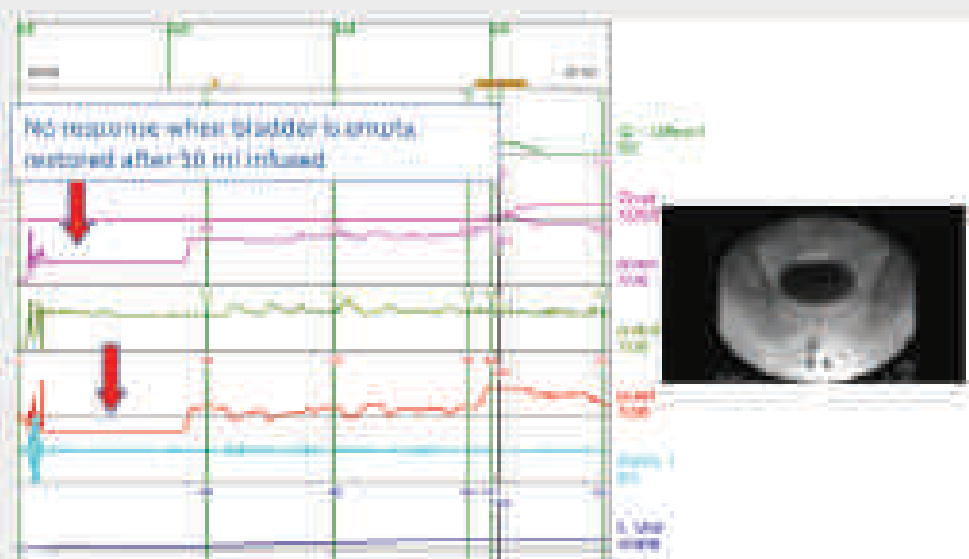
742



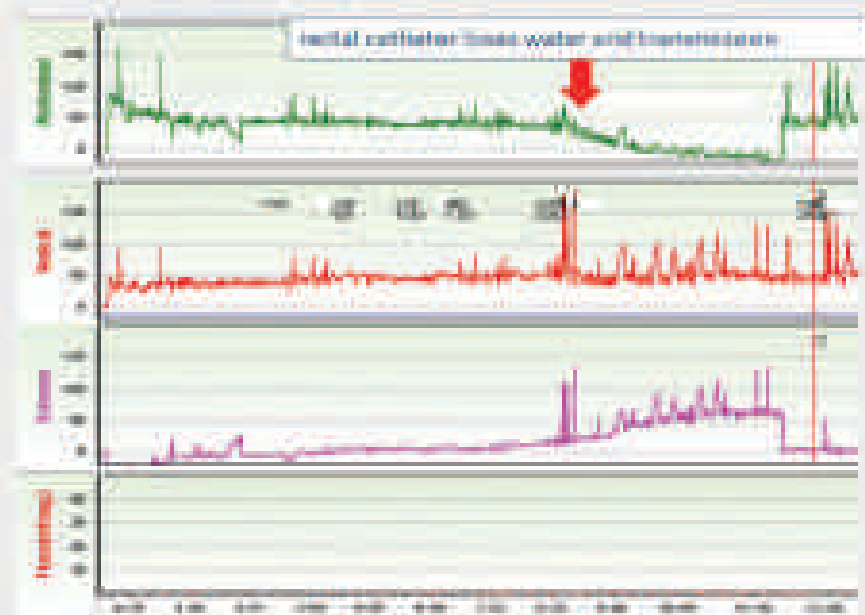
## Line open to syringe (water)



## Empty bladder (poor response)

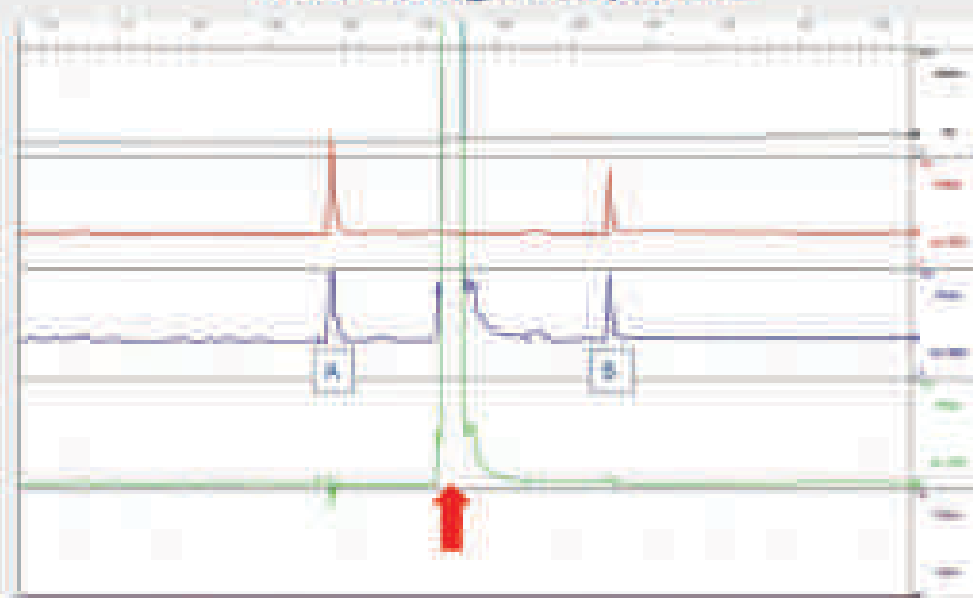


## Empty rectal catheter (water)



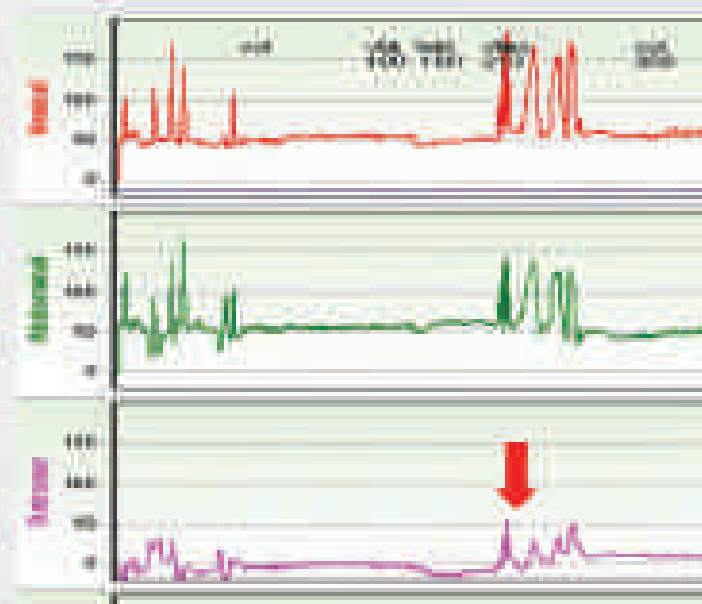
ICS Teaching Module

## Poor cough response



ICS Teaching Module

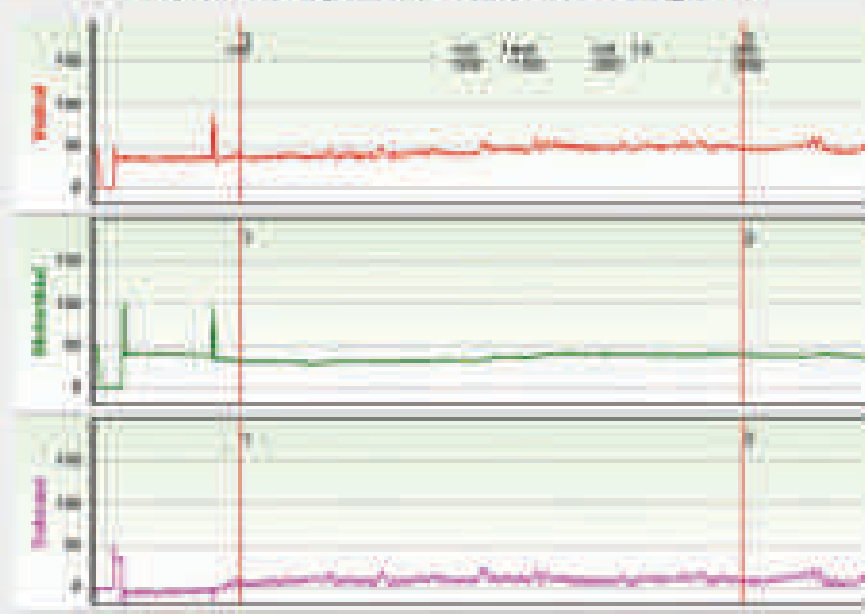
## Poor cough response



ICS Teaching Module

100

## Poor response to live signal



ICS Teaching Module

100



## ICS Teaching Module: Artefacts in Urodynamic Pressure Traces (Basic Module)

Andrew Gammie,<sup>1\*</sup> Carlos D'Ancona,<sup>2</sup> Hann-Chorng Kuo,<sup>3</sup> and Peter F.W. Rosier<sup>4</sup>

<sup>1</sup>Bristol Urological Institute, Southmead Hospital, Bristol, United Kingdom

<sup>2</sup>University of Campinas–, UNICAMP, Sao Paulo, Brazil

<sup>3</sup>Department of Urology, Buddhist Tzu Chi General Hospital and Tzu Chi University, Hualien, Taiwan

<sup>4</sup>University Medical Centre–Urology, Utrecht, the Netherlands

**Aims:** To present the ICS Teaching Module on artefacts in urodynamics pressure traces. **Methods:** Slides from three urodynamics centres were assembled. Descriptions and labels were agreed by the authors and the module presented at the ICS Annual Scientific Meeting in Brazil 2014. **Results:** Ten artefacts that should be recognized while using water-filled urodynamic systems are presented and remedial action described. **Conclusions:** This manuscript serves as scientific background for the slide set made available on the ICS website. By following the guidelines in this teaching module, good quality urodynamics can be more readily achieved. *Neurourol. Urodynam.* 36:35–36, 2017.

© 2015 Wiley Periodicals, Inc.

**Key words:** artefacts; pressure measurement; quality

### INTRODUCTION

The International Continence Society (ICS) Urodynamics Committee presents the first teaching module of Artefacts in Urodynamic Pressure Traces as a resource to enhance good urodynamic practice.

An artefact is understood to be ‘Something ...that is not naturally present but occurs as a result of ...the procedure.’<sup>1</sup> When artefacts arise during the test, they should be removed or can sometimes be compensated for, thus improving the quality of urodynamic results. If artefacts have not been corrected during the test they should be recognized during post-test evaluation. This module presents the artefacts that this working group has considered to be the most prevalent when water-filled urodynamic systems are used. They are described as patterns on the urodynamic traces, and all are recognizable and correctable during the test. Some artefacts may, however, necessitate repetition of the test.

We present ten artefact patterns with an explanation of their causes and a description of the remedies. Further understanding of the prevalence and nature of artefacts can be found in Hogan et al.,<sup>2</sup> and a full presentation of Good Urodynamic Practices is found in Schaefer et al.<sup>3</sup> These underline that signal quality is only assured through using adequate equipment, with careful installation of the whole system and with skilled and alert staff performing the test. The teaching module referred to here consists of this manuscript and a slide presentation available at [www.ics.org/eLearning](http://www.ics.org/eLearning). An advanced module will also be made available dealing with less common artefacts, along with those found in other types of pressure measurement systems.

### CONTENTS

The ten artefacts described in this module are:

- Movement/tube knock
- Patient position change
- Expelled vesical catheter
- Expelled rectal catheter
- Flushed catheter
- Line open to syringe

© 2015 Wiley Periodicals, Inc.

- Empty bladder (poor response)
- Empty rectal catheter
- Poor cough response
- Poor response to live signal

The descriptions below are all with reference to water-filled pressure measurement systems, although some of these artefacts do occur in other types of system. Each artefact has the observed effect, underlying cause and recommended remedy described.

### ARTEFACT DESCRIPTIONS, CAUSES AND REMEDIES

#### Movement/Tube Knock

**Effect observed.** High frequency, short duration pressure spikes visible in  $p_{ves}$ ,  $p_{abd}$ , or both, with spikes always visible in  $p_{det}$ .

**Cause of artefact.** Knocking of one or both tubes. In the example, the knock is first on the  $p_{ves}$  line, then on the  $p_{abd}$  line.

**Remedial action.** Ensure tubes are away from the cause of the knock. Ignore these spikes when analysing the trace.

#### Patient Position Change

**Effect observed.** A lasting change in  $p_{ves}$  and  $p_{abd}$  of equal magnitude on both, usually between 8 and 35 cmH<sub>2</sub>O.<sup>2</sup> It is often accompanied by noisy signals as the lines are knocked.

**Cause of artefact.** A change in patient position. In the example, the patient has begun supine, stood up, then sat down on the

Prof. Roger Dmochowski led the peer-review process as the Associate Editor responsible for the paper.

Potential conflicts of interest: Nothing to disclose

\*Correspondence to: Andrew Gammie, Bristol Urological Institute, Southmead Hospital, Bristol BS10 5NB, United Kingdom, E-mail: [andrew.gammie@bui.ac.uk](mailto:andrew.gammie@bui.ac.uk)

Received 24 August 2015; Accepted 27 August 2015

Published online 15 September 2015 in Wiley Online Library

([wileyonlinelibrary.com](http://wileyonlinelibrary.com)).

DOI 10.1002/nau.22881

commode at a position below the level of the transducer. The level of the transducers was then adjusted to the level of the symphysis pubis.

**Remedial action.** Ensure the transducers are moved to the level of the symphysis pubis after any patient position change. Transmission of pressure should also be checked after patient movement.

#### Expelled Vesical Catheter

**Effect observed.** A sudden drop in  $p_{ves}$ , usually to well below zero, with no response to transmission checks.

**Cause of artefact.** The vesical catheter is expelled from the patient, normally by the pressure of voiding.

**Remedial action.** Recatheterise and repeat the test, if the urodynamic question has not been answered.

#### Expelled Rectal Catheter

**Effect observed.** A sudden drop in  $p_{abd}$ , usually to well below zero.

**Cause of artefact.** The abdominal catheter is expelled from the patient, normally by the pressure of valsalva or straining.

**Remedial action.** Recatheterise and repeat the test, if the urodynamic question has not been answered

#### Flushed Catheter

**Effect observed.** An abrupt large increase in a single pressure trace, maintained for some seconds, followed by a sudden normalisation of pressure.<sup>2</sup>

**Cause of artefact.** Water is pushed through the transducer dome in order to remove air from the catheter and tubing.

**Remedial action.** Check for good pressure transmission after the flush. Ignore the high pressure generated when analysing trace.

#### Line Open to Syringe

**Effect observed.** Repeated flushes of the line do not restore a good response to a cough signal.

**Cause of artefact.** The syringe inadvertently remains connected to the water line, and acts as a damper on the signal. Since an air bubble is not the problem, flushing fails to resolve it.

**Remedial action.** Set the taps correctly, so the syringe is not connected to dome. Repeat the cough test for good pressure transmission.

#### Empty Bladder (Poor Response)

**Effect observed.** Response of the intravesical catheter to a pressure transmission test is poor when bladder volume is low.

**Cause of artefact.** When the bladder is empty, the catheter may touch the bladder wall, so pressure changes within the lumen cannot be registered.

**Remedial action.** Fill the bladder slightly (e.g. 50 ml) and test the pressure transmission again.

#### Empty Rectal Catheter

**Effect observed.** Deterioration in abdominal pressure transmission, with or without a change in pressure, during filling or voiding.

**Cause of artefact.** Reduction of water in the rectal balloon. The balloon fails to connect effectively with the rectal wall as a result.

**Remedial action.** Refill balloon and test for good pressure transmission

#### Poor Cough Response

**Effect observed.** One cough spike is visibly smaller than the other, despite a cough affecting  $p_{ves}$  and  $p_{abd}$  equally.

**Cause of artefact.** Usually an air bubble in the water-filled line, reducing the transmission of pressure from patient to transducer.

**Remedial action.** Flush the line through with water, pushing the air bubble from the tube. The next cough should be registered equally on both traces. If not, flushing should be repeated.

#### Poor Response to Live Signal

**Effect.** Live signal is observed on one trace (in this case  $p_{ves}$ ) and on  $p_{det}$ , despite a previous cough test being satisfactory.

**Cause.** Usually an air bubble in the water-filled line, reducing the transmission of pressure from patient to transducer, in this case in the abdominal line. It could also be the pump or patient causing noise on the affected line.

**Remedy.** Check that there is no interference on the affected line by visual inspection and stopping the pump. If it is still present, flush the line through with water (not visible on this trace), pushing the air bubble from the tube.

#### CONCLUSIONS

Poor quality urodynamic testing may easily result in inadequate or wrong diagnosis. Maintaining good quality of pressure transmission, recording, and display, and being able to interpret the traces correctly are therefore critical for patient benefit. Recognising artefacts in the pressure signals and dealing with them appropriately is an essential component of maintaining this quality. By following the guidelines in this teaching module, good quality urodynamics can be more readily achieved.

#### REFERENCES

1. Oxford English Dictionary, [www.oxforddictionaries.com](http://www.oxforddictionaries.com) accessed 26 02 2015.
2. Hogan S, Gammie A, Abrams P. Urodynamic features and artefacts. *Neurourol Urodyn* 2012;31:1104–17.
3. Schaefer W, Abrams P, Liao L, et al. Good Urodynamic Practices: Uroflowmetry, filling, cystometry and pressure flow studies. *Neurourol Urodyn* 2002;21:261–74.

# Self-Management of Indwelling Urinary Catheters

## February 2016

Mary H. Wilde, PhD, RN

Professor, School of Nursing, University of Rochester, USA

Member of the ICS Nurses' Committee



International Continence Society  
Teaching Module

## Objectives

- Our purpose is to educate continence nurses **to improve patient care and health outcomes globally.**

At the conclusion of this presentation, readers should be able to:

1. Examine **evidence in research** related to self-management in long-term urinary catheter users.
2. Describe **best practices for promoting self-management** in people using indwelling urinary catheters.
3. Use **theoretical concepts** related to catheter self-management.

## Indications for long-term catheter use

- Intractable urinary retention for those who cannot manage an intermittent catheter (and no caregiver to do it)
- Bladder outlet obstruction, not surgically treated
- Improving comfort for end-of-life care if needed
- Alternatives to consider: toileting schedule (when no retention), intermittent catheter, condom/sheath catheter (for cooperative males without obstructed urine or persistent retention )

(HRA/CDC guidelines, Hootner et al. 2009)

UIC: Teaching Module

## Long-term catheter use defined:

- Long term- over 1 months use but often extends over many years.
  - "Indefinite use" would be more accurate term, but no agreement on terminology.
- Both "catheter types" and "catheter use" for expected time of catheterization are called short and long-term, causing confusion. (Comstock et al. 2013)

UIC: Teaching Module

## Little research in urinary catheter self-management

- Self-management research is common in chronic conditions – **but not with people with catheters**
- LT catheter users **learn by trial and error**, lack support groups
- Catheters are **stigma**; can indicate decline in health
- People with catheters often **told to drink**, but not how much, nor how to manage

Adapted from: MacIntyre, 2013, p. 10

ICS Teaching Module

## My research developed inductively-- most in talking with patients

- **7 previous studies with indwelling catheters**
  - Experience of using a catheter
  - Descriptive studies to identify catheter problems
  - How UTI, blockage, fluids, urine flow were related
  - What catheter users do to prevent/address problems
- **2 studies with intermittent catheter users, expanding theoretical framework to this population. (next power-point presentation)**

Adapted from: MacIntyre, 2013, p. 10

ICS Teaching Module



## Catheter management problems

- Prevent **CAUTI**
- Avoid **leakage** (bypassing of urine)
- Minimize **catheter blockage** (& frequent changes)
- Prevent **accidental dislodgment** (catheter falling out or being pulled out)

© 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins

© ICS: Teaching Module

## Quality of life disruption with indwelling catheters

- **Daily routines** of catheter users and their families. "It's ok when it's working right." (Parker, 2002)
  - Background to foreground with a problem: "Pssstt. You're really soaked. It ruins the day. It ruins whatever you're drivin' in." (p. 10, White, 2007)
  - Troubleshooting in evening and weekend hours, causes excess health care expenses.
- **Choice of SP or urethral**: sexual activity can be more positive with SP, but not always (Chapman et al., 2014)
- Some developed **self-reliance**; others not so positive (Parker et al., 2014)

© 2014 Wolters Kluwer Health | Lippincott Williams & Wilkins

© ICS: Teaching Module

Key catheter problems in past two months (Wilde et al. 2013)		Percent %	Rate/1000 catheter days
CAUTI		81	6.22
Blockage		24	11.00
Dislodgement		12	5.57

Other catheter problems	Percent %	% Daily	% Several times/week to monthly	% Several times/month to monthly	% Once in past 2 months
Leaking	43	8	10	11	29
Sediment	63	24	29	33	7
Kinks/blocks	29	11	8	60	40
Bladder spasms	36	37	24	10	10
Autonomic symptoms	15	4	11	23	27

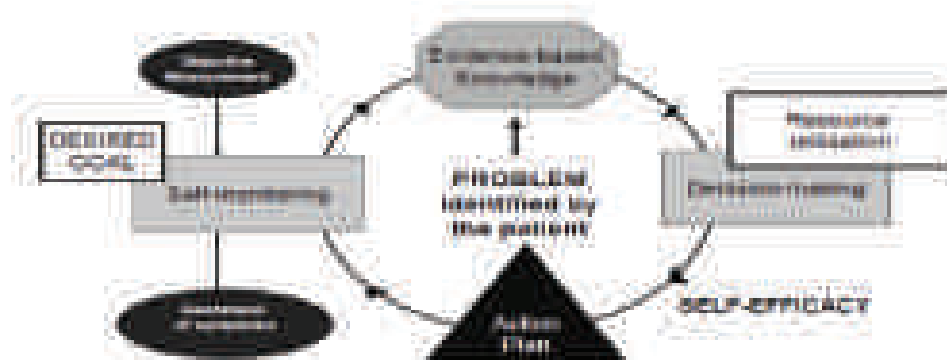
ICS Teaching Module

Treatments (Wilde et al. 2013)	UTI	Blockage	Unscheduled catheter changes	Percent %
	Percent %	Percent %	Weekly	4
Extra home nurse visit	19	10	Several times a month	31
Extra office visit	23	23	Once a month	16
Emergency department	35	18	Once in past two months	33
Hospitalized	27		Changed by staff	10
Catheter changed	65	70	Home care nurse	46
Urine cultured	65		Emergency department	31
Ambulance prescribed	100			

ICS Teaching Module

## Self-management framework

Figure 10.10.1 Self-management (2016). Self-management: theory and evidence. London: Routledge.



ICS Teaching Module

## Indwelling Urinary Catheter Self-management Randomized clinical trial

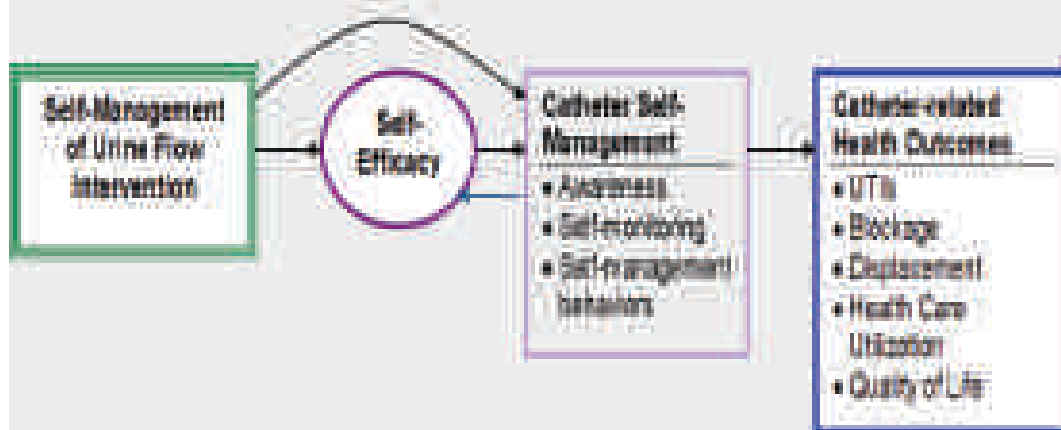
INDWELLURICAT NCT035531

Research team: Wilde, M. (PI), McMahon, J.M. (Co-I),  
McDonald, M., Tang, W., Wang, W., Brasch, J., Fairbanks, E.,  
Shah, S., Zhang, F., Chen, D.

ICS Teaching Module

## Theoretical model for Self-management of Urine Flow Intervention (RCT)

(Wille, Zheng et al. 2015)



© ICS Teaching Module

## Study design- RCT (N= 202)

- Four contacts with intervention nurse: 3 home visits, 1 telephone call
- Teaching self-monitoring for 3 days
  - Urinary diary ( I & O and catheter journal)
  - Educational booklet
- To increase awareness, self-monitoring and self-management behaviors
- Data collection bimonthly for a year (Wille, Beckmann, et al. 2022)

© ICS Teaching Module

## Sample

- Similar number **males (51%)** and **females (49%)**
- **Age: 19-96, mean 61(SD 17.4) years**
- **Urethral 56%, Suprapubic 44%**
- **Use of catheter: 1-470 months, mean 6(SD 7) years**
- **Diverse by race and ethnicity**
  - white (57%), Black (30%), Asian (2%), American Indian or Alaskan Native (2%), biracial (2%), and unknown (9%). And 11% Hispanic
- **Highly disabled:** 60% need help in bathing, dressing, toileting, and getting out of bed; 19% need help in feeding

reproduced with permission of the publisher

ICS: Teaching Module

January 2008 <b>Catheter Calendar</b>						
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Problems: Bleed? No Blockage U= Urinary Tract Infection: O = Foley Out/Obstructed		Treatments: What Was?		1		3
		A= Antiseptic O= Same Office Visit H= Home Nurse Visit E= Emergency Room H= Hospitalization R= Refill/Refill				
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

reproduced with permission of the publisher

ICS: Teaching Module

## Educational Booklet--Basic Catheter Self-Management--Fluids

- **Stay Aware.** stay aware of your body and how you feel.
- **Drink more water than any other beverage!** Limit caffeine.
- **Drink Consistently.** Optimal and consistent level all day to help prevent catheter blockage.
- **Your Body Needs Fluids.** Most people need 2000 to 3000 cc of fluid a day. For instance a 150 pound person would need 2045 cc which is equivalent to about 8½ glasses per day. More fluids are needed for hot weather or when exercising. My fluid goal is \_\_\_\_\_.
- **Pay attention to the color of your urine.** It should be light yellow all day long.

© 2019 ICS Teaching Module

ICS Teaching Module

## Basic Catheter Self-management- Prevent dislodgement

- **Notice Changes** in what you feel.
- **Notice Catheter Position** when you move and teach others.
- **Check for kinks and twists** by feeling with your hand.
- **Ask for Help.**

© 2019 ICS Teaching Module

ICS Teaching Module

## Tips from Catheter Users

"Drink the water and go!"

"I didn't know amounts of intake and output."

"I am paying attention to the color and quantity of the urine."

"Now I drink more when I am out of the house."

"I measure intake and caffeine and notice the color of urine and sediment in the tubing. I am really being aware."

"I check the position of the catheter when getting in and out of bed."

"I think about how to best secure the catheter during activities."

© 2014 by the ICS

**ICS** Teaching Module


## Quick Guide to Problems and Action Strategies

Problem	Action Strategies	See Page Number
Decreased/No Urination (Full Bladder)	Increase fluid intake	9
UTI	Increase fluid intake	9
	Recognize early symptoms of UTI and acting on it	9
Catheter leaks	Increase fluid intake	9
	Process catheter changes at set intervals	11
Adjustment to living with a catheter	Approaches for living with a catheter	8
Not sure of the best schedule for catheter changes	Process catheter changes at set intervals	11
Disks, kinks, or tugs on catheter	Prevent disks, kinks, or tugs on catheter	12
Decreased caffeine	Decrease caffeine	14
Catheter leaks	Decrease catheter leakage	15
	Empty urine bag	16
Urine bag odor	Clear urine drainage bag	17
Changes with sex	Make adjustments for sexual activity	18
Assessments (Symptoms for people with spinal cord injury)	Recognize early symptoms of hematuria, dysuria, etc.	19

**ICS** Teaching Module

## Increase fluid intake

- "I am more conscious of what I drink. I am also more about drinking 6 glasses of water" (a 60-year-old male might be associated with low age and primary tract infection [UTI])

Paying Attention	Things You Can Do
Notice whether you are getting enough fluids throughout the day.	<p>Drink 1000-3000ml. Each day. If you like the water will keep several bottles in the fridge and refill them everyday.</p> <p>To add flavor to water, try a bit of strawberry or apple juice to 8-liters of water.</p> <p>Keep glasses of water scattered in the house. Secure a jug of water in your wheelchair. You may want to drink around meal times and before bed. Have a caregiver remind you to drink water.</p>
Notice changes in color or odor of urine.	If color gets dark or urine has foul smell, increase water.
If you are on fluid restriction, make sure that you stay within the restricted range.	Try not to forget to check that you are staying within range.
Be aware of changes in activities such as sleep and stress, I & O.	<p>Use a fluid intake log to keep track of how activity affects fluid intake.</p> 

ICS: Teaching Module

## Symptoms CAUTI—long term catheters

### Urine Changes:

- Color – Discolored, cloudy, dark, blood stained
- Odor – Foul smelling, change in smell from usual
- Sediment (grit) – Increased amount

**Temperature** – Fever, chills

**Pain and/or pressure** in bladder area or back (Burning possible, not common)

**Autonomic dysreflexia** Early, mild symptoms of autonomic dysreflexia (e.g., goosebumps, headaches, sweats) mainly in people with spinal cord injury.

(See next slide for details.)

**General Symptoms** Blahs!, feeling sick

- Functioning or mental changes – weakness, spasticity, change in the level of alertness (Wills, McManus et al., 2018)

ICS: Teaching Module



## Autonomic dysreflexia (AD)

- AD is a syndrome related to a reflex of imbalanced discharges at the level of the spinal cord injury above or at Thoracic 6.
- It can lead to **severe high blood pressure and a life threatening situation if not addressed quickly.**
- It is most often caused by a blocked or poorly functioning catheter or an overly full bag.
- Constipation or pressure ulcers can also cause AD.

ICS: Teaching Module

## Results

- CAUTI and dislodgement outcomes did not differ by group.
- Blockage was significantly lower in the intervention group, but the result did not last the full 12 months.
- Rates showed **both groups improved.**
- The intervention group had more ED visits & **hospitalizations** for CAUTI and also higher self-reported CAUTI severity scores. Not powered for ED events. (Jellison, San-Matthews, et al. 2017)

© 2017 Wound Care Society

ICS: Teaching Module

## Conclusion

- Both groups improved over time--Self-monitoring r/t calendar (unintentional intervention).
- Unclear whether decreases in UTI, blockage, and dislodgement rates were related to the intervention.
- Symptom identification, severity of UTIs, & getting care early could be r/t higher hospitalization for CAUTI in the intervention group.

© 2019 ICS. All rights reserved.

ICS Teaching Module

## Implications

- Recommend additional nurse support over time to sustain intervention.
- Value in optimal/consistent fluid intake.
- Catheter calendar, a minimal intervention, could be easily implemented.
- Dissemination for education and research (indwelling and intermittent catheter studies). Contract with University of Rochester email Mary Wilde:  
mary\_wilde@urmc.rochester.edu

© 2019 ICS. All rights reserved.

ICS Teaching Module

## References

- Cottenden, A., Bliss, D., Buckley, B., Fader, M., Gartley, C., Hayer, D., Ostaszewicz, J., Pieters, R., & Wilde, M.H. (2013). Management using continence products. In P. Abrams, L.
- Chapple, A., Prinjha, S., & Feneley, R. (2015). Comparing transurethral and suprapubic catheterization for long-term bladder drainage: A qualitative study of the patients' perspective. *Journal of Wound, Ostomy, and Continence Nursing*, WOCN, 42(7), 170-175. doi:10.1097/WON.0000000000000096 [doi]
- Fowler, S., Godfrey, H., Fader, M., Timoney, A. G., & Long, A. (2014). Living with a long-term, indwelling urinary catheter: Catheter users' experience. *Journal of Wound, Ostomy, and Continence Nursing*, WOCN, 41(6), 597-603. doi:10.1097/WON.0000000000000068 [doi]
- Gould, C. V., Umscheid, C. A., Agarwal, R. K., Kuntz, S., Pegues, D. A., & the Healthcare Infection Control Practices Advisory Committee (HICPAC). (2009). *Guideline for prevention of catheter-associated urinary tract infections 2009*. Atlanta, GA: Centers for Disease Control and Prevention.

© ICS: Teaching Module

- Wilde, M. H. (2002). Understanding urinary catheter problems from the patient's point of view. *Home Healthcare Nurse*, 20(7), 449-456.
- Wilde, M. H. (2003). Life with an indwelling urinary catheter: The dialectic of stigma and acceptance. *Qualitative Health Research*, 13(9), 1189-1204.
- Wilde, M. H., Bliss, D.Z., Booth, J., Chester, P.M., & Tannenbaum, C. (2014). Self-management of urinary and fecal incontinence. *American Journal of Nursing*, 114(1): 38-45.
- Wilde, M. H., McDonald, M. V., Branch, J., McMahon, J., Fairbanks, E., Shah, S., Tang, W., & Scheid, E. (2013). Long-term urinary catheter users self-care practices and problems. *Journal of Clinical Nursing*, 22, 356-67.
- Wilde, M. H., McMahon, J. M., McDonald, M. J., Tang, W., Wang, W., Branch, J., Fairbanks, E., Shah, S., Zhang, F., & Chen, Q. (2015). Self-management intervention for long-term indwelling urinary catheter users: Randomized clinical trial. *Nursing Research*, 64(1), 24-34. DOI: 0.1097/NNR.0000000000000071.
- Wilde, M. H., Zhang, F., Fairbanks, E., Shah, S., McDonald, M. V., & Branch, J. (2013). Perceived value of a urinary catheter self-management program in the home. *Home Healthcare Nurse*, 31(8), 463-471. doi: 10.1097/NHH.0b013e3182ab9781

Revised and updated 12/2016/2017

© ICS: Teaching Module

# Thank You!

From Mary Wilde and the ICS Nurses' Committee

ICS Training Module



# NIH Public Access

## Author Manuscript

*J Clin Nurs*. Author manuscript; available in PMC 2014 February 06.

Published in final edited form as:

*J Clin Nurs*. 2013 February ; 22(0): 356–367. doi:10.1111/jocn.12042.

## Long-term Urinary Catheter Users Self-Care Practices and Problems

Mary Wilde, RN, PhD<sup>1</sup>, Margaret V. McDonald, MSW<sup>2</sup>, Judith Brasch, RN, BS<sup>1</sup>, James M. McMahon, PhD<sup>1</sup>, Eileen Fairbanks, RN, MS, PNP<sup>1</sup>, Shivani Shah, MPH<sup>2</sup>, Wan Tang, PhD<sup>1</sup>, and Eileen Scheid, RN, MS<sup>1</sup>

<sup>1</sup>University of Rochester, School of Nursing

<sup>2</sup>Visiting Nurse Service of New York, Center for Home Care Policy and Research

### Abstract

**Aims**—The aims were to characterize a sample of 202 adult community-living long-term indwelling urinary catheter users, to describe self-care practices and catheter problems, and to explore relationships among demographics, catheter practices, and problems.

**Background**—Long-term urinary catheter users have not been well studied, and persons using the device indefinitely for persistent urinary retention are likely to have different patterns of catheter practices and problems.

**Design**—The study was a cross-sectional descriptive and exploratory analysis.

**Methods**—Home interviews were conducted with catheter users who provided information by self-reported recall over the previous two months. Data were analyzed by descriptive statistics and tests of association between demographics, catheter practices, and catheter problems.

**Results**—The sample was widely diverse in age (19–96 years), race, and medical diagnosis. Urethral catheters were used slightly more often (56%) than suprapubic (44%), for a mean of 6 yrs. (SD 7 yrs.). Many persons were highly disabled, with 60% having difficulty in bathing, dressing, toileting, and getting out of the bed; 19% also required assistance in eating. A high percentage of catheter problems were reported with: 43% experiencing leakage (bypassing of urine), 31% having had a urinary tract infection, 24% blockage of the catheter, 23% catheter-associated pain, and 12% accidental dislodgment of the catheter. Treatments of catheter-related problems contributed to additional health care utilization including extra nurse or clinic visits, trips to the emergency department, or hospitalization. Symptoms of catheter associated urinary tract infections were most often related to changes in the color or character of urine or generalized symptoms.

**Conclusions**—Catheter related problems contribute to excess morbidity and health care utilization and costs.

**Relevance to clinical practice**—More research is needed in how to minimize catheter associated problems in long-term catheter users. Information from this study could help inform the development of interventions in this population.

Corresponding Author: Mary Wilde, RN, PhD, Associate Professor Nursing and Center for Community Health, University of Rochester, 601 Elmwood Ave., Box SON, Rochester, NY, 14642, Work: 585-275-9682, Fax: 585-273-1270, mary\_wilde@urmc.rochester.edu.

Study Design: MW, JM

Data Collection and Analysis: MW, MM, JM, JB, EF, SH, WT, ES

Manuscript Preparation: MW, MM, JM, JB, EF, SH, WT, ES

## Keywords

urinary catheterization; nursing; urinary tract infection; urinary retention; complications; self-care

## Introduction and Background

Living with an indwelling urinary catheter presents numerous challenges that must be addressed on a daily bases. Nevertheless, it can be indicated for persons unable to use any other bladder management method, including people with persistent urinary retention who lack sufficient cognition or hand dexterity for self-catheterizations and no one to do it for them. Also a catheter can be an option to improve quality of life in selected cases of severe incontinence or when a disability makes it difficult to use the bathroom (Cottenden et al., 2009). The majority of long-term catheter users have a neurogenic bladder dysfunction related to a disability, such as spinal cord injury (SCI) or multiple sclerosis (MS) (Wilde & Dougherty 2006, Wilde et al. 2010). While catheter problems are well known—recurrent and persistent blockage, catheter-related urinary tract infection (CAUTI), accidental dislodgment, and leakage of urine (bypassing)—data on the frequency and severity of these problems are limited. Information on catheter management, such as drainage bag replacement and/or cleaning and caregiver assistance, is even less well known. Moreover, community dwelling study samples are often small (<45) in persons with long-term use, (Wilde & Carrigan 2003, Wilde & Dougherty 2006, Wilde & Brasch 2008, Wilde et al. 2010), thus making it difficult to characterize the population and their needs.

This is a report of a cross-sectional analysis of data from 202 persons with long-term indwelling urinary catheters (urethral or suprapubic [SP]). The purpose of this analysis is to describe catheter care practices and catheter-related problems to inform clinicians and researchers. Having information from a large sample will help fill a gap in the literature in which small samples have been the norm.

## Methods

### Design

This analysis is based on baseline data collected for a single blinded randomized trial of an educational program in urinary catheter self-management with long-term catheter users. This analysis is based on data derived through a one-time home interview of 202 study participants, prior to randomization, conducted by trained interviewers from June 2009 through June 2011. The aims of this analysis were to:

1. Characterize the sample of 202 community-dwelling long-term adult indwelling urinary catheter users who had catheter problems in the past 6–12 months or those new to a catheter within the past year.
2. Depict how persons with catheters take care of the device on a day to day basis, including others who help in this care.
3. Describe the prevalence and incidence of self-reported catheter-related problems over a two month period.
4. Explore relationships among demographics, catheter practices, and catheter problems

**Setting and sample—**The study was conducted at two sites—the University of Rochester, NY (Utica to Buffalo region) and at the Visiting Nurse Service of New York (VNSNY) in New York City and parts of Nassau and Westchester Counties—with separate

*J Clin Nurs*. Author manuscript; available in PMC 2014 February 06.

teams conducting the study activities using the same procedures and tools. To be eligible for the study, participants had to: (1) be 18 years of age or older; (2) expect to use an indwelling urethral or SP catheter for at least one year; (3) report having a catheter-associated problem (UTI in the last year, or blockage or dislodgement in the last six months) OR report using a catheter for less than one year (4) complete study measurements alone or with the help of a family member; and (5) communicate in English. Despite the need in the parent study to include only persons who would benefit the most from the intervention, only 3.6% of those screened were excluded for criteria #3 above. Individuals were excluded if they had a terminal illness. Institutional approval was obtained and synchronized for human subject's ethics at both sites.

### Data Collection

**Measures**—Two instruments were used for this cross sectional analysis: 1) *Demographics and Catheter Care Questionnaire (DMC)* and 2) *Catheter Problems Questionnaire (CPQ)*. Both instruments were developed by the Principal Investigator (PI) for research in similar populations (Wilde & Dougherty 2006, Wilde & Brasch 2008) and modified for this study. For the *DMC*, 50 items measured demographics and catheter-related variables to describe the sample, and included: 1) person/family--age, race/ethnicity, type/presence of caregivers (e.g., relative or paid person), education, employment, insurance; 2) chronic conditions--diagnosis, list of medications, and functional ability through the Katz score (Katz, Ford, Moskowitz, Jackson, & Jaffee 1963) and 3) catheter related-- catheter type (e.g., silicone or latex coated), interval for catheter changes, and bag care. The content validity scores were found to be acceptable in previous studies using the same instrument (Wilde & Dougherty 2006, Wilde & Brasch 2008).

Catheter related problems (e.g., UTI, blockage [encrustation within the catheter]) were measured using the *CPQ*. Content validity scores for a previous study (Wilde & Brasch 2008) indicated that the items were acceptable. *CPQ* was modified to include additional information related to CAUTIs, i.e., severity and symptoms. Frequency of catheter related problems was asked, and for CAUTI and blockage of the catheter, associated treatments were solicited. Information was recorded for up to six CAUTI events and up to 12 blockage events (as blockages were sometimes frequent).

**Procedures**—Study participants at the Rochester site were recruited through provider referral from clinics, home care agencies and private urological offices. In New York City, a database was used to identify people with catheters. Potential participants at both sites were screened for eligibility and interest by telephone call. At intake, participants provided informed consent, and subsequent to enrollment—but prior to random assignment-- home interviews were conducted. An electronic data collection system, Questionnaire Development System (QDS), was used to collect and manage data. Participants received an honorarium of \$20 for the interview.

### Data Analysis

Prior to analysis, data were verified, cleaned and checked for consistency with a full range of logic checks. Decisions about how to code missing data and outliers (Yang, Xie, & Ngee Goh 2011) were made by the team, with input from the statistician. Data were analyzed descriptively for central tendency (mean, median), dispersion (SD, range), and distribution (skew, kurtosis). Specific emphasis was on describing prevalence and incidence of major catheter problems of CAUTI, blockage, and dislodgment of the catheter. Associations were explored (*t*-tests or Pearsons'  $r$  for interval level data and Chi Sq. or odds ratios and confidence intervals (CI) for categorical data) among variables believed to contribute to

these catheter-related problems. Analyses were performed using IBM Statistical Program for Social Sciences (SPSS) 19 and SAS 9.2.

## Results

### Demographics

The sample was diverse by age, race, and medical diagnosis. The male to female ratio was roughly equivalent at 51 and 49% respectively. Ages ranged from 19 to 96 with a mean and median age of 61, SD of 17.4 years. The race identified most often by participants was white (57%), followed by Black (30%), Asian (2%), American Indian or Alaskan Native (2%), biracial (2%), and unknown (9%). Eleven percent of the sample was Hispanic. Diversity was also demonstrated by the marital status selections, with approximately 34% of participants reporting never having been married, over 19% separated or divorced, 18% widowed, 27% married and 2 % common law married or living with a life partner. A single diagnosis believed to affect bladder function was identified for each person and we labeled them as “primary” in Table 1, categorizing by the order in the table. Many persons had other diagnoses affecting the bladder, and these were labeled “secondary.” Spinal cord injury (SCI) and multiple sclerosis (MS) were the most common medical diagnoses, with 40% and 23% respectively.

Medications included 26 different classes, and many persons took more than one medicine in a single category, for instance heart medicine was taken by 44%, but of these patients over half took more than one cardiac medicine. Eleven percent were on antibiotics and 4% on urinary antiseptics. Other bladder medicines included: anticholinergics (20%), antispasmodic/ antimuscarinics (3%), alpha blocker (5%), and muscle relaxants (39%). Frequent medicines were for MS (13%), anticonvulsants (30%), upper gastrointestinal ([GI] 33%), laxatives (34%), psychological/depression (44%), diuretics (24%), diabetes (17%), hypertension (25%), respiratory (19%). Pain medicine was taken by many, including NSAIDS/aspirin (38%), Tylenol (26%), and narcotics (34%). Smaller numbers took medicine for cancer (8%), sleep (5%), or steroids (5%). Eighty-four percent reported taking at least one vitamin or mineral, most typically a multivitamin, calcium or vitamin D.

The majority of participants lived with another person, generally family (55%); only 8% lived with paid caregivers, and 37% lived alone. Employment rates were minimal with only 11 persons working, six of them full time. Most individuals had some type of public insurance and 48% reported having private insurance. Education levels of the subjects varied greatly with 16 % not completing high school, 27% with high school or GED, 19% with some college, and 38 %with a college degree, including 12% with a graduate degree.

Activities of daily living (ADL)--in bathing, dressing, toileting, getting out of bed, and eating---were evaluated by the Katz scale, with item responses calculated as 1 point for independent and 2 points for needs assistance. The range was 5–10 for the total scale, with a higher score indicating less functional ability; the mean was 7.75 (SD1.9) and mode was 9. Twenty-four percent reported that they were independent in all activities, 24% needed assistance with 1–3 ADLs, 35% needed assistance with 4 ADLs and 17% needed help with all 5 ADLs.

### Catheter Care Practices

**Catheter characteristics**—The length of time of catheter use varied considerably from 1 to 470 months (39 yrs.). The mean was 72.5 months or 6 yrs. (SD 85.4months, 7yrs.). Median use was 3.25 yrs. Urethral catheters were used more often than SP, with 112 (56%) and 89(44%), respectively; one person had both types (Table 2). Fifty-eight of those with SP



had used urethral catheters in the past; whereas, only two currently using a urethral catheter had tried a SP catheter. In the past, 35% had used an intermittent catheter, 16% an external condom catheter, 29% had used Crede, and 83% had used absorbent products.

Catheter sizes and the amount of water in the balloon varied. Catheter sizes ranged from 12–30 Fr. with a mean of 18.5 (SD 3.2), and in general urethral catheters were significantly smaller (mean 17.1 Fr., SD2.1) than SP catheters (mean 20Fr., SD 3.5;  $t$  test  $-7.29$ ;  $df$  182;  $P < 0.01$ ). Balloon size varied from 5–30 mL with 70% being 5–10mL; the water within the balloon was reported as 2–50mL, with the majority (55%) using 5–10mL. Some people (8%) did not know the size of the catheter and 23% did not know the balloon size or amount of water instilled. (See Table 2 for details.)

**Drainage bag use**—Most persons (58%) used both leg and overnight (night) bags, switching between them. Some individuals used just one type, with leg bags used alone by 17% and night bags used alone by 23%. Three persons used other collection methods: one a belly bag, one connected tubing to empty the bladder directly from the catheter, and another used a plastic cover over the end and emptied the catheter (without a clamp). Only four persons (2%) used a leg bag continuously, connecting it to the night bag later in the day. The majority switched between leg and night bag, and most also cleaned them (leg bags by 54% and night bags by 59%). Solutions for cleaning bags and the frequency for replacing and cleaning the bags are in Table 3.

**Catheter changes**—Catheter changes were performed by professionals (nurses, physicians) in homes, clinics and offices (Table 4). Unscheduled changes were reported in the previous two months by 37% ( $n=74$ ), with 3 who said this occurred weekly, 15 said several times a month, 12 monthly, and 43 once in two months. Catheter users changed it themselves 8% ( $n=16$ ) of the time for routine changes and 10% ( $n=20$ ) for unscheduled; likewise spouses/family members did so 8% ( $n=14$ ) of the time for routine changes and 10% ( $n=19$ ) for unscheduled. For regularly scheduled changes, out of 12 males who did this, 2 changed urethral and 10 SP; out of 4 females, all changed urethral catheters. For unscheduled changes, out of 14 males who changed their own catheter, 2 had urethral and 12 had SP; out of 6 females, five had urethral catheters, and one had SP. Physicians or home attendants also changed or assisted with catheter changes, for routine changes for 4 persons and unscheduled for 9. Noteworthy is that in the previous two months, 3.5% had used the emergency department (ED) for routine changes, and 31% among those who reported unscheduled changes. Significant differences were found for routine changes in the ED by study sites, with 6 in the NYC site and 1 in Rochester (Chi Sq. 7.0;  $df=1$ ;  $P=.008$ .) However, the unscheduled changes in the ED were not significantly different, with 52 in NYC and 11 in Rochester. (Chi Sq. 2.6;  $df=1$ ;  $P=.106$ ).

**Catheter irrigations**—Irrigating the catheter, which is not a recommended practice (Cottenden et al. 2009, Gould et al. 2009), was done by 42%. Of those who irrigated, 18% did so daily or more often, 13% did it one or more times a week, 43% did it one or more times a month, and 25% once in two months, and persons who irrigated daily were more likely to have had blockage (Chi-Sq. 13.50,  $df=1$ ,  $P=.019$ ). Preventive irrigations were done by 37%, for urine flow problems by 34%, and both preventively and for problems by 39%. Those who irrigated for prevention and problems were more likely to also have had blockage, (Chi-Sq. 13.57,  $df=1$ ,  $P=.001$ ). Solutions for irrigation included: saline 76%, sterile water 23%, tap water 9%, and Renacidin™ (an acidic solution for instillation) 4%. Irrigating the catheter was significantly related to blockage (Chi-Sq. 15.94,  $df=1$ ,  $P < .001$ ) but the pattern of irrigation and blockage vs. CAUTI varied by the individual. Out of 83 who irrigated, 14 had both blockage and CAUTI, 17 had only blockage, 18 had only CAUTI, 32 had no blockage or CAUTI, and 2 did not know.

## Catheter Problems

Prevalence and incidence of self-reported catheter related problems for the previous two months are described in Table 5, including means, SDs, and rates per 1000 catheter use days for CAUTI, blockage, and dislodgement. CAUTI was defined as a urinary infection treated with an antibiotic. Self-reported prevalence of CAUTI was 31% (63/202). In 63 persons, there were 75 episodes reported, with 54 persons having 1 event, seven having 2, one having 3 and one having 4. Blockage in the previous two months was reported by 48 persons (24% prevalence) and frequency of the event was reported by 47 of 48 persons: from 1–2 times in 31 persons, 3–4 times in 9, 7–9 times in 4, and 20 or more times in 3. Frequencies and other details are reported in Table 5 of leakage (bypassing), sediment, kinks/twists, bladder spasms, and autonomic dysreflexia (AD), a painful syndrome caused by injury to central nerves.

### Relationships among demographics, catheter practices, and complications—

No significant associations were found related to CAUTI in the past two months (Yes/No) for catheter size, type of catheter (urethral or SP), leakage, kinks/twists or dislodgement of the catheter. Younger persons were more likely to have reported CAUTI, with a mean age of 57.5 years (SD 16.3) as compared with 63 years (SD 17.6) for those who did not ( $t$  test = 2.11,  $df$  199,  $P$  = 0.036) and to have used the catheter for a longer period of time (Pearson's  $r$  = -0.157,  $P$  = 0.026). Catheter size and length of time using a catheter were not significantly correlated with the number of CAUTIs.

All chi-square tests of associations were not significant for CAUTI or blockage (Yes/No) for catheter management issues related to caregivers who assist with catheter care (e.g., spouse, family, paid helpers); frequency of bag changes (night and/or leg bag); or cleaning the bag.

Blockage was significantly related to CAUTI, with the odds of having a CAUTI were 2.29 times as great (95% CI = 1.17, 4.48) among those with blockages compared with those reporting no blockages. Out of 47 persons reporting frequency of blockage at least once in two months, 22 had at least one UTI (46%); in contrast, out of 152 persons with no blockage, 41 reported UTI (27%).

**Treatments—**Treatments associated with excess healthcare utilization for UTI or blockage, such as extra nurse home visits or hospital visits, are listed in Table 6. All persons reporting UTI had associated treatments, 96% of those with blockage had excess treatments, and only one person out of 88 with either UTI or blockage had no excess treatments. Some treatments required additional family or patient time or use of extra supplies. For example, in those with blockage, the catheter position was adjusted by 19% in relation to blockages, and irrigation was done for blockages by 49%. Doubtless some of the irrigations also were done by the catheter users or caregivers in the home, not nurses. In the previous two months, 17 study participants reported they were hospitalized for UTI for a total of 165 days. The mean number of days hospitalized was 9.71 (SD 7.41), and if including all of those who had UTI but were not hospitalized, the mean days per hospitalization was 2.62 (SD 5.75).

**Symptoms of UTI—**Questions of frequency and severity of UTI symptoms were asked. Symptoms associated with 75 episodes of UTI were asked, with yes or no to each symptom (Table 7). The most frequent symptoms were related to a change in the color (#1) or character of the urine (odor #2; sediment #5). Generalized symptoms also were reported often (malaise #3, bladder spasm #4). Severity of UTI symptoms were reported also for 74 events in two months. On a scale of 1–10 with 1 being very mild and 10 being the most severe UTI you can imagine, a score of 1–4 was reported 22% of the time, a score of 5–7 was reported 43% of the time, and a score of 8–10 was reported 35% of the time.

*J Clin Nurs*. Author manuscript; available in PMC 2014 February 06.

**Leaking/sediment**—Of the 86 persons (43%) who reported leaking (bypassing of urine), 8% indicated it was not a problem, 31% a small problem, 29% a moderate problem, and 32% a large problem. Sediment was noticed by 127 (63%), of these 41% saying it was a small amount (hardly noticeable); 34% a moderate amount (can be seen in tubing and bag if looking for it); and 25% a large amount (very easy to see in tubing and bag. In the previous two months, presence of sediment was associated with blockage (Chi-Sq. 13.93, df=1,  $P<.001$ ) but not CAUTI (Chi-Sq. .48, df=1,  $P=0.49$ ).

**Pain**—Catheter related pain was reported by almost a quarter of the sample ( $n=46$ , 23%), and of those with catheter pain it was attributed to positioning (e.g., sitting on it) by 46%, bladder spasms 46%, some catheter changes 30%, and every catheter change 26%. Fifteen percent said that the pain bothered them very little, 46% said somewhat, and 39% said a great deal. Three percent ( $n=6$ ) said they have catheter pain all the time. In addition, AD can be painful, and this was experienced by 41 persons (20%) at some time, most within the past two months (Table 5). Primarily those with AD had SCI (38 of 41).

**Difficult insertions/removals**—Twenty-four individuals (12%) reported having difficulty with the insertion of their catheter in the previous 2 month and 11 (5%) persons had difficulty during removal. While 31 of 35 people said this difficulty had occurred just once or twice in the past two months (mean 1.7, SD 1.1), four persons had experienced it between 3 and 6 times. For those reporting any difficulty, the level of difficulty for the most difficult insertion or removal experienced (defined as difficult or challenging for the patient) was assessed with a visual analogue scale from 1–10, with 1 being just a little more difficult than usual and 10 being a very challenging situation. The difficulty mean score was 6.9 (SD 3.0), and more than half (54%) were rated from 8–10.

When asked if the catheter interfered with daily life, 29% said not at all, 26% said very little, 29% said somewhat and 16% said it interfered a great deal. However, in further analyses, the catheter significantly interfered “a great deal” in persons with blockage (14 of 31; Chi Sq. 9.53, df 3,  $P= 0.023$ ) and those with difficult catheter changes (11 of 32; Chi Sq. 8.65, df 3,  $P= 0.034$ ).

## Discussion

Although the majority of the persons enrolled in this study were recruited from a home care agency in New York City (75%), the sample is believed to be a good representation of this population because recruitment also took place through clinics and private offices in the Rochester site. Only 3.6% of the persons recruited were not eligible because of not having any major catheter problems, which is consistent with another study in this population in which not one of the 43 persons were problem free during the eight months’ study (Wilde et al. 2010). The sample was older than in some previous studies, with a mean of 61 yrs. as compared with a mean of 49yrs. in two recent studies (Wilde et al. 2010, Wilde & Brasch 2008) with similar populations that had more persons with SCI. The current sample, with a total of 87% recruited through home care agencies, may reflect a more vulnerable population than in earlier studies. Multiple secondary diagnoses and co-morbidities were reported as well as a wide range of medications. Often large studies with catheter users involve retrospective chart audits related to a single medical diagnosis, most often SCI, aimed at finding out about urinary health or catheter management strategies over time (Cameron et al. 2010, El-Masri, Chong, Kyriakider, & Wang 2011).

### Catheter Practices and Care

This is the first known large study (N=202) providing great detail on catheter management practices and problems. Many people lacked knowledge about their catheters, such as the balloon size (47persons/23%) and a few gave us information that was questionable for accuracy, such as catheter sizes of 15 and 17Fr, which are not known to exist. Also, 34% said the catheter was all latex; it is possible that some did not know it might have a Teflon™ coating, as this is a commonly used coating over latex and only one person indicated this type. It was of concern that 29 persons said the balloon was size 30 mL since this is only recommended for postoperative bleeding. The 8 persons who said their 30mL balloons were inflated part way might also be mistaken, but if they were correct, inflating between 16–29 mL could contribute to asymmetry of the balloon and possible erosion into the bladder mucosal lining (Cottenden et al. 2009). Patients and their caregivers need to know more about the proper size of catheters and balloons so that the sizes can be decreased if increased for a specific reason, such as bleeding.

It was not surprising that most people received help with managing their catheters (Table 2), given the large number of people with neurological disorders and the high mean Katz score of 7.8, which indicates a high level of disability. The level of disability is similar to the score of 7.6 (Wilde & Dougherty 2006) cited in a study of 30 catheter users, and in another study with 43 individuals, 44% required assistance from another to dress the upper body, and 91% were in wheelchairs (Wilde et al. 2010).

**Drainage bag replacement and cleaning—**There was much variation in how often the drainage bag was replaced by a brand new one and/or cleaned, but the reason for the frequency was not asked. Logically, the percentage of persons cleaning the leg bag increased as the number of days between replacements extended. However, some people replaced the bag infrequently (e.g., within 22–30 days or >30 days) and not all cleaned the bag between replacements (Table 3). It was unanticipated that so few used a bleach solution to clean since it is the only product recommended for cleaning drainage bags (Gould et al. 2009); however, bleach is caustic and it can damage clothing and irritate the skin or eyes. Nor was vinegar used much, and this had been the standard in home settings in the past (Wilde 1986, Wilde 1991). A lack of research in this area, as well as whether supplies are reimbursed, puts catheter users in a position to make their own decisions about cleaning and reuse of bags. Somewhat surprising was that only 2% indicated they kept the leg bag attached all the time, adding a night bag to it for continuous evening drainage. This practice is recommended at the VNSNY and it is commonly recommended in the United Kingdom due to a belief that this keeps the catheter less disturbed and more of a closed system (Jones, Brooks, Foxley, & Dunkin 2007, Royal College of Nurses (England 2008). In contrast to our sample, in the U.K., leg and night bags are routinely changed every seven days or more often if needed, i.e., appear dirty or have an odor. (Personal communication, M. Fader, August 2011).

**Catheter changes—**This is the first time detailed information about who changes catheters was reported and that catheter users and family members sometimes changed it (Table 4). People in home settings with chronic illnesses often manage complex technology, even as complicated as total parenteral nutrition. Yet catheter changes are not always simple, particularly in men. However, significantly more males routinely changed their catheters more often than females, and SP catheters were significantly more often changed than urethral for unplanned changes. Providing careful teaching for those changing their own catheters is essential to prevent traumatic insertions, especially when taking into consideration the proportion of people who experienced difficult insertions (12%) and removals (5%). Home care nurses changed the great majority of catheters, understandably

*J Clin Nurs*. Author manuscript; available in PMC 2014 February 06.

since the majority of the sample came through home care agencies. Thus, it was particularly surprising that unscheduled changes were often done in the emergency department (31% of the time) and more often in NYC than in the Rochester site. Also ED visits for routine changes (3.5%) contribute to substantial costs that could be reduced through planning and use of home care agencies. The homebound restrictions in Medicare might have contributed to this as people who are able to get out, hold a job, etc. are not eligible for home care services under Medicare. Further research in reasons for catheter related ED use is warranted.

### Catheter Problems

Even though this is a selected group of patients who experienced catheter related problems in the past year or were relatively new to catheter use, this analysis related to data from a two month period confirms the widespread prevalence of catheter related problems. The current report on nine catheter related problems, frequency of occurrence, and their associated professional treatments is the first with this level of detail. In just two months prior to study enrollment, 31% reported having had a CAUTI, blockage of the catheter was reported by 24%, dislodgement by 12%, leakage by 43%, and pain by 23 %. Though the rates of CAUTI was 6.2/1000 catheter days (95% CI= 4.8, 7.6), lower than the 8.4/1000 days reported in a study of 43 long-term catheter users over a six month period (Wilde et al. 2010), it is much higher than the rate of 1.7/1000 days reported through a home care benchmarking project which includes short and long-term catheter users (MAHC 2011). In comparison with other research, (Maki & Tambyah 2001, Wilde et al. 2010) catheter size and gender were not associated with CAUTI.

The rates for blockage and dislodgment are the first known to be published. This report affirms the relationship of blockage and CAUTI reported in previous samples of 24 (Wilde & Carrigan 2003) and 30 (Wilde & Dougherty 2006). Research is needed to explicate the relationship between CAUTI and blockage, such as bladder mucosal bleeding from distension related to poor urine flow (Pearman 1984) or bladder stones.

**Symptoms of CAUTI**—In a recent report of a study in 43 community dwelling adults, the most frequently reported symptoms of CAUTI were urinary sediment, foul odor, general malaise and changes in the color of the urine.(Wilde et al. 2010) In three other studies, foul urine odor was a common symptom (Wilde 1986, Wilde & Dougherty 2006, Wilde & Brasch 2008) though other symptoms varied. These symptoms were confirmed in the current study with the top five being: changes in urine color and odor, malaise, weakness, and sediment. While there are individual differences, this population did not report as often the typical symptoms of UTI in the general public (i.e., burning, urgency, and fever). Of concern, in a study of patients with intermittent urinary catheters, accuracy in predicting UTIs based on their symptoms was not well validated (Massa, 2009). Although cloudy urine was the most accurately reported symptom of UTI, the researchers concluded that most patients were better at identifying when they did not have a UTI, rather than when it was present. This study underlines the need for further symptom research in long-term catheterized patients. Without better knowledge in this area, it is not known whether symptom awareness alone can prevent episodes of symptomatic CAUTI. Thus for patients to seek early treatment, they must know what symptoms to watch for and in particular which ones are their own valid symptoms. This could benefit their health and reduce excess healthcare utilization, especially if ED visits and/or hospitalization can be avoided.

### Limitations

All data are self-reported, and thus we expect some errors. Also there were limitations in sampling because the majority was recruited through one large home care agency and there

were differences in recruitment processes (referral versus database). Persons more bothered by catheter problems might have been more willing to join the study, contributing to selection bias. Some information from study participants might have been inaccurate, for instance catheter sizes of 15 and 17Fr. described above. However, we have confidence in the accuracy of our self-reported data. In a comparison of self-report to chart accuracy in a small sample of a similar population of catheter related problems, congruence was reported as 97% (Wilde et al. 2010).

## Conclusion and Relevance to Clinical Practice

This report characterizes a diverse sample of the population of long-term indwelling urinary catheter users in a way not reported before, providing detailed information about demographics, catheter care practices, and numerous catheter related problems and associated healthcare utilization. The widespread report of catheter problems is of concern because the timeframe was just two months, this population is likely to need an indwelling catheter indefinitely, and many of these problems negatively impact personal health and associated healthcare expenditures. Gaps in research include optimal frequency for replacement and methods of cleaning urinary drainage bags, increasing the predictive value of CAUTI symptoms, decreasing excess ED use (especially for catheter changes), and best practices for educating caregivers (family and paid carers). To better portray this vulnerable population, prospective longitudinal research is needed with long-term catheter users having a range of diagnoses. Also, for surveillance, CAUTI rates for short and long-term users should be distinguished.

Implications for practice involve providing complete information about the catheter to those who use the device, using the appropriate catheter balloon size and water inflation, and consideration of criteria for teaching catheter changes to patients and caregivers. Moreover, since disability levels can change over time, such as in those with MS, monitoring catheter self-care capability over time could proactively identify people whose caregivers need to learn more about catheter management.

Many of the catheter-related problems reported in this study could be prevented or minimized with more attention to catheter management, early identification of problems, and more evidence-based catheter practices. Therefore, information from this study is critical to researchers who wish to plan interventions to address the persistent catheter related problems that affect large proportions of long-term indwelling urinary catheter users.

## Acknowledgments

We wish to thank persons who assisted in this study with: data collection, Yessica Terrero, Christopher Clinton, Laura Edlitz, JoAnn Moda, Manny Schwimmer, Paula Wilson, and Maria Viterbo-Verna; information technology, Brian Harrington, Michael Fisher, Annette Curtis, Sridevi Sridharan, Timothy Peng, Richard Dumpson; nursing consultation, Paula Wilson, Seon Lewis-Holman, Yanick Martelly; medical consultation, Bob Mayer; data and safety monitoring, Susan Fisher, Christopher Murtaugh; and administrative guidance Penny H. Feldman, Pamela Sawdey.

Funding for this study was through the United States National Institute of Nursing Research, National Institutes of Health #R01 NR0155.

## References

- Cameron AP, Wallner LP, Tate DG, Sarma AV, Rodriguez GM, Clemens JQ. Bladder management after spinal cord injury in the United States 1972 to 2005. *The Journal of Urology*. 2010; 184(1): 213–217. [PubMed: 20478597]

- Cottenden, A.; Bliss, D.; Fader, M.; Getliffe, K.; Buckley, B.; Wilde, MH., et al. Management using continence products. incontinence, 4th international consultation in incontinence. 4th ed.. Paris: Health Publication Ltd; 2009.
- El-Masri YWS, Chong T, Kyriakides AE, Wang D. Long-term follow-up study of outcomes of bladder management in spinal cord injury patients under the care of the midlands centre for spinal injuries in oswestry. *Spinal Cord*. 2011
- Gould, CV.; Umscheid, CA.; Agarwal, RK.; Kuntz, G.; Pegues, DA.; and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Guideline for prevention of catheter-associated urinary tract infections 2009. Atlanta, GA: Centers for Disease Control and Prevention; 2009.
- Jones S, Brooks A, Foxley S, Dunkin J. Care of urinary catheters and drainage systems. *Nursing Times*. 2007; 103(42):48–50. [PubMed: 17985750]
- Katz S, Ford A, Moskowitz R, Jackson B, Jaffee M. Studies of illness in the aged. the index of ADL: A standardized measure of biological and psychosocial function. *JAMA*. 1963; 185:914–915. [PubMed: 14044222]
- MAHC. Bladder catheter infection rate comparison Q32011 Infection Surveillance Project. 2011 Missouri Alliance for Home Care.
- Maki DG, Tambyah PA. Engineering out the risk for infection with urinary catheters. *Emerg Infect Dis*. 2001; 7(2):342–347. [PubMed: 11294737]
- Massa LM, Hoffman JM, Cardenas DD. Validity, accuracy, and predictive value of urinary tract infection signs and symptoms in individuals with spinal cord injury on intermittent catheterization. *The Journal of Spinal Cord Medicine*. 2009; 32(5):568–573. [PubMed: 20025153]
- Pearman, J. Prevention and management of infection: The urinary tract. In: Bedford, SG., editor. Lifetime care of the paraplegic patient. New York: Churchill Livingstone; 1985. p. 106-118.
- Royal College of Nurses (England). Catheter care: RCN guidance for nurses. 2008. Pub. Code. 003–237 ed. [www.rcn.org.uk](http://www.rcn.org.uk).
- Wilde MH. Living with a foley. *Am J Nurs*. 1986; 86(10):1121–1123. [PubMed: 3639703]
- Wilde MH. Foley catheter management at home. *Home Healthc Nurse*. 1991; 9(3):39–45. [PubMed: 2061084]
- Wilde MH, Brasch J, Getliffe K, Brown KA, McMahon JM, Smith JA, et al. Study on the use of long-term urinary catheters in community-dwelling individuals. *Journal of Wound, Ostomy, and Continence Nursing* : Official Publication of the Wound, Ostomy and Continence Nurses Society / WOCN. 2010; 37(3):301–310.
- Wilde MH, Carrigan MJ. A chart audit of factors related to urine flow and urinary tract infection. *J Adv Nurs*. 2003; 43(3):254–262. [PubMed: 12859784]
- Wilde MH, Dougherty MC. Awareness of urine flow in people with long-term urinary catheters. commentary by B. Roe. *Journal of Wound, Ostomy, and Continence Nursing*. 2006; 33:164–175.
- Wilde MH, Brasch J. Self-monitoring of urine flow in people with long-term urinary catheters. *Res Nurs Health*. 2008; 31(5):490–500. [PubMed: 18418847]
- Yang J, Xie M, Ngee Goh T. Outlier identification and robust parameter estimation in a zero-inflated poisson model. *Journal of Applied Statistics*. 2011; 38(2):421–424.

Table 1  
Primary and secondary diagnoses

Primary			Secondary					
	#	%	MS	Diabetes	Stroke	Prostate	Spina bifida	Neurogenic bladder
SCI	81	40	1	20	9	8	1	39
MS	46	23		7	4	3		23
Diabetes	25	12	7		7	5		10
Stroke	4	2	4	7		3		2
Prostate	20	10	3	5	3			13
Spina bifida	2	1						1
Neurogenic Bladder	16	8	23	15	2	13	1	
Parkinsons	3	2						
Other	5	3						



Table 2

Catheter characteristics and catheter care practices

Time using catheter	%	Catheter material	# (%)		
Up to 1 yr.	22	All latex	69/34		
> 1 to 3 yrs.	26	Teflon™ coated latex	1/1		
> 3 to 5 yrs.	13	Silicone coated	71/35		
> 5 to 10 yrs.	22	All silicone	12/6		
>10 to 15 yrs.	8	Hydrogel coated	3/2		
>15 to 20 yrs.	6	Silver coated	5/3		
> 20 to 40 yrs.	5				
Catheter size (Fr) all # (%)	Urethral #	SP #	Balloon size all #/%	Urethral #	SP #
12	1 (1)	0	5–10 mL.	124(61	62
14	8(4)	1	30 mL.	29(14	19
15–16	62(31)	17	Don't know	47(23	10
17–18	57(28)	34	Other Text 15	2(1	
20	16(8)	7	9	Amount of water in balloon all # (%)	SP #
22	18(9)	2	16	<5cc	2(1)
24	17(8)	3	14	5–10	110(55)
26	3(2)	0	3	11–15	10(5)
28	1(1)	0	1	16–29	12(5)
30	2(1)	0	2	30	9(5)
Not known	17(8)	14	3	40–50	2(1)
Helps with catheter #(%) (some selected more than one)					
No one	47(23)	Friend	7(4)		
Spouse/partner	38(19)	Paid aide	126(62)		

Wilde et al.

Page 14

Time using catheter	%	Catheter material	# (%)
Other family member	34(17)	Other	1(1)

*J Clin Nurs*. Author manuscript; available in PMC 2014 February 06.

**Table 3**

## Drainage bag cleaning and replacements

Type of bag used	(%)	Cleaning solutions	Percentage in leg bag users	Percentage in night bag users
Leg bag only	17	Soap & water	29	27
Night bag only	23	Water alone	35	31
Both leg and night bag	58	Vinegar & Water	33	36
Leg bag always attached, & adds night bag	2	Bleach and water	16	22
Other (e.g., homemade clamp)	2	Commercial product, e.g., Urolux™	1	1
		Household cleaners, e.g., Lysol™	12	12
		Other	1	2
<b>Replacement</b> with brand new bag, within:	Leg bag users (%)		Night bag users (%)	
	Replacement	Also cleans leg bag (%)	Replacement	Also cleans night bag (%)
1–7 days	49	62	31	64
8–14 days	20	77	26	69
15–21 days	11	88	14	83
22–30 days	16	75	20	76
>30 days	5	86	9	93

Table 4

Routine & unscheduled catheter changes

Person changing catheter	Routine changes # (%)			Unscheduled changes # (%)		
	#(%) all	# UR-SP	# M-F	# (%) all	# UR-SP	# M-F
(some selected more than one)						
Self	16(8)	6-10	*12-4	20(10)	*7-13	14-6
Spouse-partner	7(4)	3-4	4-3	9(5)	4-5	6-3
Family member	7(4)	5-2	2-5	10(5)	7-3	4-6
Home care Nurse	112 (55)	**73/39	***42-70	96(46)	*63-33	38-58
Nurse or physician at clinic	45(22)	*19-26	31-14	45(22)	20-25	25-20
Nurse or physician at private medical office	29(14)	12-17	19-10	22(11)	9-13	16-6
Emergency department	7(4)	6-1	3-4	63(31)	32-31	40-23

UR= urethral; SP= suprapubic catheter. Significant differences in Chi Square tests

\* P= ≤ .05

\*\* ≤ .01

\*\*\* <.001

Table 5

## Catheter problems

Key catheter problems in past two months	Number persons	Percentage *	Mean (SD) entire sample	Rate/1000 catheter days		
UTI	63	31	0.37 (0.63)	6.22		
Blockage	48	24**	0.67 (1.71)	6.22		
Dislodgement	25	12	0.21 (0.68)	11.08		
Other catheter problems in past two months	Number persons	Percentage *	Frequency of those with problem (%)			
			Daily	Once - several Times week	Once - in past 2 months	
Leaking (bypassing urine)	86	43	9	10	51	29
Sediment	127	63	24	29	39	7
Kinks/twists	40	20	13	8	40	40
Bladder spasms	72	36	37	24	30	10
Autonomic dysreflexia	26	13	4	31	38	27

\* Indicates the percentage of study participants who had this happen at any time during the previous two months, rounded to nearest percent.

\*\* The outlier test based on zero-inflated Poisson models (Yang et al. 2011) identified three observations in blockage variable. Outliers were replaced with the observations closest to them, 9, for the calculation of means.

**Table 6**  
Treatments associated with catheter problems in two months

Treatments/	UTI (n=63)			Blockage (n=47)*		
	Total # events	% affected	**Mean (SD)	Total # events	% affected	**Mean (SD)
Extra nurse home visit	14	19	0.22 (0.49)	26	30	0.55(.99)
Extra office visit	18	25	0.29 (0.52)	13	23	0.28 (0.54)
ED visit	25	35	0.40 (0.61)	16	19	0.34 (0.84)
Hospitalized**	20	27	0.32 (0.56)	N/A		
Rehab or nursing home stay						
Catheter changed	48	65	0.76 (0.64)	58	70	1.23 (1.22)
Urine cultured	54	76	0.86 (0.59)	N/A		
Antibiotic prescribed	75	100	1.19 (0.53)			

\* One additional person had blockage but did not know the frequency.

\*\* Means (SDs) calculated only for those affected with the problem, i.e., 63 with UTI and 47 with blockage. Treatments were not asked for blockages over 12 events/person, which was reported by three persons.

**Table 7**

Symptoms of UTI (n=63)

Symptom	Mean (SD)	Times reported	Percent with symptom *	Rank order of frequency
Urine color change	0.94 (0.74)	59	76	1
Odor in urine	0.84 (0.77)	53	68	2
Malaise	0.71 (0.77)	45	59	3
Weakness	0.60 (0.73)	38	51	4
Sediment	0.59 (0.75)	37	48	5
Pain Bladder	0.57 (0.76)	36	46	6
Burning	0.57 (0.78)	36	44	7
Bladder Spasm	0.51 (0.64)	32	43	8
Chills	0.49 (0.72)	31	41	9
Blood	0.49 (0.69)	31	40	10
Fever	0.44 (0.62)	28	40	11
Pain Back/Side	0.44 (0.67)	28	37	12
Muscle Spasm	0.40 (0.71)	25	32	13
Other	0.29 (0.52)	18	25	14
Mental Changes	0.27 (0.51)	17	24	15
Leakage	0.25 (0.47)	16	24	16
Autonomic dysreflexia	0.21 (0.63)	13	14	17

\* Percentage with symptom rounded to a whole number.



# NIH Public Access

## Author Manuscript

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

Published in final edited form as:

*Nurs Res.* 2015 ; 64(1): 24–34. doi:10.1097/NNR.0000000000000071.

## Self-Management Intervention for Long-Term Indwelling Urinary Catheter Users: Randomized Clinical Trial

**Mary H. Wilde, RN, PhD [Associate Professor],**

University of Rochester, School of Nursing, Rochester, New York

**James M. McMahon, PhD [Associate Professor],**

University of Rochester, School of Nursing, Rochester, New York

**Margaret V. McDonald, MSW [Associate Director of Research Studies],**

Visiting Nurse Service of New York, Center for Home Care Policy and Research

**Wan Tang, PhD [Research Associate Professor],**

University of Rochester, Department of Biostatistics and Computational Biology, Rochester, New York

**Wenjuan Wang, PhD [Post-Doctoral Fellow],**

University of Rochester, Department of Biostatistics and Computational Biology, Rochester, New York

**Judith Brasch, RN, MS [Project Nurse],**

University of Rochester, School of Nursing, Rochester, New York

**Eileen Fairbanks, RN, MS, PNP [Health Project Coordinator],**

University of Rochester, School of Nursing, Rochester, New York

**Shivani Shah, MPH [Research Analyst],**

Visiting Nurse Service of New York, Center for Home Care Policy and Research

**Feng Zhang, RN, BS [MS/PhD Student], and**

University of Rochester, School of Nursing, Rochester, New York

Corresponding author: Mary H. Wilde, RN, PhD, Associate Professor Nursing and Center for Community Health, University of Rochester, 601 Elmwood Ave., Box SON, Rochester, NY, 14642. mary\_wilde@urmc.rochester.edu.

**Mary H. Wilde, RN, PhD,** is Associate Professor, University of Rochester, School of Nursing, Rochester, New York.

**James M. McMahon, PhD,** is Associate Professor, University of Rochester, School of Nursing, Rochester, New York.

**Margaret V. McDonald, MSW,** is Associate Director of Research Studies, Visiting Nurse Service of New York, Center for Home Care Policy and Research.

**Wan Tang, PhD,** is Research Associate Professor, University of Rochester, Department of Biostatistics and Computational Biology, Rochester, New York.

**Wenjuan Wang, PhD,** is Post-Doctoral Fellow, University of Rochester, Department of Biostatistics and Computational Biology, Rochester, New York.

**Judith Brasch, RN, MS,** is Project Nurse, University of Rochester, School of Nursing, Rochester, New York.

**Eileen Fairbanks, RN, MS, PNP,** is Health Project Coordinator, University of Rochester, School of Nursing, Rochester, New York.

**Shivani Shah, MPH,** is Research Analyst, Visiting Nurse Service of New York, Center for Home Care Policy and Research.

**Feng Zhang, RN, BS,** is MS/PhD Student, University of Rochester, School of Nursing, Rochester, New York.

**Ding-Geng (Din) Chen, PhD,** is Professor, University of Rochester, School of Nursing and Department of Biostatistics and Computational Biology, Rochester, New York.

Clinical Trial Registration number from clinicaltrials.gov is NCT00883220.

Conflicts of Interest Statements: Mary H. Wilde has been a consultant with NovaBay Pharmaceuticals Inc. since June 2013. The remaining authors have no conflicts of interest to report.



**Ding-Geng (Din) Chen, PhD [Professor]**

University of Rochester, School of Nursing and Department of Biostatistics and Computational Biology, Rochester, New York

**Abstract**

**Background**—People using long-term indwelling urinary catheters experience multiple recurrent catheter problems. Self-management approaches are needed to avoid catheter-related problems.

**Objectives**—The aim was to determine effectiveness of a self-management intervention in prevention of adverse outcomes (catheter-related urinary tract infection, blockage, and accidental dislodgement). Healthcare treatment associated with the adverse outcomes and catheter-related quality of life was also studied.

**Method**—A randomized clinical trial was conducted. The intervention involved learning catheter-related self-monitoring and self-management skills during home visits by a study nurse (twice during the first month and at four months—with a phone call at two months). The control group received usual care. Data were collected during an initial face-to-face home interview followed by bimonthly phone interviews. A total of 202 adult long-term urinary catheter users participated. Participants were randomized to treatment or control groups following collection of baseline data. Generalized estimating equations (GEE) were used for the analysis of treatment effect.

**Results**—In the intervention group, there was a significant decrease in reported blockage in the first six months ( $p = .02$ ), but the effect did not persist. There were no significant effects for catheter-related urinary tract infection or dislodgment. Comparison of baseline rates of adverse outcomes with subsequent periods suggested that both groups improved over 12 months.

**Discussion**—A simple-to-use catheter problems calendar and the bimonthly interviews might have functioned as a modest self-monitoring intervention for persons in the control group. A simplified intervention using a self-monitoring calendar is suggested—with optimal and consistent fluid intake likely to add value.

**Keywords**

longitudinal research; quality of life; randomized clinical trial; self-management; urinary catheterization

---

Indwelling urethral or suprapubic catheters are used by individuals with chronic urinary retention who are unable to perform intermittent-catheterization because of poor hand dexterity, no caregiver assistance, difficulty in using the bathroom, or in select cases of incontinence. While many catheter users have spinal cord injury (SCI) or multiple sclerosis (MS), the population also includes those with other neurological disorders, diabetes, or disease/injury to the bladder region. Unfortunately, indwelling urinary catheters are seldom trouble free (Cottenden et al., 2013; Wilde, McDonald et al., 2013). Data collected in a longitudinal study of 43 long-term catheter users indicated that recurrent problems affect the great majority. Prevalence rates during eight months of catheter use were 70% for catheter-associated urinary tract infection (CAUTI) with a rate of 8.4/1000 catheter days; 74% for

blockage; and 33% for catheter expulsion or dislodgement (Wilde, et al., 2010). For a two-month period prior to the beginning of this randomized clinical trial (RCT), catheter problems were reported as: 31% for CAUTI, 24% blockage, and 12% dislodgment (Wilde, McDonald et al., 2013).

These complications are distressing to patients/families (Wilde & Cameron, 2003; Wilde, 2003) and contribute to increased healthcare expenses, such as additional clinic, home care, or emergency department visits or hospitalization (Wilde, McDonald et al., 2013). Interventions to address prevention of CAUTI in long-term catheter users such as the use of silver coated or antimicrobial coatings on the catheter (Parker et al., 2009) installations to the drainage bag (Thompson et al., 1984), or special cleaning of the urinary meatus (Burke, Jacobson, Garibaldi, Conti, & Alling, 1983) have not been successful. Although research in self-management of chronic conditions in diabetes (Coyle, Francis, & Chapman, 2013), stroke (Lennon, McKenna, & Jones, 2013), and asthma (van Gaalen et al., 2013) has grown, no self-management clinical trials have been found in catheter users (Cottenden et al., 2013; Niël-Weise, van den Broek, Peterhans, da Silva, & Silva, 2012).

The research clinical trial (RCT) for the current report was developed inductively through six previous studies conducted primarily by the first author (MHW). These studies included research with 30 individuals who kept a urinary diary and were interviewed twice to determine what their self-care practices were (Wilde & Dougherty, 2006). A concept analysis was next conducted of self-monitoring, delineating key attributes and how it fit within self-management literature (Wilde & Garvin, 2007). Then a pilot study teaching self-monitoring of urine flow in long-term catheter users was conducted. The results of the pilot study indicated that optimal fluid intake and preventing dislodgment were the most useful self-management components reported by study participants. Importantly, CAUTI decreased in the six months during the single group pilot (Wilde & Brasch, 2008a). Taken together, the theoretical model for the current study proposed that the intervention would affect catheter self-management indirectly through self-efficacy, and directly; and that higher levels of awareness, monitoring, and behaviors related to catheter care would improve outcomes (Figure 1; Wilde, Zhang et al., 2013).

The aim of the study was to determine the effect of the self-management intervention on health outcomes compared to the usual care control. It was hypothesized that the self-management group would: (a) have fewer episodes of UTI (and severity), blockage, and dislodgement of the catheter; (b) have decreased unplanned catheter-related healthcare utilization, including hospitalizations, emergency department visits, and fewer nurse home/or clinic visits; and (c) report higher catheter-related quality of life.

## Methods

### Design

The study was a randomized, single-blinded experimental design with repeated measures every two months over a 12-month period. The design called for 101 individuals to receive the self-management intervention and 101 to receive usual care (catheter-related care provided by home care nurses, clinics, or private providers).

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

### Inclusion/Exclusion Criteria

Eligible participants were adults age 18 and over. Inclusion criteria were: (a) expect to use an indwelling urethral or suprapubic catheter for at least one year, and will be in the study region for at least four months; (b) can complete study measurements alone or with the help of a caregiver; (c) speak English; and (d) have access to a telephone for data collection. Because we wanted to target only individuals who might benefit from this study and, thus, better determine effectiveness, our participants also must have had a catheter problem of CAUTI within the last year, or blockage or dislodgement within the last six months, or be new to a catheter within the last year. Individuals were excluded for terminal illness or cognitive impairments. Children under 18 were not included because they might not have the capacity for self-care, which includes directing others.

### Setting and Recruitment

Participants consisted of community-dwelling individuals recruited in two distinct regions by two study sites: (a) a university in a large northeastern U.S. state, and (b) a home care agency which conducts research in a large metropolitan area in the same state. For the university site, participants were recruited through nurses or physicians in home care agencies, medical center clinics, hospitals, and private medical offices (e.g., urology). Screening for eligibility and interest in participation was conducted by phone by the first author (MHW) or the project coordinator after contact information was received from providers who had permission to do so from potential participants. Some catheter users contacted the researchers themselves. In the home care agency, their database was used to identify potential participants with a catheter for telephone call screenings and recruitment by trained study interviewers. Using data from the agency's U.S. Outcome and Assessment Information Set (OASIS) for home care, catheter users were screened and excluded if they had a poor prognosis/life expectancy, cognitive impairment, confused, severe speech impairment, behavior problems, diagnosis indicating dementia, or had been previously interviewed (in another study or declined). Data were collected from June 2009-June 2012 in the homes of community-dwelling individuals and through telephone contacts over 12 months of participation.

### Sample Size and Power Calculations

Power calculations were performed to determine a sample size for an adequately powered study to detect clinically meaningful effects across multiple outcomes. For each of the primary outcomes, *a priori* range of clinically meaningful effect sizes was determined based on previous research. All calculations employed a significance level of .05 and 80% power. Power analyses were performed with SAS 9.1 using Monte Carlo simulation resampling techniques for general estimating equation (GEE) analysis (Gastañaga, McLaren, & Delfino, 2006; Yuan & Hayashi, 2003). The analysis indicated that a sample of 220 (160 completers) would provide sufficient power to detect medium effect sizes (15% to 30% differences between groups) for the primary health status outcomes. However, health care utilization measures, such as hospitalizations and ED visits, require larger samples due to their relatively rare frequency of occurrence.

### Ethics/Human Subjects

The study was approved at each site by their respective bodies for protection of human subjects. A coordinated approach assured that the same processes were used, including the same consent form with stamps and contact information from both sites. A Data Safety Monitoring Board was formed and convened annually to assess interim results and potential adverse events.

### Randomization and Blinding

Randomization was conducted by the main study statistician who directed the processes with the study coordinators at each site—each of whom subsequently enrolled participants at their own site and allocated them to treatment or usual care after completion of the baseline home visit (HV) interview. Participants were stratified by site to balance the large number of study subjects in the large metropolitan area (75% of participants), as compared with the university site (25% of participants) which was a combination of urban, suburban, and rural areas. Block randomization with random block sizes of 4, 6, or 8 was carried out independently at the two sites to balance the two treatment groups. For each site, a sequence of random assignments was generated by the study statistician and sealed in sequentially numbered envelopes by the study coordinator. The participants were sequentially assigned the treatment after completing the consent and initial HV interview; then, the study nurse called those allocated to the intervention and made arrangements for the first nurse contact in the home. Study investigators, data gathering teams, and statisticians were blinded to allocation status until the final analyses were completed.

### The Urinary Catheter Self-Management Intervention

The intervention designed to improve self-management in people with long-term, indwelling urinary catheters was based on self-efficacy theory (Bandura, 1997). Sources of urinary catheter self-efficacy were targeted in the nurse home visit interventions—specifically mastery experiences—vicarious observation, verbal persuasion, and knowledge about physiological status.

Each of the two study sites followed identical intervention protocols, which consisted of three home visits and one telephone call by a trained registered nurse to deliver the intervention. Two home visits took place in the first month and a third (booster) visit occurred at four months. During the first home visit, participants were taught to conduct self-monitoring using a three-day urinary diary to record observations and measurements of fluid intake and output (I & O), urine characteristics, and sensations of flow. This was to teach awareness of urine flow, basic self-monitoring skills, and to increase their level of mastery, thus, contributing to increased catheter related self-efficacy. During the second home visit, about a week later, self-management skills were taught first by reviewing the information from the urinary diary, calculating the intake and output averages and comparing these to an optimal volume (30ml/kg body weight), and identifying the individual's catheter-related problems. Anything notable about I & O, the color/character of urine, or of urinary sensations, was discussed and implications for self-management pointed out.

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

An educational booklet which had been piloted and viewed as very helpful (Wilde, Zhang, et al., 2013) was then provided and discussed, which focused on basic catheter self-management skills related to: (a) maintaining optimal and consistent fluid intake; and (b) preventing catheter dislodgement—which were the key components of the intervention. In the presence of certain bacteria which cause urea in the urine to split, sodium, magnesium, and calcium will precipitate from the urine—often at about a pH of 6.8, causing sediment and encrustation. However, researchers found that urine pH could increase to as high as 9 or 10, and the catheter might not block if fluid intake is increased to dilute the concentration of minerals (Khan, Housami, Melotti, Timoney, & Stickler, 2010). This is our foundation for the fluid intake requirements, which we set at 30ml/kg body weight (Gray & Krissovic, 2003).

Other modules of the booklet were reviewed briefly or in-depth, depending on interest or need. These were: recognizing early symptoms of CAUTI; living with the catheter; promoting optimal catheter change intervals; decreasing caffeine; decreasing leakage; emptying and cleaning the drainage bag; making adjustments for sex; and recognizing early symptoms of autonomic dysreflexia (for people with spinal cord injury/disease). Goals, if any, were written in the educational booklet. A motivational bookmark with quotes and pictures was reviewed to help encourage participants to be attentive to urine flow.

Two weeks later, the study nurses called to answer questions and, if needed, helped the participants revise goals or plans. At four months, a third home visit served as a booster of the intervention to further refine or modify goals/plans as the catheter user desired. Family or caregivers were encouraged to be present, but the intervention was delivered to the catheter user.

**Intervention compliance and fidelity**—Two study nurses (one at each site), who were trained together at the beginning of the project, delivered all the intervention components. Multiple strategies were used to establish and sustain the fidelity and integrity of the intervention. These involved: (a) standardization of the intervention and training, including use of a detailed training manual that incorporated Bandura's self-efficacy concepts (Bandura, 1997); (b) randomly selected fidelity assessments of 10% of the interventions—half by audiotape and half in-person home observations; (c) at least monthly conference calls; (d) training study nurses together; (e) tracking study nurse activities and responsiveness of the participants; (f) assessment of participant skills at the end of the study; and (g) inclusion of fidelity assessment in the analysis plan. The results of the audiotape and in person fidelity assessment indicated that competence and adherence to the intervention parameters were highly scored with most means between 4–5 (5 was the highest possible score). Also, because there was little variability in the proportion of the intervention participants who received the intervention contacts (i.e., 98% for HV1, 95% for HV2, 93% TC at two weeks, and 91% HV3 at four months), we decided it was not necessary to adjust for fidelity in the main outcomes analysis. All participants, regardless of group allocation, continued to receive usual nursing and medical care.

## Usual Care

Participants randomized to the control group received usual care.

## Measures

Measures were developed for this study based on previous research of the first-author's team (Wilde & Brasch, 2008a; Wilde & Dougherty, 2006). Instrumentation was modeled on the Stanford Chronic Disease Self-Management programs (<http://patienteducation.stanford.edu/>). Participants in both groups were administered identical data collection instruments. At baseline, self-report was used for data collection related to the two-month timeframe prior to the study (for evaluating equivalence of the groups), and every two months for 12 months thereafter through telephone call interviews. To improve accuracy of recall, all participants were asked to maintain an ongoing catheter calendar over the 12 months of the study, using letter symbols for problems: CAUTI (U), blockage (B), and dislodgement (D). Treatments were identified as antibiotic (A), extra nurse home visit (HV), extra office visit (O), hospitalization (H), and emergency department visit (ED). For missed interviews, data were collected for the primary outcomes at the next scheduled interview—if the study participant had kept track of problems in their catheter calendar. This occurred only nine times.

## Outcomes

Primary outcomes consisted of catheter-related complications of CAUTI, blockage, and dislodgement. CAUTI was defined as a urinary tract infection that was treated with an antibiotic prescribed by the person's healthcare provider. Blockage was defined as an occurrence in which the urine would not flow through the catheter due to an obstruction of the catheter tube. Blockage was distinguished from kinks or twists that are external to the catheter tube. Dislodgement occurred when the catheter fell out or became displaced accidentally due to traction (i.e., pulling on it). Catheter-related quality of life was also a primary outcome using our previously developed measure with a five-point Likert scale from 1 = *strongly agree* to 5 = *strongly disagree*; higher scores reflect better quality of life (Wilde, Brasch, Getliffe, McMahon et al., 2010).

Excess healthcare expenditures (treatments) related to catheter problems were also primary outcomes; these included extra nurse or clinic visits, hospitalizations, rehabilitation, and emergency department visits. Additional information was asked about each episode of CAUTI regarding the perceived severity of the infection (on a scale of 1–10, with 1 = *very mild* and 10 = *most severe imaginable*), and the number of days hospitalized or in rehabilitation specifically related to the CAUTI.

## Data Analysis

Standard data cleaning procedures were applied to screen for errors and potential univariate and multivariate outliers. These procedures led to the removal of blockage data (percentages/month, counts, treatments) for one participant due to inconsistent and contradictory responses. All other data were used; several outliers for blockage were

adjusted by windsorizing to 9 as the maximum number of events in a two-month period for testing group differences.

Intention-to-treat analysis was used. Data were analyzed with SAS 9.3 (SAS Institute Inc., Cary, NC, USA). Generalized linear models were utilized with an identity link function for continuous outcomes (CAUTI severity and QOL) and a logit link function for binary outcomes. Randomization achieved comparability on demographic characteristics of participants and aspects of catheter use (Tables 1 and 2) in treatment and usual care groups. The groups were similar on key outcome variables during the two months prior to the study, except for catheter blockage ( $p < .05$ ) and days hospitalized ( $p < .01$ ) (Table 2). Thus, we fitted each of the models with and without controlling for baseline information on the outcome variable. First, data for the first six months were modeled; then, data from the entire 12 month period of the study were modeled.

**First six months—**We let “group” be the indicator of treatment assignment (0 = *usual care*; 1 = *treatment*), and  $y_{it}$  be the outcome for the  $i^{\text{th}}$  subject at month  $t$ . Three models were developed for each outcome over the first six months of the study: a group differences model, a model for interaction of group and time; and a model controlling for baseline and time. The group differences model is

$$\mu_{it} = E(y_{it}) = f(\beta_0 + \beta_1 * \text{group}) \quad (1)$$

where  $f$  is the appropriate link function, the intercept  $\beta_0$  is the  $y$ -intercept in the usual care group when  $f$  is an identity function and mean log odds for the usual care group when  $f$  is the logit link,  $\beta_1$  is the treatment effect, and the “\*” symbol denotes multiplication. The interaction model, controlling for baseline and time is

$$\mu_{it} = E(y_{it}) = f(\beta_0 + \beta_1 * \text{group} + \beta_2 * y_{i0} + \beta_3 * \text{month} + \beta_4 * \text{group} * \text{month}). \quad (2)$$

When the interactions in Equation 2 were not significant, we further modeled the data controlling for baseline and time, with

$$\mu_{it} = E(y_{it}) = f(\beta_0 + \beta_1 * \text{group} + \beta_2 * y_{i0} + \beta_3 * \text{month}). \quad (3)$$

In the models given in Equations 1 and 3, inference about  $\beta_1$  provides information about the treatment effect, either as difference in outcome (CAUTI severity, quality of life) or difference in log odds of the outcome (binary outcomes) as a function of group (Equation 1) or group, baseline, and time in months (Equation 3).

**Complete 12 month outcomes—**We applied the same group difference model in Equation 1 to the 12-month data (i.e.,  $t = 2, 4, 6, 8, 10$  and 12). For the models controlling for baseline and time (Equations 2 and 3), an indicator variable “second” was added to allow modeling differences between the first and second six months of the study (scored 0 when  $t = 2, 4$ , or 6 months and 1 when  $t = 8, 10$ , and 12 months). An interaction term between

“second” and “group” was added to the models described in Equations 2 and 3 to detect possible treatment effects between the first and last six months of the study, shown as

$$\mu_{it} = E(y_{it}) = f(\beta_0 + \beta_1 * \text{group} + \beta_2 * y_{i0} + \beta_3 * \text{month} + \beta_4 * \text{second} + \beta_5 * \text{group} * \text{second}) \quad (4)$$

and

$$\mu_{it} = E(y_{it}) = f(\beta_0 + \beta_1 * \text{group} + \beta_2 * y_{i0} + \beta_3 * \text{month} + \beta_4 * \text{second}). \quad (5)$$

To deal with the dependency among the repeated measures, generalized estimating equations (GEE) with a first order autoregressive structure for the working correlation were utilized. We chose to use GEE because of the complexity and difficulty in modeling the correlations among the repeated measures—especially for discrete outcomes. As a semiparametric approach, GEE has the advantage that the inference is robust to the misspecification of the working correlation matrix—in the sense that estimates are consistent even when the working correlation departs from the true correlations among repeated measures (Diggle, Heagerty, Liang, & Zeger, 2002). Nominal *p*-values of .05 for two-tailed tests were used.

## Results

### Sample Description

Baseline characteristics of participants are displayed in Table 1. Ages ranged from 19–96 years (*Mdn* = 61). The range in duration of catheter use was 1 to 470 months (39 years). Self-reported diagnoses involved SCI (40%), MS (23%), diabetes (12%), stroke (2%), prostate (10%), spina bifida (1%), neurogenic bladder not otherwise reported (8%), Parkinson’s disease (2%), and other (3%). Indications for indwelling catheter use were: immobility or difficulty moving around (58%), incontinence (57%), neurogenic bladder (54%), obstructed urine (32%), healing wounds (11%), and other reasons (11%). More than one indication could be listed. Additional detailed information about the participants at baseline is available in Wilde, McDonald et al. (2013).

Table 2 lists catheter-related health status, healthcare related to CAUTI, healthcare related to blockage, and quality of life at baseline by treatment group. Following randomization, groups appeared equivalent except that, during the two months prior to the study, the percentage of participants who had catheter dislodgement and the number of days hospitalized for a catheter-related CAUTI were higher in the control group.

Attrition was similar in both groups (Figure 2). There were more deaths in the experimental group than the control group (10 vs. 7). More participants whose catheters were removed were in the control group, mostly late in the study (3 vs. 10). Three persons withdrew from each arm of the study.



## Treatment Effects

Table 3 lists treatment effects for primary outcomes for models depicted in Equation 3 (short term effects during the first six months of the study, controlling for baseline value and time) and Equation 5 (longer-term effects, controlling for baseline value, time, and first vs. second half of study). Complete statistical results are available from the authors (MHW).

**First six months**—Without controlling for any covariates, the overall short-term effect of the intervention relative to the control condition was assessed over the first six months (Equation 1). During the first six months, patients in the experimental group were less likely to report catheter blockage ( $p < .05$ ) and fewer blockage-related nurse visits ( $p < .05$ ), but they reported experiencing more severe CAUTI ( $p < .001$ ) and significantly more CAUTI-related emergency room visits ( $p < .05$ ), in terms of the percentage reporting such events. As shown in Table 3, we obtained similar conclusions controlling for the outcome variables at baseline (such as CAUTI) as well as time (Equation 3).

**Complete 12 month outcomes**—Without controlling for any covariates, the overall long-term effect of the intervention compared to the control condition was assessed over the whole 12-month period (Equation 1, with  $t = 2, 4, 6, 8, 10, 12$ ). However, the overall difference in blockage between the two groups was not significant over this longer period. The experimental group continued to report significantly higher CAUTI severity scores ( $p < .01$ ) and CAUTI-related emergency room visits (percentage reporting these events [ $p < .001$ ] and frequencies of events [ $p < .01$ ], as well as more hospitalizations for CAUTI (percentage [ $p < .01$ ], frequencies [ $p < .01$ ], and days hospitalized [ $p < .05$ ]; Table 3; Table 4 [days hospitalized]).

Additional statistical tests of treatment effect controlling for baseline outcomes, time, and study period (“second”) were conducted (Equation 4, not shown in a table.). The experimental group tended to report more CAUTI compared to the control group in the second half ( $\hat{\beta}_1 = 0.66$ ; 95% CI [0.03, 1.30],  $p = .04$ ), and no difference between the two groups during the first half year. The experimental group reported higher CAUTI severity than the control group in the first half year ( $\hat{\beta}_1 = -2.80$ ; 95% CI [-4.62, -0.97],  $p < .0001$ ), but no difference between the two groups during the second half. This indicates that the experimental group’s CAUTI severity scores decreased relative to the control group from the first to the second half of the year. Blockages were fewer in the experimental group (by percentage) compared with the control group in the first half of the year ( $\hat{\beta}_1 = 1.17$ , 95% CI [0.38, 1.97],  $p < .05$ ), but not in the second half of the year.

For other outcomes, the interaction was not significant, and was therefore removed. Treatment effect was estimated controlling for baseline outcomes and time. The experimental group had higher hospitalization for CAUTI ( $p < .01$ ) and emergency room visits ( $p < .001$ ; Table 3). Catheter-related quality of life did not differ significantly by group (Table 3).

## Rates Comparisons

Table 4 provides detailed information about rates of blockage, CAUTI, dislodgement, and hospitalizations within groups over the course of the study and between groups. See Table 4 for a figure displaying the percentage of persons who reported experiencing catheter adverse outcomes of blockage, CAUTI, or dislodgement by group over time.

**Catheter-related health status**—Comparison of between- and within-groups rates per 1000 catheter days from baseline provided further details about changes in the primary outcomes over the first six months, second six months, and full study of 12 months. Blockage rates were significantly lower in the experimental group during the first six months ( $p < .01$ ) and for the full study ( $p = .03$ ), but there were no differences during the second half of the study ( $p = .31$ ). Blockage improved significantly within each group at each assessment time from baseline.

For CAUTI, there were significant rate differences favoring the control group during the second half of the study ( $p = .01$ ), but no differences for the first half ( $p = .55$ ) or the full study ( $p = .16$ ). Compared with baseline rate estimates, the experimental group had significant decreases in CAUTI rates during the first half of the study ( $p = .02$ ), and for the overall full study time period of 12 months ( $p = .05$ ). The control group had a significant decrease in CAUTI during the second half of the study ( $p = .02$ ).

For dislodgement, rates decreased steadily in both groups by six months and 12 months, and there were no significant group differences. Dislodgement rates were lower in the experimental group at baseline, and larger decreases in dislodgement took place over time in the control group. During the second half of the study, the experimental group rate was slightly better than the control, but not significantly so ( $p = .06$ ).

**Hospitalization rates**—Hospitalizations were significantly higher in the experimental group for most time points (Table 4). While the hospitalization rates favored the control group, rates decreased in both groups compared with their respective rates at baseline. Slight increases in rates were found during the second six months in the experimental group, compared with the first six months, but control group rates continued to decrease during the second six months. With further analysis at the individual level, we found that one person (in the experimental group) was hospitalized six times during the study, and five of these occurred in the second six months of the study. All others hospitalized in either group were hospitalized either once or twice during the study.

## Discussion

### Key Findings

Four Cochrane reviews concluded that there was an astounding lack of evidence to guide practice in long-term catheter use (Cottenden et al., 2013). Almost all intervention research in the past has focused on applications such as silver or antibiotic coatings (Johnson, Kuskowski, & Wilt, 2006) to the catheter, special cleaning of the urinary meatus (Burke, Jacobson, Garibaldi, Conti, & Alling, 1983), or drainage bag additives (Washington, 2001). None have proven effective in long-term catheter users. We believe this study is a unique

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

contribution because it is the first known study of its kind using a randomized clinical trial with an inductively derived, theory-based behavioral intervention (Wilde, 2002; Wilde & Brasch, 2008b; Wilde and Dougherty, 2006; Wilde & Garvin, 2007) to assess whether teaching catheter users self-management skills could decrease short-term, catheter-related problems, and whether improvements could be sustained over 12 months.

The GEE analyses indicated that there was a significant group difference in the first six months only for the blockage outcome—favoring the experimental group. Several interactions suggested that effects of the intervention were stronger for the first six months than the long-term effects over 12 months. Comparisons of rates for the first six months, second six months, and full study of 12 months—as well as the changes in rates from baseline—provided additional information suggesting that both groups improved over time. The line graphs (see Supplemental Digital Content) also indicate a general downward trend for both groups over the 12-month study.

The decreases in rates for CAUTI and blockage are believed to be clinically meaningful in both groups. In a recent report from the Agency on Healthcare Research and Quality (2013, p. 26), decreases in CAUTI in hospitalized persons went down in two months from 2.56 to 2.39/1000 catheter days—a relative reduction of 6.3%. The rate decreased even further at 14 months to 2.14/1000 catheter days—a 16.1% relative reduction in 14 months. These changes reflected that “progress has been made” toward national goals. CAUTI rates in community-dwelling persons can be as high as 8.4/1000 catheter days (Wilde, Brasch, Getliffe, Brown et al., 2010). In our study in the experimental group, the baseline CAUTI rate of 6.93/1000 catheter days decreased to 4.89 (a 29% relative reduction) and in the control group from 5.5/1000 catheter days to 4.12 (a 25% relative reduction; see Table 4).

Blockage prevalence is often cited as about 50% (Getliffe, 2003), but our previous research reflects a wide range of 74% over eight months in 43 persons (Wilde, Brasch, Getliffe, Brown et al., 2010) to 24% in our cross-sectional analysis—before random assignment at baseline in the current study (Wilde, McDonald et al., 2013). Importantly, there is no agreement of whether blockage is a one-time occurrence or a persistent pattern, and this might explain the wide range in blockage prevalence. Because our study tested group differences in this randomized trial, the blockage rates reported should be viewed with caution because blockage outliers were adjusted statistically to a maximum of 9 in a two-month time period. Prior to our study, there were no known reports of dislodgement rates. Therefore, we recommend that in future research, rates per 1000 catheter days should be calculated for blockage and dislodgement, as well as CAUTI.

Although blockage decreased significantly in the first six months in the experimental group—as compared with the control group—it is not known whether this was truly of benefit since the control group also improved and started with more blockages. In addition, since this effect did not last over the full 12 months, and the three nurse home visits took place in months one and four, there might be a benefit in expanding the intervention dose over time.

One major issue remains: whether the self-management intervention contributed to more hospitalizations, whether the experimental group was sicker and more prone to severe

CAUTIs requiring hospitalization, or whether this group simply noticed signs of CAUTI and acted on them more quickly. A priori, we had identified hospitalization as an indicator of CAUTI severity. Nevertheless, we had hypothesized that the intervention participants would contact care providers earlier and, thus, avoid some of the hospitalizations. However, if the experimental group were to have been more prone to serious CAUTIs—as severity scores suggested—then seeking early care—even if it included hospitalization—might have kept them from more serious consequences, such as long hospitalizations, sepsis, or death. There is no way to know this.

In a recent analysis addressing reasons for rehospitalization, chronic disease and vulnerability in patients' conditions seem to play a big role. Also, morbidity and mortality appeared to be inversely related, meaning sicker patients were treated more often at a hospital and extending their lives. Thus, hospitalization is not necessarily an indicator of poor quality in care (American Hospital Association, 2011). As with the other primary outcomes, we found a pattern of both groups improving over time in relation to hospitalization. That is, rates in hospitalization (times hospitalized and days hospitalized) decreased in both groups, and there were larger decreases in the first six months of the study (see Supplemental Digital Content).

The experimental and control groups both appeared to have improved during the study. Simple self-monitoring through use of the catheter calendar for bimonthly data collection by study participants in both groups could have contributed to fewer catheter problems overall. Essentially, it is possible that study participants in both groups became more aware of catheter problems due to the calendar, and were reminded of their catheter through the phone call interviews every two months. This could have contributed to changes in self-management behaviors, such as increasing fluids for early CAUTI symptoms. Teaching people with indwelling urinary catheters to keep track of key catheter problems (self-monitoring) in a simple notation calendar could be easy and practical to implement in practice. Because blockage decreased significantly in the first six months of the study, in the intervention group, there could be added value in teaching about optimal and consistent fluid intake.

Research implications include replication with additional nurse contacts over time, simplifying the intervention to focus on optimal fluid intake and preventing dislodgement, and using a simple catheter calendar as a self-monitoring intervention. Testing in a multisite RCT using data collection forms embedded in the home care patient records could eliminate self-reported data for outcomes. Evidence-based policies will lag until more randomized trials—or other forms of scientifically sound research—are conducted in this understudied and vulnerable population that use indwelling catheters for long-term bladder management.

### Limitations

Self-reported data were used because standardized health records were not available. The catheter calendar was used to minimize self-report error. In addition, recall during the pilot study was excellent using bimonthly telephone interviews (Wilde & Brasch, 2008a). Agreement between self-reported catheter problems (CAUTI, blockage, dislodgement) and chart data was high in another study (97%; Wilde, Brasch, Getliffe, Brown et al., 2010).

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

Use of a medical diagnosis with antibiotic treatment for defining CAUTI could include some inaccurate diagnoses because some providers could have treated asymptomatic bacteriuria. Because bacteriuria is universal in this population after 30 days, colony counts would be useless. It was not possible to review multiple sources of data in multiple agencies to determine symptoms which might have been used for treatment decision making. Moreover, symptoms vary among individuals and over time. Thus, the decision for treating symptomatic CAUTI is complex, and it requires clinical judgment of the provider.

Attrition was similar in both groups. It was addressed regularly by the team during monthly meetings. Each of the 17 deaths that occurred during the study was evaluated. At the large home care agency site, charts were audited to determine whether there was any person whose death might have been related to the study. In one or two instances, details about comorbidities were discussed with the urologist on the team. The data safety monitoring board (DSMB) met annually with the lead investigators, statistician, urologist, and an outside researcher to review information about each death. The DSMB conclusion was that no deaths were related to the study, and that comorbidities contributed to each event.

## Conclusions

Adults with a variety of health conditions are challenged with managing urinary catheter self-care to avoid complications and enhance quality of life. In a one-year RCT setting, participants receiving a self-monitoring, self-management intervention had less catheter blockage during the first six months. No other differences between treatment and control groups were noted. Participants in experimental and control groups improved over 12 months, compared with baseline. The simple-to-use catheter problems calendar and bimonthly interviews used for data collection may have served as a modest intervention in both groups.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgments

The authors acknowledge funding by National Institute of Nursing Research, National Institutes of Health (U.S.) #R01 NR01553.

The authors also acknowledge Penny Feldman, PhD, Sr. Vice President at the Center for Home Care Policy and Research, Visiting Nurse Service of New York; Harriet Kitzman, RN, PhD, Senior Associate Dean for Research, University of Rochester School of Nursing; and Robert Mayer, MD, Professor, University of Rochester/Strong Memorial Hospital.

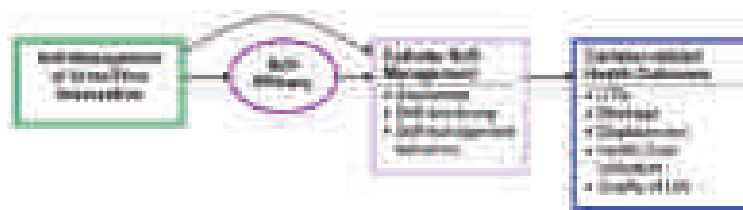
## References

- Agency for Healthcare Research and Quality. Eliminating CAUTI: Interim data report: A national patient safety imperative. Rockville, MD: Author; 2013. Retrieved from <http://www.ahrq.gov/professionals/quality-patient-safety/cusp/cauti-interim/index.html>
- American Hospital Association. Trendwatch: Examining the drivers for readmissions and reducing unnecessary readmissions for better patient care. 2011. Retrieved from <http://www.aha.org/research/reports/tw/11sep-tw-readmissions.pdf>
- Bandura, A. Self-efficacy: The exercise of control. New York, NY: W. H. Freeman; 1997.

- Burke JP, Jacobson JA, Garibaldi RA, Conti MT, Alling DW. Evaluation of daily meatal care with poly-antibiotic ointment in prevention of urinary catheter-associated bacteriuria. *Journal of Urology*. 1983; 129:331–334. [PubMed: 6834501]
- Cottenden, A.; Bliss, D.; Buckley, B.; Fader, M.; Getliffe, KC.; Patterson, J.; Wilde, MH. Management using continence products. In: Abrams, P.; Cardozo, L.; Khoury, S.; Wein, AJ., editors. *Incontinence: 5th international consultation on incontinence*. Arnheim, The Netherlands: ICUD-EAU Publishers; 2013. p. 1651-1786.
- Coyle ME, Francis K, Chapman Y. Self-management activities in diabetes care: A systematic review. *Australian Health Review*. 2013; 37:513–522.10.1071/AH13060 [PubMed: 24018058]
- Diggle, PJ.; Heagerty, P.; Liang, K-Y.; Zeger, S. *Analysis of longitudinal data*. Oxford, UK: Oxford University Press; 2002.
- Gastañaga VM, McLaren CE, Delfino RJ. Power calculations for generalized linear models in observational longitudinal studies: A simulation approach in SAS. *Computer Methods and Programs in Biomedicine*. 2006; 84:27–33.10.1016/j.cmpb.2006.07.011 [PubMed: 16982112]
- Getliffe K. Managing recurrent urinary catheter blockage: Problems, promises, and practicalities. *Journal of Wound, Ostomy and Continence Nursing*. 2003; 30:146–151.10.1067/mjw.2003.120
- Gray M, Krissovic M. Does fluid intake influence the risk for urinary incontinence, urinary tract infection, and bladder cancer? *Journal of Wound, Ostomy and Continence Nursing*. 2003; 30:126–131.10.1067/mjw.2003.117
- Johnson JR, Kuskowski MA, Wilt TJ. Systematic review: Antimicrobial urinary catheters to prevent catheter-associated urinary tract infection in hospitalized patients. *Annals of Internal Medicine*. 2006; 144:116–126.10.7326/0003-4819-144-2-200601170-00009 [PubMed: 16418411]
- Khan A, Housami F, Melotti R, Timoney A, Stickler D. Strategy to control catheter encrustation with citrated drinks: A randomized crossover study. *Journal of Urology*. 2010; 183:1390–1394. <http://dx.doi.org/10.1016/j.juro.2009.12.024>. [PubMed: 20171661]
- Lennon S, McKenna S, Jones F. Self-management programmes for people post stroke: A systematic review. *Clinical Rehabilitation*. 2013; 27:867–878.10.1177/0269215513481045 [PubMed: 23543340]
- Niël-Weise BS, van den Broek PJ, da Silva EMK, Silva LA. Urinary catheter policies for long-term bladder drainage. *Cochrane Database Systematic Review*. 2012; 8:CD004201.10.1002/14651858.CD004201.pub3
- Parker D, Callan L, Harwood J, Thompson DL, Wilde M, Gray M. Nursing interventions to reduce the risk of catheter-associated urinary tract infection: Part 1: Catheter selection. *Journal of Wound, Ostomy and Continence Nursing*. 2009; 36:23–34.10.1097/01.WON.0000345173.05376.3e
- Thompson RL, Haley CE, Searcy MA, Guenther SM, Kaiser DL, Gröschel DH, Wenzel RP. Catheter-associated bacteriuria: Failure to reduce attack rates using periodic instillations of a disinfectant into urinary drainage systems. *JAMA*. 1984; 251:747–751.10.1001/jama.1984.03340300039025 [PubMed: 6363727]
- van Gaalen JL, Beerhuizen T, van der Meer V, van Reisen P, Redelijkheid GW, Snoeck-Stroband JB, Sont JK. Long-term outcomes of internet-based self-management support in adults with asthma: Randomized controlled trial. *Journal of Medical Internet Research*. 2013; 15:e188.10.2196/jmir.2640 [PubMed: 24028826]
- Washington EA. Instillation of 3% hydrogen peroxide or distilled vinegar in urethral catheter drainage bag to decrease catheter-associated bacteriuria. *Biological Research for Nursing*. 2001; 3:78–87.10.1177/109980040200300203 [PubMed: 11931525]
- Wilde MH. Urine flowing: A phenomenological study of living with a urinary catheter. *Research in Nursing & Health*. 2002; 25:14–24.10.1002/nur.10020 [PubMed: 11807916]
- Wilde MH. Life with an indwelling urinary catheter: The dialectic of stigma and acceptance. *Qualitative Health Research*. 2003; 13:1189–1204.10.1177/1049732303257115 [PubMed: 14606409]
- Wilde MH, Brasch J. A pilot study of self-monitoring urine flow in people with long-term urinary catheters. *Research in Nursing and Health*. 2008a; 31:490–500.10.1002/nur.20281 [PubMed: 18418847]

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.

- Wilde MH, Brasch J. Teaching self-management to long-term urinary catheter users. *International Journal of Urological Nursing*. 2008b; 2:62–71.
- Wilde MH, Brasch J, Getliffe K, Brown KA, McMahon JM, Smith JA, Tu X. Study on the use of long-term urinary catheters in community-dwelling individuals. *Journal of Wound, Ostomy and Continence Nursing*. 2010; 37:301–310.10.1097/WON.0b013e3181d73ac4
- Wilde MH, Getliffe K, Brasch J, McMahon J, Anson E, Tu X. A new urinary catheter-related quality of life instrument for adults. *Neurourology and Urodynamics*. 2010; 29:1282–1285.10.1002/nau.20865 [PubMed: 20127834]
- Wilde MH, Cameron BL. Meanings and practical knowledge of people with long-term urinary catheters. *Journal of Wound, Ostomy and Continence Nursing*. 2003; 30:33–43.
- Wilde MH, Dougherty MC. Awareness of urine flow in people with long-term urinary catheters. With Commentary from B. Roe and Response by Authors. *Journal of Wound Ostomy and Continence Nursing*. 2006; 33(2):164–75.
- Wilde MH, Garvin S. A concept analysis of self-monitoring. *Journal of Advanced Nursing*. 2007; 57:339–350.10.1111/j.1365-2648.2006.04089 [PubMed: 17233653]
- Wilde MH, McDonald MV, Brasch J, McMahon JM, Fairbanks E, Shah S, Scheid E. Long-term urinary catheter users self-care practices and problems. *Journal of Clinical Nursing*. 2013; 22:356–367.10.1111/jocn.12042 [PubMed: 23301577]
- Wilde MH, Zhang F, Fairbanks E, Shah S, McDonald MV, Brasch J. Perceived value of a urinary catheter self-management program in the home. *Home Healthcare Nurse*. 2013; 31:465–473.10.1097/NHH.0b013e3182a89791 [PubMed: 24081128]
- Yuan KH, Hayashi K. Bootstrap approach to inference and power analysis based on three test statistics for covariance structure models. *British Journal of Mathematical and Statistical Psychology*. 2003; 56:93–110.10.1348/000711003321645368 [PubMed: 12803824]



**FIGURE 1.**  
Theoretical model for self-management of urine flow intervention (Wilde, Zhang et al., 2013). Used with permission.





**FIGURE 2.**  
CONSORT flow diagram

TABLE 1

Baseline Characteristics by Group

Characteristic	Intervention		Control	
	<i>M</i>	( <i>SD</i> )	<i>M</i>	( <i>SD</i> )
Age (years)	60.6	(16.6)	62.2	(18.2)
Catheter (months)	73.1	(87.4)	71.9	(83.8)
Catheter size (Fr)	18.4	(3.3)	18.7	(3.2)
	<i>n</i>	(%)	<i>n</i>	(%)
Gender (male)	53	(52.4)	50	(50.0)
Catheter type				
Urethral	57	(56.4)	55	(54.5)
Suprapubic	43	(42.6)	46	(45.5)
Both	1	(0.0)	0	(0.0)
Catheter balloon size				
5–10 ml	64	(63.4)	60	(59.4)
30 ml	11	(10.9)	18	(17.8)
Other	1	(1.0)	1	(1.0)
Unknown/no answer	25	(24.8)	22	(21.8)

*Note.* There were 101 participants in each group. None of the characteristics was significantly associated with treatment group assignment. Median duration of catheter use in the intervention group was 42 months; control group median was 37 months. Additional detailed information about the sample is available in Wilde, McDonald et al. (2013).

**TABLE 2**  
Baseline Comparison of Key Outcomes by Group (For the Two Months Prior to the Study)

Outcome	Intervention					Control					<i>p</i>
	<i>M</i>	( <i>SD</i> )	% <sup><i>a</i></sup>	Rate <sup><i>b</i></sup>	95% CI	<i>M</i>	( <i>SD</i> )	% <sup><i>a</i></sup>	Rate <sup><i>b</i></sup>	95% CI	
Catheter-related health status											
Urinary tract infection (yes)	.42	(.071)	33	6.9	[5.0, 9.4]	.33	(.053)	30	5.50	[3.8, 7.7]	ns
Catheter blockage (yes)	.56	(.155)	21	9.3	[7.0, 12.1]	.69	(.067)	26	11.50	[9.0, 14.6]	.05
Dislodgement (yes)	.17	(.068)	8	2.8	[1.6, 4.5]	.26	(.068)	17	4.33	[2.8, 6.4]	ns
Healthcare related to CAUTI											
Hospitalization (number)	0.11	(0.37)	9	1.8	[0.9, 3.3]	0.1	(0.32)	8	1.50	[0.69, 2.85]	ns
Hospitalization (days)	0.61	(2.33)	9	10.2	[7.8, 13.1]	1.0	(4.26)	8	17.17	[14.01, 20.82]	.01

Note. CAUTI = catheter-associated urinary tract infection; CI = confidence interval; ns = not significant at  $p < .05$ ; SD = standard deviation.

<sup>*a*</sup>Percent experiencing the event during the two months prior to the study.

<sup>*b*</sup>Rate per 1000 catheter days.

TABLE 3

## Treatment Effects for Primary Outcomes

Outcome	First six months <sup>a</sup>				Full 12 months <sup>b</sup>			
	$\beta_1$	(SE)	p	95% CI	$\beta_1$	(SE)	p	95% CI
Catheter-related health status								
CAUTI (yes)	-0.17	(0.266)	ns	[-0.69, 0.35]	0.16	(0.222)	ns	[-0.27, 0.60]
CAUTI severity <sup>c</sup>	2.76	(0.590)	<.001	[1.60, 3.92]	1.60	(0.467)	<.01	[0.68, 2.51]
Blockage (yes)	-0.74	(0.343)	<.05	[-1.42, -0.07]	-0.23	(0.291)	ns	[-0.81, 0.34]
Dislodgment (yes)	0.29	(0.328)	ns	[-0.36, 0.93]	0.01	(0.287)	ns	[-0.55, 0.57]
Healthcare for CAUTI								
Hospitalized (yes)	0.81	(0.527)	ns	[-0.23, 1.84]	1.33	(0.428)	<.01	[0.49, 2.17]
Emergency visit (yes)	0.88	(0.373)	<.05	[0.15, 1.61]	1.06	(0.337)	<.001	[0.40, 1.72]
Nurse home visit (yes)	-0.06	(0.402)	ns	[-0.85, 0.73]	0.00	(0.317)	ns	[-0.62, 0.62]
Clinic visit (yes)	-0.37	(0.408)	ns	[-1.17, 0.43]	-0.06	(0.333)	ns	[-0.71, 0.59]
Healthcare for blockage								
Emergency visit (yes)	-0.62	(0.978)	ns	[-2.53, 1.30]	1.10	(0.575)	ns	[-0.02, 2.23]
Nurse home visit (yes)	-1.35	(0.642)	<.05	[-2.61, -0.09]	-1.02	(0.470)	<.05	[-1.95, -0.10]
Clinic visit (yes)	-0.62	(0.629)	ns	[-1.86, 0.61]	-0.42	(0.560)	ns	[-1.52, 0.68]
Quality of life <sup>d</sup>	-1.66	(1.581)	ns	[-4.76, 1.44]	-2.03	(1.389)	ns	[-4.75, 0.69]

Note. CAUTI = catheter-associated urinary tract infection; CI = confidence interval; ns = not significant at  $p < .05$ ; SE = standard error. A positive sign for  $\beta_1$  favors the control (usual care group); a negative sign favors the intervention group. Complete statistical results are available from the authors (MHW).

<sup>a</sup>Treatment effects were obtained controlling for baseline outcomes and time (Equation 3).

<sup>b</sup>Treatment effects were obtained controlling for baseline outcomes, time from 2 to 12 months, and first vs. second half of the study (Equation 5).

<sup>c</sup>Scored from 1 = very mild to 10 = most severe imaginable.

<sup>d</sup>Scored from 1 = strongly agree to 5 = strongly disagree; higher scores reflect better self-rated quality of life.

TABLE 4

Rates of Blockage, CAUTI, Dislodgement and Hospitalization in Treatment and Control Groups Over Time

Outcome	Experimental		Control		p	Within groups <sup>d</sup> (p)	
	Rate <sup>b</sup>	95% CI	Rate <sup>b</sup>	95% CI		E	C
Blockage							
Baseline	9.26	[6.98, 12.05]	11.50	[8.95, 14.55]	ns		
First 6 months	4.28	[3.32, 5.43]	7.41	[6.14, 8.86]	<.01	<.0001	.004
Second 6 months	5.31	[4.15, 6.67]	4.45	[3.41, 5.71]	ns	<.0001	<.0001
Full 12 months	4.76	[4.00, 5.62]	6.04	[5.20, 6.99]	.03	<.0001	<.0001
CAUTI							
Baseline	6.93	[5.00, 9.37]	5.50	[3.79, 7.72]	ns		
First 6 months	4.37	[3.40, 5.53]	4.83	[3.82, 6.03]	ns	.02	ns
Second 6 months	5.48	[4.31, 6.87]	3.29	[2.41, 4.39]	.01	ns	.02
Full 12 months	4.89	[4.12, 5.75]	4.12	[3.42, 4.91]	ns	.05	ns
Dislodgement							
Baseline	2.80	[1.63, 4.49]	4.33	[2.83, 6.35]	ns		
First 6 months	2.60	[1.86, 3.52]	2.74	[1.99, 3.67]	ns	ns	ns
Second 6 months	1.45	[0.89, 2.24]	2.44	[1.69, 3.41]	ns	.05	.03
Full 12 months	2.06	[1.58, 2.65]	2.60	[2.06, 3.24]	ns	ns	.02
Hospitalizations (number)							
Baseline	1.82	[0.91, 3.25]	1.50	[0.69, 2.85]	ns		
First 6 months	1.01	[0.58, 1.65]	0.43	[0.17, 0.89]	ns	ns	.01
Second 6 months	1.68	[1.07, 2.52]	0.22	[0.04, 0.63]	<.001	ns	.004
Full 12 months	1.32	[0.94, 1.81]	0.33	[0.16, 0.61]	<.001	ns	.001
Hospitalization (days)							
Baseline	10.23	[7.84, 13.12]	17.17	[14.01, 20.82]	.01		
First 6 months	7.73	[6.4, 9.23]	4.03	[3.11, 5.13]	.01	ns	<.0001
Second 6 months	8.26	[6.81, 9.93]	1.01	[0.55, 1.69]	.001	ns	<.0001
Full 12 months	7.98	[6.99, 9.06]	2.63	[2.08, 3.28]	.001	ns	<.0001

Note. C = control; E = experimental.

<sup>a</sup> Change from baseline.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

$\lambda$   
Rate is per 1000 catheter days.

*Nurs Res.* Author manuscript; available in PMC 2016 January 01.



# NIH Public Access

## Author Manuscript

*Home Healthc Nurse*. Author manuscript; available in PMC 2014 October 01.

Published in final edited form as:

*Home Healthc Nurse*. 2013 October ; 31(9): 465–473. doi:10.1097/NHH.0b013e3182a89791.

## Perceived Value of a Urinary Catheter Self-Management Program in the Home

**Mary Wilde, RN, PhD [School of Nursing],**  
University of Rochester, Rochester, New York.

**Feng Zhang, RN, BS [School of Nursing],**  
University of Rochester, Rochester, New York.

**Eileen Fairbanks, RN, MS, PNP [School of Nursing],**  
University of Rochester, Rochester, New York.

**Shivani Shah, MPH [Visiting Nurse Service of New York],**  
Center for Home Care Policy and Research, New York City, New York.

**Margaret V. McDonald, MSW [Visiting Nurse Service of New York,], and**  
Center for Home Care Policy and Research, New York City, New York.

**Judith Brasch, RN, MS [School of Nursing]**  
University of Rochester, Rochester, New York.

### Abstract

A long-term indwelling urinary catheter intervention was tested in a randomized trial that is described in this article. The perceived value of the intervention to the catheter users, one of the study's specific aims, was assessed at the end of their 12-month participation and is reported here. Study participants' responses, our findings, and implications for home healthcare are discussed.

### Introduction and Purpose of the Study

There is limited evidence to guide long-term urinary catheter users for self-management. They ordinarily are not in support groups of any sort and might not know others using such a device, yet many use an indwelling urinary catheter (suprapubic or urethral) for years (Wilde et al., 2013) or indefinitely. Those with intractable urinary retention who are unable to perform intermittent catheterization or have no one to do it are sometimes without other options. This type of urinary retention is most often caused by a neurologically based injury or disease, such as a spinal cord injury, multiple sclerosis, diabetes, or by obstructive prostate disease (Cottenden et al., 2013). In our experience, individuals with long-term catheters often learn about self-managing through piecemeal instruction from healthcare providers and by trial and error.

This report describes a new intervention to teach self-management to community-living long-term indwelling urinary catheter users and their perceived value of the intervention.

Address for correspondence: Mary Wilde, RN, PhD, Associate Professor Nursing and Center for Community Health, University of Rochester, 601 Elmwood Ave., Box SON, Rochester, NY 14642, (mary\_wilde@urmc.rochester.edu).

Study Nurses: Paula Wilson, RN, BSN, MPH (VNSNY) and Margaret Lash, RN, MS (Rochester); also at Visiting Nurse Service of New York: Penny Feldman, PhD, Seon Lewis-Holman RN, MS-C; Yanick Martelly-Kebreau, RN, MS, CWOCN.

The authors declare no conflicts of interest.

Understanding how the study participants responded provides information that could be useful in dissemination and/or changes in the research.

## Background and Literature Review

Although policies and procedures are well developed for patients with indwelling urinary catheters in home care and in clinics, an emphasis on self-management is not the norm. Self-management is a form of collaborative care with a healthcare provider (nurse or physician) in which the patient learns to pay attention to bodily symptoms, makes observations and recordings (e.g., diaries), and determines how behavioral changes they are making affect the condition. Self-management research is often conducted with people having chronic conditions, such as arthritis (Ackerman et al., 2013), diabetes (Rothman et al., 2008), or asthma (Kaptein et al., 2010), but self-management research has not been done in indwelling urinary catheter users.

The National Home and Hospice Care Study conducted in 2000 by U.S. National Center for Health Statistics estimated that there are 148,400 urinary catheter users in the United States, for a prevalence of 0.05% in the adult population in community settings (CDC, 2013a). A more recent National Home and Hospice Care Survey in 2007 reported catheter prevalence in home care (excluding hospice) at 9% ( $n = 4683$ ) (CDC, 2013b) or 135,000 people with catheters of the 1.5 million home care patients in 2007 (<http://www.cdc.gov/nchs/fastats/homehealthcare.htm>). However, it is not known how many of them have long-term catheters nor whether they use indwelling or nonindwelling catheters (Lisa Dwyer, National Center for Health Statistics, personal communication, June 20, 2013).

Persistent catheter-related problems are common in long-term catheter users. In one recent study of 43 people over an 8-month period, 74% experienced blockage of the catheter from encrustations, 70% had catheter-associated urinary tract infection (CAUTI), 79% had leakage of urine (bypassing), and 33% had accidental dislodgement (Wilde et al., 2010). In a larger study with 202 long-term indwelling urinary catheter users, catheter problems were recorded by recall for the previous 2-month period, and in this short period of time, 31% had experienced CAUTI, 24% had blockage, 12% had accidental dislodgment, 43% had leakage of urine, and 23% had catheter-associated pain (Wilde et al., 2013).

Most research in the past has focused on improving the catheter itself through: coatings, such as silver or antibiotic (Johnson et al., 2006), catheter materials like silicone (Schumm & Lam, 2008), instillations into the drainage bag (Washington, 2001), and special care to the urinary meatus (Burke et al., 1983), but none have proven effective in preventing blockage or CAUTI (Parker et al., 2009). Other interventions, commonly believed to be of value, such as smaller catheter size, cranberry juice consumption (Jepson & Craig, 2008), and acidic instillations or irrigations, have not been tested in randomized controlled trials in people with catheters (Moore et al., 2009). Closed drainage, which has been shown to significantly reduce the rate of CAUTI, is the only critical innovation in the last 40 years to prove beneficial (Stickler & Feneley, 2010). However, many persons with catheters open them daily to switch from leg to night bags or to clean the bags between uses. In the aforementioned larger study of 202 long-term catheter users, 58% used both leg and overnight bags, and a majority cleaned their bags, using water, soap and water, or a solution of water with bleach or vinegar (Wilde et al., 2013). Cleaning with a diluted bleach solution was shown in a seminal study to increase bag life to 1 month; however, rates of CAUTI remained unchanged (Dille et al., 1993). Consumption of a citrated drink (water with lemon juice) or additional fluids was tested in one study, and results are promising that either can decrease catheter blockage (Khan et al., 2010), but trials have not been done. Thus, evidence-based self-management strategies for persons using indwelling urinary catheters remain in a preliminary stage.

*Home Healthc Nurse.* Author manuscript; available in PMC 2014 October 01.



A first step for catheter users to prevent or minimize catheter-related problems (e.g., CAUTI, blockage, or accidental dislodgement) is to become aware of what to notice and how to self-monitor urine flow. Strategies can then be selected for self-managing the catheter based on this knowledge to address problems early to prevent more serious complications, such as an insidious CAUTI requiring intravenous antibiotics and hospitalization.

### Study Description

A research study was conducted, building on the prior investigations. A new catheter self-management educational intervention was piloted (Wilde & Brasch, 2008a, 2008b) and tested for effectiveness in a randomized clinical trial in long-term indwelling urinary catheter users. The 4-year study was conducted in one northeastern U.S. state, including a large city and a mix of urban/suburban and rural areas. Two hundred and two adult persons with long-term indwelling catheters (56% urethral and 44% suprapubic) who were expecting to use catheters indefinitely, or at least for a year, were enrolled in the study for 12 months. Equal numbers of 101 were assigned to the intervention group or the control group. One hundred seventy-five study participants (87%) were recruited through home care agencies (one large city agency enrolled 152 persons); the rest were referred through a combination of clinics or private urological offices. Approximately equal numbers of men and women were enrolled, aged 19 to 96 years (mean 61, SD 17.4), with racial and ethnic diversity (White 57%, Black 30%, other races 13%).

The self-management intervention was theoretically based on Bandura's self-efficacy theory (Bandura, 1997). Self-efficacy is the confidence to perform a specific behavior and, in this study, optimal and consistent levels of fluid intake and preventing accidental dislodgment were the key behaviors targeted. Study participants were taught to pay attention to urine flow, self-monitor bodily changes, and choose appropriate self-management behaviors. The theoretical concepts of awareness, self-monitoring, and self-management (Wilde & Garvin, 2007) were central to the intervention, and Stanford's Chronic Disease Self-management program (Lorig et al., 2001) provided the overall model (Figure 1). The intervention was designed to enhance self-management of urine flow in the intervention group. The control group received only their usual care.

Study outcomes were: (a) catheter-related complications (CAUTI, catheter blockage, and accidental dislodgement), (b) complications' associated costs, and (c) quality of life. To measure study outcomes, data were collected from both groups about catheter-related problems for a year, once face to face in their homes when enrolled and then in six follow-up bimonthly telephone interviews with trained interviewers.

The intervention group was visited by a study nurse in their home three times, for a total of three home visits. Two of them occurred in the first month. The first home visit was to teach about self-monitoring using a urinary diary, and the second home visit was to use this information to plan for improved self-management and to introduce an educational booklet. This was followed by one phone call 2 weeks later to identify any additional issues and to reinforce the teaching. The third home visit was a "booster" of the intervention at 4 months to further refine teaching.

Specifically, study participants were taught to increase their awareness of sensations of urine flow and to learn how these change with daily activities or catheter-related problems. Problem areas were identified in conjunction with information from the 3-day urinary diary (intake and output and open-ended journal). After learning about basic catheter self-management (Table 1 from the Paying Attention Educational Booklet), all were taught to pay attention to fluid intake and catheter position to prevent dislodgement. Then the study

nurse reviewed all sections of the educational booklet, focusing on areas of individual interest (Table 2 and Figure 2). The study nurse filled out forms after each encounter, which were similar to a care plan, to remind her of the participant's catheter problems and interests or goals. Whenever possible, measurable goals were set and written into the educational booklet.

Below is a report of one of the specific aims of this study, to describe the perceived value of the self-management intervention received by the intervention group. A full report of the main outcomes for this research will be published elsewhere.

## Perceived Value of the Catheter Self-Management Program

### Methods

Study participants who received the catheter self-management intervention were contacted by phone by one of the two study coordinators within a month of their year-long study participation to assess their perceived value of the intervention. Not everyone was able to be reached or was not able to be interviewed; therefore, out of the 74 persons who completed the intervention arm of the study, 60 brief telephone interviews were conducted. Study participants were asked several quantitative questions about helpfulness of each component of the intervention, using a modification of items previously piloted (Wilde & Brasch, 2008a, 2008b), on a scale of 1 to 10, with 1 being not helpful at all and 10 being very helpful. Study participants were also asked five open-ended questions, allowing for comments to be shared, related: (a) goals, (b) changes to behavior, (c) impact on self-management, (d) helpfulness of the program, and (e) suggestions for improving the program. The interviewers took brief notes to obtain the comments data, which were entered into a spreadsheet and SPSS.

### Data Analysis

Quantitative items were analyzed descriptively for means and standard deviations. For the comments data, a descriptive analysis was conducted using simple coding by two researchers, the principal investigator and a doctoral student. Coded comments were then organized into tables before writing a descriptive summary of responses for each item. Both coders agreed on the final codes, the organization of data, and the summary.

### Results

Based on the scores, the study nurse visits and the intake and output part of the urinary diary were the most favored elements of the intervention (Table 3). A large majority of the persons rated each component of the intervention (i.e., intake and output, journal, educational booklet, study nurse encounters, and learning self-management) between 8 and 10 on the 10-point scale. The means (SD) for each component ranged from 7.25 (2.40) to 8.33 (3.15). The open-ended journal, which was identified in the study nurses' process recordings (not reported in this article) as being used by only 2% of the intervention sample, was valued less with the lowest mean score 7.25 (3.15).

Out of the 60 persons interviewed, goals were recalled by 21 persons (35%), not set by 36 (60%), and 3 (5%) did not remember. Responses to whether they were doing anything differently with the catheter because of the study were: 25 (42%) said no, 18 (30%) said yes somewhat, and 17 (28%) said yes greatly. 43 (71%) had suggestions for improving the program and 17 (29%) did not.

*Home Healthc Nurse.* Author manuscript; available in PMC 2014 October 01.

### Goals Set During the Study

Fifteen persons had goals related to hygiene or preventing urinary tract infections (UTI), specifically cleaning near the catheter, drinking adequate fluids, and preventing UTI. Self-monitoring goals by 14 persons involved noticing changes in the urine, such as watching for sediment or urine color, or in paying attention to the catheter to maintain an appropriate position, or prevent dislodgment, kinks/twists, or leaks. Two persons also stated they wanted to stay healthy urologically.

### Changes to Behavior

Study participants who had said they were doing things differently because of the study were asked to describe in what ways. Some reported changes that were similar to the goals they cited. Self-monitoring of the catheter was identified by nine persons related to repositioning the catheter to prevent leakage and twists, or checking the catheter position in relation to the bag or body; or watching for changes in the urine, sediment, or color. Eight said they paid attention more often to urine output or to avoid letting the bag get too full. Nine said they have increased their fluid intake and two said they keep better track of fluids. Eleven were focused more on the catheter itself, such as knowing the exact amount of water in the balloon, about irrigation or cleaning the bag, changing the catheter more often, and in managing the catheter when traveling by using a larger bag at home and smaller one for travelling, or knowing the locations of available bathrooms. Two stated they knew better when to call the provider for catheter problems. One worked on bowel management more and one stays away from caffeine. One reported fewer UTIs.

### Impact on Self-Management

Participants also were asked how the study affected their catheter self-management. Six said they were more aware in relation to: cleaning the catheter, noticing urine color, emptying the bag to prevent urine buildup, and knowing where bathrooms were. Six reported having fewer UTIs, and two had less sediment, blockage, or mucus. One individual had more catheter comfort and was pain-free. Five people spoke of being more knowledgeable about and supported with the catheter, or knew when to call the provider. A few recognized patterns of problems, such as burning sensations and kinks. One noted being hospitalized four times recently (but we are not sure what that meant).

### Helpfulness of the Program

The comments related to whether learning self-management was helpful or not were aimed at understanding more about the value of the catheter self-management intervention. Comments from 17 individuals were primarily about catheter-related knowledge gained, skills acquisition (including enhanced awareness of their bodily symptoms related to the catheter), and feeling cared for by the study nurse making home visits. There were just four negative comments: three who did not learn anything new and one who did not think program helped. Also three persons said they do not self-manage, but one said it was helpful to know.

### Suggestions for Improving the Self-Management Program

Many suggestions and comments were received also, including more use of Web sites, combining the urinary diary forms (i.e., intake and output forms with the journal), managing pain, and sketches of instructions. Several asked for better designed catheters and equipment.

## Discussion

For the quantitative assessment of intervention components, there was a possible small ceiling effect with higher percentages reporting 10 (very helpful) for the study nurse encounters and intake and output, by 41% and 32% of the sample respectively. The open-ended journal was not used by most study participants (2%) and this was the case also during the pilot study (Wilde & Brasch, 2008a, 2008b), and thus it should probably be eliminated from future tests of this intervention.

The information solicited about goals at the end of this 12-month intervention with 60 individuals is in stark contrast to the information collected by the study nurses in their process forms in which 82 persons set initial goals (81% of 101 in the self-management intervention group), and over 70% said they met their goals during the phone call in month 2 or the home visit in month 4. Perhaps goal setting was not a high priority or there was insufficient recall at 12 months, when so much time had passed after the intervention visits. However, those persons who did set goals used language to reflect the key components taught in the intervention, such as goals about fluid intake, preventing UTI, and noticing changes in urine or in the position of the catheter.

Intervention participants showed that they understood key study concepts because they described activities that demonstrated awareness, self-monitoring, and self-management related to fluid intake, preventing CAUTI, and proper positioning of the catheter. Some seemed to have an emotional connection with the study nurse, saying they felt “cared for” by her. A few said that no one else has talked with them like this about the catheter and in such depth, and this made them feel valued as persons. Responses also illustrated individual variation in how much the self-management intervention was liked and for what reasons.

## Implications for Practice

Long-term indwelling catheter users can be taught to pay attention to urine flow. Specifically they should know how much fluid intake is right for them and what types of fluids should be monitored (e.g., caffeine). By noticing catheter-related changes—such as the color or character of the urine, catheter position, or kinks/twists in the tubing—and by responding quickly, catheter-related problems might be avoided or minimized. In this study, catheter users’ comments indicated how they valued and learned from the self-management intervention. Home care nurses are in an important and unique position to partner with their patients with catheters and their families to improve care and quality of life.

## Conclusion

This may be the first self-management intervention in long-term indwelling urinary catheter users. Knowing how the study participants responded to the intervention is critical in determining its dissemination and overall research value. In summary, research participants seemed to like the intervention, were able to identify what they should pay attention to, and told us what they were doing differently related to their catheter. These new behaviors should be beneficial in their catheter-related health. Although this intervention is not ready yet for full dissemination—due to ongoing analysis and writing reports of the main study results—many of the components, such as the urinary diary (I and O), the basic self-management tips in Table 1, and the sample educational page on identifying UTI, could be useful for home care nurses teaching catheter self-management to long-term indwelling urinary catheter users.

## Acknowledgments

Funding by National Institute of Nursing Research, National Institutes of Health (U.S.) #R01 NR01553.

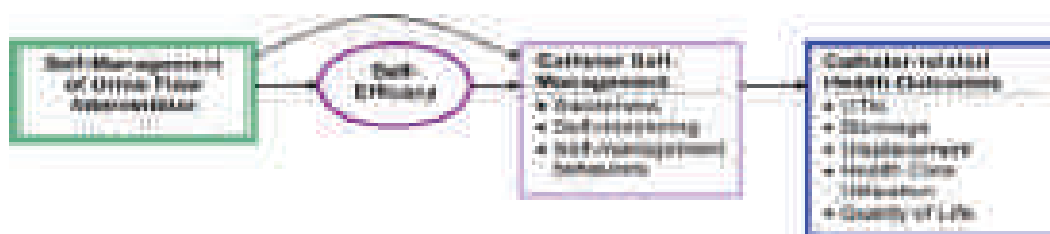
*Home Healthc Nurse.* Author manuscript; available in PMC 2014 October 01.

## References

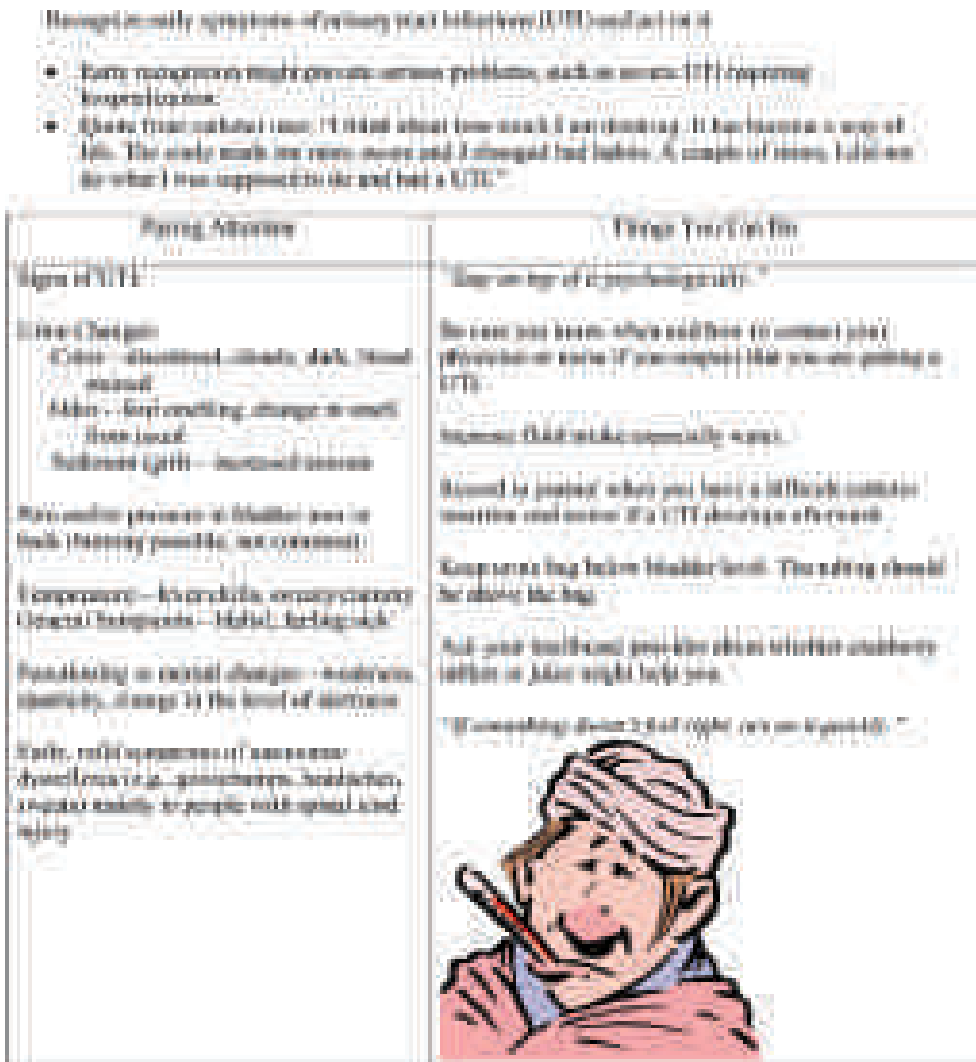
- Ackerman IN, Buchbinder R, Osborne RH. Factors limiting participation in arthritis self-management programmes: An exploration of barriers and patient preferences within a randomized controlled trial. *Rheumatology*. 2013; 52(3):472–479. [PubMed: 23148089]
- Bandura, A. *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman; 1997.
- Burke JP, Jacobson JA, Garibaldi RA, Conti MT, Alling DW. Evaluation of daily meatal care with poly-antibiotic ointment in prevention of urinary catheter-associated bacteriuria. *Journal of Urology*. 1983; 129(2):331–334. [PubMed: 6834501]
- CDC. [Accessed on April 24, 2013] National center for health statistics, NIH. The national home care study. 2013a. at <http://www.cdc.gov/nchs/nhhcs.htm>
- CDC. [Accessed on July 1, 2013] National center for health statistics, NIH. The 2007 National Home and Hospice care Survey. 2013b. <http://www.cdc.gov/nchs/nhhcs.htm>, data from: [ftp://ftp.cdc.gov/pub/Health\\_Statistics/NCHS/Datasets/NHHCS/2007](ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/NHHCS/2007)
- Cottenden, A.; Fader, M.; Wilde, MH.; Bliss, D.; Buckley, B.; Hayer, D., et al., editors. *Management Using Continence Products, Incontinence: 5th International Consultation on Incontinence*. 5th ed.. Arnheim, the Netherlands: ICUD-EAU; 2013.
- Dille CA, Kirchhoff KT, Sullivan JJ, Larson E. Increasing the wearing time of vinyl urinary drainage bags by decontamination with bleach. *Archives of Physical Medicine and Rehabilitation*. 1993; 74(4):431–437. [PubMed: 8466427]
- Jepson RG, Craig JC. Cranberries for preventing urinary tract infections. *Cochrane Database of Systematic Reviews* (Online). 2008; (1):CD001321.
- Johnson JR, Kuskowski MA, Wilt TJ. Systematic review: Antimicrobial urinary catheters to prevent catheter-associated urinary tract infection in hospitalized patients. *Annals of Internal Medicine*. 2006; 144(2):116–126. [PubMed: 16418411]
- Kaptein AA, Klok T, Moss-Morris R, Brand PL. Illness perceptions: Impact on self-management and control in asthma. *Current Opinion in Allergy and Clinical Immunology*. 2010; 10(3):194–199. [PubMed: 20386435]
- Khan A, Housami F, Melotti R, Timoney A, Stickler D. Strategy to control catheter encrustation with citrated drinks: A randomized crossover study. *Journal of Urology*. 2010; 183(4):1390–1394. [PubMed: 20171661]
- Lorig KR, Ritter P, Stewart AL, Sobel DS, Brown BW Jr, Bandura A, et al. Chronic disease self-management program: 2-year health status and health care utilization outcomes. *Medical Care*. 2001; 39(11):1217–1223. [PubMed: 11606875]
- Moore KN, Hunter KF, McGinnis R, Bacsu C, Fader M, Gray M, et al. Do catheter washouts extend patency time in long-term indwelling urethral catheters? A randomized controlled trial of acidic washout solution, normal saline washout, or standard care. *Journal of Wound, Ostomy, and Continence Nursing: Official Publication of the Wound, Ostomy and Continence Nurses Society/ WOCN*. 2009; 36(1):82–90.
- Parker D, Callan L, Harwood J, Thompson DL, Wilde M, Gray M. Nursing interventions to reduce the risk of catheter-associated urinary tract infection. Part 1: Catheter selection. *Journal of Wound, Ostomy, and Continence Nursing: Official Publication of the Wound, Ostomy and Continence Nurses Society/WOCN*. 2009; 36(1):23–34.
- Rothman RL, Mulvaney S, Elasy TA, VanderWoude A, Gebretsadik T, Shintani A, et al. Self-management behaviors, racial disparities, and glycemic control among adolescents with Type 2 diabetes. *Pediatrics*. 2008; 121(4):e912–e919. [PubMed: 18381520]
- Schumm K, Lam T. Types of urethral catheters for management of short-term voiding problems in hospitalised adults. *Cochrane Database of Systematic Reviews* (Online). 2008; (2):CD004013.
- Stickler DJ, Feneley RC. The encrustation and blockage of long-term indwelling bladder catheters: A way forward in prevention and control. *Spinal Cord*. 2010; 48(11):784–790. [PubMed: 20368711]
- Washington EA. Instillation of 3% hydrogen peroxide or distilled vinegar in urethral catheter drainage bag to decrease catheter-associated bacteriuria. *Biological Research For Nursing*. 2001; 3(2):78–87. [PubMed: 11931525]

- Wilde MH, Brasch J. Teaching self-management to long-term urinary catheter users. *International Journal of Urological Nursing*. 2008a; 2(2):62–71.
- Wilde MH, Brasch J. A pilot study of self-monitoring urine flow in people with long-term urinary catheters. *Research in Nursing & Health*. 2008b; 31(5):490–500. [PubMed: 18418847]
- Wilde MH, Brasch J, Getliffe K, Brown KA, McMahon JM, Smith JA, et al. Study on the use of long-term urinary catheters in community-dwelling individuals. *Journal of Wound, Ostomy, and Continence Nursing: Official Publication of the Wound, Ostomy and Continence Nurses Society/WOCN*. 2010; 37(3):301–310.
- Wilde MH, Garvin S. A concept analysis of self-monitoring. *Journal of Advanced Nursing*. 2007; 57(3):339–350. [PubMed: 17233653]
- Wilde MH, McDonald MV, Brasch J, McMahon JM, Fairbanks E, Shah S, Scheid E. Long-term urinary catheter users self-care practices and problems. *Journal of Clinical Nursing*. 2013; 22(3–4): 356–367. [PubMed: 23301577]

*Home Healthc Nurse*. Author manuscript; available in PMC 2014 October 01.



**Figure 1.**  
Theoretical Model of the Study. UTI = urinary tract infection.



**Figure 2.** Sample of educational module (Note: the quotes are from previous study participants (Wilde & Brasch, 2008a, 2008b).<sup>1</sup> UTI = urinary tract infection.



**Table 1**

## Basic Catheter Self-Management

- 
- **Stay aware.** Having a catheter requires that you *stay aware of your body* and how you feel.
- 
- **Drink more water** than any other beverage! Limit coffee, and consider substituting tea and decaffeinated beverages.
  - **Drink consistently.** Fluid intake needs to be at a good *level for your weight* and you need to drink in a *consistent* way to help prevent catheter blockage.
  - **Your body needs fluids.** Most people need 2,000 to 3,000 cc of fluid a day. For instance, a 150-lb person would need 2,550 cc that is equivalent to about 10.5 glasses per day. More fluids are needed for hot weather or when exercising. My fluid goal is \_\_\_\_\_.
  - **Pay attention** to the *color* of your urine. It should be light yellow all day long. The color of urine can be used a quick way to know whether you are drinking enough during the day.
  - **Notice changes.** If the urine color changes, notice if you are doing something different, such as drinking less water or more caffeinated beverages or are using a diuretic medicine or water pill, such as furosemide or chlorothiazide.
  - **Notice catheter position.** Notice where the catheter is after each change in your position and reposition it if needed. If you have others who help you, teach them to do this.
  - **Check for kinks and twists** in the catheter by feeling with your hand from where the catheter leaves your body all the way to the drainage bag.
  - **Ask for help.** If you need assistance with the catheter, learn to ask for help.
-

**Table 2**  
Quick Guide to Catheter Problems (from the Paying Attention Educational Booklet)

Problem	Action Strategies
Decreased/inconsistent fluid intake	Increase fluid intake
Urinary tract infection	Increase fluid intake Recognize early symptoms of urinary tract infection and act on it
Catheter blocks	Increase fluid intake Promote catheter changes at best intervals
Adjustment to living with a catheter	Approaches for living with a catheter
Not sure of the best schedule for catheter changes	Promote catheter changes at best intervals
Kinks, twists, or tugs on catheter	Prevent kinks, twists, or tugs on catheter
Too much caffeine	Decrease caffeine
Catheter leaks	Decrease catheter leakage Empty urine bag
Urine bag odor	Clean urine drainage bag
Changes with sex	Make adjustments for sexual activity

*Home Healthc Nurse.* Author manuscript; available in PMC 2014 October 01.

**Table 3****Helpfulness of the Self-Management Program Components**

On a scale of 1–10, With 1 Being Almost No Help, and 10 Meaning It Was a Very Big Help	<i>n</i>	<i>M</i>	<i>SDs</i>	1–4	5–7	8–10
1. Intake and output	56	8.04	2.40	11%	12%	77%
2. Catheter journal	56	7.25	3.15	20%	14%	66%
3. Educational booklet	57	7.72	2.79	12%	19%	68%
4. Study nurse's home visits and TC	58	8.33	2.53	10%	12%	78%
5. How helpful was learning self-management	60	8.18	2.65	10%	18%	63%

*Home Healthc Nurse.* Author manuscript; available in PMC 2014 October 01.

# Self-Management of Intermittent Urinary Catheters

## February 2016

Mary H. Wilde, PhD, RN

Professor, School of Nursing, University of Rochester, USA

Member of the ICS Nurses' Committee



International Continence Society  
Teaching Module

## Objectives

- Our purpose is to educate continence nurses to improve patient care and health outcomes globally.

At the conclusion of this presentation, readers should be able to:

1. Describe an approach to intermittent catheter self-management using a **web-based application** (related to a recent research study).
2. **Evaluate its usefulness** in promoting self-management in clinical practice and/or further research.

# Study: A Web-Based Self-Management Intervention for Intermittent Urinary Catheter Users

NIH/NIDDK funding: R21 NR012763

Wilde, M.H. (PI), Fairbanks, E., Parshall, R., Zhang, F., Miner, S., Thayer, D., Harrington, B., Brasch, J., Schneiderman, D., McMahon, J. M. (Co-I).

ICS: Teaching Module

## Intermittent catheter problems

- Psychological concerns, including stigma. (Shaw et al., 2008)
- Worries about CAUTIs
- Inconvenience in everyday activities
  - Inaccessible bathrooms-too small, lacking in privacy, and/or unclean (Wilde et al., 2011)
- Inadequate insurance, choice catheters/supplies
- Catheter type varies by individual; some find lubricated catheters hard to manage.

(Tully et al., 2014; Wilde et al., 2011)

ISSN: 1545-8694

ICS: Teaching Module

## Aims and Goals of new online self-management intervention for people with spinal cord injury (SCI) using CIC

- **Feasibility** (acceptability and usability)
- Preliminary **effectiveness** of the intervention
- Develop and test **new measures** of CIC self-efficacy and self-management
- **Goals** :
  - **Learn more** about own patterns with CIC
  - Obtain **support and information** for self-management
  - **Sustain CIC** over time

© 2019 ICS. All rights reserved.

ICS Teaching Module

## Design

- **Interventional study** – teaching **awareness, self-monitoring, self-management**
- **Web resources**—catheter products; educational booklet
- **Online urinary diary**: I&O, observation of self-cathing
- **3 phone calls** with study nurses
- **Pretesting group of 4 people** with SCI to refine intervention
- **Discussion forums** with peer leaders

© 2019 ICS. All rights reserved.

ICS Teaching Module

## Sample at baseline N=29

- SCI: 45% complete, 45% incomplete, 10% other SC disease
- 48% female
- Age 44 (SD 13) years, median 47 years
- Use of CIC: 16 years (range 1-39, SD 16 years; n=28)
- Diverse by race and ethnicity: 72% white, 14% black, 2% Asian, 10% more than one race, 3% Hispanic
- ADL - Katz score = 5.97 (SD 1.6), range 5-10; lower scores indicate more independent function.
  - 28/29 chair-fast but wheel independently
  - 1 used assistive device and/or person

Source: KJ000000000

ICS Teaching Module

**Managing an Intermittent Catheter**

A Web-Based Self-Management Intervention

Log With an account: [Forgot Password](#)

[Home](#) [About](#) [Getting Started](#) [Catheter Care](#) [Troubleshooting](#) [Contact Us](#)

**Welcome Patient**

Intermittent catheterization (IC) is a safe and effective way to manage urinary incontinence. It involves inserting a catheter into the bladder through the urethra to drain urine. IC is used by many people with spinal cord injury (SCI) and other conditions that affect the bladder. This intervention provides information and support to help you manage your IC effectively.

[Get Started](#)

**Links to Other Pages**

- [About the Intervention](#)
- [How to Use the Intervention](#)
- [Contact Us](#)
- [Feedback](#)

[Log In](#) [Forgot Password](#)

[Home](#) [About](#) [Getting Started](#) [Catheter Care](#) [Troubleshooting](#) [Contact Us](#)

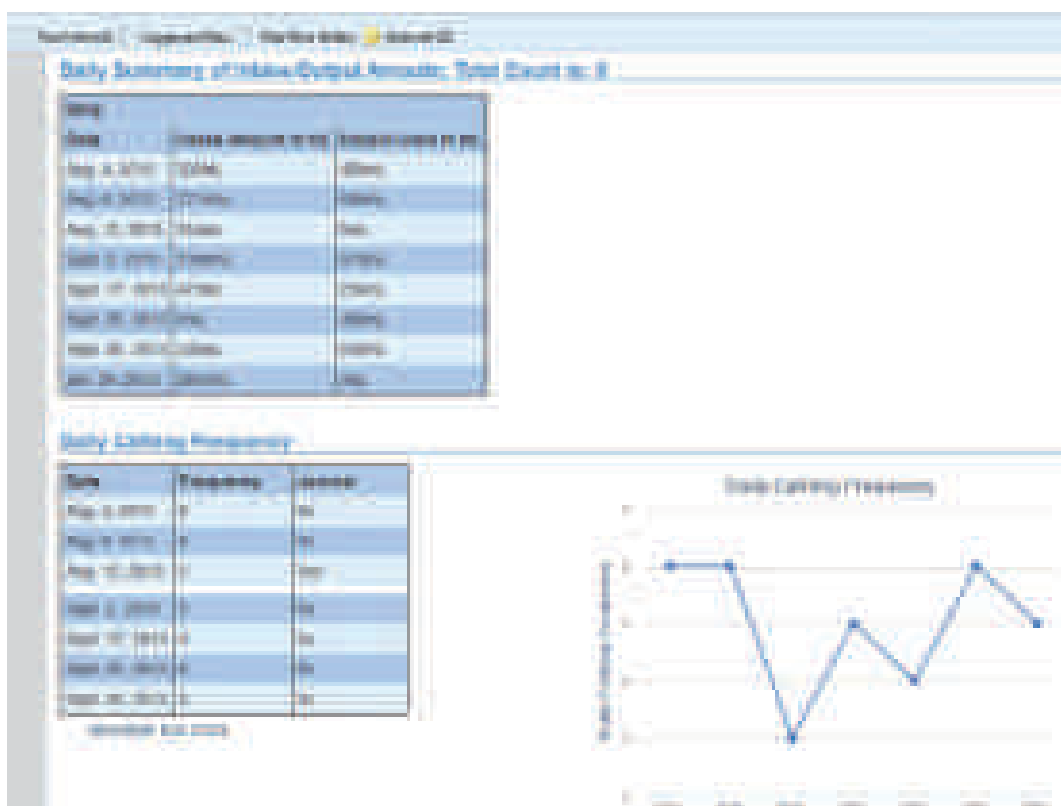
© 2010 ICS. All rights reserved.

ICS Teaching Module









## Feasibility evaluation

- Several people withdrew or were lost to follow up early. 26 of 30 had nurse consultations for the intervention.
- Websites (recruitment and intervention sites) worked well, little difficulty navigating.
- Forums used by 10 of 26 but rated positively. Most posts r/t travel, insurance, medications, treatments for SCI.
- Liked intervention: educational materials, urinary diary, nurse consultations, and discussion forums.

Source: [unclear]

## Results

- Frequency catheterizing 4-6 times a day increased slightly, 69-77% (NS)
- Self-management of the intermittent catheter increased significantly (P= .032)
- Self-efficacy and quality of life scores improved (NS).
- CAUTI, leakage and pain decreased (NS.)
- Measures performed adequately– need further development in larger sample with more power.
- Increases in fluid intake biggest self-management change

Presented by: Jennifer L. Pitt

ICS: Teaching Module

## One person said:

- "I'm probably more conscious of my intake of fluids than anything because I was one that was really slacking on taking fluids and I needed to– I needed to do something about it and I just sort of was lazy...[and] after the 2nd time we talked [with the study nurse] I really cranked up my intake of water because I was not a water drinker. And now I'm probably drinking probably 36 ounces of water a day. And I've cut out carbonated drinks."

Presented by: Jennifer L. Pitt

ICS: Teaching Module

## Conclusion and Implications

- Multi-site larger study in SCI units
- Newly injured and experienced people with CIC; plus others
- Compare web-urinary diary with paper and pencil
- Cohort-enrollments for forum of about 30 people
- More information for logins, actions taken etc.
- Evaluation of this web-based approach will require more use of it, and for evidence of its value, more research.
- Dissemination for education and research (indwelling and intermittent catheter studies)-Contract with University of Rochester email Mary Wilde: Mary\_wilde@urmc.rochester.edu

www.ics-standards.org

ICS Teaching Module

## References

- Kelly, L., Spencer, S. & Barrett, G. (2014). Using intermittent self-catheters: experiences of people with neurological damage to their spinal cord. *Disability and Rehabilitation*, 36(3), 229-236. DOI: 10.3109/09638237.2014.919006
- Shaw, C., Logan, R., Wetliw, L., Broome, L., & Samuel, S. (2008). Effect of clean intermittent self-catheterisation on quality of life: A qualitative study. *Journal of Advanced Nursing*, 62(1), 641-50.
- Wilde MH, Fackbanks E, Penhall R, Zhang F, Miles S, Thayer D, Harrington B, Brasch J, Schneideman D, & McMahon J. M. (May/June 2013). A Web-based self-management intervention for intermittent catheter users. *Urologic nursing*, 33, 3, 127-133. DOI:10.7252/1065-810X.2013.33.5.127
- Wilde, M.H., Fackbanks, E., Penhall, R., Zhang, F., Miles, S., Thayer, D., Harrington, B., Brasch, J., Schneideman, D., McMahon, J. M. (2015) Development of a web-based self-management intervention for intermittent urinary catheter users with spinal cord injury. *CW Computers, Informatics and Nursing*, 33, 438-446, PMID: 26161267
- Wilde, M.H., Fackbanks, E., Penhall, R., Zhang, F., Miles, S., Thayer, D., Harrington, B., Brasch, J., Schneideman, D., McMahon, J. M. Feasibility of a web-based self-management intervention for intermittent urinary catheter users with spinal cord injury. (In review)

www.ics-standards.org

ICS Teaching Module

# Thank You!

From Mary Wilde and the ICS Nurses' Committee

ICS Teaching Module














**Table 3**  
**Believe Fluids with Caution: Optimal Fluid Intake**

Before you start taking the health-promoting products, use some measurements of the bladder and the rate needed to urinate (see Section 4.1.1).

Quote: "My long-term goal is to take fluid restriction. There's no one else I'll."

Things to Remember	Things You Can Do
<p>Make sure you are getting enough fluid—ask your doctor to measure the rate.</p> <p>Experiment with another different kind of fluid when you restrict your fluid intake to see how you feel.</p> 	<p>If you feel you are restricting enough, do anything you can to make it easier to do.</p> <p>Take the fluid restriction as a challenge, and make it a goal to do it.</p> <p>To make it easier to do, try 2 cups of water or 1 cup of juice (1/2 cup of juice) every 2 hours. You can also try 1/2 cup of juice every 2 hours.</p> <p>Keep track of your fluid intake. For example:</p> <ul style="list-style-type: none"> <li>Take a glass of water to your bedside.</li> <li>Use a glass of water to see if you are drinking too much.</li> <li>Use a glass of water to see if you are drinking too little.</li> <li>Use a glass of water to see if you are drinking too much.</li> </ul>
<p>Make changes in your diet to help you feel better.</p>	<p>Get a good idea of your diet to help you feel better. Get a good idea of your diet to help you feel better.</p> <p>Make your diet as healthy as you can. Increase your fluid intake.</p>
<p>If you are restricting your fluid intake, make sure you are getting enough fluid.</p>	<p>Make sure you are getting enough fluid. Make sure you are getting enough fluid.</p>
<p>Be aware of changes in your diet, such as eating, drinking, or food.</p>	<p>Use a glass of water to see if you are drinking too much. Use a glass of water to see if you are drinking too little. Use a glass of water to see if you are drinking too much.</p>

**Source:** Copyright © 2014 by the author. All rights reserved. Content should be used for educational purposes only.

measured by including fluid intake in the study and fluid intake during the week of study with the subject.

### Study Data Collection

The study was conducted in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume. The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume.

After the study, the data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume. The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume.

### Personal/Personal Fluid Intake

(Data were collected in three phases.)

The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume. The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume.

### Personal/Personal Fluid Intake

The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume. The data were collected in three phases. The first phase was to track the daily urinary volume, including use of the personal bladder for urinary volume. The second phase was to collect data on the use of the personal bladder for urinary volume. The third phase was to collect data on the use of the personal bladder for urinary volume.



# Jian Guo Wen

Affiliations to disclose<sup>1</sup>:

Nothing to disclose

Funding for speaker to attend:

- ☒ Self-funded
- ☐ Institution (non-industry) funded
- ☐ Sponsored by:

 ICS Education Module

## ICSTEACHING MODULE

### Urodynamics in children

#### Part 1. CYSTOMETRY IN CHILDREN

Jian G Wen MD, Ph.D, Jens C Djurhuus, Dr. Med.Sc.,  
Peter F.W.M Rosier MD, PhD, Stuart Bauer, MD

1. Pediatric Urology, First Affiliated Hospital of Zhengzhou University, China  
2. Department of Clinical Medicine, Aarhus University, Denmark  
3. Department of Urology, University Medical Center Utrecht, The Netherlands  
4. Department of Urology, Boston Children's Hospital, USA

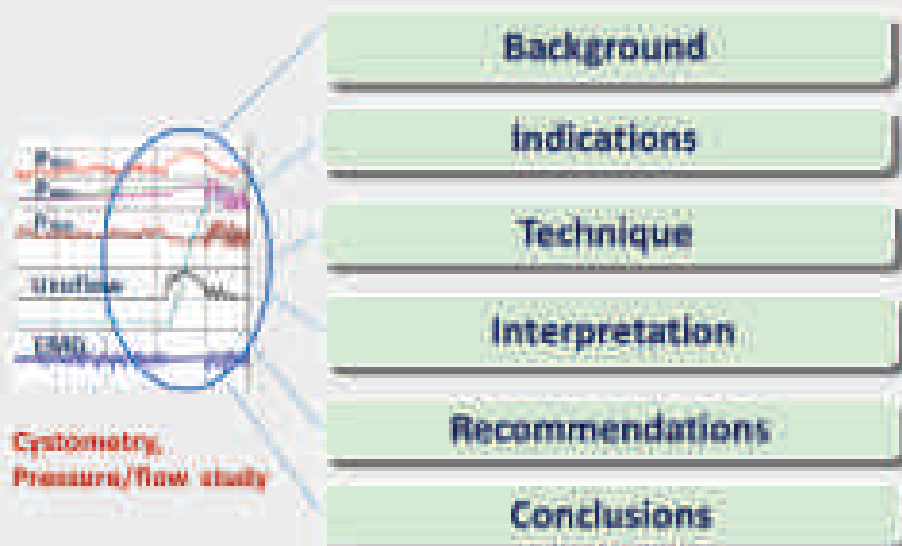
The ICS Education Module is a series of modules designed to provide a comprehensive overview of the field of urology and related disciplines. The modules are designed to be used as a reference for urologists and related disciplines.

© 2014 International Continence Society. All rights reserved.



International Continence Society  
Education Module

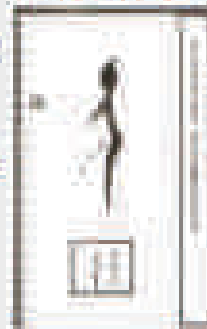
## Cystometry: outline



## Background

- Lower urinary tract dysfunction in children is encountered frequently (20-30%) in clinical practice. Some need to be evaluated by urodynamic studies following a careful history & physical examination
- The aim of urodynamic testing is to reproduce symptoms, to identify the underlying causes for symptoms, and to quantify underlying pathophysiological processes
- This section follows the guideline from ICS & ICCS on Good Urodynamic Practice

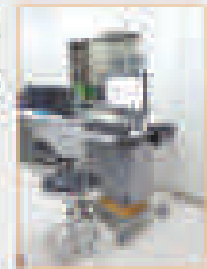
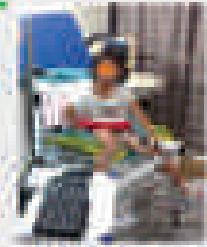
Grade: "Pre"  
1000-2000 B.C.



<http://www.ics.org/>

## Cystometry

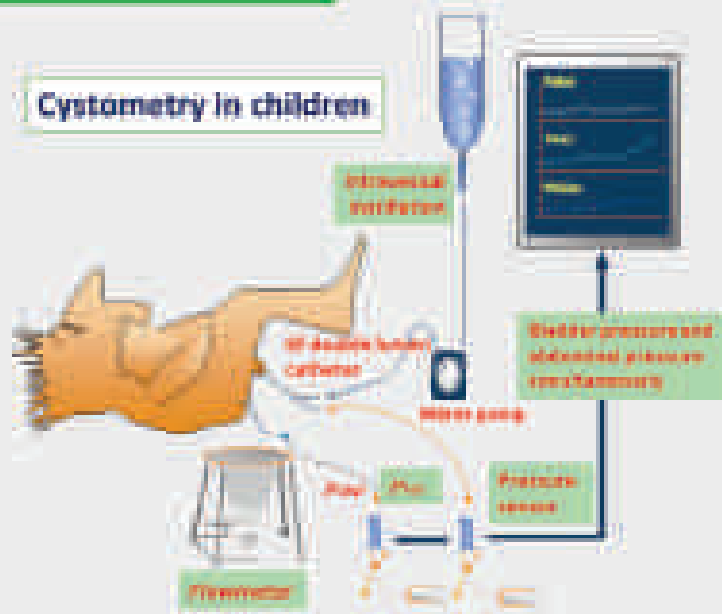
- When undertaken, cystometry is the core evaluation of pediatric urodynamic study (PUDS) in the evaluation of LUTD/LUTS
- It measures the pressure-volume relationship of the bladder during the filling
- In this module, its techniques and recording parameters will be introduced in details
- Pressure flow study & video-urodynamic studies will not be covered in this section



## Cystometry in Children

- Indicated from birth and onwards *primarily*
- to monitor compliance and thereby avoid potential damage to kidney function

1000



## Conventional Cystometry

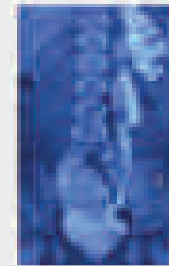
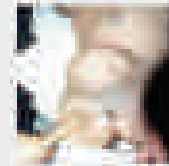
- 1: 6-F transurethral double lumen catheter**  
To monitor vesical pressure and for filling
- 2: 8-F (optionally balloon) catheter in rectum**  
To register abdominal pressure
- 3: Levelling the transducers both to pubic level**  
Filling rate usually 5-10% of expected bladder capacity
- 4: Electronic subtraction of abdominal pressure from vesical pressure = detrusor pressure**

**ICS** Education Platform



## Indications

1. Suspicion of, or overt neuropathic voiding dysfunction, LUT obstruction, DSD, etc
2. Profound non-neuropathic detrusor-sphincter dysfunction (ie., dilating ureter(s), high grade vesicoureteral reflux, valve bladder syndrome)
3. Significant PVR with no apparent reason
4. Congenital malformations of the lower urinary tract (ie., exstrophy, epispadias, ureterocele, multiple bladder diverticula)

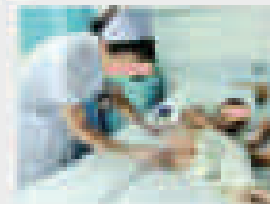


## Indications and preparation

5. The procedure is assumed to effect treatment strategies & for evaluating the treatment response or follow up
6. It is undertaken after history taking, physical examination, voiding diaries & uroflow patch EMG recordings, if these measures do not answer the questions related to causes, nor provide management schemes for LUTD

### Preparation

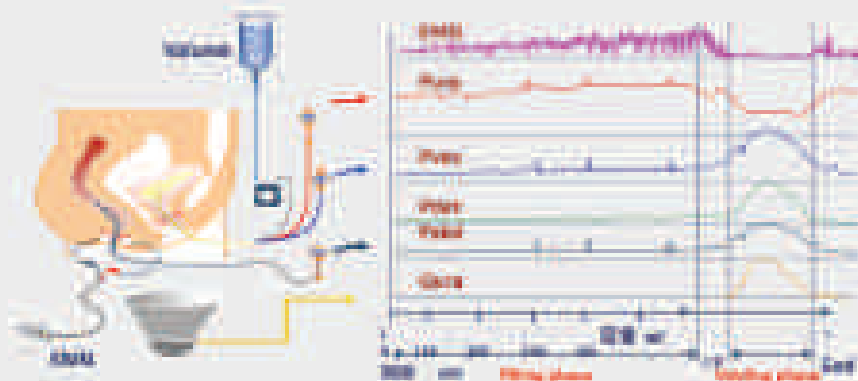
- Empty the rectum. Enema Glycerini is recommended. Severe constipation may need cleaning enema
- Drink sufficient quantities of water in order to have a full bladder for an initial uroflowmetry



Cleaning enema

## Technique: insert catheters

- Double-lumen catheter for Pves, or triple lumen catheter for Pves & Pura recording (3rd channel for filling); rectal balloon catheter for Pabd recording



ICS Education Module

## Technique: place surface electrodes

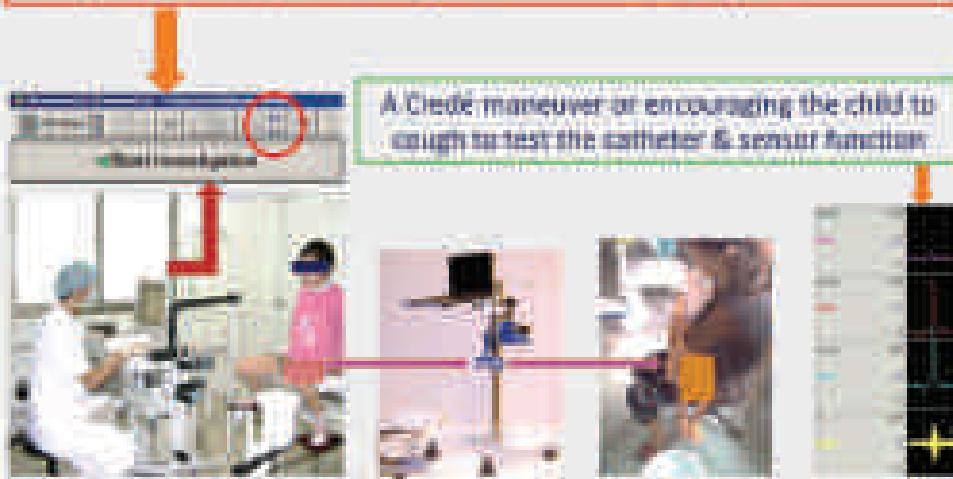
- Surface electrodes are positioned symmetrically left & right from the external anal sphincter, to record the reactivity of pelvic floor muscles



ICS Education Module

## Technique: position and zeroing the pressure

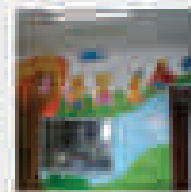
Upright or supine position – babies may be held in mother's arm. Before filling the bladder, the vesical pressure channel must be zeroed to the atmosphere with the transducer placed at the level of the pubis.



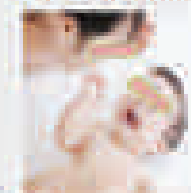
ICS Education Module

## Cooperation: during filling

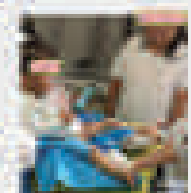
- To build the lab so it looks like a kindergarten, and e.g. animation wall with TV
- Employ dedicated & knowledgeable staff able to give children an explanation of the procedure and aim of the urodynamic study. If possible, engage the infants to cooperate
- Have a well cleansed rectum
- After inserting the catheter in the bladder, if the child is still agitated, engage parents to help to keep him/her calm



Animation wall



To avoid cry

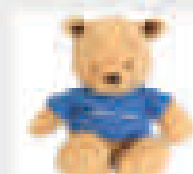


Start until calm

ICS Education Module

## Cooperation: during filling

- The urodynamic evaluation approach should start with as minimally tests as possible, ending up with the invasive investigations, if needed
- Toys, eating or drinking, reading, allow mother to be present, during the examination
- Apply 1% lidocaine jelly or other topical anesthetic solution instilled into the urethra to aid in catheter passage
- Administer sedative if necessary but not an anesthetic, & document if child is very fearful



Toys



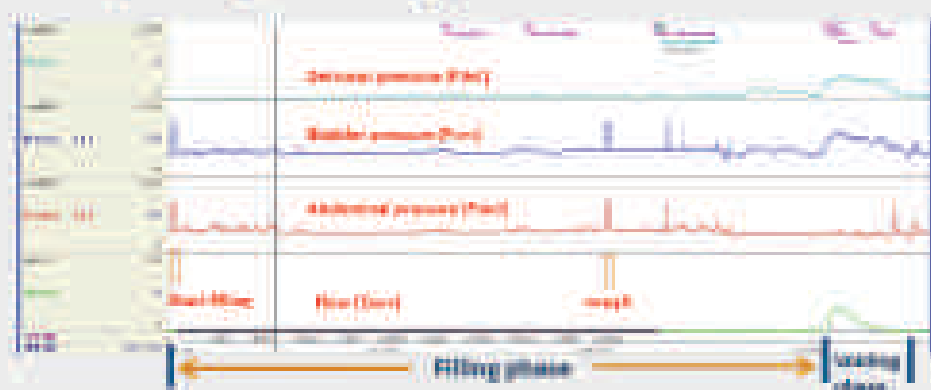
Drinking



Mother with child

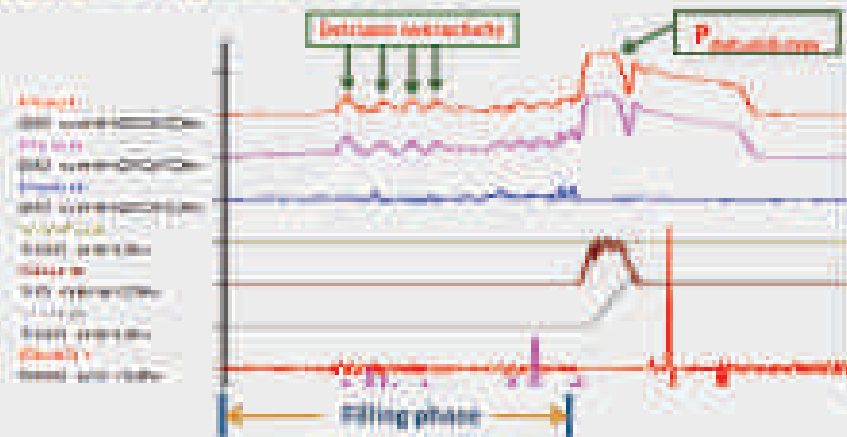
## Interpretation: filling pressure

- $P_{bladder}$  increases initially ( $< 5$  cm  $H_2O$ ) immediately at the start of filling, & incrementally with further filling of the bladder, it reaches a maximum just before the urge to void (normally,  $< 15$  cm  $H_2O$ ).



## Interpretation: detrusor overactivity

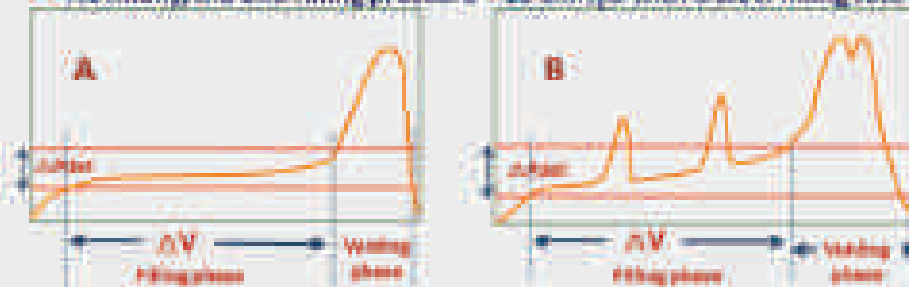
- Detrusor overactivity indicates a detrusor contraction that occurs during the filling phase **before expected bladder capacity is reached**, which may occur in 10% of normal children. While in children with VUR, it may be seen in more than half of the infants.



ICS Education Module

## Interpretation: detrusor compliance ( $\Delta C$ )

- $\Delta C = \Delta V / \Delta P_{det}$  – measures the visco-elastic properties of the bladder.  $\Delta C < 10 \text{ ml/cmH}_2\text{O}$  indicates decreased bladder compliance, which may be due to decreased bladder capacity or increased  $P_{det}$  or both.
- Normally, the end filling pressure  $< 15 \text{ cmH}_2\text{O}$  with a slow filling rate.



- A. The non-linear portions – the beginning & end of the V/Pdet diagram do not contribute to compliance. B.  $\Delta V / \Delta P_{det}$  essentially captures the angle of the line describing the incremental increase in resting pressure.

ICS Education Module

## Interpretation: estimated bladder capacity based on age

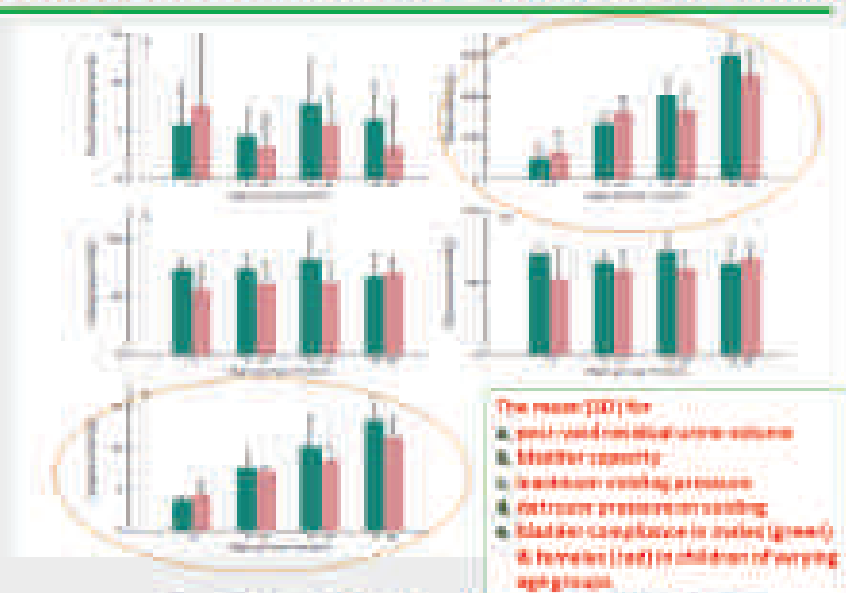
Bladder capacity (BC), post-void residual (PVR), maximum detrusor pressure during voiding (P<sub>det</sub>max) in the first three

Age	BC (ml)	max (ml)	Post-void residual (ml)
<b>Normal</b>			
Preterm infant (33–36w)	15.2 ± 4.8	1.5 ± 1.0	—
Infant (36w)	22.8 ± 7.8	—	—
Term infant (1yr)	34.6 ± 10.9	1.4 ± 1.1	—
Infant (2yr)	33.8 ± 8.7	1.2 ± 1.0	—
<b>Infant</b>			
3 month	18 ± 18	1.7 ± 4.8	50–75
12 month	30 ± 30	1.1 ± 6.5	41–59
24 month	39 ± 32	6.4 ± 3.0	38–50
36 month	48 ± 32	8.4 ± 5.5	38–58

Expected capacity (ml) = 30 + (age in years × 30) in a child > 1 year of age

Expected capacity (ml) = 30 + 2.5 % age (months) for infants < 1 year old

## Interpretation: bladder capacity, compliance

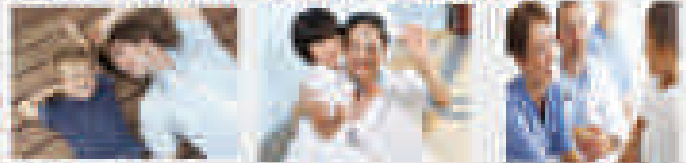


From Ware, et al. British Journal of Urology 2000; 85: 408-79

## Interpretation: estimate sensation of filling

- Evaluating sensation of filling depends on both verbal or non-verbal signs, such as movement of the feet, awakening from sleep, a sudden cry. Bladder filling should be stopped when the filling pressure exceeds 40 cm H<sub>2</sub>O
- In older children, ask them to hold & not void at their first sensation to void, especially if expected or known maximum bladder capacity has not been reached
- For newborn & infants < 1year, it is difficult to identify the sensation of bladder filling; however, it is easy to generate urination during the cystometry in these children

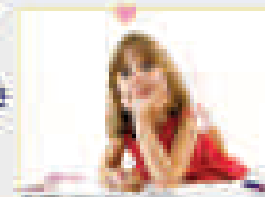
Verbal  
communication



ICS Education Module

## Conclusions

- Cystometry with an initial 'free' uroflowmetry is a useful tool to evaluate the LUT function in children
- It should be considered as one procedure, but not the only one, to clarify the diagnosis & to make therapeutic decisions as well as for follow up
- To understand the findings at cystometry, normal voiding parameters as well as following ICS & ICCS recommendations are the basis of successful testing



ICS Education Module

# ICS educational module: Cystometry in children

Jian G. Wen<sup>1,2</sup>  | Jens Christian Djurhuus MD<sup>3</sup> | Peter F.W.M. Rosier<sup>4</sup>  |  
Stuart B. Bauer<sup>5</sup>

<sup>1</sup> Pediatric Urodynamic Centre, the First Affiliated Hospital of Zhengzhou University, Zhengzhou, China

<sup>2</sup> Department of Pediatric Surgery, the First Affiliated Hospital of Xinxiang Medical University, Weihui, China

<sup>3</sup> Department of Clinical Medicine, Aarhus University, Aarhus N, Denmark

<sup>4</sup> Department of Urology, University Medical Centre Utrecht, Utrecht, The Netherlands

<sup>5</sup> Department of Urology, Boston Children's Hospital, Boston, Massachusetts

## Correspondence

Jian G. Wen, Pediatric Urodynamic Centre, the First Affiliated Hospital of Zhengzhou University, Jianshe East Road No.1, Zhengzhou, 450052, China.  
Email: wenjg@hotmail.com

**Aims:** To introduce the standard procedure of cystometry and interpretation of the results in children.

**Methods:** The literature on cystometry in children in PubMed for the last 20 years was reviewed. The updated knowledge regarding indication, preparation, technique, and interpretation of cystometry in children were summarized.

**Results:** Filling cystometry is the core content of a paediatric urodynamic study. In this section, the technique for performing cystometry is introduced in details. Emphasis is placed on correctly setting up the equipment according to ICS and ICCS guidelines, using appropriate terminology, providing indications for its performance with specific considerations for children, and proper interpretation of results.

**Conclusions:** Cystometry can be used in children including newborn to evaluate lower urinary tract dysfunction.

## KEYWORDS

children, cystometry, procedure, urodynamics

## 1 | INTRODUCTION

The International Continence Society (ICS) and International Children Continence Society (ICCS) define filling cystometry as the urodynamic procedure by which the pressure-volume relationship of the bladder is measured. Filling cystometry is done to provide information on storage function (detrusor activity, sensation, compliance, and cystometric capacity). Filling cystometry in children is usually performed in combination with perineal EMG skin electrodes to add information regarding pelvic floor striated muscle activity.<sup>1–4</sup> On rare occasions needle electrodes are inserted into the pelvic floor musculature to precisely define denervation in patients with neurogenic bladder dysfunction.

The ICS educational module consists of an oral presentation in combination with this manuscript, the latter serving as a scientific background review; the evidence gathered for the ICS PowerPoint presentation is available via <http://www.icsoffice.org>. The presentation explains when and how to do a filling cystometry and how to analyze the results in children.

Filling cystometry is the core content of a paediatric urodynamic study. In this section, the technique for performing cystometry will be discussed in detail. Emphasis will be placed on correctly setting up the equipment according to ICS and ICCS guidelines,<sup>2–4</sup> using appropriate terminology, providing indications for its performance with specific considerations for children, and proper interpretation of results.<sup>5</sup> Other elements of a urodynamic investigation, for example, pressure flow study or video-urodynamic study will be covered in specific educational modules.

## 2 | INDICATIONS AND PREPARATION

Filling cystometry is indicated when history and clinical examination raises a suspicion of either anatomic and/or neurologic lower urinary tract dysfunction involving primarily the storage phase, or there is a question that cannot be answered by less invasive testing. Additionally, filling cystometry is relevant when anatomical or functional bladder



outflow obstruction (voiding phase) (eg, valve bladder syndrome, detrusor-sphincter dyssynergia associated with neuropathic bladder), or congenital anomalies of the bladder (exstrophy, ureterocele, multiple bladder diverticula) may be causing symptoms and signs of dysfunction that may need further delineation.<sup>6</sup> When a urodynamic investigation is ordered the patient and/or his/her parents should fully understand the reason(s) for the test. It is assumed results of the investigation will define pathophysiology and influence treatment strategies. When constipation exists, it should be managed according to set guidelines before cystometry is undertaken. Having an empty rectum before the urodynamic study is advantageous as this allows for accurate monitoring of abdominal pressure and hence detrusor pressure.

Apart from a comprehensive history and complete physical examination, a voiding (or catheterization) diary, uroflowmetry, and post-void residual volume, as measured by ultrasonography, are to be conducted before ordering this invasive urodynamic study. In children, more than one uroflowmetry is strongly suggested to establish with certainty the necessity of an invasive study.<sup>1,2</sup> The child is advised to arrive at the urodynamics suite with a full bladder if possible and the examination starts with a free uroflowmetry. This is best accomplished by adequate but not excessive hydration beforehand and/or appropriate timing of a previous void so the bladder is relatively full at the time the child arrives at the urodynamics facility.

The (parents and) child should be instructed that all lower urinary tract modulating medications be taken either at a set time before the study or stopped at a sufficient interval to minimize their effect. Depending on the reason for the study, it should be however decided individually whether to continue or to stop medication (eg, in follow up evaluation). For children who are anxious or fearful beyond consolation, administration of a sedative (not anesthetics) may be considered but its timing and dose should be documented.

### 3 | TECHNIQUE

Current guidelines recommend multichannel fluid filled pressure recordings for filling cystometry as the standard in children. This educational module combines ICCS and ICS standards, into practical protocol elements to perform cystometry.

As the documents related to the tip-transducer or air-charged catheter used in pediatric urodynamic studies are limited and the pressures measured using air-charged catheters, microtip catheters are not readily comparable with fluid-filled systems, also in pediatric urodynamic studies fluid-filled systems are considered the ICS standard.

#### *Inserting the catheter and placement of surface EMG electrodes*

- (1) A transurethral catheter is used to measure the pressure within the bladder. A 6 Fr double-lumen catheter that allows both filling and recording of pressure is recommended. The catheter is inserted after applying lubricating gel. No evidence exists regarding how well this gel acts as an anesthetic in children. In some facilities, a suprapubic double lumen catheter is inserted following administration of a short anesthetic the day before the test.
- (2) The transurethral urodynamic catheter can be used to empty the bladder before starting the cystometry; if a relatively large volume is measured ultrasonographically or expected, it may be helpful to empty the residual by aspirating the bladder via the urodynamic catheter.
- (3) A completely fluid filled open 8-Fr. feeding tube or a small air-free fluid filled balloon catheter is inserted into the rectum to record abdominal pressure.
- (4) Both transurethral and rectal catheters should be secured with tape adjacent to their respective skin openings. After insertion, the catheters are attached, via connecting tubes, to the external pressure transducers and leveled to the height of the pubic symphysis.
- (5) After cleaning the skin two surface EMG electrodes are positioned symmetrically, left, and right from the external anal sphincter, to record reactivity of pelvic floor muscles. No specific evidence regarding skin preparation to reduce impedance or electrode placement is available.<sup>2</sup> A third reference electrode should be placed at an electrically neutral position; preferably over a bony prominence and not an abdominal or leg muscle.

#### *Position and zeroing the pressure*

- (6) Filling cystometry is preferably best performed in a seated position; however, lying supine or an infant held in mother's arm is also acceptable.
- (7) Before filling the bladder, the bladder pressure channel must be zeroed to atmospheric pressure with the transducer situated at the level of the symphysis pubis, irrespective of the position of the child.
- (8) Testing the catheter and sensor: Initial resting pressure should roughly represent the weight of the abdominal contents (below the diaphragm, in centimeter "water"-column) above the pelvic floor, for example, 15-25 cm H<sub>2</sub>O. The fluid filled transurethral catheter requires some fluid in the bladder to allow for a degree of "unfolding" in order to obtain an accurate initial resting pressure. Furthermore, when using gel to insert the catheter, it should be flushed away from the pressure measuring side holes. When the child is upright the initial subtracted detrusor pressure should be close to zero. To further test catheter and sensor function in

infants the lower abdomen is gently pressed (Credé) whereas older children are encouraged to cough. The abdominal pressure rise should have a response peak similar to bladder pressure so detrusor pressure remains about zero.

- (9) Even though children usually move and/or talk during the investigation, causing pressure variations that may serve as a quality control measure during the test, regular cough “tests,” or Credé maneuvers in infants, should be promoted throughout filling to continuously check the catheters’ ability to accurately record pressures.
- (10) In children old enough (and neurologically able) to respond: the sensation of filling should be ascertained according to the ICS standard sequence, as defined by: “first sensation of filling” and subsequently and respectively, “normal desire” and “strong desire to void.” These landmarks should be indicated on the urodynamic tracing.

#### **Filling cystometry**

- (11) Based on bladder diary notations or estimating capacity based on age ( $\text{age [yrs]} + 1 \times 30 = \text{capacity [mL]}$ ) bladder filling should occur at a rate approximating 5-10% of estimated capacity per minute, using saline, as recommended by the ICCS. Apart from the bladder diary, age related and expected capacities should be kept in mind.<sup>7,8</sup>
- (12) During filling, intravesical and abdominal pressures are recorded and subtracted simultaneously to obtain true detrusor pressure. During the recording, the flowmeter is kept in position so leakage or incontinence will be shown in the uroflow tracing curve.
- (13) When voiding or leakage occurs, or a strong desire to void is expressed (movement in newborns or infants or curling of toes in older children) these observations may be interpreted as a sign of a full bladder. The filling is stopped and this event marked as the end of filling. It also represents the end of the filling cystometry. Storage function is evaluated until this point.
- (14) Subsequently, as an older child is encouraged to urinate, voiding pressures, and uroflow measurements are recorded simultaneously, thus obtaining a pressure flow study. The pressure flow study will not be discussed further here.
- (15) Directly after voiding an evaluation of the technical quality as well as the clinical representativeness of the study should be undertaken to determine whether a second filling cystometry (and pressure flow study) is necessary. Depending on the specific question being asked or the local protocol, performing a second filling cystometry may be initiated. Often at this time the child

is relaxed enough so that a more accurate tracing of the filling phase is obtained.

#### **End of test**

- (16) When the filling cystometry (and pressure flow study) is conclusive, all catheters and the EMG electrodes are removed.
- (17) Children are instructed to carry out their normal activities but advised to drink an additional water after the test to “void away” any urethral irritation as well as to reduce chances of developing a urinary tract infection.
- (18) A clinical evaluation report is completed immediately after the test to be optimally able to integrate urodynamic observations and features with clinical observations during the measurement, while still fresh in the mind of the observer.

#### **Notes:**

1. For EMG kinesiological recording, surface electrodes are widely used in children to study pelvic floor activity. Electrophysiologic standards require that the skin should be degreased and desquamated tissue removed before applying a conductive gel and the electrodes. Hooked needle electrodes can be used for kinesiological EMG recording when it is important to determine denervation in neurologically compromised individuals; however, the invasiveness of obtaining this measurement should be weighed against the expected gain from the information. Concentric needle electrodes are useful for motor unit potential analysis during urodynamic testing when it is necessary to know if new onset or progressive sacral spinal cord denervation is present.
2. For retrograde filling, 0.9% saline is recommended. In young children, temperature of the filling solution as well as the medium itself may influence bladder capacity and detrusor activity. It has been established that filling rate and fluid medium have an impact on bladder function.<sup>9</sup> It is important to use an appropriate rate of filling (5-10% of estimated bladder capacity per minute) in infants.<sup>1,5</sup>
3. A double lumen catheter has the advantage that it can stay in place (especially during voiding if adequately secured) for a second filling cystometry, if deemed necessary.
4. It is unnecessary to routinely use a warmed infusion solution for urodynamic studies in children; however, for those younger than 2 years, a warmed solution (37°C) is recommended.<sup>10</sup>
5. The best position for the child during standard cystometry is in a sitting position, watching a video or DVD surrounded by one or both parents, so as to minimize anxiety. Young children (infants) may be held in their mother's (or caregiver's) arms to achieve a meaningful evaluation. It has not been proven in children that patient position during the procedure has a significant and

clinically relevant effect on cystometry. However, this has been proven in adults, patient position during the procedure plays a significant and clinically relevant role.<sup>11</sup>

6. The study should not be performed under general anesthesia; intranasal midazolam may be administered in certain situations, as it does not appear to have a significant effect on outcome.<sup>12</sup>

## 4 | INTERPRETATION

### *Parameters during the Filling Phase*

1. The filling detrusor pressure ( $P_{\text{det,fill}}$ ) means the detrusor pressure during filling. The maximum detrusor filling pressure ( $P_{\text{det,fill,max}}$ ) may be reported in the analysis. Detrusor compliance is calculated on the basis of the difference between the initial resting pressure and the detrusor pressure at cystometric capacity. Any phasic pressure increments, interpreted to be caused by detrusor overactivity, should be omitted in the evaluation of the detrusor compliance calculation. It may be advantageous to stop the infusion when reduced compliance is observed to allow the pressure to “equilibrate” for a minute or two in order to uncover artificially reduced compliance, which is sometimes observed as a consequence of too rapid filling rate.
2. Phasic detrusor pressure increments of any amplitude, during the filling cystometry (until end of filling and permission to void is given) are defined as detrusor overactivity. Detrusor overactivity may arise spontaneous or be provoked by a cough or Credé. When history and/or clinical examination have confirmed a relevant neurologic abnormality the term neurogenic detrusor overactivity is used.<sup>1-4,13</sup> Otherwise, idiopathic detrusor overactivity is the preferred term.
3. Detrusor compliance (compliance =  $\Delta V/\Delta P$ ) is an important parameter to note during cystometry. It represents detrusor elasticity or volume adaption. A value of  $<10 \text{ mL/cm H}_2\text{O}$  indicates low bladder compliance. Assessing the entire pressure curve during filling in this regard may determine when it is best to measure. The  $\Delta P$  represents the detrusor pressure difference until just before voiding (or pressure at the end of filling); consequently, compliance will represent the overall bladder compliance, from start to a completely full bladder. It has been suggested that quartiles of compliance measurements during filling be considered. The filled volume does not take into account the amount of actual diuresis occurring during the test. To integrate this volume the cystometric capacity and filling phase compliance should be calculated using voiding volume plus PVR measured immediately after voiding or emptying.

4. Incontinence is defined when any loss of fluid during the filling phase is detected. In children unable to void willingly, fluid loss occurring before the expected bladder capacity is also called incontinence (as opposed to physiologic—normal but uninhibited—voiding when it occurs at “normal for age” capacity).

5. Leak point pressure (LPP) indicates the pressure at which leakage occurs. Detrusor leak point pressure (DLPP) indicates the lowest value of detrusor pressure at which leakage is observed in the absence of increased abdominal pressure or a detrusor contraction. Abdominal leak point pressure (ALPP) refers to measures of the lowest value of intentionally increased intravesical pressure that provokes urinary leakage in the absence of a detrusor contraction. High DLPP (eg,  $>40 \text{ cm H}_2\text{O}$ ) is usually induced by a decrease in bladder compliance and/or detrusor underactivity, is associated with upper urinary tract deterioration.<sup>1,5</sup> Low DLPP indicated urethral incompetence.<sup>1,5</sup> Techniques and evaluation are not further standardized in this document describing filling cystometry.

6. Bladder filling sensation should be reported, on the basis of observations during the test or, when applicable, on the basis of the child's report. ICCS standard terms in this regard apply also for children.<sup>1,2,6</sup>

## 5 | RECOMMENDATIONS

Based on standards and clinical practice guidelines, the results of complete patient history, comprehensive clinical examination, bladder diary, uroflowmetry, and PVR should be available before considering a filling cystometry (and/or other invasive urodynamic tests).

Filling cystometry is preferably done with a 5-6 Fr double lumen catheter and at a filling rate of  $\pm 10\%$  per minute of a diary determined maximum or age—expected bladder capacity.

Filling cystometry should be performed in the sitting position. When relevant medication or sedation is used it should be accounted for while evaluating the filling cystometry and be included in the report. In addition, it is important to note the time of last administration of medication in relation to the start of the cystometrogram, in order to determine the influence of any bladder modulating medication. Immediate evaluation of the test (before removing the catheters) should be done to determine technical quality and clinical relevance, as well as the ability to answer the clinical question that prompted the investigation, initially.

## 6 | CONCLUSION

To understand the characteristics as well as following good urodynamic practice (GUP), recommendations from the ICS

and ICCS are the basis of successful testing. This educational module provides recommendations for good clinical practice to completing filling cystometry in children using these standards. This narrative manuscript is based on expert consensus about the information contained in the existing literature. We hope that this teaching module will also serve as a challenge to improving (evidence-based) practice.

## ORCID

Jian G. Wen  <http://orcid.org/0000-0003-0952-118X>  
 Peter F.W.M. Rosier  <http://orcid.org/0000-0003-0445-4563>

## REFERENCES

1. Wen JG, Lu YT, Cui LG, et al. Bladder function development and its urodynamic evaluation in neonates and infants less than 2 years old. *Neurourol Urodyn*. 2015;34:554–560.
2. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. *Urology*. 2003;61:37–49.
3. Gammie A, Clarkson B, Constantinou C, et al. International Continence Society guidelines on urodynamic equipment performance. *Neurourol Urodyn*. 2014;33:370–379.
4. Rosier P, Schaefer W, Lose G, et al. International continence society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
5. Austin PF, Bauer SB, Bower W, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the standardization committee of the International Children's Continence Society. *Neurourol Urodyn*. 2016;35:471–481.
6. Austin PF, Bauer SB, Bower W, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the Standardization Committee of the International Children's Continence Society. *J Urol*. 2014;191:1863–1865.
7. Wen JG, Yeung CK, Chu WC, et al. Video cystometry in young infants with renal dilation or a history of urinary tract infection. *Urol Res*. 2001;29:249–255.
8. Holmdahl G, Hanson E, Hanson M, et al. Four-hour voiding observation in healthy infants. *J Urol*. 1996;156:1809–1812.
9. Sorensen SS, Nielsen JB, Norgaard JP, et al. Changes in bladder volumes with repetition of water cystometry. *Urol Res*. 1984;12:205–208.
10. Chin-Peuckert L, Rennick JE, Jednak R, et al. Should warm infusion solution be used for urodynamic studies in children? A prospective randomized study. *J Urol*. 2004;172:1657–1661.
11. Al-Hayek S, Belal M, Abrams P. Does the patient's position influence the detection of detrusor overactivity? *Neurourol Urodyn*. 2008;27:279–286. Review. PubMed PMID: 17724734.
12. Bozkurt P, Kilic N, Kaya G, et al. The effects of intranasal midazolam on urodynamic studies in children. *Br J Urol*. 1996;78:282–286.
13. Abrams P. Describing bladder storage function: overactive bladder syndrome and detrusor overactivity. *Urol*. 2003;62:28–37.

**How to cite this article:** Wen JG, Djurhuus JC, Rosier PF, Bauer SB. ICS educational module: Cystometry in children. *Neurourology and Urodynamics*. 2018;37:2306–2310.  
<https://doi.org/10.1002/nau.23729>

## ICSTEACHING MODULE

### Urodynamics in children

#### Part 2. THE PRESSURE FLOW ANALYSIS IN CHILDREN

Jian G Wen MD, Ph.D, Jens C Djurhuus, Dr. Med. Sci.,  
Peter F.W.M Rosier MD, PhD, Stuart Bauer, MD

1. Pediatric UG-Center, First Affiliated Hospital of Zhengzhou University, China

2. Department of Clinical Medicine, Aarhus University Hospital

3. Department of Urology, University Medical Center Utrecht, The Netherlands

4. Department of Urology, Boston Children's Hospital, USA

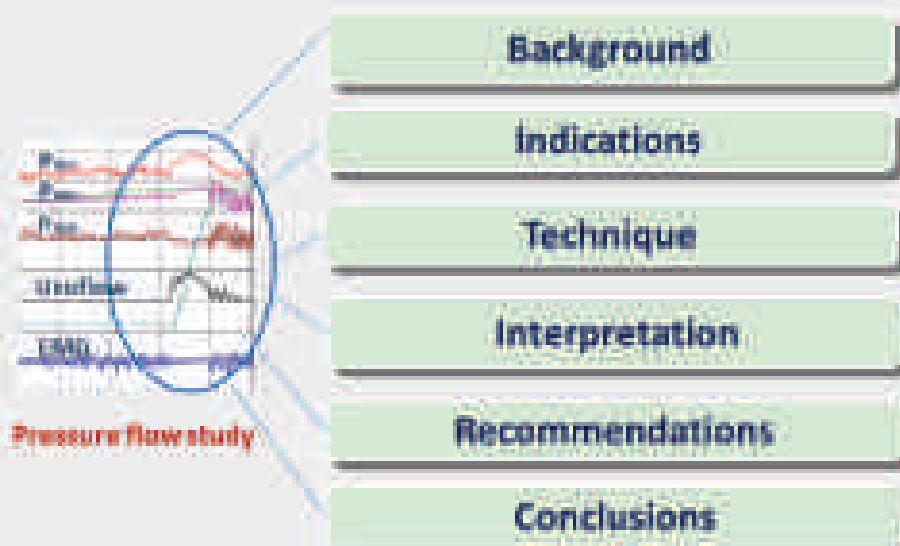
The ICS teaching module is a series of modules that are designed to provide a comprehensive overview of the field of urodynamic studies in children. The modules are designed to be used as a teaching tool for urologists and pediatric urologists.

© International Continence Society 2014



International Continence Society  
Education Module

### Pressure flow study: outline



Education Module

## Background

- Pressure flow study (PFS) is an important tool to evaluate the voiding function in children with lower urinary tract dysfunction (LUTD)/lower urinary tract symptoms (LUTS)
- PFS is defined as measuring the detrusor pressure & uroflow during the micturition or voiding phase. It begins when the child & the urodynamicist decide that 'permission to void' has been given or when uncontrollable voiding begins
- This section follows the guideline from ICS & ICCS on Good Urodynamic Practice

<http://www.ics.org/>

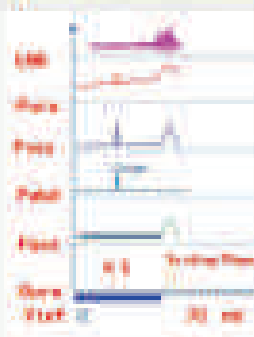
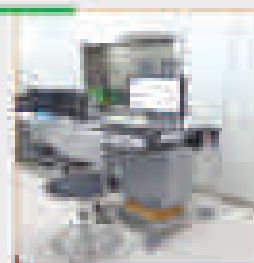
Oracle – "Pee"  
1000-2000 B.C.  
in China



ICS Education Module

## Pressure flow study (PFS)

- PFS has become the gold standard in assessing LUTD/LUTS
- During PFS  $Q_{max}$ , voided volume & detrusor pressure are recorded
- During voiding the either detrusor or urethral sphincter may be classified as normal, underactive, or overactive
- PFS can be obtained subsequent to filling cystometry with no specific additional equipment (apart from a flowmeter).

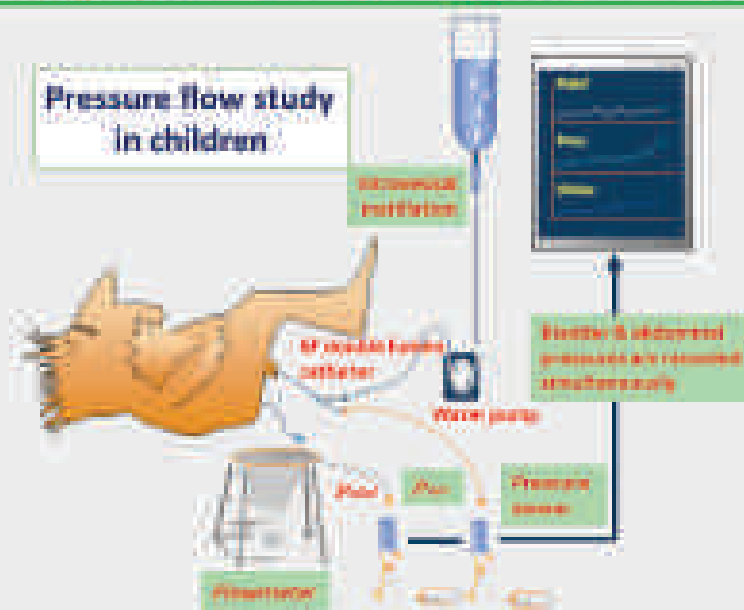


ICS Education Module

## Indications

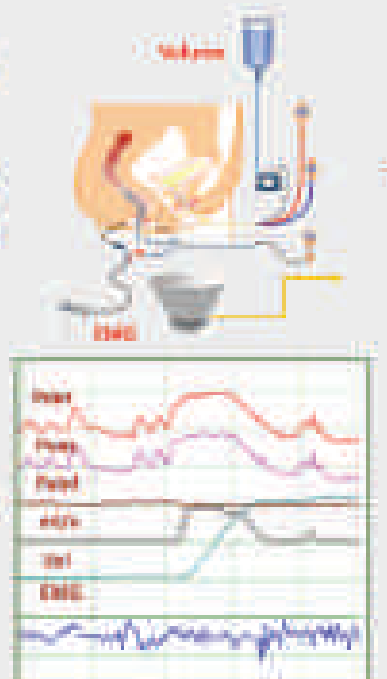
- Congenital malformations of the lower urinary tract (i.e., exstrophy, epispadias, ureterocele, multiple bladder diverticula)
- The procedure must have an impact on treatment strategies
- It is undertaken after history taking, physical examination, voiding diaries & uroflow/patch EMG recordings, if these measures do not answer the questions related to causes, nor provide effective management schemes for LUTD

## Technique: the setting is the same as in cystometry



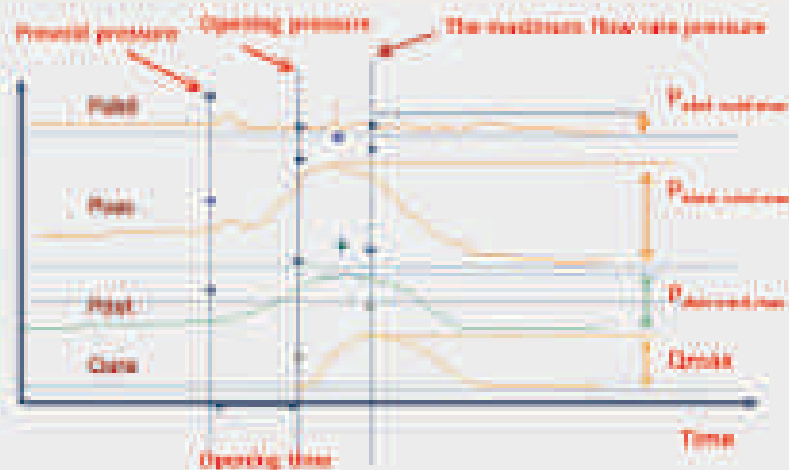
## Technique: voiding phase

- The voiding is initiated when the urodynamicist allows, or when uncontrollable voiding begins
- During the recording a flowmeter connected to the urodynamic equipment allows flow rate parameters to be juxtaposed against pressure data & correlated with one another



ICS Education Module

## Technique: parameters recorded during voiding phase



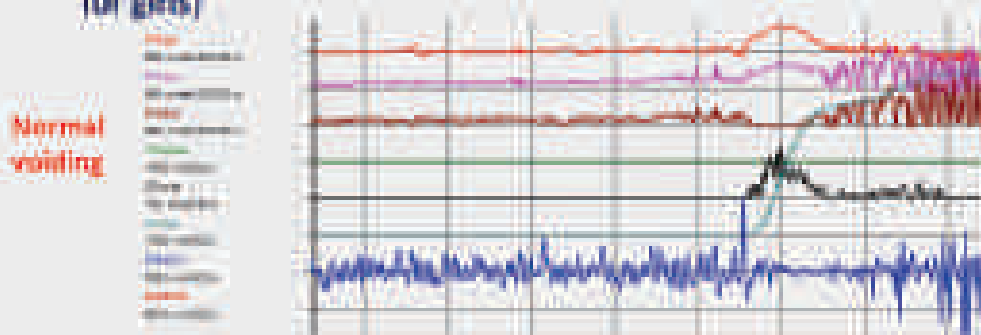
The terminology of voiding phase

ICS Education Module



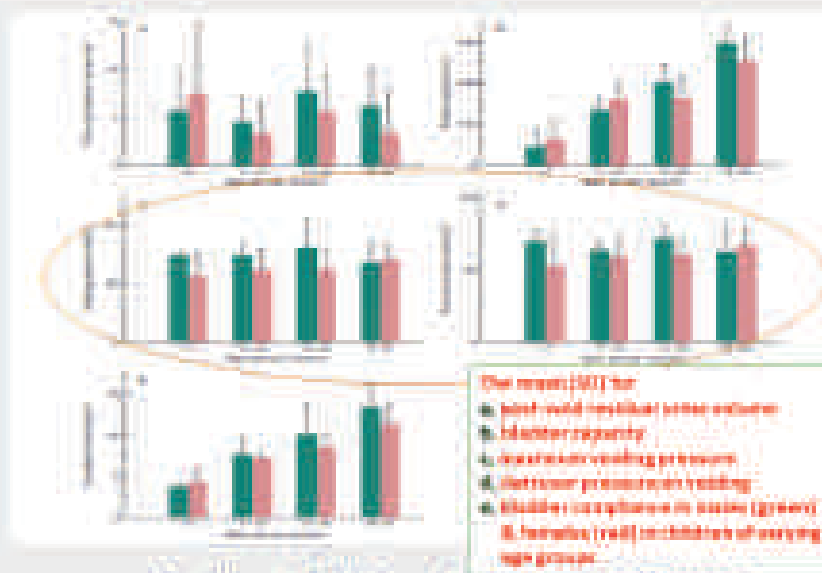
## Interpretation: normal voiding detrusor function

- Normal voiding is achieved by a voluntary, continuous detrusor contraction which leads to complete emptying of the bladder within an acceptable time span
- If the DSD occurred during the voiding, the  $P_{\text{detrusor}}$  max is higher than that of adults (118 - 127 cm H<sub>2</sub>O for boys & 72 - 75 cm H<sub>2</sub>O for girls)



ICS Education Module

## Interpretation: voiding pressure



From Wen, et al. British Journal of Urology 1998; 81, 405-10

ICS Education Module

## Interpretation: detrusor underactivity (DU)

DU is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within the normal time span. This often results in an increase of PVR on the completion of voiding.

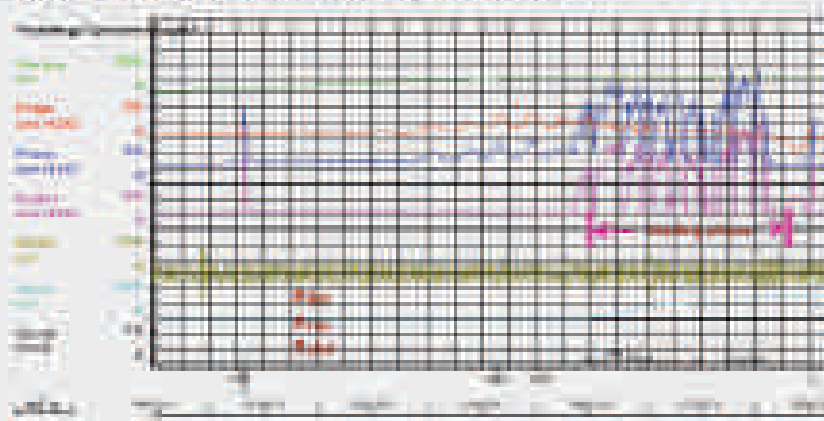


Detrusor underactivity (arrow)

ICS Education Module

## Interpretation: acontractile detrusor

An acontractile detrusor displays decreased contractile activity during urodynamic assessment



Acontractile detrusor in a child with neurogenic bladder; urination achieved by increasing abdominal pressure

ICS Education Module

## Interpretation: voiding phase

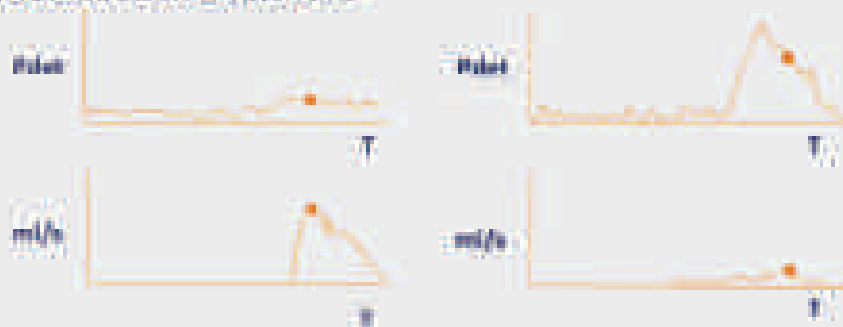
- The voiding efficiency is calculated by functional bladder capacity ( $V_{\text{func,max,250s}}$ ) / maximum bladder capacity ( $V_{\text{max,cap}}$ )
- High voiding detrusor pressures which may be induced by significant resistance as is seen in BOO. Conversely, if urethral resistance is low this may be reflected by a low pressure contraction



High voiding detrusor pressure with low  $Q_{\text{max}}$  (arrow)

## Interpretation: voiding phase

Pressure at maximum flow, in combination with corresponding maximum uroflow, give a clinically relevant grading of bladder outlet with obstruction when used in a formula



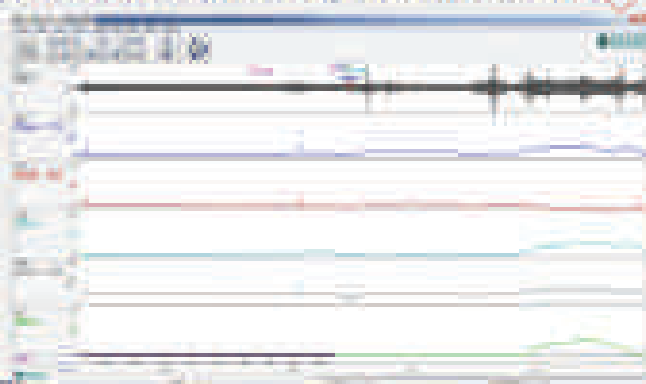
Without obstruction

Obstruction

## Interpretation: voiding phase

- DSD during voiding: a sustained or increased response or intermittent changes in urethral sphincter activity during the voiding phase
- DSD is common in infant boys. High  $P_{det, void, max}$  in infants or a staccato detrusor pressure curve during voiding indicates the existence of DSD

An increased response in urethral sphincter activity during the voiding phase (Arrow)

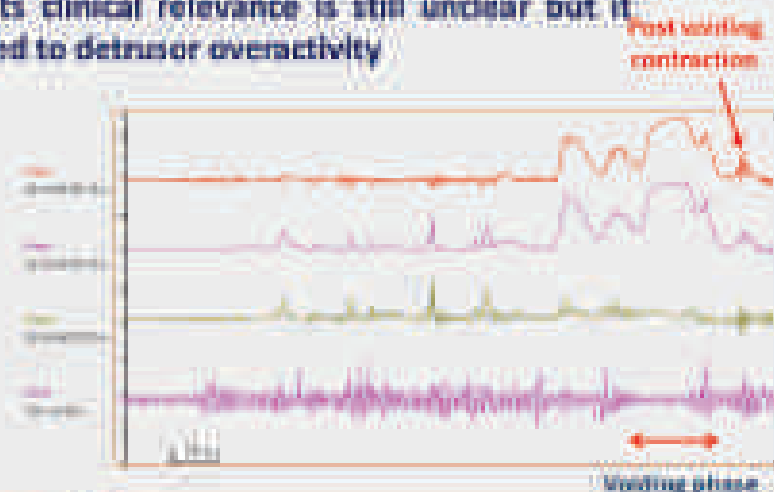


ICS Education Module

## Interpretation: voiding phase

A post voiding contraction indicates a detrusor contraction which occurs immediately after micturition has ended. Its clinical relevance is still unclear but it may be related to detrusor overactivity

A 2.5 months old baby with normal voiding

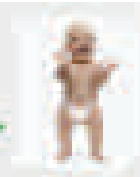


ICS Education Module

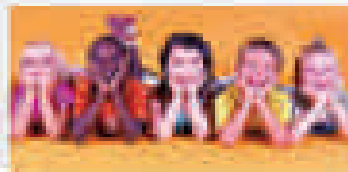
## Interpretation: how to exclude the artifact

- The parameters of free flow measurement such as the PVR & maximum flow rate are useful tools to be compared with the flow pattern during PFS. If the flow rate & PVR show big difference from that obtained from PFS, it indicates that artifacts may exist.
- For example, the flow rate was lower & the PVR substantially higher significantly compared to these parameters from the free flowmetry (before catheterization), the PFS results may be not representative of "obstructed", or "underactive" or "DSD" or "dysfunctional".

## Conclusions



- PFS is an useful tool to evaluate lower urinary tract function in children
- Investigators must keep in mind that normal bladder capacity increases with increasing age. DSD is common in infant boys so high  $P_{det\text{void}/max}$  is often seen
- To understand the characteristics in PFS, knowing normal voiding parameters as well as following ICS & ICCS recommendations are the basis of successful testing



# ICS educational module: Pressure flow study in children

Jian G. Wen<sup>1,2</sup>  | Jens C. Djurhuus MD<sup>3</sup> | Peter F.W.M. Rosier<sup>4</sup>  |  
 Stuart B. Bauer<sup>5</sup>

<sup>1</sup> Pediatric Urodynamic Centre, The First Affiliated Hospital of Zhengzhou University, Zhengzhou, China

<sup>2</sup> Department of Pediatric Surgery, The First Affiliated Hospital of Xinxiang Medical University, Weihui, China

<sup>3</sup> Department of Clinical Medicine, Aarhus University, Aarhus N, Denmark

<sup>4</sup> Department of Urology, University Medical Centre Utrecht, Utrecht, The Netherlands

<sup>5</sup> Department of Urology, Boston Children's Hospital, Boston, Massachusetts

## Correspondence

Jian G. Wen, Pediatric Urodynamic Centre, the First Affiliated Hospital of Zhengzhou University, Jianshe East Road No. 1, Zhengzhou, 450052, China.  
 Email: wenjg@hotmail.com

**Aims:** To introduce the standard procedure and results interpretation of pressure/flow study (PFS) in children.

**Methods:** The literature on PFS in children in PubMed for the last 20 years was reviewed. The updated knowledge on PFS in children regarding indication, preparation, technique, and interpretation were summarized.

**Results:** This educational module explains when and how to do a PFS and how to analyze the results. All requirements and instructions for the PFS in children described in this document follow ICS reports on Good Urodynamic Practice and urodynamic equipment performance as well as guidelines from the ICCS. PFS can be obtained subsequent to filling cystometry with no specific additional equipment (apart from a flowmeter) or patient preparation needed. It requires both vesical and intra-abdominal pressures being recorded. Information from clinical history, physical examination, voiding diaries, and free uroflowmetry with or without perineal patch EMG and pertinent imaging results should be available before undertaking urodynamic testing.

**Conclusions:** Following ICS and ICCS guidelines, PFS is an easy procedure and a useful tool to provide information on voiding function in children.

## KEYWORDS

children, pressure/flow study, procedure, urodynamics

## 1 | INTRODUCTION

Pressure/flow study (PFS) provides information on voiding function (outflow obstruction, flow pattern, detrusor contractility, and its sustainability as well as intravesical pressure). Combined with filling cystometry, it is the gold standard for evaluating voiding function in children with lower urinary tract dysfunction (LUTD)/lower urinary tract symptoms (LUTS), especially when less invasive studies fail to provide an adequate explanation for the symptoms and/or the signs of dysfunction.<sup>1–7</sup>

The aim of pressure/flow studies is to reproduce symptoms, to identify the underlying causes for voiding symptoms, and to quantify related pathophysiological processes. It is used to establish as clearly as possible a

baseline, so that changes resulting from treatment and/or growth can be assessed, indicating that the investigation may need to be repeated, and to provide some guidelines for the choice of treatment (although results of urodynamic testing may not necessarily be the deciding factor).

The ICS Urodynamics Committee presents this educational module “Pressure/flow analysis in children” to serve as a standard education module of Good Urodynamic Practice for everyone concerned when prescribing, performing, and analyzing pressure/flow testing in general and especially in children with symptoms and signs of LUTD. The educational module consists of a presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base, for the ICS PowerPoint presentation; available via <http://www.icsoffice.org/>. The presentation

explains when and how to do a PFS and how to analyze the results. The presentation and this manuscript use expert's opinion where evidence is, especially for the clinical practice aspects, unavailable and is marked with: "eo" (expert's opinion).

Voiding dysfunction is prevalent in pediatric urology practice. The subjective bias by both the child and the clinician and the considerable overlap between symptoms from varying disorders make it difficult to evaluate voiding function without employing some objective parameters. All requirements and instructions for the PFS in children described in this section follow ICS reports on Good Urodynamic Practice<sup>2,3</sup> and urodynamic equipment performance<sup>4</sup> as well as guidelines from the ICCS.<sup>5</sup> Pressure/flow measurements can be obtained subsequent to filling cystometry with no specific additional equipment (apart from a flowmeter) or patient preparation needed. It requires both vesical and intra-abdominal pressures being recorded. Information from clinical history, physical examination, voiding diaries, and free uroflowmetry with or without perineal patch EMG and pertinent imaging results should be available before undertaking urodynamic testing.

## 2 | INDICATIONS AND PREPARATION

The indications and preparation for PFS are similar to that for cystometry. Whether the child is able to void voluntarily or not, evaluation of the voiding, measured in a continuous fashion after the filling cystometry is complete, can be regarded as standard practice. The child and caregiver should be informed in advance along with an explanation as to why both phases, storage (filling), and voiding are going to be measured. The child's cooperation is explicitly sought whenever possible.

## 3 | TECHNIQUE

PFS is defined as measuring the detrusor pressure and uroflow during the micturition or voiding phase. The detrusor pressure is equal to the bladder pressure minus the abdominal pressure, thus representing the pressure produced by the detrusor. The voiding phase begins when the child and the urodynamicist decide that "permission to void" has been given, or when involuntary voiding begins.<sup>6</sup> This occurs when the maximum cystometric capacity (MCC) has been reached in children with no voiding dysfunction.<sup>7</sup> During this phase the detrusor contracts, producing voiding detrusor pressure as the bladder outlet relaxes. It is not always possible to have very young children follow instructions to void, but in older children it is.

At this phase, the detrusor pressure increases as the pelvic floor relaxes and the urethral pressure decreases resulting in

voiding. The pressures are recorded through the same catheter that is used for cystometry. During the recording, a flowmeter connected to the urodynamic equipment, allows flowrate parameters to be juxtaposed against pressure data and correlated with one another. At the completion of voiding the detrusor relaxes and the urethra/bladder outlet "closes."

During voiding the detrusor may be classified as normal, underactive, or acontractile. Normal voiding is achieved by a voluntarily initiated detrusor contraction; it is sustained and cannot be suppressed easily once it has begun. In the absence of bladder outlet obstruction, a normal contraction will lead to complete emptying.<sup>6</sup> When the child feels voiding is complete, this phase ends and storage phase begins again. During the voiding phase, a flowmeter connected to the urodynamic equipment, allows flowrate parameters to be juxtaposed against pressure data and correlated with one another.

During PFS  $Q_{\max}$  and voided volume are recorded. Pressure parameters that can be obtained during the voiding phase are: pre-micturition pressure, opening pressure, opening time, maximum detrusor pressure, detrusor pressure at maximum flow, closing pressure, minimum voiding pressure. The maximum detrusor pressure ( $P_{\det, \max}$ ) is clinically relevant in determining the presence of bladder outlet obstruction (BOO) or contractile detrusor.

After the PFS, the PVR is measured again through the catheter and confirmed by ultrasound.

### 3.1 | Cooperation

Cooperation is important for successful cystometry and PFS. The following steps might be valuable for achieving this.

- Bowel or rectum preparation; defecation (at home) before the test whenever possible.
- Dedicated and knowledgeable staff able to provide an explanation about the procedure and the aim of urodynamic studies to the patient is paramount: if applicable, engage the child to increase cooperation.
- Administration of sedatives (not anesthetics), and documenting if the child was very fearful is mandatory.
- Prior application of 1% lidocaine jelly or a liquid solution instilled into the urethra as a topical anesthetic may aid in catheter insertion.
- The approach to urodynamic evaluation should be, start with as minimally invasive tests as possible and proceed with invasive investigations, as necessary, to answer the question.
- If the child is still agitated after inserting the catheter in the bladder, having parents present to help calm their child, is advisable.
- Toys, video games, or movies during the examination are very helpful to distract the child and minimize artifact.

- Two cycles of cystometry and PFS to determine the consistency or representativeness of findings is preferable.

#### 4 | INTERPRETATION

The aim is to analyze accurately, and to critically report results after carefully performing the PFS in children.

1. Normal voiding detrusor function- Normal detrusor function is characterized by an initial (voluntary) relaxation of the external urethral sphincter/pelvic floor followed immediately by a continuous detrusor contraction that leads to complete bladder emptying within a normal time span, in the absence of obstruction.
2. Maximum voiding detrusor pressure ( $P_{\text{detr-void,max}}$ ) should be reported and related to the flowrate to determine diagnosis. The flowrate should be compared to the free flowrate as one means of evaluating the representativeness of the (pressure/flow) voiding.
3. Detrusor-Sphincter Dyssynergia (DSD): describes a detrusor contraction concurrent with an involuntary contraction of the urethral and/or periurethral striated muscle. Occasionally the flow may be prevented altogether  
 .. DSD is usually evaluated by a pressure/flow/EMG study or with simultaneous bladder/urethral pressure recordings. High  $P_{\text{detr-void,max}}$  in infants or a staccato detrusor pressure curve during voiding when flowrate reductions are synchronous with detrusor pressure increments indicate the existence of DSD.
4. PVR > 20 mL or > 15% of bladder capacity (BC) in children age 7-12 years and > 30 mL or > 21% BC for children 4-6 years on two consecutive uroflows indicates an abnormality.<sup>8</sup> The uroflow is considered normal if the bladder empties at least once during two uroflow measurements. If a low PVR is demonstrated during free flow uroflowmetry then any raised PVR during the urodynamic assessment can be considered as an artifact due to the artificial circumstances of the test and the presence of an in-situ urethral catheter.
5. Detrusor underactivity is defined as a voiding contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.<sup>8</sup> Pressure flow nomograms or calculations are needed to quantify detrusor contractility. Detrusor underactivity may occur with or without an elevated PVR.
6. An acontractile detrusor does not demonstrate any contractile activity during urodynamic assessment. Some children, however, cannot or will not generate a detrusor contraction in a "laboratory" setting. This could be mistaken for a diagnosis. Spending extra time

encouraging the child to void, dripping water on the pubic area, or lower extremity and/or having the mother or caregiver encourage the child to void, helps in the process to induce the child to urinate.

7. A high voiding detrusor pressure (usually > 74 cmH<sub>2</sub>O in boys, 63 cmH<sub>2</sub>O in girls<sup>7</sup>) with a low urine flow indicates BOO; low pressure with a low flow indicates underactive detrusor. A pressure flow plot is useful to evaluate the pressure flow relationship in this regard, although clinical calibration is not yet available for children.
8. High voiding detrusor pressures may be induced by significant resistance as is seen in BOO where the detrusor compensates for BOO. Conversely if urethral resistance is low this may be reflected by a low pressure (high velocity) detrusor contraction.
9. A post voiding contraction indicates a detrusor contraction that occurs immediately after micturition is complete. Its clinical relevance is uncertain, but it may be related to detrusor overactivity and/or a sign of CNS dysfunction as well as collapsing mucosa on catheter pressure channel openings.
10. Bladder voiding efficiency (BVE) = (voided volume/total bladder capacity) × 100%.<sup>9</sup>
11. Cystometry volume parameters can be corrected for any diuresis during the test after pressure flow study by immediately recording the PVR and adding it to the voided volume.

The parameters of free flow measurement such as the PVR and maximum flowrate are useful for determining the accuracy of the flowrate and PVR obtained from PFS. If the flowrate and PVR show substantial differences from those obtained during PFS, it indicates an artifact may exist. For example, if the flowrate is lower and the PVR, significantly higher compared to that obtained from free flowmetry (before catheterization), the PFS results may be not representative.

#### 5 | CONCLUSION

PFS is a useful tool for evaluating lower urinary tract function in children. It should be considered as one procedure, along with a "free" voiding uroflowmetry and filling cystometry, but not the only one, to clarify the diagnosis and to make therapeutic decisions as well as to follow up treatment responses to the voiding dysfunction, when less invasive studies are inconclusive. To understand the characteristics in PFS, normal voiding parameters as well as following GUP recommendations from the ICS and ICCS are the basis of successful testing. We present the evidence background for the PowerPoint presentation, to be used for educational the practice of the test, as is available on the ICS website.



## ORCID

Jian G. Wen  <http://orcid.org/0000-0003-0952-118X>

Peter F.W.M. Rosier  <http://orcid.org/0000-0003-0445-4563>

## REFERENCES

1. Wen JG, Lu YT, Cui LG, et al. Bladder function development and its urodynamic evaluation in neonates and infants less than 2 years old. *Neurourol Urodyn*. 2015;34:554–560.
2. Schafer W, Abrams P, Liao L, et al. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21:261–274.
3. Rosier P, Schaefer W, Lose G, et al. International Continence Society good urodynamic practices and terms 2016: urodynamics, uroflowmetry, cystometry, and pressure-flow study. *Neurourol Urodyn*. 2017;36:1243–1260.
4. Gammie A, Clarkson B, Constantinou C, et al. International Continence Society guidelines on urodynamic equipment performance. *Neurourol Urodyn*. 2014;33:370–379.
5. Bauer SB, Nijman RJ, Drzewiecki BA, et al. International Children's Continence Society standardization report on urodynamic studies of the lower urinary tract in children. *Neurourol Urodyn*. 2015;34:640–647.
6. Christopher RC, Scott AM, Anand P. *Urodynamics Made Easy*. 3rd ed. London: Elsevier Churchill Livingstone; 2009;83–102.
7. Wen JG, Tong EC. Cystometry in infants and children with no apparent voiding symptoms. *Br J Urol*. 1998;81:468–473.
8. Austin PF, Bauer SB, Bower W, et al. The standardization of terminology of lower urinary tract function in children and adolescents: update report from the standardization committee of the International Children's Continence Society. *Neurourol Urodyn*. 2016;35:471–481.
9. Abrams P. Bladder outlet obstruction index, bladder contractility index and bladder voiding efficiency: three simple indices to define bladder voiding function. *BJU Int*. 1999;84:14–15.

**How to cite this article:** Wen JG, Djurhuus JC, Rosier PF, Bauer SB. ICS educational module: Pressure flow study in children. *Neurourology and Urodynamics*. 2018;37:2311–2314.  
<https://doi.org/10.1002/nau.23730>

## 6. ICS GLOSSARY

Welcome to the ICS Glossary of Terminology. Find the latest terms standardised by ICS.

Please also visit [www.ics.org/glossary](http://www.ics.org/glossary) to browse by glossary section, by letter or search to find the terms and appropriate reference you need to cite in your work.



**Bernard Haylen**

ICS Glossary Editor & Standardisation Steering Committee Chair

### A

#### **Abdominal leak point pressure (ALPP - cm H<sub>2</sub>O)**

##### *Investigation*

This is a dynamic test. It is the intentionally increased abdominal pressure that provokes urine leakage in the absence of a detrusor contraction.

#### **Abdominal Leak Point Pressure (female) - ALPP - cm H<sub>2</sub>O**

##### *Investigation*

Abdominal leak point pressure (abdominal LPP): This is a dynamic test. It is the lowest value of the intentionally increased intravesical pressure that provokes urinary leakage in the absence of a detrusor contraction.<sup>32</sup> The increase in pressure can be induced by a cough (cough LPP) or Valsalva (Valsalva LPP). Multiple estimates at a fixed bladder volume (200–300 ml) are desirable. Catheter size will influence LPP values and should be standardized. LPP values might also be affected by many other factors such as the technique to confirm urine loss, location of catheter, type of pressure sensor, bladder volume, rate of bladder filling, and patient position. A low abdominal LPP is suggestive of poor urethral function.

#### **Abdominal Pressure Catheter for Urodynamics**

##### *Investigation*

'Flaccid filled' punctured balloon in the rectal ampulla are used to measure abdominal ('perivesical') pressure. vaginal or stoma placement of the abdominal pressure catheter is used alternatively only if rectal catheter placement is impossible.

#### **Abdominal pressure (p abd - female)**

##### *Investigation*

The pressure surrounding the bladder. It is usually estimated from measuring the rectal pressure, though vaginal and infrequently the pressure through a bowel stoma can be measured as an alternative. The simultaneous measurement of abdominal pressure is essential for interpretation of the intravesical pressure trace. Artefacts on the detrusor pressure trace may be produced by an intrinsic rectal contraction.

#### **Abdominal pressure (Pabd - cm H<sub>2</sub>O) - male**

##### *Investigation*

The pressure in the abdominal cavity surrounding the bladder. Usually estimated by measuring the rectal pressure, though pressure through a bowel stoma can be an alternative. The simultaneous measurement of abdominal pressure is essential for interpretation of the intravesical pressure trace. Artefacts on the detrusor pressure trace may be produced by a rectal contraction.

#### **Abdominal signs**

##### *Sign*

Amongst numerous possible abdominal signs are: (i) Bladder fullness / retention: The bladder may be felt by abdominal palpation or suprapubic percussion; (ii) Other abdominal masses: or distension (e.g. ascites); (iii) Scars: indicating previous relevant surgery or traumas or evidence of previous radiotherapy; (iv) Renal Area: Examination for tenderness, masses.

#### **Abnormal (bladder filling) sensations**

##### *Symptom*

Complaint of an awareness of sensation in the bladder, urethra or pelvis, described with words like "tingling", "burning" or "electric shock", in the setting of a clinically relevant neurologic disorder (e.g. incomplete spinal cord lesion).

#### **Abnormal sensations - Filling cystometry**

##### *Investigation*

Awareness of sensation in the bladder, urethra or pelvis described with the words like "tingling", "burning" or "electric shock" in the setting of a clinically relevant neurologic disorder (e.g. incomplete spinal cord lesion).

#### **Abnormal urethral function during voiding - pressure flow studies**

##### *Investigation*

The urethral sphincter(s) do not relax completely or they are (temporarily) contracted during voiding, resulting in increased detrusor pressure. Bladder emptying may be complete or incomplete (PVR present).

#### **Absent bladder filling sensation**

##### *Symptom*

Complaint of both the absence of the sensation of bladder filling and a definite desire to void.

#### **Absent bladder sensation - filling cystometry**

##### *Investigation*

No bladder sensation during filling cystometry, at least to expected capacity of 500 mL.

#### **Absorbent Products**

##### *Conservative Management – Female*

Absorbent products are those that have been specifically developed to help manage leakage or soiling, such as absorbent pads and pants, absorbent bed sheets and chair covers.

**Abstinence (sexual) due to pelvic organ prolapse***Symptom*

Non-engagement in sexual activity due to prolapse or associated symptoms.

**Accuracy of Uroflowmeters***Investigation*

The desired clinical accuracy may differ from the technical accuracy of a flow meter. The ICS Technical report recommended the following standards: a range of 0-50 ml/s for Q<sub>max</sub> and 0-1,000 ml for voided volume, maximum time constant of 0.75 s ; an accuracy of 5% relative to full scale, although a calibration curve representing the percentage error over the entire range of measurement should be made available.

However, technical specifications from the manufacturers are rare and often not in accordance with ICS recommendations: this situation should be rectified .

**Acontractile detrusor - pressure flow studies***Investigation*

The detrusor cannot be observed to contract (i.e. no increase in P<sub>det</sub>) during urodynamic studies resulting in failure to void (CHANGED). Limited voiding may occur by straining. The possibility of "inhibition" of a detrusor voiding contraction must be considered if the man subsequently voids normally post-cystometry. An acontractile detrusor can be of neurogenic or non-neurogenic origin.

**Acute on chronic retention***Diagnosis*

An individual with chronic retention goes into acute retention and is unable to void.

**Acute Pain***Symptom*

Pain related to acute trauma, infection or other well-defined disease process.

**Acute urinary retention***Symptom*

Complaint of a rapid onset, usually painful suprapubic sensation (from a full bladder) due to the inability to void (non-episodic), despite persistent intensive effort.

**Acute urinary retention***Diagnosis*

A patient is unable pass any urine despite having full bladder, which on examination is painfully distended and readily palpable or percussible.

**Acute urinary tract infection symptoms***Symptom*

Symptoms such as increased bladder sensation, urgency, frequency, dysuria/stranguria, pain in the lower urinary tract with or without urgency urinary incontinence might suggest lower urinary tract infection. Confirmation of a UTI requires evidence of significant microorganisms and pyuria.

**Adult***Sign*

Fully grown and physically mature.

**Adult neurogenic lower urinary tract dysfunction (ANLUTD)***Diagnosis*

Abnormal or difficult function of the bladder, urethra (and/or prostate in

men) in mature individuals in the context of clinically confirmed relevant neurologic disorder.

**Adult neurogenic lower urinary tract dysfunction (ANLUTD) - symptoms***Symptom*

LUTS are classified neurogenic in the presence of a relevant neurological disease ONLY.

**Aims of Clinical Urodynamics***Investigation*

The aim of clinical urodynamics is to reproduce symptoms whilst making precise measurements in order to identify the underlying causes for the symptoms, and to quantify the related pathophysiological processes. By doing so, it should be possible to establish objectively the presence of a dysfunction and understand its clinical implications. Thus, we may either confirm a diagnosis or give a new, specifically urodynamic diagnosis. The quantitative measurement may be supplemented by imaging (video-urodynamics).

**Aims of filling cystometry***Investigation*

These are to assess bladder sensation, bladder capacity, detrusor activity and bladder compliance as well as to document (the situation of and detrusor pressures during) urine leakage.

**Altered libido***Symptom*

Complaint of change in interest in sexual activity

**Ambulatory urodynamics***Investigation*

A functional test of the lower urinary tract for which a transurethral catheter is placed in the bladder -performed outside the clinical setting, involving natural bladder filling by drinking and continuous recording of bladder pressure (P<sub>ves</sub>) for a longer period of time (e.g. 12 hours). It can reproduce bladder function and urine loss during an individual's everyday activities.

**Anal Canal - Endoanal ultrasonography (EAUS)***Imaging*

Anal Canal - The anal canal in adults is between 2.5 and 5cm in length and begins as the rectum narrows, passing posteriorly between the levator ani. Three levels of assessment in the axial plane.

- (1) Upper level: the hyperechoic sling of the puborectalis muscle (PR) and the complete ring of the internal anal sphincter (IAS).
- (2) Middle level: corresponds to the superficial part of the EAS (concentric band of mixed echogenicity), the conjoined longitudinal layer, the IAS (concentric hypoechoic ring), and the transverse superficial perineal muscles.
- (3) Lower level: corresponds to the subcutaneous part of the EAS where the IAS is absent.

**Anal endosonography (AES) - ultrasound imaging (male)***Imaging*

Anal ultrasound imaging looking for sphincter defects.

**Anal fissures***Sign*

Longitudinal split in the skin of the anal canal, exposing the internal anal sphincter muscle. The majority of fissures are found in the mid-line posteriorly and there may be a skin tag associated with them.

**Anal incontinence***Symptom*

Complaint of involuntary loss of flatus or feces.

### **Anal laxity**

#### *Symptom*

Complaint of the feeling of a reduction in anal tone.

### **Anal Manometry**

#### *Investigation*

Anal manometry is a test to assess the mechanical strength of the anal sphincters. A range of methods is available, including water perfused, solid state, and micro-balloon systems. The length of the canal is measured either by station pull-through or continuous pull-through. Station pull-through involves inserting the catheter to 6cm from the anal verge, withdrawing the catheter at 5–10mm intervals and measuring for 1–5min at each “station”. Continuous pull-through involves withdrawing the catheter at a set speed by hand or by a mechanical puller. As normal values can differ substantially between laboratories according to the style of catheter used, each unit is encouraged to generate its own normal data. In patients with fecal incontinence the value of manometry is: (a) To define functional weakness of one or both sphincter muscles (as a compliment to anal endosonography). (b) To support findings of other tests and to monitor outcome and predict response to biofeedback training. (c) In cases where anal endosonography is not available, vector manometry may help identify anatomic defects of the anal sphincter complex. In constipated patients the value of manometry is: (a) To exclude Hirschsprung's disease. (b) To identify and predict responses to biofeedback training (pelvic floor dyssynergia = failure to expel a water-filled balloon).

### **Anal Manometry - Balloon expulsion pressure**

#### *Investigation*

The balloon expulsion pressure is the anal canal pressure during straining with a filled balloon in the rectum. Balloon expulsion can be performed on patients with evacuatory difficulty. An inappropriate increase in sphincter pressure on attempted voiding evacuation is usually reported as a present or absent response, rather than numerically. Such increased pressure is referred to as “anismus” or “paradoxical sphincter contraction.”

### **Anal Manometry - Endurance Squeeze Pressure**

#### *Investigation*

The endurance squeeze pressure is the length of time the individual is able to maintain the pressure during a voluntary contraction. To assess the endurance squeeze pressure, measurements are taken during a 5–10sec squeeze (normal 5sec). Incontinent patients typically have fatigue rate of greater than two-thirds of initial pressure at the end of the sustained squeeze. By calculating fatigability, the fatigue rate (using linear regression on the mean pressure over one second periods throughout the endurance squeeze) can be derived.

### **Anal Manometry - Involuntary Maximum Squeeze Pressure**

#### *Investigation*

A common maneuver is a maximal cough to measure this involuntary increment, usually reported as a present or absent response, rather than numerically.

### **Anal Manometry - Maximum resting pressure**

#### *Investigation*

The maximum resting pressure is the maximum resting pressure generated in the anal canal at rest. Strictly speaking, it is defined as the difference between the intrarectal pressure and the highest recorded rectal pressure at rest. However, rectal contents may affect the accuracy of rectal pressure measurements. The internal anal sphincter (IAS) exhibits continuous tonic activity and is responsible for 55–85% of the resting anal canal pressure. Its

contribution to resting tone is variable along the length of the anal canal with the proximal two thirds being more reliant on IAS tone to maintain adequate resting pressures. The range of maximal resting pressure is typically between 60 and 120cm H<sub>2</sub>O. The EAS has constant tonic activity contributing to the resting anal canal pressure.

### **Anal Manometry - Maximum Squeeze Pressure**

#### *Investigation*

The maximum squeeze pressure is the maximum pressure generated in the anal canal during a voluntary contraction. Although the EAS contributes to the resting pressure the specific function of the EAS can be assessed during the squeeze and cough maneuvers. The pressure increment above resting pressures during these maneuvers is a direct representation of EAS function. The normal range, as stated above, varies according to measurement modality in each laboratory, but is approximately above 60 cm H<sub>2</sub>O. Typically, higher values are obtained by automated pull-through rather than station withdrawal methodologies.

### **Anal Manometry - Rectoanal Inhibitory Reflex (RAIR)**

#### *Investigation*

The recto-anal inhibitory reflex (RAIR) a relaxation response in the IAS following rectal distension. A drop of at least 25% of resting pressure has to occur with subsequent restoration to at least two thirds of resting pressure for it to be deemed present. It is elicited by rapid insufflation and disinflation of 50mls of air into a balloon positioned in the distal rectum during anal manometry at the level of the proximal high pressure zone. This reflex is absent in Hirschsprung's disease: of greater physiological meaning, this reflex is thought to underlie the sampling response that allows rectal content to be sensed by the anal mucosa, thus ensuring continence of flatus and stool.

### **Anal Manometry (Advanced) - High Resolution Manometry**

#### *Investigation*

In this technique, a catheter with a large number of pressure sensors spaced less than 0.5mm apart along the length of the catheter. This allows complete definition of the intra-anal pressure environment. The resulting data is displayed on a topographical three dimensional plot to allow easier pattern recognition. It is a measurement with the variables of pressure (displayed as the color), distance into the anal canal (y-axis) and time (x-axis). Normal ranges are slightly higher than measured with standard manometry, but the readings agree well with each other.

### **Anal Manometry (Advanced) - Vector Manometry**

#### *Investigation*

Vector manometry is a quantitative measure of radial symmetry and volume of the anal sphincter. It involves withdrawing (commonly using a mechanical puller) a radially arranged multi-channel anorectal manometry catheter through the length of the anal canal. The following parameters are identified: Radial asymmetry index (RAI) is a quantitative measure of the radial symmetry and can be calculated at any level in the anal canal but most commonly refers to the level at which the highest resting pressure is generated. The principle is that an asymmetrical sphincter is more likely to have a sphincter defect. The vector volume is the volume of the 3D shape generated and provides a value which reflects the overall length and symmetry of the sphincter.

### **Anal Plugs**

#### *Conservative Management – Female*

Anal plugs are containment devices aimed at blocking the loss of stool to control fecal incontinence. Plugs come in different designs, sizes, and compositions, such as polyurethane and polyvinyl-alcohol.

### **Anal sexual practices with body parts**

#### *Symptom*

Stimulation of the anus and/or rectum with bodily parts other than the penis (e.g., finger, fist) for sexual purposes by the recipient and/or a partner.

### **Anal Sexual practices with non-living objects**

#### *Symptom*

Stimulation of the anus and/or rectum with non-living objects (e.g., dildo) for sexual purposes by the recipient and/or a partner.

### **Anejaculation**

#### *Symptom*

Complaint of the absence of seminal fluid emission. May be associated with the absence of the sensation of orgasm or anorgasmia.

### **Anodyspareunia**

#### *Symptom*

Complaint of pain or discomfort associated with attempted or complete anal penetration.

### **Anorectal examination - female position**

#### *Sign*

The patient lies in the left lateral position with hips flexed and ankles away from the examiner. Dorsal lithotomy position could also be used.

### **Anorectal examination (female) - perianal sensation/ reflex**

#### *Sign*

In patients with possible neurogenic pelvic floor dysfunction there should be particular note of those neurological signs related to S2-4 but these should be complimented by a more general neurological examination as indicated. Specific to ano-rectal dysfunction, assessment of anal reflex, and perianal sensation should be performed.

### **Anorectal incontinence**

#### *Symptom*

Complaint of involuntary loss of flatus or feces.

### **Anorectal Manometry - Ambulatory**

#### *Investigation*

Using solid-state catheters, prolonged ano-rectal motor events have been recorded, including in ambulant subjects. The clinical applicability of these techniques has not been established.

### **Anorectal Neurophysiology - Pudendal Nerve Terminal Motor Latencies (PNTML)**

#### *Investigation*

The PNTML is a measurement of the delay between the electrical stimulation of the pudendal nerve and the EMG activity of the EAS. The pudendal nerve is stimulated as it passes over the ischial spine using a specially designed electrode attached to the index finger of the assessor in the rectum. The surface EMG recording electrode which sits on the base of the assessor's index finger and measures external sphincter activity. The test does not reliably reflect the pudendal nerve damage. This may be because PNTMLs measure the speed of nerve conduction, which involves the fastest nerve fibers that are least susceptible to damage. The latencies are reported as normal if below 2.2msec, but are also very operator dependent, with poor reproducibility and hence not recommended for general clinical use.

### **Anorectal neurophysiology - Surface EMG**

#### *Investigation*

Electrodes placed on the skin of the perineum or inside the vagina or rectum. Surface recordings from the sphincter show increased activity with

body actions and decreased activity in sleep. Needle EMG however is regarded as superior. Some centers use surface EMG as an indicator of anal sphincter activity to provide feedback for patients undergoing behavioral biofeedback training for fecal incontinence or constipation.

### **Anorectal Neurophysiology (female) - Concentric fibre EMG**

#### *Investigation*

Concentric needle EMG can be used to record activity in the external sphincter and puborectalis. The responses of these muscles to voluntary contraction, coughing and straining can be displayed. The data are qualitative and compared to appearances in these muscles at rest. The muscles can also be studied at several sites to define areas of functioning muscle and identify sites of muscle injury (sphincter mapping) although this has now been superseded by anal endosonography.

### **Anorectal neurophysiology (female) - single fibre EMG**

#### *Investigation*

A single fiber needle EMG technique is used to measure the muscle fiber density in the external sphincter and puborectalis. A raised fiber density indicates re-innervation in the muscles, which may occur following partial denervation. Calculating EAS fiber density is another method of assessing denervation and re-innervation of the EAS. It is used almost exclusively as a research tool. Conventional EMG can be used to quantify the re-innervation of the EAS by detecting prolongation in the duration of the motor unit potential.

### **Anorectal pain symptoms**

#### *Symptom*

Complaint of pain, pressure or discomfort particularly during defecation or straining to defecate, but can occur at any time.

Pain during defecation or straining to defecate.

Inflammatory: characterized by burning or stinging

Non-inflammatory: blunted anorectal or muscular-spasm type pain

### **Anorectal Pain Syndromes (Female)**

#### *Diagnosis*

1: Levator ani syndrome: Episodic rectal pain caused by spasm of the levator ani muscle. Proctalgia fugax (fleeting pain in the rectum) and coccydynia (pain in the coccygeal region) are variants of levator ani syndrome. 2: Proctalgia fugax definition: Proctalgia fugax (or Levator syndrome) is a severe, episodic, rectal and sacrococcygeal pain. It can be caused by cramp of the pubococcygeus or levator ani muscles 3: Pudendal neuralgia Pudendal Neuralgia (PN) is a painful condition that is caused by inflammation of the pudendal nerve involving its dermatome. It can affect both men and women.

### **Anorectal prolapse**

#### *Symptom*

Complaint of external protrusion (bulge) of the anus or rectum (differentiation on subsequent examination between rectal mucosal prolapse and full thickness rectal wall prolapse which includes muscle and serosal layers).

### **Anorectal prolapse (female)**

#### *Symptom*

Complaint of a "bulge" or "something coming down" towards or through the anus/rectum. The woman may state she can either feel the bulge by direct palpation or see it aided with a mirror

### **Anorectal prolapse (female)**

#### *Sign*

Full thickness eversion of the lower part of the rectum and anal canal. The exposed mucosa is red with circumferential folds around the central pit,

which is the lumen of the rectum. Look for associated utero-vaginal prolapse, fistulas, sepsis, and ulcers.

### **Anorectal sensory measurements (female) - Assessment of rectal sensation to distension**

#### *Investigation*

Rectal sensation to distension is most commonly assessed by manually inflating an intrarectal domestic balloon at a rate of approximately 5ml/second. The following are elicited: Volume which elicits the first sensation of balloon expansion (threshold) [typical normal range 12–25ml], Volume to get an urge to defecate (typical normal range 35–65ml), Maximal tolerated volume (typical normal range 120–300ml) - [normal ranges for the latter two sensations are highly variable due to lack of consensus on measurement technique especially of the nature and speed of inflation of the balloon]. The pressure required to elicit these sensations can also be measured using an electro-mechanical barostat and may be more reproducible. The barostat measures the volume and the pressure required to elicit these volumes sensations. Typically distension thresholds with a barostat are higher, with larger volumes being required to elicit the same sensation. However, again, the published ranges vary widely between units: typically distension volumes 1.5 to 3 times are published for thresholds with a barostat compared to manual balloon inflation. Distension sensitivity testing is of proven value in: (a) Patients with fecal incontinence to help with biofeedback training by normalization of the initial sensation sensory thresholds. (b) Identifying visceral hypersensitivity, poor rectal compliance, or rectal irritability if maximal tolerated volumes are low. There is no evidence to support use of the sensory thresholds for diagnosis and biofeedback training of patients with constipation. Compliance testing has also not proven valuable in identifying candidates for specific therapies.

### **Anorectal sensory measurements (female) - Mucosal Electrosensitivity**

#### *Investigation*

This is test to measure anal and rectal sensory thresholds. Mucosal electrical stimulation is performed using a probe with two ring electrodes between which a small electrical potential is applied generating an alternating square wave with a variable frequency. Normal ranges have been established as anal electrosensation <10mA, and rectal as <30mA. In general, prolonged anal electrosensation is suggestive of damage to the sensory fibers of pudendal nerve, and prolonged rectal electrosensation is suggestive of autonomic neuropathy.

### **Anorectal Sepsis**

#### *Diagnosis*

1: Abscess Infection in a (non Crohn's) anal gland, located at the base of the dentate line, that initially forms an abscess, which can be located in one of the potential spaces surrounding the anus and rectum. 2: Ano-rectal/vaginal/perineal fistula: Rectovaginal fistula is a communication from the rectum to the vagina and rarely the perineal area. An anovaginal/perineal fistula is an abnormal communication from the anal canal to the vagina or perineal area.

### **Anorectal/vaginal/perineal fistula**

#### *Sign*

Is an abnormal communication from the anal canal to the vagina or perineal area.

### **Ano-rectal/vaginal/perineal fistula**

#### *Sign*

Is an abnormal communication from the anal canal to the vagina or perineal area.

### **Anorgasmia or difficulty in achieving orgasm (female)**

#### *Symptom*

Complaint of lack of orgasm; the persistent or recurrent difficulty, delay in or absence of attaining orgasm following sufficient sexual stimulation and arousal, which causes personal distress.

### **Anorgasmic intercourse**

#### *Symptom*

Complaint of lack of orgasm; the persistent or recurrent difficulty, delay in or absence of attaining orgasm following sufficient sexual stimulation and arousal, which causes personal distress.

### **Anoscopy of proctoscopy**

#### *Investigation*

This is the inspection of the anal canal to identify anal fissure, fistula, or hemorrhoids as a cause of anal symptoms.

### **Anterior enterocele**

#### *Sign*

Hernia of peritoneum and possibly abdominal contents into the anterior vaginal vault, most commonly after prior reconstructive surgery.

### **Anterior vaginal repair - colporrhaphy - native tissue**

#### *Surgery – Female*

Repair the vaginal by excision and suturing of the edges of any defect, most commonly by midline fascial plication.

### **Anterior vaginal repair (colporrhaphy) - mesh or graft re-inforcement**

#### *Surgery – Female*

A structural addition or inclusion used to give additional strength in function. It should be noted whether the graft is biologic, absorbable synthetic or permanent synthetic.

### **Anterior vaginal wall (compartment) prolapse**

#### *Sign*

Observation of descent of the anterior vaginal wall (compartment). Most commonly this might represent bladder prolapse (cystocele). Higher stage anterior vaginal wall prolapse will generally involve descent of uterus or vaginal vault (if uterus is absent). Occasionally there might be an anterior enterocele (hernia of peritoneum and possibly abdominal contents), most commonly after prior reconstructive surgery.

### **Anterior vaginal wall (compartment) prolapse**

#### *Imaging*

Diagnosis by symptoms and clinical examination, assisted at times by any relevant imaging (i.e. clinically evident) descent of the anterior vaginal wall (compartment).

### **Anterior vaginal wall (compartment) prolapse**

#### *Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the anterior vaginal wall (compartment).

### **Anteverted uterus**

#### *Sign*

The axis of the uterus is directed forwards overlying the bladder. Cervix is noted in/ towards the posterior fornix with fundus perhaps palpable anteriorly on bimanual palpation.

### **Aseptic intermittent catheterization**

Conservative Management – General



This implies genital antiseptic preparation and the use of sterile (single-use) catheters and instruments/gloves in a designated clean area.

### **Associated POP-related Radiology (female)**

#### *Imaging*

Defecography demonstrates normal anatomy of the anorectum as well as disorders of rectal evacuation. With barium paste inserted rectally prior to defecation, measurement of the anorectal angle is allowed with evidence of the presence, size or emptying of any rectocele. Enteroceles, rectal intussusception and mucosal prolapse might be diagnosed as well as a spastic pelvic floor (anismus).

### **Atrophic**

#### *Sign*

Decrease from previous normal size of the body or a part, cell, organ, or tissue. An organ or body part's cells may be reduced in number, size or both. Atrophy of some cells and organs is normal at certain points in the life cycle. Other causes include malnutrition, disease, disuse, injury, and hormone over- or underproduction

### **Autonomic dysreflexia**

#### *Diagnosis*

## **B**

### **Balanitis xerotica obliterans (BXO - syn lichen sclerosis et atrophicus)**

#### *Symptom*

Depigmentation of the penile skin, scrotum or glans.

### **Balanoposthitis**

#### *Sign*

Inflammation of the foreskin and glans penis.

### **Behavioral and Cognitive Therapies**

#### *Conservative Management – Female*

The way someone behaves, especially toward other people, and behavioral science is the study of human behavior.

1. Behavior therapy: a type of psychotherapy that attempts to modify observable maladjusted patterns of behavior by substituting a new response or set of responses to a given stimulus. The treatment techniques involve the methods, concepts, and procedures derived from experimental psychology; they include assertiveness training, aversion therapy, contingency management, flooding, modeling, operant conditioning, and systematic desensitization. It is also called behavior modification. 2. Cognitive therapy: any of the various methods of treating mental and emotional disorders that help a person to change their attitudes, perceptions, and patterns of thinking, from rational to realistic thoughts about the self and situations. The technique is often used in association with behavior therapy principles. 3. Cognitive behavior therapy (CBT): Cognitive techniques are often used in association with behavior therapy principles; this is called cognitive behavior therapy (CBT).

### **Bladder abnormalities - ultrasound imaging (male)**

#### *Imaging*

Tumor, foreign body, overdistension, stones, diverticulum.

### **Bladder compliance - factors affecting (female)**

#### *Investigation*

(i) Bladder filling: Faster filling is more provocative. An artifact may be produced which settles when filling is interrupted; (ii) Contractile / relaxant

This is a syndrome resulting from upper thoracic or cervical spinal cord injury above T6, elicited by a stimulus in the field of distribution of the autonomic sympathetic nucleus, characterized by unregulated sympathetic function below the lesion and compensatory autonomic responses. Can be asymptomatic if there is an increase in blood pressure without any other symptoms.

### **Average (urine) flow rate (AUFR - mL/s) - Qave**

#### *Investigation*

Voided volume divided by the flow time.

### **Average voided volume**

#### *Sign*

Summation of volumes voided divided by the number of voided during an assessment period of frequency-volume chart (FVC).

properties of the detrusor: e.g. post-radiation changes of the detrusor wall; (iii) Starting point for compliance calculations: Usually the detrusor pressure at the start of bladder filling and the corresponding bladder volume (usually zero); (iv) End point for compliance calculations: The detrusor pressure (and corresponding bladder volume) at cystometric capacity or immediately before the start of any detrusor contraction that causes significant leakage (and therefore causes the bladder volume to decrease, affecting compliance calculations). Both points are measured excluding any detrusor contraction.

### **Bladder (detrusor) compliance - filling cystometry (mL/cmH<sub>2</sub>O)**

#### *Investigation*

Relationship between the change in bladder volume and change in detrusor pressure as a measure for the distensibility of the bladder. Compliance = Change Vol/ change Pdet. Compliance reflects the amount of fluid in the bladder to increase the bladder pressure by 1 cm H<sub>2</sub>O (mL per cm H<sub>2</sub>O)

### **Bladder diary**

#### *Sign*

Adds to the Frequency Volume Chart (FVC), the fluid intake, pad usage, incontinence episodes, the degree of incontinence and the circumstances at the time of the leakage.

Episodes of urgency and sensation might also be recorded, as might be the activities performed during or immediately preceding the involuntary loss of urine. Additional information obtained from the bladder diary involves: severity of incontinence in terms of leakage episodes and pad usage.

### **Bladder expression**

#### *Conservative Management – General*

This refers to various compression manoeuvres aimed at increasing intravesical pressure to facilitate bladder emptying with or without obvious sensation from the bladder.

### **Bladder filling (sensory) symptoms**

#### *Symptom*

Abnormal sensations experienced during bladder filling.

**Bladder outlet obstruction (BOO - male)***Diagnosis*

A diagnosis based on urodynamic investigations (pressure-flow studies +/- imaging +/- EMG), generally (but not always) with relevant symptoms and signs, manifest by an abnormally slow urine flow rate, with evidence of abnormally high detrusor voiding pressures and abnormally slow urine flow during pressure-flow studies, with or without a high PVR.

BOO can be functional (bladder neck obstruction, detrusor sphincter dysfunctions or pelvic floor overactivity) or mechanical (prostatic enlargement, sphincter sclerosis, urethral stricture, meatal stenosis).

**Bladder outlet obstruction (BOO) - pressure flow studies (male +/- VCU, EMG)***Investigation*

This is the generic term for obstruction during voiding. It is a reduced urine flow rate with a simultaneously increased detrusor pressure. PVR may be present.

**Bladder outlet obstruction (female)***Investigation*

This is the generic term for obstruction during voiding. It is a reduced urine flow rate and/or presence of a raised PVR and an increased detrusor pressure. It is usually diagnosed by studying the synchronous values of urine flow rate and detrusor pressure and any PVR measurements. A urethral stricture or obstruction due to higher degrees of uterovaginal prolapse or obstructed voiding after stress incontinence procedures are amongst possible causes.

**Bladder oversensitivity - filling cystometry***Investigation*

Increased sensation during bladder filling with: early first desire to void; early strong desire to void, which occurs at low bladder volume; lower cystometric bladder capacity; no abnormal increases in detrusor pressure.

**Bladder Oversensitivity (BO)***Diagnosis*

Increased perceived bladder sensation during bladder filling with specific cystometric findings of early first desire to void; early strong desire to void, which occurs at low bladder volume; low maximum cystometric bladder capacity; no abnormal increases in detrusor pressure.

**Bladder pain***Symptom*

Complaint of suprapubic or retropubic pain, pressure or discomfort related to the bladder, and usually associated with bladder filling. It may persist or be relieved after voiding.

**Bladder Pain Syndrome (BPS - Chronic)***Symptom*

Persistent or recurrent chronic pelvic pain, pressure or discomfort perceived to be related to the urinary bladder accompanied by at least one other urinary symptom such as an urgent need to void or urinary frequency.

**Bladder wall thickness (BWT) - ultrasound imaging (male)***Investigation*

Distance from the outer border of the mucosa to the outer border of the adventitia on the anterior bladder wall with a linear 7,5MHz linear array in a bladder filled to over 250ml.

**Bowel diary***Sign*

It is a recording of bowel actions. Bowel diaries have been widely used in diagnostic and intervention studies. Patient recall is less accurate than a diary. Patients tend to underestimate symptom frequency, in one study by over 50 %. However, there are few published examples and no consensus on what should be included. Elements that might be included: (i) urgency; (ii) fecal incontinence (amount, consistency); (iii) flatus incontinence; (iv) passive staining/soiling (tends not be discrete episodes); (v) pads (changes, degree of soiling); (vi) straining/difficulty/time in the toilet; (vii) unsuccessful attempts to defecate; (viii) assistive measures (e.g. digital stimulation, manual evacuation, irrigation); (ix) laxative or rectal evacuant use; (x) diet and fluids (type and/or timing). Patients often need careful and detailed instructions on how to complete a diary, and still many are poorly completed. An incomplete diary is difficult to interpret and is liable to misinterpretation as a low bowel/event frequency.

**Bulbospongiosus reflex (BSR)***Sign*

A reflex contraction of the striated muscle of the pelvic floor (anal sphincter) and the bulbo-spongiosus muscle that occurs in response to various stimuli in the perineum or genitalia.

**Burch colposuspension - open, laparoscopic, robotic***Surgery – Female*

Elevation or attachment of the upper paraurethral tissue adjacent to the bladder neck region to the iliopectineal ligament bilaterally. Although a recognized treatment for stress incontinence, this procedure will often correct associated anterior wall prolapse.

**C****Catheterization***Conservative Management – General*

This is a technique for bladder emptying employing a catheter to drain the bladder or a urinary reservoir.

**Catheterization - aseptic intermittent***Conservative Management – General*

This implies genital antiseptic preparation and the use of sterile (single-use) catheters and instruments/gloves in a designated clean area.

**Catheterization - clean intermittent (CIC)***Conservative Management – General*

This is the use of a clean technique. This implies ordinary hand and genitals washing techniques and use of disposable or cleansed reusable catheters.

**Catheterization - indwelling***Conservative Management – General*

An indwelling catheter remains in the bladder, urinary reservoir or urinary conduit for a period longer than one emptying.

**Catheterization - intermittent (IC)***Conservative Management – General*

Drainage of the bladder or a urinary reservoir with subsequent removal of the catheter mostly at regular intervals



### **Catheterization - no-touch technique intermittent**

#### **Conservative Management – General**

This was introduced as an easier way for the patient to perform self-intermittent catheterization with a ready-to-use catheter (pre-lubricated catheter, usually a hydrophilic catheter). A pull-in aid or special packages are used to handle the catheter without directly touching the sliding surface of the hydrophilic catheter.

### **Catheterization - sterile intermittent**

#### **Conservative Management – General**

Complete sterile setting, including genital skin antisepsis, sterile gloves, forceps, gown and mask.

### **Central sensitization**

#### *Symptom*

Nociceptor sensitization results in synaptic strengthening by incoming afferent volleys (sensitization) and is expressed as hyperalgesia (a form of non-associative learning characterized by an increase in responsiveness upon repeated exposure to a stimulus)

### **Centrally generated pain/ Deafferentiation pain**

#### *Symptom*

Pain which may result from injury to either the peripheral or central nervous system, leading to burning pain below the level of the lesion. It can be sympathetic-nervous system maintained pain, which may result in chronic regional pain syndrome (CRPS). There is increased responsiveness of nociceptive neurons in the central nervous system to normal or sub-threshold afferent input.

### **Chronic Bladder Pain Syndrome - Cystoscopic evaluation**

#### *Investigation*

Cystoscopic findings by hydrodistension are important in subclassification of Bladder Pain Syndrome (BPS) / Interstitial Cystitis (IC).

i. Glomerulation during cystoscopy with hydrodistension, glomerulations, with or without waterfall lesions (blood trickling downwards), may often be observed ii. Hunner Lesion.

A Hunner lesion is not an ulcer, but an inflammatory infiltrate. Morphologic findings in Hunner Lesion

1. Inflammatory infiltrate on examination of biopsy taken with electro-resection or by cold cup biopsy. 2. Lymphocyte-like cells dominate in the infiltrate, but neutrophilic and eosinophilic granulocytes as well as plasma cells and mast cells are also found. 3. Perineural and perivascular arrangement of lymphocyte-like cell infiltrates. Granulation tissue.

### **Chronic Intra-abdominal Female Genital Pain Syndrome - Evaluation**

#### *Investigation*

1. Questionnaires

i. Visual Analog Scale for pain.

2. Laboratory Testing

i. Culture. ii. Complete blood count.

3. Laparoscopy (with or without biopsy) 4. Ultrasound (US) 5. MRI 6. Venography (to rule out Pelvic Congestive Syndrome)

### **Chronic Musculoskeletal Pain Syndromes - Evaluation**

#### *Investigation*

1. Questionnaires i. McGill Pain Questionnaire. ii. Pelvic Floor Distress Inventory (PFDI). iii. Female Sexual Function Index (FSFI). iv. Female Sexual Distress Scale (FSDS). 2. Pain Location Drawing (Pain Mapping) i. Pain Chart body map. 3. Evaluation of Muscle Tension There is no single tool which is able to measure all components of muscle tone. Some tools may be able to measure aspects of tone such as contractility, stiffness or elasticity. Instrumented methods may have a role in the valid and reliable evaluation

of muscle tone, for example, surface electromyography, dynamometry, real-time ultrasound, elastometry, myo-tonometry. i. Pressure manometry is the measurement of resting pressure or pressure rise generated during contraction of the pelvic floor muscles using a pressure device (a manometer) inserted into the urethra, vagina or anus. ii. Surface electromyography (sEMG) refers to the bioelectrical activity generated by muscle fibres. iii. Dynamometry is the measurement of pelvic floor muscle resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina. iv. Real-time ultrasound measures pelvic floor muscle morphology and function via a non-invasive (trans-abdominal or trans-perineal) probe. v. Elastometry measures the elasticity of a tissue. 4. Trigger point injection or needling has been used as a diagnostic test to identify pain generators. 5. *Imaging*  
i. X-Ray. ii. Ultrasound. iii. MRI.

### **Chronic Neuropathic Pain Syndromes - Evaluation**

#### *Investigation*

A. Neuropathic Pain Questionnaires 1. VAS Pain Score. 2. Pain DETECT (Validated for CPPS evaluation). 3. Leeds Assessment for neuropathic symptoms and signs (not validated for chronic pelvic pain). 4. Douleur Neuropathique 4 Questionnaire. B. Quantitative Sensory Testing

1. 1Q-tip touch sensitivity. 2. Sensory pain mapping. 3. Reflex evaluation. 4. Electromyography.

C. Nerve Blocks 1. May/may not be done under Computed Tomography, Ultrasound or EMG guidance.

#### *D. Imaging*

1. Ultrasound 2. Magnetic resonance Imaging (MRI)

### **Chronic Pain**

#### *Symptom*

Persistent or continuous/recurrent pain for at least 6 months. If non-acute and central sensitization pain mechanisms are well documented, then the pain may be regarded as chronic, irrespective of the time period.

### **Chronic Pain and Fatigue Syndromes**

#### *Diagnosis*

Chronic pain and fatigue syndromes are characterized by pain, often widespread; fatigue; sleep disturbances; and disability. The symptoms are usually medically unexplained, have no known pathophysiology or organic basis and show no abnormal laboratory or imaging investigations. The literature suggests that many of these conditions share demographic characteristics, clinical course and psychosocial profiles. Examples are:

1. Fibromyalgia: symptoms are widespread musculoskeletal pain, fatigue, non-restorative sleep, psychological distress, and regions of localized tenderness. 2. Temporomandibular Joint Disorders: symptoms consist of complaints of facial, jaw, neck, or shoulder pain. The pain is experienced in or around the ear with chewing, speaking, or opening the mouth, with or without migraine. 3. Chronic Fatigue Syndrome: is defined as clinically evaluated, unexplained, persistent or relapsing fatigue plus four or more specifically defined associated symptoms (self-reported impairment in short term memory or concentration; sore throat; tender cervical or axillary nodes; muscle pain; pain in multiple joints without redness or swelling; headaches of a new pattern or severity; unrefreshing sleep).

### **Chronic Pelvic Floor Muscle Pain Syndrome**

#### *Investigation*

1. Questionnaires. i. Visual Analog Scale for pain. ii. Pelvic Floor Distress Inventory (PFDI). iii. Prolapse and Incontinence Sexual Questionnaire (PISQ). 111

2. Laboratory Testing

i. Wet Mount, Culture. ii. Biopsy.

3. Imaging References

- i. Ultrasound (4D if available for visualization of mesh, where applicable). ii. MRI (with or without defecography). iii. Defecography.

### **Chronic Pelvic Joint, Ligament or Bone Pain Syndrome**

#### *Diagnosis*

1. Joint pain:
  - i. Sacroiliac or pubic symphysis joint.
2. Ligament pain:
  - i. Sacro-spinous or Sacro-tuberous ligament.
3. Bony pain:
  - i. Pain described in or along the margins of the pubic ramus, ilium, ischial spine or ischial tuberosity.

### **Chronic Pelvic Pain**

#### *Diagnosis*

Chronic pelvic pain is characterized by persistent pain lasting longer than 6 months or recurrent episodes of abdominal/pelvic pain, hypersensitivity or discomfort often associated with elimination changes, and sexual dysfunction often in the absence of organic etiology.

### **Chronic Pelvic Pain - Characteristics**

#### *Symptom*

a. Duration of pain: Six months or more of persistent pain. b. Location of pain: Pelvis, lower abdomen, low back, medial aspect of thigh, inguinal area, perineum. c. Perception of pain: Patients may describe the pain as sharp, burning, aching, shooting, stabbing, pressure or discomfort, sexual pain (dyspareunia). d. Modality of pain: Persistent and/or continuous, recurrent and/or episodic and/or cyclic (related to menstrual cycle).

### **Chronic (persistent or recurrent) Anorectal Pain Syndrome**

#### *Diagnosis*

1. Chronic Proctalgia—rectal pain, more than 20min of duration per episode, for at least 3 months with symptom onset at least 6 months prior to diagnosis.
  - i. Persistent or recurrent rectal pain. ii. Rectal pressure or aching episodes. iii. In the absence of other causes of rectal pain.
2. Levator Ani Syndrome (the term may refer to the same syndrome as “pelvic floor muscle pain syndrome”/ “tension myalgia of the PFM”).
  - i. Pain with sitting. ii. Pain with defecation.
3. Proctalgia Fugax
  - i. Severe recurrent episodic pain localized in the anus or lower rectum. ii. Duration seconds to minutes. iii. No pain between episodes.

### **Chronic (persistent or recurrent) Epididymal Pain Syndrome**

#### *Diagnosis*

Pain is specific/localized to the epididymis.

- i. Persistent or recurrent episodic pain. ii. Spontaneous, or reproduced by digital pressure and physical activities. iii. Lower urinary tract symptoms or sexual dysfunction.

### **Chronic (persistent or recurrent) Pelvic Muscle Pain Syndrome**

#### *Diagnosis*

1. Pelvic Floor Muscle Pain (Pelvic Floor Myalgia):
  - i. Pain in the muscles of the pelvic floor (perineal or levator ani).
2. Intra-Pelvic Muscle Pain:
  - i. Pain in the pelvic side wall muscles (obturator internus, piriformis, coccygeus).
3. Anterior Pelvic/Lower Abdominal Muscle Pain:
  - i. Pain in the rectus abdominus, oblique or transverse abdominus muscles, described below the umbilicus.
4. Posterior Pelvic/Buttock Muscle Pain:
  - i. Pain in the gluteal muscles.

### **Chronic (persistent or recurrent) penile pain syndrome**

#### *Diagnosis*

Pain within the penis that is not primarily in the urethra and may be:

- i. Persistent or recurrent. ii. Spontaneous, or reproduced by digital pressure and physical activities. iii. Lower urinary tract symptoms or sexual dysfunction.

### **Chronic (persistent or recurrent) Prostate Pain Syndrome**

#### *Diagnosis*

Persistent or recurrent prostate pain, associated with symptoms suggestive of urinary tract and/or sexual dysfunction. No proven infection or other obvious pathology is present to account for the symptoms. Bladder, perineal, testicular, penile and/or groin pain.

- i. Perception of pain: variable. ii. Persistent or recurrent. iii. Dyspareunia or erectile dysfunction. iv. Voiding and post micturition symptoms (for example: hesitancy, intermittency, feeling of incomplete emptying).

### **Chronic (persistent or recurrent) Scrotal Pain Syndrome**

#### *Diagnosis*

Chronic scrotal pain (generic term used when site of pain is not clearly in the testis or epididymis).

- i. Persistent or recurrent episodic pain, unilateral or bilateral. ii. Spontaneous, or reproduced by digital pressure and physical activities. iii. Pain is not in the skin of the scrotum but perceived within its contents. iv. Lower urinary tract symptoms or sexual dysfunction.

### **Chronic (persistent or recurrent) testicular pain syndrome**

#### *Diagnosis*

- i. Persistent or recurrent episodic pain. ii. Spontaneous, or reproduced by digital pressure and physical activities. iii. Lower urinary tract symptoms or sexual dysfunction.

### **Chronic Prostatic Pain Syndrome - Evaluation**

#### *Investigation*

1. Quantitative assessments. i. Bladder diary. ii. CPSI (Chronic Prostatitis Symptom Index). iii. Visual Analog Scale for Pain (VAS).
2. Laboratory Testing
  - i. Urinalysis (including post prostate massage). ii. Urine Culture post prostate massage. iii. Semen Culture.
3. Uroflowmetry, Post voiding residual volume, pressure flow study 4. Cystoscopy 5. Ultrasonography, with or without biopsy

### **Chronic retention of urine (female)**

#### *Diagnosis*

This is defined as a nonpainful bladder, where there is a chronic high PVR.

### **Chronic Scrotal, Epididymal, Testicular and Penile Pain Syndrome - Evaluation**

#### *Investigation*

1. Quantitative assessments i. VAS for Pain. 2. Ultrasonography

### **Chronic Sexual Pain Disorder**

#### *Diagnosis*

#### *Dyspareunia*

i. Female sexual pain: Burning, ripping, tearing, or aching sensation associated with penetration. The pain can be at the vaginal opening, deep in the pelvis, or anywhere between. It may also be felt throughout the entire pelvic area and the sexual organs and may occur only with deep thrusting. ii. Male sexual pain: Sexual activity may induce a central sensitization process characterized by hypersensitivity or hyperalgesia. History should include duration of symptoms, identification of disorder, impact on quality of life, and partner relationship. Partner interviews may be very helpful as erectile

dysfunction, delayed or premature ejaculation in males with hypoactive sexual desire disorder result in a 4–30 times increased risk of female partner desire, arousal or orgasmic disorder.

### **Chronic Sexual Pain Syndrome**

#### *Diagnosis*

##### i. Penile

1. Prior to penetration (example: pain with erection). 2. With penetration. 3. Post coital.

##### ii. Perineal

1. During intercourse. 2. After intercourse.

##### iii. Orgasmic Pain (during ejaculation)

1. Penile. 2. Anorectal. 3. Pelvic.

### **Chronic Urethral Pain Syndrome - Evaluation**

#### *Investigation*

1. Quantitative assessments

i. Bladder diary. ii. VAS for Pain.

2. Laboratory Testing

i. Urinalysis (including post prostate massage, Ureaplasma/Chlamydia as appropriate).

3. Urethroscopy/Urethrography 4. Ultrasonography

### **Chronic urinary retention**

#### *Symptom*

Complaint of chronic or repeated inability to empty the bladder, despite the ability to pass some urine. This may result in the frequent passage of small amounts of urine or urinary incontinence and a distended bladder.

### **Chronic (urinary) retention**

#### *Diagnosis*

This defined as a generally (but not always) painless and palpable or percussible bladder, where there is a chronic high PVR where the patient experiences slow flow and incomplete bladder emptying. Overflow incontinence can occur. Some individuals with retention present with impaired renal function and/or hydronephrosis.

### **Chronic Vulvar, Vestibular and Clitoral Pain Syndromes - Evaluation**

#### *Investigation*

1. Questionnaires i. Visual Analog Scale for pain. ii. Female Sexual Function Index (FSFI). iii. Female Sexual Distress Scale (FSDS).

2. Laboratory Testing

i. Culture. ii. Biopsy.

3. Diagnostic Testing

i. Vulvoscopy, with or without biopsy. ii. Quantitative Sensory Testing (Q-tip touch sensitivity test).

### **Chyluria (albiduria)**

#### *Symptom*

Complaint of the passage of chyle (pale or white, milky cloudy) urine.

### **Classification**

Surgery – Complication related

A systematic arrangement into classes or groups based on perceived common characteristics.

### **Clean intermittent catheterization (CIC)**

Conservative Management – General

This is the use of a clean technique. This implies ordinary hand and genitals washing techniques and use of disposable or cleansed reusable catheters.

### **Climacturia**

#### *Symptom*

Complaint of involuntary loss of urine at the time of orgasm.

### **Closing pressure**

#### *Investigation*

Pressure recorded at the end of measured flow.

### **Closure of the Enterocele Sac - Open, Laparoscopic, Robotic**

#### *Surgery – Female*

(a) Moschowitz procedure - Concentric purse-string suture(s) are placed around the cul-de-sac to include the posterior vaginal wall, pelvic side-walls and serosa of the sigmoid. (b) Halban procedure- Obliteration of the cul-de-sac by using successive sutures placed sagittally between the uterosacral ligaments. (c) Uterosacral ligament plication – transverse plication of the uterosacral ligaments to obliterate the cul-de-sac. Successive sutures are placed into the medial portion of one ligament, into the back wall of the vagina and into the medial border of the opposing ligament. Variations in technique for all abdominal mesh/graft procedures

### **Coccygeal pain (coccydynia)**

#### *Symptom*

Complaint of pain, pressure or discomfort felt in the coccygeal region

### **Coccyx Pain Syndrome**

#### *Diagnosis*

Complaint of chronic or recurrent pain in the coccyx or sacro-coccygeal joint.

### **Coital fecal (flatal) incontinence (female)**

#### *Symptom*

Fecal (flatal) incontinence occurring with vaginal intercourse.

### **Coital fecal incontinence**

#### *Symptom*

Complaint of involuntary loss of stool occurring with intercourse.

### **Coital fecal urgency (female)**

#### *Symptom*

Feeling of impending bowel action during vaginal intercourse.

### **Coital urinary incontinence**

#### *Symptom*

Urinary incontinence occurring during or after vaginal intercourse.

### **Coital urinary incontinence (female)**

#### *Symptom*

Complaint of involuntary urine loss during or after coitus. This symptom might be further divided into that occurring with penetration and that occurring at orgasm.

### **Coital urinary urgency (female)**

#### *Symptom*

Feeling of urgency to void during vaginal intercourse.

### **Colonoscopy**

#### *Investigation*

Colonoscopy examines the entire colon following a full oral preparation to clear the bowel to allow this.

### **Colonoscopy**

#### *Investigation*

The entire colon is examined following a full oral preparation to clear the bowel to allow this.

### **Colpocleisis**

Surgery – Female

Operation for obliterating the lumen of the vagina.

### **Colporecto-cystourethrography (colpo-cystodefecography)**

#### *Imaging*

This involves the instillation of radio-opaque media into bladder, vagina, and rectum simultaneously for pelvic floor evaluation with images obtained during rest and straining

### **Colporecto-cystourethrography: (Colpo-cystodefecography)**

#### *Imaging*

This involves the instillation of radio-opaque media into bladder, vagina and rectum simultaneously for pelvic floor evaluation with images obtained during rest and straining.

### **Combination therapy (also known as polytherapy, multimodal therapy or combined modality therapy)**

#### *Conservative Management – Female*

Combination therapy is the use of more than one intervention concurrently to treat a single condition with one or multiple symptoms, for example, a combination of medication with PFM training (PFMT).

1. Adjunctive therapies: any treatment or modality used to augment or assist the main treatment. In conservative treatments, adjunctive therapies often refer to equipment or a secondary therapy used to supplement the effect of the primary therapy, e.g., biofeedback-assisted PFMT or neuromuscular electrical stimulation to augment PFMT.

### **Complaint**

#### *Symptom*

The description of the symptom.

### **Complex Regional Pain Syndrome (CRPS)**

#### *Diagnosis*

Sympathetic, centrally generated pain. 1. CRPS 1- Triggered by tissue injury with no underlying nerve injury. 2. CRPS 2- Associated with nerve injury. i. Burning pain. ii. Increased skin sensitivity. iii. Changes in skin temperature, color, and/or texture.

### **Compliance - bladder (female)**

#### *Investigation*

This describes the relationship between a change in bladder volume and change in detrusor pressure. Compliance is calculated by dividing the volume change (Change V) by the change in detrusor pressure (Change Pdet) during that change in bladder volume (Compliance = Change V/Change Pdet). Compliance is expressed as ml per cm H2O.

### **Complication**

Surgery – Complication related

A morbid process or event that occurs during the course of a surgery that is not an essential part of that surgery.

### **Compromise**

Surgery – Complication related

Bring into danger.

### **Computerized tomography (CT) - male**

#### *Imaging*

(1) CT Urogram (CT-U): CT study of the urinary tract system using injected

contrast, used to clarify diagnoses such as (i) tumors; (ii) renal disease; (iii) abnormal fluid collections/abscesses (iv) bladder pathology.

(2) CT Kidneys, ureter, bladder (CT- KUB): Non-contrast study aimed primarily at identifying stones but may identify other pathology. Aka “stone protocol”.

### **Computerized tomography (CT) of the pelvic floor**

#### *Imaging*

Computed tomography (CT) is not routinely recommended for imaging the pelvic floor mainly due to irradiation and poor soft tissue contrast. However multiplanar spiral CT may offer an accurate visualization of the pelvic floor soft and bony structures by reconstruction of axial images using 1 mm thick slices without gaps thus increasing the diagnostic accuracy of pelvic floor anatomical disorders (ie. LAM trauma).

### **Conditions for cystometry - female**

#### *Investigation*

(i) Pressures: All systems are zeroed at atmospheric pressure; (ii) External pressure transducers: Reference point is the superior edge of the pubic symphysis; (iii) Catheter mounted transducers: Reference point is the transducer itself; (iv) Initial bladder volume: Bladder should be empty; (v) Fluid medium: Usually water or saline (or contrast if radiology involved); (vi) Temperature of fluid: Should ideally be warmed to body temperature; (vii) Position of patient: Sitting position is more provocative for abnormal detrusor activity than the supine position. At some point in the test, filling might desirably take place with the patient standing; (viii) Filling rate: The filling rate, including any changes during testing, should be noted on the urodynamic report.

### **Constipation (General)**

#### *Symptom*

Complaint that bowels motions are infrequent and/or incomplete and/or there is a need for frequent straining or manual assistance to defecate (Rome IV criteria)

### **Constipation (obstructed defecation)**

#### *Symptom*

Complaint of difficulty in evacuation due to a mechanical obstruction.

### **Constipation (slow transit)**

#### *Symptom*

Infrequent bowel motions due to a delay in transit of bowel contents to reach rectum.

### **Continuous urinary incontinence**

#### *Symptom*

Complaint of continuous involuntary loss of urine

### **Contraction**

Surgery – Complication related

Shrinkage or reduction in size.

### **Contraction pressure at maximum flow**

#### *Investigation*

This is the difference between pressure at maximum flow and the pre-micturition pressure.

### **Cough-Associated Detrusor Overactivity**

#### *Investigation*

Cough associated DO is reported when the onset of the DO (with or without leakage) occurs immediately following the cough pressure peak. No precise definition of cough associated detrusor activity is available. 'Cough induced DO' is sometimes reported, although the precise (patho-)physiology remains speculative and only the association in time can be observed. The ICS

WG presents a descriptive definition and does not discuss the consequences for management.

### **Counseling in Pelvic Floor Dysfunction**

#### *Conservative Management – Female*

Counseling is the provision of professional assistance and guidance in resolving personal or psychological problems and may be part of any clinician's management.

1. Patient education: providing patients with knowledge and understanding of their condition, thereby empowering them to play an active role in its management. 2. Motivational interviewing: a directive, client-centered counseling style for eliciting behavior change by helping clients to explore and resolve ambivalence. Compared with nondirective counseling, it is more focused and goal-directed. The examination and resolution of ambivalence is its central purpose, and the counselor/clinician is intentionally directive in pursuing this goal. 3. Coping strategies: intervention aimed at helping patients to live with the condition in the best way possible under the circumstances, to regain a feeling of being in control, to adjust their lifestyle where necessary, and to take a positive rather than a negative approach. 4. Self-care: the set of activities that comprise daily living, such as bed mobility, transfers, ambulation, dressing, grooming, bathing, eating, and toileting. 5. Self-help: various methods by which individuals attempt to remedy their difficulties without making use of formal care providers. 6. Self-efficacy: an individual's belief that he or she is capable of successfully performing a certain set of behaviors.

### **Cremasteric reflex**

#### *Sign*

Contraction of the ipsilateral cremaster muscle, drawing the testis upwards, when the upper inner aspect of the thigh is stroked longitudinally.

### **CTS Complication code**

#### *Surgery – Complication related*

The category (C), time (T) and site (S) classes and divisions have a sensitivity that should encompass all conceivable scenarios for describing insertion complications and healing abnormalities. The CTS code for each complication, involving three (or four) letters and three numerals is likely to be very suitable for any surgical audit or registry, particularly one that is procedure-specific.

### **Cyclical (menstrual) pelvic pain**

#### *Symptom*

Cyclical pelvic pain related to menses that raises the possibility of a gynecological cause.

### **Cystic dilatations of epididymal tubules**

#### *Sign*

Cystic dilatations of epididymal tubules (epididymal cysts or spermatocele) and hydroceles (fluid collections between the visceral tunica albuginea and parietal layer of the testicular peritoneum)- usually benign. The examination of these structures would be generally non-tender and without pain.

### **Cystometric capacity - filling cystometry**

#### *Investigation*

Bladder volume at the end of filling cystometry, when a "permission to void" is usually given by the urodynamicist.

### **Cystometric capacity - filling cystometry (mL)**

#### *Investigation*

Bladder volume at the end of filling cystometry, when a "permission to void" is usually given by the urodynamicist.

### **Cystometrogram**

#### *Investigation*

Graphical recording of the bladder pressure(s) and volume(s) over time.

### **Cystometry**

#### *Investigation*

Measurement of the pressure-volume relationship of the bladder during filling.

### **Cystometry - Aftercontraction**

#### *Investigation*

An after-contraction, is a continued or new detrusor pressure rise immediately after flow ended. It is important to note if this occurs with the complete emptying of the bladder.

### **Cystometry - Catheter flush**

#### *Investigation*

When one of the catheters is flushed during the test a steep pressure rise is observed in that pressure line for one or two seconds followed by an immediate fall to resting pressure.

### **Cystometry - conditions (female)**

#### *Investigation*

(i) Pressures: All systems are zeroed at atmospheric pressure; (ii) External pressure transducers: Reference point is the superior edge of the pubic symphysis; (iii) Catheter mounted transducers: Reference point is the transducer itself; (iv) Initial bladder volume: Bladder should be empty; (v) Fluid medium: Usually water or saline (or contrast if radiology involved); (vi) Temperature of fluid: Should ideally be warmed to body temperature; (vii) Position of patient: Sitting position is more provocative for abnormal detrusor activity than the supine position. At some point in the test, filling might desirably take place with the patient standing; (viii) Filling rate: The filling rate, including any changes during testing, should be noted on the urodynamic report.

### **Cystometry - Cough Pressure Peak**

#### *Investigation*

A cough pressure peak is recognizable during post-test evaluation as a phasic positive pressure change observed in pves and in pabd.

### **Cystometry - Dead Signal**

#### *Investigation*

A signal that is not showing small pressure fluctuations and is not adequately responding on straining, patient movements or coughing is reported as a dead signal.

### **Cystometry - Expelled Catheter**

#### *Investigation*

When a catheter is expelled, this is observed as a sudden drop in either pves or pabd, usually below zero.

### **Cystometry - Poor Pressure Transmission**

#### *Investigation*

Poor pressure transmission has occurred when the cough/effort pressure peak signals on pves and pabd are not nearly equal.

### **Cystometry - Position Change**

#### *Investigation*

A change in patient position, either active or passive (e.g. tilting), is visible on the cystometry trace by a lasting change of equal magnitude in both pves and pabd. Note: A position change should be (is readily) noted during the test and followed by readjustment of the external pressure sensors height to the standard so that the physiological pves and pabd are observed



again. A position change should not affect pdet. The position change pattern should be recognized during post-test evaluation of the cystometry.

#### **Cystometry - Pressure Drift**

##### *Investigation*

Continuous slow fall or rise in (one of either) pressure, that is physiologically inexplicable.

#### **Cystometry - Pump Vibrations**

##### *Investigation*

Pump vibrations are visible as stable frequency oscillations of small but constant amplitude if the filling tube touches the pressure connecting tube (when a two catheter system is used) and the pump is switched on (switching of the pump can ascertain the situation).

Note: ICS standard is double lumen catheter, and despite the channels being side by side, with the usual filling rate and measuring scale, oscillations are not typically observable.

#### **Cystometry - Rectal Contractions**

##### *Investigation*

Rectal Contractions are temporary phasic increases in pabd without synchronous change in pves resulting in negative deflections of pdet.

#### **Cystometry - Straining**

##### *Investigation*

Straining is observable as a temporary increase in both pves and pabd pressure. Straining may be associated with (patient -active) position change (such as repositioning from leaning backwards to upright).

#### **Cystometry - Tube Knock**

##### *Investigation*

Tube Knock is observable as high frequency, short duration spikes visible in pves, pabd, or both, and with spikes also usually visible in pdet.

#### **Cystometry - Urodynamic Stress Test**

##### *Investigation*

The urodynamic stress test is used for any physical effort of the person tested, to elevate abdominal pressure, during cystometry with the aim of testing for (urodynamic) stress urinary incontinence.

ICS has defined urodynamic stress incontinence. Evidence is lacking (or conflicting) with regard to the preferred technique of stress testing. Note: The provocation method, the pressure measuring catheter(size) and method, the leak detection method as well as the absolute or relative (percentage of cystometric capacity) intravesical volume(s) while testing may be reported.

#### **Cystometry Position**

##### *Investigation*

ICS standard cystometry is done in the vertical position (standing or normally seated) whenever physically possible. A pressure-flow study is done comfortably seated (women, some men) or standing if that is preferred position (men).

## **D**

#### **Daytime**

##### *Sign*

The period between waking up with the intention of rising until going to bed with the intention of sleeping (awake hours - ideally recorded on chart or diary)

#### **Daytime (urinary) frequency**

##### *Sign*

Number of micturitions during daytime (awake hours, including first void after waking up from sleep and last void before sleep).

#### **De novo (postoperative) dyspareunia**

##### *Symptom*

Dyspareunia first reported after surgery or other interventions

#### **De novo postoperative) sexual dysfunction symptoms**

##### *Symptom*

New onset sexual dysfunction symptoms (not previously reported before surgery)

#### **Decreased arousal (female)**

##### *Symptom*

Persistent or recurrent inability to achieve or maintain sexual excitement. This may be expressed as lack of excitement, lack of lubrication, lack of vaginal and clitoral engorgement, or lack of expression of other somatic responses.

#### **Decreased libido (male)**

##### *Symptom*

Complaint of a decreased interest in sexual activity in comparison with previous experience

#### **Decreased libido or sexual desire (female)**

##### *Symptom*

Absent or diminished feelings of sexual interest or desire, absent sexual thoughts or fantasies, and a lack of responsive desire. Motivations (here defined as reasons/incentives) for attempting to become sexually aroused are scarce or absent. The lack of interest is considered to be beyond the normative lessening with lifecycle and relationship duration.

#### **Decreased libido or sexual desire (female)**

##### *Symptom*

Absent or diminished feelings of sexual interest or desire, absent sexual thoughts or fantasies, and a lack of responsive desire. Motivations (here defined as reasons/incentives) for attempting to become sexually aroused are scarce or absent. The lack of interest is considered to be beyond the normative lessening with lifecycle and relationship duration.

#### **Decreased (low) semen volume**

##### *Symptom*

Complaint of smaller amount of seminal fluid than normal or previously experienced.

#### **Deep dyspareunia**

##### *Symptom*

Complaint of pain or discomfort on deeper penetration (mid or upper vagina)

**Defecatory dysfunction (female)***Diagnosis*

A diagnosis by clinical history and examination, assisted, at times, by the results of diagnostic tests involving the confirmation of abnormal or difficult function in the initiation, passage or completion of defecation.

**Defecatory/Post-defecatory symptoms***Symptom*

Symptoms experienced during or following the act of defecation.

**Defecography (female)***Imaging*

This demonstrates normal anatomy of the anorectum as well as disorders of rectal evacuation. Barium paste is inserted rectally prior to defecation over a translucent commode. Measurement of the anorectal angle is allowed with evidence of the presence, size or emptying of any rectocele. Enteroceles, rectal intussusception and mucosal prolapse might be diagnosed as well as a spastic pelvic floor (anismus).

**Defecography (male)***Imaging*

This demonstrates the anatomy of the anorectum as well as disorders of rectal evacuation. Barium paste is inserted rectally prior to defecation over a translucent commode.

**Deficient perineum / cloacal-like defect***Sign*

A spectrum of tissue loss from the perineal body and rectovaginal septum with variable appearance. There can be a common cavity made up of the anterior vagina and posterior rectal walls or just an extremely thin septum between the anorectum and vagina.

**Dehiscence***Surgery – Complication related*

A bursting open, splitting or gaping along natural or sutured lines.

**Delayed ejaculation***Symptom*

Complaint of an increase in the time taken for ejaculation to occur.

**Detrusor acontractility (male)***Diagnosis*

A diagnosis by urodynamic investigation, generally (but not always) with relevant signs and symptoms, manifest by the absence of an observed detrusor contraction during pressure-flow studies resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span. Voiding is usually achieved by straining or manual pressure on the bladder resulting generally in an abnormally slow urine flow rate and/or an abnormally high postvoid residual.

*Subtypes:*

- (I) Neurogenic
- (II) Non-neurogenic

**Detrusor leak point pressure (DLPP - cm H<sub>2</sub>O)***Investigation*

This is a static test. The pressure is the lowest value of the detrusor pressure at which leakage is observed in the absence of either a detrusor contraction or increased abdominal pressure.

**Detrusor Leak Point Pressure (female) - DLPP - cm H<sub>2</sub>O***Investigation*

This is a static test. The pressure is the lowest value of the detrusor pressure at

which leakage is observed in the absence of increased abdominal pressure or a detrusor contraction. High detrusor LPP (e.g., over 40 cm H<sub>2</sub>O) may put patients at risk for upper urinary tract deterioration, or secondary damage to the bladder in the cases of known underlying neurological disorders such as paraplegia or MS. There are no data on any correlation between detrusor LPP and upper tract damage in nonneurogenic patients.

**Detrusor leak point volume (DLPV)***Investigation*

The bladder volume at which urine leakage first occurs, either with detrusor overactivity or low compliance.

**Detrusor opening pressure (cm H<sub>2</sub>O) - pressure flow studies***Investigation*

Detrusor pressure recorded immediately before the initial isovolumetric contraction.

**Detrusor overactivity - filling cystometry***Investigation*

The occurrence of detrusor contraction(s) during filling cystometry. These contractions, which may be spontaneous or provoked, produce a waveform on the cystogram, of variable duration and amplitude. Symptoms, e.g. urgency and/or urgency incontinence or perception of contraction may or may not occur.

**Detrusor overactivity - Subtypes***Diagnosis*

- (i) Idiopathic (primary) detrusor overactivity: No identifiable cause for the involuntary detrusor contraction(s).
- (ii) Neurogenic (secondary) detrusor overactivity: There is detrusor overactivity and evidence (history; visible or measurable deficit) of a relevant neurological disorder.
- (iii) Non-neurogenic (secondary) detrusor overactivity: An identifiable possible non-neurological cause exists for involuntary detrusor contraction(s) during bladder filling. e.g. functional (obstruction); stone, tumor (e.g. carcinoma in situ), UTI.

**Detrusor Overactivity (DO)***Diagnosis*

In men and women with LUT/PF symptoms when detrusor muscle contractions occur during filling cystometry.

**Detrusor overactivity (DO) - filling cystometry***Investigation*

The occurrence of detrusor contraction(s) during filling cystometry. These contractions, which may be spontaneous or provoked, produce a wave form on the cystometrogram, of variable duration and amplitude. The contractions may be phasic or terminal. They may be suppressed by the patient, or uncontrollable. Symptoms, e.g. urgency and/or urgency incontinence or perception of the contraction may (note if present) or may not occur.

**Detrusor Overactivity (female)***Diagnosis*

This diagnosis by symptoms and urodynamic investigations is made in women with lower urinary tract symptoms (more commonly OAB-type symptoms)—when involuntary detrusor muscle contractions occur during filling cystometry

**Detrusor overactivity leak point pressure (DOLPP)***Investigation*

Lowest detrusor pressure rise with detrusor overactivity at which urine

leakage first occurs in the absence of a voluntary detrusor contraction or increased abdominal pressure.

#### **Detrusor pressure at end of flow (Pdet-ef – unit: cm H2O) - pressure flow studies**

##### *Investigation*

Detrusor pressure recorded at the end of urine flow.

#### **Detrusor pressure at maximum flow (Pdet-Qmax – unit: cm H2O)**

##### *Investigation*

Detrusor pressure recorded at maximum urinary flow rate.

#### **Detrusor pressure (Pdet - cm H2O)**

##### *Investigation*

The component of intravesical pressure that is created by forces in the bladder wall (passive and active). It is calculated by subtracting abdominal pressure from intravesical pressure

( $P_{det} = P_{ves} - P_{abd}$ ).

#### **Detrusor sphincter dyssynergia (DSD) - female**

##### *Investigation*

This is incoordination between detrusor and sphincter during voiding due to a neurological abnormality (i.e. detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscle). This is a feature of neurological voiding disorders. Neurological features should be sought. Videocystourethrography (VCU) is generally valuable to conclude this diagnosis.

#### **Detrusor sphincter dyssynergia (DSD) - pressure flow studies (male +/- VCU, EMG)**

##### *Investigation*

Dyscoordination between detrusor and smooth or striated sphincter function during voiding due to a neurological abnormality (i.e. detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscle). This is a feature of neurological voiding disorders.

#### **Detrusor underactivity (DU)**

##### *Diagnosis*

A diagnosis based on urodynamic investigations, generally (but not always) with relevant symptoms and signs, manifest by low detrusor pressure or short detrusor contraction in combination with a low urine flow rate resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span (a high postvoid residual may be present).

#### **Detrusor underactivity (DU) - pressure flow studies.**

##### *Investigation*

Low detrusor pressure or short detrusor contraction time, usually in combination with a low urine flow rate resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.

#### **Detrusor wall thickness (DWT) or Bladder wall thickness (BWT)**

##### *Imaging*

Transabdominal visualization of the anterior bladder wall with a (linear) high frequency ultrasound scanner for the detection of BOO if DWT is  $\geq 2$  mm in bladders filled with  $\geq 250$  ml (or BWT is  $\geq 5$  mm in bladders filled with 150 ml).

#### **Diagnosis**

##### *Diagnosis*

The determination of the nature of a disease; clinical: made from a study

of the symptoms and signs of a disease; laboratory: investigative options/procedures to be mentioned.

#### **Digital rectal examination (DRE - female)**

##### *Sign*

The gloved finger should be placed in the center of the anus with the finger parallel to the skin of the perineum in the midline. The finger should then be pressed gently into the anal canal but at the same time pressed backwards against the skin of the posterior wall of the anal canal and underlying sling of the puborectalis muscle. This overcomes most of the tone of anal sphincter and allows the finger to straighten and slip into the rectum. This will allow assessment of: (a) Resting anal tone, voluntary squeeze of the anal sphincter as well as the levator muscles, sustained squeeze over 5 sec and involuntary contraction elicited during a cough; (b) Obvious hemorrhoids can be palpated but grade II and grade III. Hemorrhoids are better assessed by proctoscopy. Painful examination may be associated with fistula in ano, fissure in ano, infection or pilonidal abscess; (c) Palpable anal sphincter gap. An assessment can be made of a palpable anal sphincter gap to assess if there has been previous obstetric or surgical damage. The perineal body can be assessed for deficiency; (d) Rectal contents. The contents of the rectum can be assessed. The feces may be hard or soft, the rectum may be empty or collapsed and sometimes ballooned out. This allows assessment of fecal impaction; (e) Confirmation of presence of rectocele, enterocele, or perineocele. Use of POP-Q for staging of prolapse; (f) Bidigital examination may be carried out with the patient supine in a gynecological examining position. By inserting the index finger in the vagina and the middle finger in the rectum, the rectovaginal septum and any intervening small bowel loops can be palpated to differentiate a rectocele from an enterocele, during a Valsalva maneuver; (g) Rectal lesions such as carcinoma, intussusception or recto-vaginal fistula. If a mass is felt on a fingertip, the patient should be asked to strain, and this will often move the mass down to bring it within reach; (h) An assessment can be made of the rectovesico/rectouterine pouch to look for extra rectal masses.

#### **Digital Recto-vaginal examination**

##### *Sign*

While the patient is straining and the prolapse is maximally developed. The aim is to try to differentiate between a high rectocele and an enterocele.

#### **Digitation (female)**

##### *Symptom*

Use of fingers in rectum or vagina to manually assist in evacuation of stool contents.

#### **Diminished rectal sensation (rectal hyposensitivity)**

##### *Symptom*

Complaint of diminished or absent sensation of filling in the rectum.

#### **Direct electrical neurostimulation**

##### *Conservative Management – General*

This is a direct stimulation of the nerves or neural tissue to effect function of the end organ. It is done through electrodes implanted directly or near the nerve or neural tissue.

#### **Directly**

##### *Surgery – Complication related*

Without an intermediary or intervening factor.

#### **Disability associated urinary incontinence**

##### *Symptom*

Complaint of urinary incontinence in the presence of a functional inability



to reach a toilet/urinal in time because of a physical impairment, (e.g. orthopedic, neurological) and/or mental impairment.

#### **Discharge (female)**

Sign

Perianal or vaginal bloody or mucus discharge.

#### **Diurnal polyuria**

*Symptom*

Complaint that daytime urine excretion volume is noticeably larger than the previous experience.

#### **Division**

Surgery – Complication related

A separation into two or more parts.

#### **Double incontinence**

*Symptom*

Complaint of both anal incontinence and urinary incontinence.

#### **Dysfunction**

*Diagnosis*

Difficult or abnormal function

#### **Dysfunctional voiding - pressure flow studies (male +/- VCU, EMG)**

*Investigation*

This is characterized by an intermittent and/or fluctuating flow due to inadequate or variable relaxation generally of the external sphincter during voiding in neurologically normal men (i.e. no historical, visible or measurable evidence of neurological disease).

#### **Dysfunctional voiding (female)**

*Investigation*

This is characterized by an intermittent and/or fluctuating flow rate due to

involuntary intermittent contractions of the peri-urethral striated or levator muscles during voiding in neurologically normal women. This type of voiding may also be the result of an acontractile detrusor (abdominal voiding) with electromyography (EMG) or video-urodynamics required to distinguish between the two entities.

#### **Dyspareunia**

*Symptom*

Complaint of persistent or recurrent pain or discomfort associated with attempted or complete vaginal penetration.

#### **Dyspareunia - deep**

*Symptom*

Complaint of pain or discomfort on deeper penetration (mid or upper vagina).

#### **Dyspareunia - superficial (introital)**

*Symptom*

Complaint of pain or discomfort on vaginal entry or at the vaginal introitus.

#### **Dyspareunia with penile vaginal movement**

*Symptom*

Pain that is caused by and is dependent on penile movement.

#### **Dysuria**

*Symptom*

Complaint of pain, burning or other discomfort during voiding. Discomfort may be intrinsic to the lower urinary tract (e.g. bladder or urethra), external or referred from other adjacent similarly innervated structures e.g. lower ureter.

## **E**

#### **Ejaculatory dysfunction**

*Symptom*

Complaint of alteration of the emission of seminal fluids during ejaculation.

#### **Ejaculatory pain**

*Symptom*

Complaint of pain, pressure or discomfort felt in the perineum, suprapubic region and/or penis during ejaculation but may continue for a time afterwards.

#### **Electrical Currents Used in Pelvic Floor Therapies**

*Conservative Management – Female*

a) Faradic current: an alternating and interrupted low frequency current capable of stimulating (depolarizing) nerve fibers through the skin using surface-stimulating electrodes. It is used to stimulate innervated muscles, causing them to contract. b) TENS: an alternating and interrupted low-frequency current capable of stimulating (depolarizing) nerve fibers through the skin using surface-stimulating electrodes for pain modulation or pain relief. c) Interferential current: a medium frequency, amplitude modulated electrical current that results from the interference (hence the word interferential) caused by crossing two or more medium-frequency alternating sine wave currents with different carrier frequencies. The carrier frequency

of these medium, alternating sine wave currents ranges between 2,000 and 5,000 cycles per second.

#### **Electrical neuromodulation**

*Conservative Management – General*

This is the stimulation of the nerves or neural tissue to modulate function and induce therapeutic response of the LUT.

#### **Electrical Therapies - Mode of Application**

*Conservative Management – Female*

1. Surface electrodes: non-invasive placement of electrodes, including intravaginal and intra-anal electrodes, in contrast to electrodes that pierce the skin, i.e., needle stimulation. a) Non-invasive electrical nerve stimulation or transcutaneous electrical nerve stimulation (TENS): the application of electrical energy to stimulate cutaneous nerve and peripheral motor nerves, via suprapubic, perineal or sacral placement of electrodes, or other external sites, or intravaginal or intra-anal plug electrodes. Tibial nerve stimulation (TNS) is a form of peripheral neuromodulation targeting symptom relief of overactive bladder (OAB) and urinary urge incontinence. Indirect access to the sacral plexus is achieved by intermittent, electrical stimulation of the tibial nerve, which lies behind the medial malleolus, using skin surface electrodes applied to the medial malleolar area (transcutaneous TNS). There are two main types of electrical stimulation with surface electrodes: i) Long-term or chronic electrical stimulation: is delivered below the sensory thresh-

old. It is aimed at inhibiting detrusor activity by afferent pudendal nerve stimulation. The device is used 6–12h per day for several months. ii) Maximal neuromuscular electrical stimulation: applies a high-intensity stimulus, set just below the pain threshold. It is aimed at improving urethral closure, via striated muscle recruitment. Detrusor inhibition by afferent pudendal nerve stimulation has also been suggested as a mechanism of effect. Maximal electrical stimulation (35–70Hz) is applied over short period (15 to 30min), is used several times per week (and up to 1–2 times daily), and may be provided via in-clinic application or via portable devices at home).

### **Electrical Therapy**

#### *Conservative Management – Female*

Electrical therapy is the use of electric potential or currents to elicit therapeutic responses. Current may be directed at motor or sensory functions. It is not within the scope of this document to define all electrical stimulation terms. Electrical muscle stimulation (also known as neuromuscular electrical stimulation or electromyostimulation). Electrical muscle stimulation (EMS) is the application of electric impulses directly to striated PFM (end-plate) to facilitate contraction. EMS is often referred to as “pelvic floor muscle electrical stimulation” (PFES) or “functional electrical stimulation.” PFES is the application of electrical current to the PFM. All of these stimulations may (indirectly) cause inhibition of the detrusor contraction.

### **Electromyography**

#### *Investigation*

Electromyography (EMG) is the recording of electrical potentials generated by the depolarization of muscle fibers. Electromyographic diagnosis is made by evaluating the state of the muscle (muscle pathology) by recording and analyzing the electrical activity generated by the muscle. 1. Intramuscular EMG: insertion of a wire or needle electrode into the muscle to record motor unit action potentials. 2. Surface electromyography: electrodes placed on the skin of the perineum or inside the urethra, vaginal or rectum.

### **Electrophysiological Parameters**

#### *Conservative Management – Female*

1. Electrical current: the flow (current) of electrons (electricity) from an electron source (stimulator) the wires and electrodes used to deliver such an electrical current to soft tissues. There are three types of current: direct, alternating, and pulsed. – a) Direct: the continuous, unidirectional flow of charged particles for 1s or longer, the direction of which is determined by the polarity selected. Polarity refers to two oppositely charged poles, one positive and one negative. Polarity determines the direction in which current flows. b) Alternating: the continuous, bidirectional flow of charged particles, for 1s or longer, relative to the isoelectric baseline. c) Pulsed: the noncontinuous, interrupted, and periodic flow of direct (DC) or alternating (AC) currents.

### **Electrostimulation - direct electrical neurostimulation**

#### *Conservative Management – General*

This is a direct stimulation of the nerves or neural tissue to effect function of the end organ. It is done through electrodes implanted directly or near the nerve or neural tissue.

### **Electrostimulation - electrical neuromodulation**

#### *Conservative Management – General*

This is the stimulation of the nerves or neural tissue to modulate function and induce therapeutic response of the LUT.

### **Electrostimulation - pelvic electrical stimulation**

#### *Conservative Management – General*

This is the application of electrical current to stimulate the pelvic viscera or their nerve supply.

### **Electrostimulation - transcutaneous electrical nerve stimulation (TENS)**

#### *Conservative Management – General*

This is electrical stimulation of the nerves through intact skin to modulate function and induce therapeutic response of the LUT.

### **Endoanal Ultrasonography (EAUS) or Anal Endosonography (AES)**

#### *Imaging*

Ultrasound of the anal canal performed with a pole-like ultrasound probe placed in the anal canal giving a 360 degree image of the anal canal. It is usually performed with the patient placed in the lithotomy, prone position or sometime left lateral. Two dimensional AES; three dimensional AES – three-dimensional reconstruction of the anal canal is performed using either axial or sagittal images.

### **Enterocoele**

#### *Sign*

Bulge of upper wall of the vagina associated with herniation of the peritoneal sac and loops of small bowel.

### **Enterocoele**

#### *Sign*

Hernia of peritoneum and possibly abdominal contents into the vault.

### **Enuresis**

#### *Symptom*

Complaint of intermittent incontinence that occurs during periods of sleep. If it occurs during the main sleep period, then it could be qualified by the adjective “nocturnal”. The patient has to be asleep when enuresis happens and is usually unaware of it.

### **Enuresis**

#### *Sign*

“Wetting” while asleep

### **Enuresis - acquired**

#### *Symptom*

Complaint of intermittent incontinence that occurs during periods of sleep that has developed in adulthood.

### **Enuresis - primary**

#### *Symptom*

Complaint of intermittent incontinence that occurs during periods of sleep that has been present lifelong.

### **Episodic inability to void**

#### *Symptom*

Complaint of inability to initiate voiding despite relaxation and/or intensive effort (by abdominal straining, Valsalva or suprapubic pressure).

### **Epispadias**

#### *Sign*

Urethral meatus sited on dorsal surface of the penis, either congenital or acquired, proximal to its normal position on the tip of the glans.

### **Erectile dysfunction (male)**

#### *Symptom*

Complaint of inability to achieve and sustain an erection firm enough for satisfactory sexual performance.

### **Excoriation**

#### *Sign*

Perianal excoriation, skin rashes.

## Exercise and Exercise Training

### *Conservative Management – Female*

Exercise is a form of leisure time activity that is usually performed on a repeated basis over an extended period of time (exercise training) with specific external objectives, such as improvement of fitness, physical performance, or health. Exercise training includes: endurance training, strength training, flexibility training, and motor control (including balance), all of which may apply to the PFM.

Therapeutic exercise/exercise therapy: consists of interventions directed toward maximizing functional capabilities. It includes a broad range of activities intended to improve strength, range of motion (including muscle length), cardiovascular fitness, flexibility, or to otherwise increase a person's functional capacity.

1. Rehabilitation/re-education: help individuals to regain skills and abilities that have been lost as a result of illness, injury or disease, or incarceration, restoring a disabled individual to maximum independence commensurate with his or her limitations. Mode of exercise training: is not only the type of activity to be performed (for instance, fast walking, jogging, or swimming, strength training), but also the temporal pattern of activity that is recommended (that is, continuous or intermittent activity), with a detailed specification of the duration of exercise and rest periods in the case of intermittent activity bouts. Authors are encouraged to specifically describe all components of the mode of exercise and the dose provided.

## Explant

Surgery – Female

## F

### **Fecal (flatal) urgency incontinence.**

#### *Symptom*

Complaint of an involuntary loss of feces (flatus) associated with fecal urgency.

### **Fecal incontinence**

#### *Symptom*

Complaint of involuntary loss of feces.

- when feces is solid and/or
- when feces is liquid

### **Fecal Incontinence (Female)**

#### *Diagnosis*

Fecal incontinence: involuntary loss of solid or liquid stool and could be due to: 1: Anal sphincter disruption is due to discontinuity of the external anal sphincter, internal anal sphincter or both; 2: Hypocontractile/acontractile sphincter is due to neuropathy or atrophy; 3: Combined anal sphincter disruption and hypocontractile/acontractile sphincter. 4: Rectal overactivity due to exaggerated smooth muscle contraction of the rectum could also be associated with hypersensitivity; 5: Overflow incontinence seepage of stool due to fecal impaction.

### **Fecal (rectal) urgency**

#### *Symptom*

Complaint of a sudden compelling desire to defecate that is difficult to defer.

### **Fecal urgency warning time**

#### *Symptom*

Time from first sensation of urgency to voluntary defecation or fecal incontinence.

A surgically excised prosthesis or graft.

## Exposure

Surgery – Complication related

A condition of displaying, revealing, exhibiting or making accessible e.g. vaginal mesh exposure. (NB: "erosion" is not an ICS definition).

## Extra-pelvic Muscle Activity

Conservative Management – General

Is the contraction of muscles other than those that comprise the pelvic floor, for example the abdominal, gluteal and adductor muscles. Extra-pelvic muscle activity is needed for maximal pelvic floor muscle effort.

## Extra-urethral incontinence

Sign

Observation of urine leakage through channels other than the urethral meatus, e.g. fistula.

## Extrusion

Surgery – Complication related

Passage gradually out of a body structure or tissue, e.g. a loop of tape protruding into the vaginal cavity. (NB "Erosion" is not an ICS definition)

## Fecaluria

### *Symptom*

Complaint of passage of feces (per urethram) in the urine.

## Feeling of incomplete (bladder) emptying

### *Symptom*

Complaint that the bladder does not feel empty after voiding has ceased.

## Feeling of incomplete bowel evacuation

### *Symptom*

Complaint that the rectum does not feel empty after defecation. May be accompanied by the desire to defecate again.

## Female Anorectal Dysfunction - Assessment of Pelvic Floor Muscle Function

Sign

Pelvic floor muscle function can be qualitatively defined by the tone at rest and the strength of a voluntary or reflex contraction as strong, normal, weak, or absent or by a validated grading symptom. Voluntary pelvic floor muscle contraction and relaxation may be assessed by visual inspection, by digital palpation (vaginal or anorectal) (circumferentially), electromyography, dynamometry, manometry, or ultrasound. Factors to be assessed include muscle strength (static and dynamic) (graded as strong, normal, weak or absent), voluntary muscle relaxation (graded as absent, partial, complete, delayed), muscular endurance (ability to sustain maximal or near maximal force), repeatability (the number of times a contraction to maximal or near maximal force can be performed), duration, co-ordination, and displacement. Assessment can be made of each side of the pelvic floor separately to allow for any unilateral defects and asymmetry. Assessment of displacement (perineal elevation or descent) of the pelvic floor can be made during cough or Valsalva. Normally, there is some downward movement of the pelvic floor muscles or there is a ventral movement (perineal elevation, inward (cephalad) and upward movement of vulva, perineum, and anus). Rectal examination obser-

vations can include: (a) Anal sphincter tone and strength: given the absence of a formal quantitative assessment via the rectal route, assessment of anal tone and strength on digital examination, can be graded using the same convention used when grading transvaginally—as strong, normal, weak, or absent or by a validated grading symptom. (b) Anal sphincter tear: may be recognized as a clear “gap” in the anal sphincter on digital examination.

### **Female Anorectal Dysfunction - Clinical Applications of Defecating Proctography**

#### *Imaging*

Assuming that posterior wall prolapse and rectocele can be considered the same anatomic entity, clinical examination is not accurate in diagnosing anatomical defects of posterior vaginal wall and enteroceles compared to defecography as reference standard. Clinical examination overestimates the presence of the posterior wall defects (large false positive rates) but misses enterocele in patients with primary POP (large false negative rates). The major function of proctography is not merely to document evacuatory abnormalities, but also to classify those abnormalities into those potentially surgically relevant, those likely to benefit from behavioral biofeedback therapy alone, or indeed those which are incidental. 1: Pelvic floor descent: Pelvic floor descent, defined as the distance moved by the ARJ or ARA at rest to the point of anal canal opening, is considered abnormal if it exceeds 3cm. 2: Intussusception and prolapse Intussusception refers to infolding of the rectal wall into the rectal lumen. It may be described as intra-rectal, intra-anal or external to form a complete rectal prolapse. 3: Rectocele: Rectocele diagnosis on evacuation proctography is defined as any anterior rectal bulge. The depth of a rectocele is measured from the anterior border of the anal canal to the anterior border of the rectocele. A distance of <2cm is classified as small, 2–4cm as moderate and >4cm as large. Of more relevance however is barium trapping at the end of evacuation (defined as retention of >10% of the area, and this itself is related the size of the rectocele. 4: Enterocele: An enterocele is diagnosed when small bowel loops enter the peritoneal space between the rectum and vagina. Diagnosis of an enterocele on proctography is only really possible if oral contrast has been administered before the examination. Herniation of the sigmoid into the rectogenital space (sigmoidocele) is significantly less common than an enterocele. 5: Dyssynergic defecation Various proctographic abnormalities have been described including prominent puborectal impression, a narrow anal canal and acute anorectal angulation. However these observations may be found in normal controls and are in themselves unreliable distinguishing features.

### **Female Anorectal Dysfunction - Clinical Applications of MRI in the Posterior Compartment**

#### *Imaging*

1: Fecal incontinence Endoanal ultrasound and endoanal magnetic resonance imaging (MRI) have been demonstrated to be comparable in the detection of external sphincter defects. External phased array coil MRI can replace endoluminal MRI with comparable results. 2: Levator ani injuries Abnormalities of the LA are identified on MRI as present or absent. Defect severity is further scored in each muscle from 0 (no defect) to 3 (complete loss). A summed score for the two sides (0–6) is assigned and grouped as minor (0–3) or major (4–6). 3: Obstructed defecation During maximal Valsalva maneuver, dynamic MRI may be used to demonstrate: • Rectocele: measured as the depth of wall protrusion beyond the expected margin of the normal anorectal wall. Based on sagittal MR-sections through mid of pelvis, rectoceles are graded as small (<2cm), moderate (from 2 to 4cm), and large (>4cm). • Rectal intussusception: the infolding of the rectal mucosa occurring during defecation. Depending on the location, an intrarectal intussusception, limited to the rectum, is distinguished from an intra-anal intussusception extending into the anal canal. The location of the intussusception may be anteriorly, posteriorly, or circumferentially. The intussusception either involves only the mucosa or the full thickness of the rectal wall, • Enter-

ocele: defined as a herniation of the peritoneal sac, which contains omental fat (peritoneocele), small bowel (enterocele) or sigmoid (sigmoidocele), into the rectovaginal or rectovesical space below the PCL. The largest distance between the PCL and the most inferior point of the enterocele is measured with a perpendicular line. Depending on this distance, small (<3cm), moderate (3–6cm), and large (>6cm) enteroceles are distinguished. • Dyssynergic defecation: different structural imaging findings can be seen on dynamic pelvic MRI, including prominent impression of the puborectal sling, narrow anal canal, prolonged evacuation, a lack of descent of the pelvic floor and thus a failure to increase the ARA. In comparison with clinical examination (POP-Q), dynamic MRI has no additional value in the prediction of symptoms with increasing degree of POP. 4: Perianal abscesses and fistulas.

### **Female Anorectal Dysfunction - Defecating Proctography**

#### *Imaging*

Evaluates in real time the morphology of rectum and anal canal in correlation with pelvic bony components both statically and dynamically by injection of a thick barium paste into the rectum and its subsequent evacuation. Contrast administration into the bladder and vagina provides a more comprehensive assessment of the pelvic organs and has been labelled “dynamic cystoproctography.” At rest, the anal canal is closed and rectum assumes its normal upright configuration. The position of the pelvic floor is inferred by reference to the PCL (inferior margin of pubic symphysis to the sacro-coccygeal junction). Perineal descent is measured from this line to the ARJ, and may be up to 1.8cm at rest. Some pelvic floor descent during evacuation is considered normal and a descent of up to 3cm from the rest position to anal canal opening is acceptable. The ARA is defined as the angle between the anal canal axis and the posterior rectal wall, and on average is around 90 degrees. The puborectalis length (PRL) can be estimated by measuring the distance between the ARA and symphysis pubis. A normal emptying phase at the proctogram is described by five elements: • Increase in the ARA by around 20–30 degrees; • Obliteration of the puborectalis impression and the PRL should increase by around 3–4cm; • Wide opening of the anal canal within a couple of seconds; • Evacuation of rectal contents proceeding promptly and to completion; • Lack of significant pelvic floor descent. After evacuation is complete, the anal canal should close, the ARA recover and the pelvic floor return to its normal baseline position. Post toilet imaging may be required, particularly in those suspected of retained barium within rectoceles.

### **Female Anorectal Dysfunction - Endoanal ultrasonography (EAUS)**

#### *Imaging*

The majority of current systems provide 2D & 3D Imaging which give a 360 degree axial view of the anal canal and of the rectal wall. Endoanal ultrasound can be performed with the patient placed in the dorsal lithotomy, left lateral or prone position. Irrespective of the position, the probe should be rotated so that the anterior aspect of the anal canal is superior (12 o'clock) and left lateral is right (3 o'clock) on the screen. The anal canal is divided into three levels of assessment in the axial plane referring to the following anatomical structures: • Upper level: the hyperechoic sling of the puborectalis muscle (PR) and the complete ring of the internal anal sphincter (IAS) are visualized • Middle level: corresponds to the superficial part of the EAS (concentric band of mixed echogenicity), the conjoined longitudinal layer, the IAS (concentric hypoechoic ring), and the transverse superficial perineal muscles; • Lower level: corresponds to the subcutaneous part of the EAS where the IAS is absent. The acquisition of a three-dimensional data volume (3D ultrasound) and the underlying techniques vary. Acquisition may be “free-hand” (low resolution 3D) or “automatic computer-controlled” (high resolution 3D).

### **Female Anorectal Dysfunction - Squeeze pressure**

Sign

Measurement of squeeze pressure involves the exertion of pressure, compressing the assessor's finger during digital palpation or using a mechanical device. The patient is asked to squeeze the PFM as hard as possible (maximum strength), to sustain the squeeze contraction (endurance), or to repeat squeeze contractions (repetitions). The measurement can be done in the anorectum using manual muscle testing with digital rectal palpation or pressure manometry in the vagina using manual muscle testing with digital vaginal palpation or pressure manometry, or dynamometry. So far, not all quantitative assessments and scales of pelvic floor squeeze pressure have the same methodological qualities, like validity, reproducibility, and responsiveness. Pelvic floor muscle spasm was defined as persistent contraction of striated pelvic floor muscle that cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp. Spasm over days or weeks may lead to a contracture. Pelvic floor muscle tenderness: sensation of discomfort with or without pain; discomfort of pelvic floor muscle elicited through palpation. Tenderness can be scored during a digital rectal (or vaginal) examination of levator ani, piriformis and internal obturator muscles bilaterally, according to each subject's reactions: 0, no pain; 1, painful discomfort; 2, intense pain; with a maximum total score of 12. Although not universally accepted, pelvic floor muscle traction is the use of a pulling force to examine or treat pelvic floor muscles, postulated to end pelvic muscle spasm or relieve pain.

#### **Female Anorectal Dysfunction - Transperineal ultrasonography (TPUS) Imaging**

Conventional convex transducers (frequencies between 3 and 6MHz and field of view at least 70 degrees) provide 2D imaging of the pelvic floor. Transperineal ultrasound is performed with the patient placed in the dorsal lithotomy position, with the hips flexed and abducted. If necessary, the patient can be examined standing, to maximise descent of pelvic organs, especially if the patient finds it difficult to produce an effective Valsalva maneuver. No rectal or vaginal contrast is used. Perineal ultrasound provides sagittal, coronal and oblique sectional imaging, with the mid-sagittal plane being the most commonly used as this gives an overall assessment of all anatomical structures (bladder, urethra, vaginal walls, anal canal, and rectum) between the posterior surface of the symphysis pubis (SP) and the posterior part of the levator ani (LA). The imaging is usually performed at rest, on maximal Valsalva maneuver and on pelvic floor muscle contraction (PFMC). The access to the mid-sagittal plane allows the following evaluations: • Integrity of the perineal body: appearing as a triangular shaped, slightly hyperechoic structure anterior to the anal sphincter, • Measurement of the anorectal angle (ARA): formed by the longitudinal axis of the anal canal and the posterior rectal wall, • Dynamic assessment of the posterior compartment. During Valsalva it is possible to visualize descent of an enterocele, to assess the movement of the anterior rectal wall to detect a rectocele, and to evaluate movement of the PR and ARA to diagnose pelvic floor dyssynergy. 3D TPUS may be performed with volumetric probes (electronic curved array of 4–8MHz). An advantage of this technique is the opportunity to obtain tomographic or multi-slice imaging, for example, in the axial plane, in order to assess the entire PR and its attachment to the pubic rami. It is also possible to measure the diameter and area of the levator hiatus (LH) and determine the degree of hiatal distension on Valsalva. Four dimensional (4D) imaging indicates real-time acquisition of volume ultrasound data.

#### **Female Anorectal Dysfunction - Transvaginal Ultrasound (TVUS) Imaging**

Transvaginal ultrasound is performed with the patient placed in the dorsal lithotomy position. Currently, the transducers used for pelvic floor 3D TVUS are high multi-frequency (9–16MHz), 360 degree rotational mechanical probe or radial electronic probe. The pelvic floor is divided into four levels of assessment in the axial plane referring to the following anatomical structures (not to be confused with Delancey's description of vaginal Levels of

supports). • Level I: at the highest level the bladder base is visualized on the screen at 12 o'clock position and the inferior third of the rectum at 6 o'clock position. • Level II: corresponds to the bladder neck, the intramural region of the urethra and to the anorectal junction. At this level the subdivisions of the LA (pubovaginalis, puboperinealis, puboanalis, puborectalis, and iliococcygeus) may be identified. • Level III: corresponds to the midurethra and to the upper third of the anal canal. At this level, the LA is visualized as a multilayer hyperechoic sling coursing lateral to the vagina and posteriorly to the anal canal and attaching to the inferior pubic ramus. In the axial plane of minimal hiatal dimensions, identified as the minimal distance between the inferior edge of the SP and the anterior border of the LA at the ARA, the biometric indices (anteroposterior and transverse diameters, area) of the LH can be determined. • Level IV: at the outer level, the perineal muscles (bulbospongiosus, ischiocavernosus, and superficial transverse perineii muscles), the perineal body, the distal urethra and the middle and inferior third of the anal canal are visualized. The anteroposterior diameter of the urogenital hiatus (UGH), corresponding to the SP-perineal body distance, can be determined. Transvaginal ultrasound may be also performed with electronic probes with linear array, which provide mid-sagittal image of the posterior compartment. The main advantage of this technique is the dynamic assessment of the anorectal region, during Valsalva and pelvic floor muscle contraction (PFMC).

#### **Female Anorectal Dysfunction - Ultrasonography to Assess Fecal Incontinence Imaging**

Anal inspection and digital rectal examination can give information about internal and external anal sphincter function but are inaccurate for determining external anal sphincter defects < 90 degrees and internal sphincter defects. Therefore, a sufficient diagnostic work-up should comprise at least rectal examination, anal inspection and endoanal ultrasonography. EAUS has become the gold standard for morphological assessment of the anal canal. The International Consultation on Incontinence (ICI) has recommended EAUS as the first line imaging investigation for fecal incontinence to differentiate between those with intact anal sphincters and those with sphincter lesions (defects, scarring, thinning, thickening, and atrophy). Routine use of transperineal, transvaginal and translabial ultrasonography to image the anal sphincter complex are not recommended, although research is ongoing. The operator should identify if there is a combined or isolated lesion of the IAS and EAS and report the number of defects, as well as the extent of the defect circumferentially (radial angle in degrees or in hours of the clock) and longitudinally (proximal, distal or full length). Using 3D EAUS, two scoring systems have been proposed to define the severity of anal sphincter damage. EAUS has an important role in detecting undiagnosed anal sphincter injuries following vaginal delivery and can be useful in the management of subsequent pregnancies following OASIS. It is also useful to evaluate the results of treatment (anterior sphincter repair, bulking agent injections).

#### **Female Anorectal Dysfunction - Ultrasound Imaging (General) Imaging**

Ultrasound is increasingly being incorporated as an investigation of posterior compartment disorders. An integrated multi-compartmental pelvic floor ultrasonography with a combination of different modalities has been described to assess pelvic floor dysfunction for a global and multi-compartmental perspective. Modalities in current routine clinical use: (a) Endoanal: intra-anal 360 degree sector scanning using rotational mechanical probe or radial electronic probe. (b) Transperineal: curved array probe applied in the perineum between the mons pubis and the anal margin. This term incorporates trans-labial ultrasound. Introital ultrasound is usually assumed to imply the placement of transducer with smaller footprints (such as end-firing endo-vaginal probe) within the introitus. (c) Transvaginal: intra-vaginal curvilinear, linear array, or 360 degree sector scanning.



## **Female Anorectal Dysfunction - Ultrasound in the Assessment of Levator Ani Injuries**

### *Imaging*

Levator avulsion is the disconnection of the muscle from its insertion on the inferior pubic ramus and the pelvic sidewall, whereas tears may occur in any part of the muscle. Avulsion is a common consequence of overstretching of the levator ani during the second stage of labor and it is detectable by 3D TVUS and 3D TPUS imaging as the lateral attachments of the pubic bone are clearly visualized. Defects are usually visualized most clearly on maximal PFMC. Tomographic ultrasound imaging is particularly useful. Levator ani injuries affect the size of the levator hiatus, with a hiatal enlargement to over 25sq cm on Valsalva maneuver defined as "ballooning," and are related to symptoms and signs of prolapse.

## **Female Anorectal Dysfunction - Ultrasound in the Assessment of Obstructed Defecation Syndrome (ODS)**

### *Imaging*

The term obstructed defecation syndrome (synonym: "outlet obstruction") encompasses all pelvic floor dysfunctions, which are responsible for an incomplete evacuation of fecal contents from the rectum, straining at stool and vaginal digitations. During maximal Valsalva maneuver, dynamic TPUS and TVUS may be used to demonstrate. • Rectocele: herniation of a depth of over 10mm of the anterior rectal wall; • Rectal intussusception: invagination of the rectal wall into the rectal lumen, into the anal canal or exteriorized beyond the anal canal (rectal prolapse); • Enterocoele: herniation of bowel loops into the vagina. It can be graded as small, when the most distal part descends into the upper third of the vagina, moderate, when it descends into the middle third of the vagina, or large, when it descends into the lower third of the vagina; • Dysynergic defecation: the ARA becomes narrower, the LH is shortened in the anteroposterior dimension, and the PR muscle thickens as a result of contraction.

## **Female Anorectal Dysfunction - Use of a Contrast Enema**

### *Imaging*

Contrast enema is used to identify colon pathology (benign and malignant lesions, diverticular disease, inflammatory conditions, congenital anomalies, intrinsic and extrinsic abnormalities). 1: Single-contrast barium enema: Using an appropriate catheter, a barium-water mixture or a water-soluble solution of diatrizoate sodium (Gastrografin) is inserted into the colon with the patient in the prone position until the column of barium reaches the splenic flexure. 2: Double-contrast or air-contrast barium enema: This procedure has become the routine study for evaluation of the bowel. With the double-contrast examination, the colon is coated with a thin layer of contrast material and the bowel is distended with air so that the entire mucosal circumference is visualized.

## **Female Anorectal Dysfunction - Use of Dynamic Magnetic Resonance Imaging (MRI)**

### *Imaging*

With the development of fast multi-slice sequences MR imaging has gained increasing acceptance for dynamic imaging of the pelvic floor. Because the posterior compartment is traditionally in the focus of interest, dynamic MR imaging of the pelvic floor is often called "MR defecography." Dynamic pelvic imaging may be performed in an open-configuration MR system in the sitting position, or in a closed configuration MR-system in the supine position. Both techniques are equally effective in identifying most of the clinically relevant abnormalities of the pelvic floor. For evaluation of the posterior compartment of the pelvic floor, the rectum should be filled with a contrast agent (ultrasound gel or mashed potatoes, gadolinium-based MR contrast agent) to study the actual act of defecation. The use of reference lines for image evaluation is helpful. The most used reference line is the pubococcygeal line (PCL), which is defined on mid-sagittal images as the line joining

the inferior border of the symphysis pubis to the last or second last coccygeal joint. The anorectal junction (ARJ) is defined as the cross point between a line along the posterior wall of the distal part of the rectum and a line along the central axis of the anal canal. To determine pathologic pelvic floor descent, the measurements are made on the images, which show maximal organ descent, usually during maximal straining or during evacuation. The anorectal angle (ARA) is defined as the angle between the posterior wall of the distal part of the rectum and the central axis of the anal canal and can be measured at rest, squeezing and straining. The extent of rectoceles and enteroceles are measured. The degree of pelvic floor relaxation is measured with two reference lines: the H line which represents hiatal widening and extends from the inferior aspect of the symphysis pubis to the posterior wall of the rectum at the level of the ARJ and the M line which represents hiatal descent and extends perpendicularly from the PCL to the posterior end of the H line. Lesions of the pelvic musculofascial support result in widening of the hiatus and descent of the levator plate. Thus, the H and M lines tend to elongate with pelvic floor relaxation, widening the levator plate descent. Abnormal pelvic floor relaxation is present, when the H line exceeds 6cm, and when the M line exceeds 2cm in length.

## **Female Anorectal Dysfunction - Use of Nuclear Colonic Transit Study**

### *Imaging*

Colon scintigraphy is performed at 6, 24, and 48 hr in ventral and dorsal projection after oral administration of methacrylate-coated capsule of non-resorbable <sup>111</sup>In-DTPA micropellets. The geometric center, as the sum of products of colon segment activity and colon segment number (1 - ascending colon, 2 - transverse colon, 3 - descending colon, 4 - rectosigmoid, and 5 - evacuated feces) dividing by the total counts is used to determine the velocity of colonic transit. Meals normally reach the cecum at 6 hr and are evacuated in 30 to 58 hr. Retention of radioactivity in the proximal colon at 48hr, indicates slow colonic transit while retention in the rectum indicates anorectal dysfunction.

## **Female Anorectal Dysfunction - Use of Radiological Colonic Transit Studies**

### *Imaging*

Segmental and total colonic transit time is assessed with the use of radio-opaque markers and sequential abdominal X-rays. There are different protocols. Most frequently used, utilizes a capsule containing 24 markers of 1 x 4.5mm. Patient takes one capsule on day 0 by mouth and X-ray is performed on day 5. Patients who expel at least 80% markers on day 5 have normal colonic transit. Patients who retain 6 or more markers may have follow-up abdominal X-rays within several days. If remaining markers are scattered about the colon, the condition is slow transit or colonic inertia. If the remaining markers are accumulated in the rectum or rectosigmoid, this suggests functional outlet obstruction.

## **Female Anorectal Dysfunction - Use of Static Magnetic Resonance Imaging (MRI)**

### *Imaging*

Static MRI provides detailed information of the pelvic floor anatomy. Current state-of-the-art MR imaging of the pelvic floor includes imaging at a magnetic field strength of 1.5 Tesla (T), using pelvic or phased-array coils and T2-weighted fast-spin echo (FSE) sequences. The spatial resolution can be enhanced by using endoluminal (endorectal, endovaginal) coils. In combination with T2-weighted FSE sequences, endoluminal coils provide improved signal-to-noise ratio (SNR) and high resolution images. Based on T2-weighted turbo spin-echo sequences, muscles are relative hypointense, ligaments and fascia hypointense while fat and smooth muscle are hyperintense. The prominent pelvic floor structures of the posterior compartment visualized at MRI are: • Perineal body and superficial perineal muscles; • Anal sphincters: the IAS is easily recognized as a circular hyperintense structure. It is approximately 2.9mm thick on endoluminal MRI. The inter-sphincteric

space is seen as a bright line on T2-weighted MRI. The EAS has a thickness of 4.1mm on endoluminal imaging; • Puborectalis muscle and levator ani; • Superficial perineal muscles; • Rectum and rectal support.

### **Female Orgasmic Disorder**

#### *Diagnosis*

Presence of either of the following on all or almost all (75% - 100%) occasions of sexual activity: (i) Marked delay in, marked infrequency of, or absence of orgasm; (ii) Markedly reduced intensity of orgasmic sensations

### **Female Sexual Dysfunction**

#### *Symptom*

Complaint of dyspareunia or impairment of sexual desire, arousal, or orgasm.

### **Female Sexual Dysfunction - Conservative treatments - Lifestyle modification**

#### *Conservative Management – Female*

Alterations of certain behaviors may improve sexual function. These include weight loss, appropriate sleep, adequate physical fitness, and management of mood disorders. Vulvo-vaginal pain may be treated by dietary changes and perineal hygiene (avoiding irritant soaps, detergents, and douches), although data are conflicting. Dietary modifications may be disorder specific including low oxalate diet as reduction in dietary levels of oxalate may improve symptoms of vulvodynia, or a bladder friendly diet with reductions in acidic foods and bladder irritants may treat bladder pain and associated sexual pain.

### **Female Sexual Dysfunction - Conservative Treatments - Topical Therapies**

#### *Conservative Management – Female*

Lubricants and moisturizers - Application of vaginal lubricant during sexual activity or vaginal moisturizers as maintenance may assist with atrophic symptoms and dyspareunia. Examples of some lubricants are described below, although no one lubricant or moisturizer has been adequately studied to recommend it over others. Additionally, not all products are available in all countries.

1: Essential arousal oil: Feminine massage oil applied to vulva prior to activity. Some evidence to support efficacy in treatment of sexual dysfunction, including arousal and orgasm, compared with placebo. 2: Vulvar soothing cream: Non-hormonal cream containing cutaneous lysate, to be applied twice daily. Study shows improvement in vulvar pain with use compared to placebo. 3: Prostaglandin E1 analogue, may help increase genital vasodilation. Ongoing trials to determine efficacy in arousal or orgasmic dysfunction.

### **Female Sexual Dysfunction - Non-pharmacological treatments - Clitoral suction devices**

#### *Conservative Management – Female*

This is a battery-operated hand held device, designed to be placed over the clitoris. It provides a gentle adjustable vacuum suction with low-level vibratory sensation. Intended to be used three or more times a week for approximately 5min at a time. This therapy has been shown to increase blood flow to the clitoral area as well as to the vagina and pelvis. Small non-blinded studies have shown it may significantly improve arousal, orgasm, and overall satisfaction in patients with sexual arousal disorder.

### **Female Sexual Dysfunction - Non-pharmacological treatments - Fractional CO2 Laser**

#### *Conservative Management – Female*

Use of thermoablative laser to vaginal mucosa may improve microscopic structure of epithelium. This results in increased thickness, vascularity, and connective tissue remodeling, which can improve climacteric symptoms.

Although long term data are lacking, some studies have shown significant improvements in subject symptoms of vaginal dryness, burning, itching, and dyspareunia as well as quality of life.

### **Female Sexual Dysfunction - Non-pharmacological treatments - Vaginal dilators**

#### *Conservative Management – Female*

Vaginal forms or inserts, dilators are medical devices of progressively increasing lengths or girths designed to reduce vaginal adhesions after pelvic malignancy treatments or in treatment of vulvar/vaginal pain. Can be useful for perineal pain or introital narrowing following pelvic reconstructive repairs. However, routine use after surgery not supported. Dilators can also be used for pelvic floor muscle stretching (ie, Thiele massage) and was found helpful in women with interstitial cystitis and high-tone pelvic floor dysfunctions.

### **Female Sexual Dysfunction - Non-pharmacological treatments - Vaginal exercising devices**

#### *Conservative Management – Female*

Pelvic muscle strengthening tools in form of balls, inserts or biofeedback monitors. May improve pelvic floor muscle tone and coordination by improving ability to contract and relax. Studies are lacking assessing their use without concurrent physical therapy.

### **Female sexual dysfunction - Non-pharmacological treatments - Vaginal vibrators**

#### *Conservative Management – Female*

Vaginal vibrators, external and internal: May be associated with improved sexual function, data controversial. Possibility that use of vibrators for self-stimulation may negatively impact sexual function with partner related activity.

### **Female Sexual Dysfunction - Physical therapy**

#### *Conservative Management – Female*

Manual therapy: Techniques that include stretching, myofascial release, pressure, proprioceptive neuromuscular facilitation, and massage applied externally on the perineum and internally to increase flexibility, release muscle tensions and trigger points in the pelvic floor muscles. It was found to be effective to improve sexual function in women with pelvic floor disorders in recent meta-analysis and systematic review. These therapies have also been found helpful in women with genito-pelvic pain.

1: Pelvic muscle exercises with or without biofeedback: May improve sexual function in women with pelvic floor disorders or pain. 2: Dry needling: Placement of needles without injection in myofascial trigger points. 3: Trigger point injections i. Anesthetic: Injection of local anesthetics, often Lidocaine, directed by trigger point palpation, can be external or transvaginal. ii. Botox: Injection of Botulinum toxin type A, a potent muscle relaxant, into refractory myofascial trigger points to reduce pelvic pain.

### **Female sexual dysfunction - Prescription treatments - Hormonal**

#### *Conservative Management – Female*

1: Estrogen: Available via prescription for both systemic use (oral or transdermal preparations); or locally use (creams, rings ,or tablets). May assist with overall well-being, sexual desire, arousal and dyspareunia. Role for topical use in treatment of post-surgical atrophy or mesh extrusion. 2: Ospemifene: Selective estrogen receptor modulator for treatment of moderate to severe dyspareunia related to vulvar and vaginal atrophy, in postmenopausal women. Acts as an estrogen agonist/antagonist with tissue selective effects in the endometrium. 3: Testosterone: Not approved for use in women in

the USA or UK, may be available in other countries. Variety of preparations including transdermal, oral, or pellet administration. Long term safety unknown, studies suggest improvements in satisfying sexual events, sexual desire, pleasure, arousal, orgasm and decreased distress. 4: Tibolone: Synthetic steroid with estrogenic, progestogenic and androgenic properties. It is not currently available in the USA. Studies have suggested a positive effect on sexual function with use. 5: Prasterone: dehydroepiandrosterone suppository available as a vaginal insert. It has been shown to be efficacious when compared to placebo in decreasing vulvovaginal atrophy.

### **Female Sexual Dysfunction - Prescription treatments - non-hormonal**

#### *Conservative Management – Female*

1: Bremelanotide; formerly PT-141- Melanocortin agonist, initially developed as a sunless tanning agent, utilizes a subcutaneous drug delivery system. Treatment significantly increased sexual arousal, sexual desire and the number of sexually satisfying events with associated decreased distress in premenopausal women with FSD. 2: Serotonin receptor agonist/antagonist; Flibanserin-5-hydroxytryptamine (HT)1A receptor agonist and 5-HT2A receptor antagonist, initially developed as antidepressant. Challenges in FDA applications, due to possible long term risks. Studies show improved sexual desire, satisfying sexual events, and reduced distress. 3: Dual control model in differential drug treatments for hypoactive sexual desire disorder and female sexual arousal disorder: i. Testosterone in conjunction with phosphodiesterase type 5 inhibitor (PDE-5); ii. Testosterone in conjunction with a 5-HT1A agonist. May be able to target physiologic and subjective measures of sexual functioning in a more specific manner. Premise of two types of HASDD subjects: low sensitivity to sexual cues, or prone to sexual inhibition. Tailoring on demand therapeutics to different underlying etiologies may be useful to treat common symptoms in women with lack of sexual interest and provide the appropriate therapy. Testosterone is supplied as a short acting agent 4 h prior to sexual event to lessen the side effect/risk profile. 4: Apomorphine: Nonselective dopamine agonist that may enhance response to stimuli. 5: Antidepressants and Neuropathics: Include tricyclic antidepressant and anticonvulsants, may be useful in treating sexual pain, and vulvar pain. 6: Bupropion: Mild dopamine and norepinephrine reuptake inhibitor and acetylcholine receptor antagonist, it may improve desire and decrease distress or modulate Selective Serotonin Reuptake Inhibitor (SSRI) induced FSD.

### **Female Sexual Dysfunction - Psychological intervention**

#### *Conservative Management – Female*

Counseling and therapy are widely practiced treatments for female sexual dysfunction. Even when a sexual problem's etiology and treatment is primarily urogenital, once a problem has developed there are typically psychological, sexual, relationship, and body image consequences and it may be tremendously validating and helpful for these women to be referred to counselors or therapists with expertise in sexual problems. Psychological interventions include cognitive behavioral therapy (CBT), sex therapy, and mindfulness training. While there is insufficient evidence with regard to controlled trials studying the efficacy of psychological treatment in women with sexual dysfunction, the available evidence suggests significant improvements in sexual function after intervention with traditional sex therapy and/ or cognitive behavioral therapy. Specific techniques include: 1: Sex therapy: Traditional treatment approach with aim to improve individual or couple's sexual experiences and reduce anxiety related to sexual activity; 2: Cognitive-behavioral therapy: Incorporates sex therapy components but with larger emphasis on modification of thought patterns that may interfere with sexual pleasure; 3: Mindfulness: An ancient eastern practice with Buddhist roots. The practice of "relaxed wakefulness," and "being in the moment," has been found to be an effective component of psychological treatments for sexual dysfunction.

### **Female sexual dysfunction - the effect of pelvic reconstructive surgery for prolapse and incontinence on sexual health**

#### *Surgery – Female*

Women with pelvic floor dysfunction commonly report impaired sexual function, which may be associated with the underlying pelvic floor disorder. Treatment of the underlying disorders may or may not impact sexual function. While both urinary incontinence and pelvic organ prolapse affect sexual function, prolapse is more likely than urinary incontinence to result in sexual inactivity. Prolapse is also more likely to be perceived by women as affecting sexual relations and overall sexual satisfaction. This perception is independent of diagnosis or therapy for urinary incontinence or prolapse. Very little is known about the impact of fecal incontinence on sexual function. The effect of pelvic reconstructive surgery on sexual function has increased but there is need for more focused research. Overall, randomized trials are lacking, varied outcome measures are used among studies. There is a lack of reporting per DSM-IV/DSM 5 categories and a lack of long-term follow-up. Level of Evidence (LOE) is poor in many studies and sexual dysfunction is usually reported as a secondary outcome measure. While any surgery can impact sexual function postoperatively, most commonly performed pelvic floor surgeries were not designed with the intent to improve sexual function. In general, successful surgical treatment of incontinence or prolapse may improve sexual symptoms associated with the underlying disorder. For example, coital incontinence improves after sling surgery, but whether it impacts other aspects of sexual function such as orgasm, desire, or arousal is unclear. Surgery for prolapse may improve underlying symptoms of laxity or embarrassment from bulge, which in turn may improve sexual function, but does not seem to have a direct impact on other aspects of sexual function. A small but significant number of patients will develop pain or other sexual disorders following surgery. These pain disorders spring from a variety of causes including those caused by the use of grafts. Prediction of who will develop these pain disorders is challenging. A recent paper which evaluated the effect of vaginal surgery on sexual function reported that women overall reported improved function, decrease in dyspareunia rates, and that de novo dyspareunia rates were low at 5% at 12 months and 10% at 24 months. Nonetheless, assessment of sexual activity and partner status and function prior to and following surgical treatment is essential in the evaluation of surgical outcomes. Because of the negative impact of pain on sexual function, assessment of sexual pain prior to and following procedures should also be undertaken.

### **Female Sexual Dysfunction Diagnoses - Female Orgasmic Disorder (American Psychiatric Association)**

#### *Diagnosis*

Presence of either of the following on all or almost all (75-100%) occasions of sexual activity: 1: Marked delay in, marked infrequency of, or absence of orgasm; 2: Markedly reduced intensity of orgasmic sensations

### **Female sexual dysfunction diagnoses - Female Sexual Interest/Arousal Disorder (American Psychiatric Association)**

#### *Diagnosis*

Lack of, or significantly reduced, sexual interest/arousal as manifested by 3 of the following: 1: Absent/reduced interest in sexual activity; 2: Absent/reduced sexual/erotic thoughts or fantasies; 3: No/reduced initiation of sexual activity and unresponsive to partner's attempts to initiate; 4: Absent/reduced sexual excitement/pleasure during sexual activity in almost all or all (75-100%) sexual encounters; 5: Absent/reduced sexual interest/arousal in response to any internal or external sexual/ erotic cues (written, verbal, visual) 6: Absent/reduced genital or non-genital sensations during sexual activity in almost all or all (75-100%) sexual encounters.

### **Female Sexual Dysfunction Diagnoses - General comments**

#### *Diagnosis*



The Diagnostic and Statistical Manual of Mental Disorders fifth edition (DSM-5), the International Classification of Diseases 10th edition (ICD-10), and the Joint Terminology from the fourth International Consultation of Sexual Medicine (ICSM) all have proposed diagnoses for sexual disorders in women. Many of the diagnoses from the various societies overlap; ICS have chosen the diagnoses from the DSM 5, as well as the diagnosis of genitourinary syndrome of menopause as these diagnoses seem most relevant to the population of women with pelvic floor dysfunction. The DSM 5 has combined disorders that overlap in presentation and reduced the number of disorders from six to three. Hypoactive sexual desire disorder (HSDD) and female sexual arousal disorders (FSAD) have been combined into one disorder, now called Female Sexual Interest/Arousal Disorder (FSIAD), based on data suggesting that sexual response is not always a linear, uniform process, and that the distinction between certain phases, particularly desire and arousal, may be artificial. Although this revised classification has not been validated clinically and is controversial, it is the new adopted standardization. One reason offered for the new diagnostic name and criteria were clinical and experimental observations that sexual arousal and desire disorders typically co-occur in women and that women may therefore experience difficulties in both. The DSM-IV categories of vaginismus and dyspareunia have been combined to create "genito-pelvic pain/penetration disorder" (GPPPD). Female Orgasmic Disorder remains its own diagnosis. The DSM 5 has also changed the relevant specifiers of these disorders with the goal of increasing objectivity and precision and to avoid over-diagnosis of transient sexual difficulties. In particular, all diagnoses now require a minimum duration of approximately 6 months and are further specified by severity. Genitourinary syndrome of menopause (GSM) is a new term introduced by the International Society of Sexual Medicine to describe a variety of symptoms which may be associated with sexual health. Although not validated, this diagnosis was introduced in an effort to improve communication between providers and patients regarding symptoms which may be difficult to discuss. While not a sexual dysfunction diagnosis, given the age of women who typically develop pelvic floor dysfunction, symptoms associated with GSM may be relevant to the assessment of the sexual health of women with pelvic floor dysfunction. For each of the DSM-5 diagnoses, providers should indicate whether or not the condition is lifelong or acquired, generalized or situational, and rate the severity as mild, moderate or severe in terms of the distress it causes. All of the diagnoses, except for the pain diagnoses, need to meet the criterion that it has been present for 6 months, causes significant distress, and are not a consequence of non-sexual mental disorder, severe or primarily attributable to a medication or underlying illness. For genitourinary syndrome of menopause, not all signs and symptoms need be present, but the symptoms must be bothersome and not better accounted for by another diagnosis.

#### **Female Sexual Dysfunction Diagnoses - Genito-Pelvic Pain/Penetration Disorder (American Psychiatric Association)**

##### *Diagnosis*

Persistent or recurrent difficulties with 1 or more of the following: 1: Vaginal penetration during intercourse; 2: Marked vulvovaginal or pelvic pain during intercourse or penetration attempts; 3: Marked fear or anxiety about vulvovaginal or pelvic pain in anticipation of, during, or as a result of vaginal penetration; 4: Marked tensing or tightening of the pelvic floor muscles during attempted vaginal penetration.

#### **Female Sexual Dysfunction Diagnoses - Genitourinary syndrome of menopause**

##### *Diagnosis*

The genitourinary signs and symptoms of menopause that arise from decreasing level of estrogens and other steroids. This includes burning and irritation of reproductive organs and structures, dryness, pain with intercourse and urinary urgency, dysuria and recurrent infections.

#### **Female Sexual Interest/Arousal disorder**

##### *Diagnosis*

Lack of, or significantly reduced, sexual interest/arousal as manifested by 3 of the following: (i) Absent/reduced interest in sexual activity; (ii) Absent/reduced sexual/erotic thoughts or fantasies; (iii) No/reduced initiation of sexual activity and unresponsive to partner's attempts to initiate; (iv) Absent/reduced sexual excitement/pleasure during sexual activity in almost all or all (75% - 100%) sexual encounters; (v) Absent/reduced sexual interest/arousal in response to any internal or external sexual/erotic cues (written, verbal, visual); (vi) Absent/reduced genital or non-genital sensations during sexual activity in almost all or all (75% - 100%) sexual encounters.

#### **Female Sexual Interest/Arousal Disorder (FSIAD)**

##### *Diagnosis*

Hypoactive sexual desire disorder (HSDD and female sexual arousal disorders (FSAD)) have been combined into one disorder, now called Female Sexual Interest/Arousal Disorder (FSIAD), based on data suggesting that sexual response is not always a linear, uniform process and that the distinction between certain phases, particularly desire and arousal, may be artificial.

#### **Filling cystometry**

##### *Investigation*

Pressure-volume relationship of the bladder during bladder filling. It begins with the commencement of filling and ends when a "permission to void" is given by the urodynamicist or with incontinence (involuntary loss) of the bladder content.

#### **Filling cystometry - intrinsic sphincter deficiency (ISD)**

##### *Investigation*

Very weakened urethral closure mechanism.

#### **Filling cystometry - abnormal sensations**

##### *Investigation*

Awareness of sensation in the bladder, urethra or pelvis described with the words like "tingling", "burning" or "electric shock" in the setting of a clinically relevant neurologic disorder (e.g. incomplete spinal cord lesion).

#### **Filling cystometry - absent bladder sensation.**

##### *Investigation*

No bladder sensation during bladder filling, at least to an expected capacity of 500mLs.

#### **Filling cystometry - aims**

##### *Investigation*

These are to assess bladder sensation, bladder capacity, detrusor activity and bladder compliance as well as to document (the situation of and detrusor pressures during) urine leakage.

#### **Filling cystometry - bladder (detrusor) compliance (mL/cm H2O)**

##### *Investigation*

Relationship between the change in bladder volume (Vol) and change in detrusor pressure (pdet) as a measure of the distensibility of the bladder. Compliance = Change Vol / change Pdet. Compliance reflects the amount of fluid in the bladder to increase the bladder pressure by 1cm H2O (mL per cm H2O)

#### **Filling cystometry - bladder oversensitivity**

##### *Investigation*

Increased sensation during bladder filling with: early first desire to void; early strong desire to void, which occurs at low bladder volume; lower cystometric bladder capacity; no abnormal increases in detrusor pressure.

**Filling cystometry - bladder sensation***Investigation*

Usually assessed by questioning the individual in relation to the fullness of the bladder during cystometry.

**Filling cystometry - cystometric capacity***Investigation*

Bladder volume at the end of filling cystometry, when “permission to void” is usually given by the urodynamicist. This endpoint and the level of the woman’s bladder sensation at that time, for example, “normal desire to void”, should be noted.

**Filling cystometry - cystometric capacity (mL)***Investigation*

Bladder volume at the end of filling cystometry, when a “permission to void” is usually given by the urodynamicist.

**Filling cystometry - detrusor overactivity***Investigation*

The occurrence of detrusor contraction(s) during filing cystometry. These contractions, which may be spontaneous or provoked, produce a waveform on the cystogram, of variable duration and amplitude. Symptoms, e.g. urgency and/or urgency incontinence or perception of contraction may or may not occur.

**Filling cystometry - filling rate (male)***Investigation*

The filling rate, including any changes during testing, should be noted on the urodynamic report. A medium fill rate (25-50 mL/min) should be applicable in most routine studies. Much slower filling rates (under 25 mL/min) are appropriate in men where there are concerns for poor compliance or with a bladder diary showing low bladder capacity or those with neuropathic bladder. A higher filling rate is greater than 50mL/min.

**Filling cystometry - first desire to void***Investigation*

The first feeling that the individual may wish to pass urine. The volume at which this occurs should be noted.

**Filling cystometry - first sensation of bladder filling***Investigation*

The feeling when the individual first becomes aware of bladder filling.

**Filling Cystometry - First sensation of bladder filling***Investigation***Filling cystometry - Idiopathic (primary) detrusor overactivity***Investigation*

No identifiable cause for the involuntary detrusor contraction(s)

**Filling cystometry - incompetent urethral closure mechanism***Investigation*

Leakage occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.

**Filling cystometry - Initial bladder volume***Investigation*

Bladder should be empty.

**Filling cystometry - maximum cystometric capacity (mL)***Investigation*

In an individual with normal sensation, this is the volume during filling cystometry when voiding can no longer be delayed.

**Filling cystometry - Neurogenic (secondary) detrusor overactivity***Investigation*

Detrusor overactivity and evidence (history; visible or measurable deficit) of a relevant neurological disorder.

**Filling cystometry - non-specific bladder awareness***Investigation*

Perception of bladder filling as abdominal fullness, vegetative symptoms (nausea, vomiting, faintness), spasticity or other “non-bladder”awareness, in the setting of a clinically relevant neurologic disorder (e.g. incomplete spinal cord lesion).

**Filling cystometry - normal detrusor activity/function.***Investigation*

There is little or no change in detrusor pressure with filling or any provocative activities.

**Filling cystometry - normal urethral closure mechanism.***Investigation*

A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.

**Filling cystometry - pain***Investigation*

The complaint of pain during filling cystometry is abnormal. Its site, character and duration should be noted.

**Filling cystometry - Position of female patient***Investigation*

Sitting position is more provocative for abnormal detrusor activity than the supine position. At some point in the test, filling might desirably take place with the woman standing.

**Filling cystometry - position of male patient***Investigation*

Sitting (standing) position is more provocative for abnormal detrusor activity (i.e. overactivity) than the supine position. At some point in the test, filling might desirably take place with the patient standing (in those patients able to do so). Many men will void standing.

**Filling cystometry - reduced bladder sensation.***Investigation*

Bladder sensation perceived to be diminished during filling cystometry.

**Filling cystometry - temperature of fluid***Investigation*

Fluid at room temperature is mostly used. It can be warmed to body temperature but without evidence that this influences results.

**Filling cystometry - urgency.***Investigation*

Sudden, compelling desire to void which is difficult to defer.

**Filling cystometry - urodynamic stress incontinence (USI)***Investigation*

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

**Filling cystometry: first sensation of bladder filling.***Investigation*

The feeling when the individual first becomes aware of bladder filling. Filling volume when this occurs can be noted/recorded.

**Filling cystometry: normal desire to void.***Investigation*

The feeling that leads the individual to void at the next convenient moment, but voiding can be delayed if necessary

**Filling cystometry: strong desire to void.***Investigation*

The persistent desire to void without the fear of leakage.

**First desire to void - filling cystometry***Investigation*

The first feeling that an individual may wish to void. Volume when this occurs may be noted/recorded.

**First morning void***Sign*

The first void after waking with the intention of rising.

**First sensation of bladder filling - filling cystometry***Investigation*

The feeling when the individual first becomes aware of bladder filling.

**First sensation of bladder filling - Filling cystometry***Investigation*

The feeling when the individual first becomes aware of bladder filling. Filling volume when this occurs can be noted/recorded.

**Fistula in ano***Sign*

An anal fistula is an abnormal connection between the anal canal epithelium (or rarely rectal epithelium) and the skin epithelium. Patients may complain of pain, swelling, intermittent discharge of blood or pus from the fistula and recurrent abscesses formation.

**Flatal incontinence.***Symptom*

Complaint of involuntary loss of flatus (gas).

**Flaturia***Symptom*

Complaint of passage of gas per urethra.

**Flexible sigmoidoscopy***Investigation*

This refers to the inspection of the distal colonic mucosa, typically up to the splenic flexure, with a 60 cm flexible endoscope following enema preparation.

**Flow delay (unit: s) - pressure flow studies***Investigation*

The time elapsed from initial rise in pressure to the onset of flow. This is the initial isovolumetric contraction period of micturition. It reflects the time necessary for the fluid to pass from the point of pressure measurement to the uroflow transducer.

**Flow time (FT - unit: s)***Investigation*

Time over which measurable flow actually occurs.

**Frequency-volume chart (FVC)***Sign*

Frequency-volume chart (FVC): The recording of the time of each micturition together with the volume voided for at least 24 hours. Ideally a minimum of three days of recording (not necessarily consecutive) will generally provide more useful clinical data. It is relevant to discriminate daytime and night-time micturition.

**Functional Anal Length - Anal Manometry***Investigation*

Functional anal canal length is defined as the length of the anal canal over which resting pressure exceeds that of the rectum by greater than 5mmHg or, alternatively, as the length of the anal canal over which pressures are greater than half of the maximal pressure at rest.

**Functional profile length - Urethral pressure profile - female***Investigation*

The length of the urethra along which the urethral pressure exceeds intravesical pressure in women.

**Functional profile length (on stress) - urethral pressure profile (female)***Investigation*

The length over which the urethral pressure exceeds the intravesical pressure on stress.

## G

**Generalised Vulvar Pain Syndrome***Symptom*

i. Diffuse vulvar pain perceived to be in the vestibule or beyond. ii. Dyspareunia. iii. Provocation of pain with touch, pressure or friction.

**Genital hiatus***Sign*

This is measured from the middle of the external urethral meatus to the posterior margin of the hymen.

**Genital skin signs***Sign*

Excoriation, redness, irritation secondary to urinary incontinence and the effect of pads or diapers. (ii) Mycotic infections (balanoposthitis, intertrigo, or scrotal): moist, red pruritic skin usually in men with urinary or fecal incontinence, immune suppression or poorly controlled diabetes mellitus; (iii) Skin pigmentation: balanitis xerotica obliterans (BXO – syn. lichen sclerosus) and vitiligo may cause depigmentation (penile skin, scrotum, glans); (iv) Cutaneous manifestations of sexually transmitted diseases: vesicles, ulcers.

## Genito-Pelvic Pain/Penetration Disorder

### Diagnosis

Persistent or recurrent difficulties with 1 or more of the following: (i) vaginal penetration during intercourse; (ii) marked vulvovaginal or pelvic pain during intercourse or penetration attempts; (iii) marked fear or anxiety about vulvovaginal or pelvic pain in anticipation of, during, or as a result of vaginal penetration; (iv) marked tensing or tightening of the pelvic floor muscles during attempted vaginal penetration.

## Genito-pelvic pain/penetration disorder" (GPPPD)

### Diagnosis

The categories of vaginismus and dyspareunia have been combined to create "genito-pelvic pain/penetration disorder" (GPPPD)

## Genitourinary syndrome of menopause (urogenital aging)

### Sign

(i) Pallor/erythema: Pale genital mucosa; (ii) Loss of vaginal rugae: vaginal rugae flush with the skin; (iii) Tissue fragility/fissures: genital mucosa that is easily broken or damaged; (iv) Vaginal petechiae: a petechia, plural petechiae, is a small (1–2 mm) red or purple spot on the skin, caused by a minor bleed (from broken capillary blood vessels); (v) Urethral eversion: urethral epithelium turned outside the lumen; (vi) Urethral prolapse: complaint of a lump at the external urethral meatus; (vii) Loss of hymenal remnants: absence of hymenal remnants; (viii) Prominence of urethral meatus vaginal canal shortening and narrowing: Introital retraction.

# H

## Halban procedure

### Surgery – Female

Obliteration of the cul-de-sac by using successive sutures placed sagittally between the uterosacral ligaments.

## Hematospermia

### Symptom

Complaint of the appearance of visible blood in the seminal fluid. Colour of the seminal fluid may be red or brown.

## Hematuria

### Symptom

Complaint of passage of visible blood mixed with urine. This may be initial (at the beginning), terminal (at the end) or total (throughout bladder emptying).

## Hemorrhoids

### Sign

Abnormality of the normal cushion of specialized, highly vascular tissue in the anal canal in the submucosal space. Hemorrhoids can be divided into those originating above the dentate line which are termed internal and those originating below the dentate line which are termed external. Internal hemorrhoids are graded as follows: (I) Grade I bleeding without prolapse; (II) Grade II prolapse with spontaneous reduction; (III) Grade III prolapse with manual reduction; (IV) Grade IV incarcerated, irreducible prolapse. Grade II and Grade III hemorrhoids will become evident on asking the patient to bear down and grade IV hemorrhoids are obvious at the time of the examination. A proctoscopy is essential in examining for hemorrhoids unless they are completely prolapsed.

## Good Urodynamic Practice - Key Elements

### Investigation

A Good Urodynamic Practice comprises three main elements: . A clear indication for and appropriate selection of relevant test measurements and procedures; Precise measurement with data quality control and complete documentation; Accurate analysis and critical reporting of results.

## Graft

### Surgery – Female

Any tissue or organ for transplantation. This term would be used to refer to biological materials inserted. (i) Autologous grafts: From patient's own tissues e.g. rectus sheath or fascia lata. (ii) Allografts: From post-mortem tissue banks. (iii) Xenografts: From other species e.g. modified porcine dermis, porcine small intestine and bovine pericardium. Terminology for grafts has not been separated into the different applications for POP and continence surgery.

## Granulation

### Surgery – Complication related

Fleshy connective tissue projections on the surface of a wound, ulcer or inflamed tissue surface.

## Hesitancy

### Symptom

Complaint of a delay in initiating voiding (when the individual is ready to pass urine).

## Hispareunia

### Symptom

Male partner pain with intercourse after female reconstructive surgery.

## Hormonal assessment in female sexual dysfunction

### Investigation

Hormones such as estrogen, progestin, and androgen influence sexual function and imbalance may lead to various symptoms including decreased libido, lack of arousal, vaginal dryness and dyspareunia. Depending on the underlying suspected conditions associated with sexual dysfunction, hormonal investigations such as estradiol (or FSH if symptoms of deficiency), serum testosterone, dehydroepiandrosterone acetate sulphate (DHEAS), free testosterone, dihydrotestosterone, prolactin, and thyroid function testing may be considered. Moreover, the evaluation of vaginal pH and vaginal maturation index (ie, percentage of parabasal cells, intermediate cells, and superficial cells) can be helpful in women with vulvovaginal atrophy as it has been shown to be correlated with patient's symptomatology.

## Hygiene

### Conservative Management – Female

Bladder hygiene: Bladder hygiene prevents UTI by using techniques such as wiping the urethral meatus with clean wipes in an anterior-to-posterior direction after voiding, wearing clean underwear, keeping the genital area clean, and emptying the bladder before and after sexual intercourse. Vulval hygiene: involves maintaining a clean perineum by means of washing the area on a regular basis, and wearing cotton underwear. To avoid vulval irritation, shampoo, perfumed creams or soap should be avoided. Anal hygiene:

involves keeping the perianal region clean, which is especially important when fecal seepage is present. Advice includes using soft toilet paper or moist wipes (avoiding any with an alcohol base), always wiping from front to back, washing after a bowel movement, then gently patting dry. To avoid irritation from products, the vulval hygiene advice above should be followed.

### **Hypersensitivity**

#### *Symptom*

Increased nerve activity from a standardized stimulus with an expected tissue/clinical response. The underlying mechanism remains to be defined.

### **Hypertonicity**

#### *Sign*

An increase in muscle tone related to either elevated contractile activity

and/or passive tension in the muscle. This term is used to describe increased muscle tone of neurogenic origin.

### **Hypospadias**

#### *Sign*

Urethral meatus sited on ventral surface of the penis, either congenital or acquired, proximal to its normal position at the tip of the glans. Types: glans penis (glandular hypospadias); sulcus (coronal hypospadias); shaft (penile hypospadias); scrotum (scrotal hypospadias); perineum (perineal hypospadias).

## **I**

### **ICS STANDARD**

#### *Investigation*

Best practice, based on evidence, with the use of standard terms and standard techniques, evaluated and reported clinically or scientifically, in a complete and validated manner.

### **ICS Standard Urodynamic Information Leaflet**

#### *Investigation*

Overview of the content of an ICS Standard Information Leaflet for Urodynamics.

- What is a urodynamic investigation?
- That the tests involves insertion of catheters into the bladder and rectum, and relevant technical issues.
- What is the usefulness of urodynamics? Why is the testing done?
- What are the different steps of urodynamic investigation and how they are performed (e.g. uroflowmetry, cystometry, urethral pressure measurement and pressure-flow)
- How dignity, communication and comfort during the investigation are maximized (What you do or offer in this regard).
- The symptoms that may occur following the investigation, what they indicate and how can they be handled or prevented, e.g. the fact that mild discomfort, frequency, dysuria and haematuria may be experienced, and a urinary tract infection may occasionally develop.
- Additional information including length of the investigation, sterility of relevant parts of equipment, lack of 'injections'.
- That the test is done interactively and that communication with the patient is a necessary part of the test.
- What the patient should do before the test (e.g. arrive if possible with a full bladder for uroflow, and also with an empty bowel if possible).
- Whether the patient should continue medication before the test, or whether there are specific medications that the patient should not take in (a defined period) before the test. Note: This should be individualized, e.g. with a tick box or a written instruction of the requester.
- What the patient should do after the test.
  - o e.g.: Immediately drink one portion of ½ - 1L extra fluid to ensure prompt voiding again, in order to relieve urethral irritation rapidly.
  - o All usual activities are permitted after the test.
  - o Symptoms and signs of urinary tract infection and what steps to take if these arise.

### **ICS STANDARD URODYNAMIC PROTOCOL (ICS-SUP)**

#### *Investigation*

A patient undergoing collection of a clinical history (should include (a) valid

symptom and bother score(s) and medication list), relevant clinical examination, (3 days-) bladder diary, representative uroflowmetry with post-void residual (PVR) and a complete ICS standard urodynamic test, is referred to as having had the 'ICS standard urodynamics protocol (ICS-SUP).

### **ICS Standard Urodynamic Test**

#### *Investigation*

Free uroflowmetry, postvoid residual, cystometry and pressure-flow study are termed ICS standard urodynamic test (ICS-SUT).

### **ICS Standard Urodynamics Report**

#### *Investigation*

- Overall judgement of the technical quality and the clinical reliability of the test to represent the lower urinary tract function 'as usual'; to be evaluated by the person who performed the tests.
- Uroflowmetry: Voiding position, urge (before the test) and representativeness, as reported by the patient.
- Introduction of catheters: sensation; (if occurring; pain), muscular (pelvic or adductor) defence and -perceptibly unusual- obstruction(s) during insertion.
- Position(s) during cystometry and pressure flow study.
- Patient's ability to report filling sensations and/ or urgency and/ or urine loss.
- Method of urodynamic stress test (if applicable).
- Pressure-flow: position and representativeness as reported by the patient.
- Accessory tests or measurements (if applicable -no further standard).
- Representativeness of the tests to reflect the 'usual LUT behaviour' as reported by the patient.
- Filling sensation (with volumes) -diagnosis or urodynamic condition.
- Cystometry (detrusor) pressure pattern -diagnosis.
- Pressure-flow -diagnosis (compared with uroflowmetry) includes:
  - Bladder outflow function, or obstruction (and the method for assessment)
  - Detrusor contraction, (and the method for assessment)

### **Idiopathic (primary) detrusor overactivity (DO) - filling cystometry**

#### *Investigation*

No identifiable cause for involuntary detrusor contraction(s).

**Impaired cognition urinary incontinence***Symptom*

Complaint of periodic urinary incontinence that the individual with cognitive impairment reports to have occurred without being aware of it.

**Impaired mobility urinary incontinence***Symptom*

Complaint of inability to reach the toilet on time for voiding because of physical or medical disability (similar to “disability associated urinary incontinence”).

**Implant**

Surgery – Female

A surgically inserted or embedded prosthesis or graft.

**Inability to void***Symptom*

Complaint of inability to initiate voiding despite an intensive effort (by abdominal straining, Valsalva or suprapubic pressure).

**Incompetent urethral closure mechanism - filling cystometry***Investigation*

Leakage occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.

**Incompetent urethral closure mechanism (female)***Investigation*

Leakage of urine occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.

**Increased bladder filling sensation***Symptom*

Complaint that the sensation of bladder filling occurs earlier or is more intense or persistent to that previously experienced. n.b. This differs from urgency by the fact that micturition can be postponed despite the desire to void.

**Increased daytime defecation (female)***Symptom*

Complaint that defecation occurs more frequently during waking hours than previously deemed normal by the woman.

**Increased daytime urinary frequency***Symptom*

Complaint that voiding occurs more frequently during waking hours than previously deemed normal by the individual (or caregivers).

**Increased (high) semen volume***Symptom*

Complaint of higher amount of seminal fluid than normal or previously experienced.

**Increased libido (male)***Symptom*

Complaint of increased interest in sexual activity in comparison with previous experience.

**Increased rectal sensation (rectal hypersensitivity)***Symptom*

Complaint of a desire to defecate (during rectal filling) that occurs earlier or

is more persistent to that previously experienced. Can be (i) first sensation; (ii) urge sensation; (iii) maximum tolerated volume.

**Increased Urinary Frequency***Symptom*

Complaint that voiding occurs more frequently than deemed normal by the man or woman. Time of day and number of voids are not specified.

**Increased urinary frequency***Symptom*

Complaint that voiding occurs more frequently than deemed normal by the individual (or caregivers). Time of day and number of voids are not specified.

**Indwelling catheterization**

Conservative Management – General

An indwelling catheter remains in the bladder, urinary reservoir or urinary conduit for a period longer than one emptying.

**Inflammatory Bowel Disease (IBD)***Diagnosis*

Inflammatory Bowel Disease (IBD)—Complaint of recurrent abdominal pain and discomfort of at least 3 days per month in the last 3 months. The majority of IBD patients experience periods of flares and remission.

i. Abdominal and anal pain, diarrhea which may be associated with blood, suggestive of ulcerative colitis. ii. Abdominal pain, fatigue, prolonged diarrhea with crampy abdominal pain, weight loss, and fever, with or without gross bleeding. Irregular bowel habits, with possible blood in the stool, are suggestive of Crohn's disease.

**Infrasacral (cauda equina or peripheral nerves) lesion (CEPNL)***Diagnosis*

This is a neurological lesion affecting the cauda equine and/or peripheral nerves. Neurogenic lower urinary tract dysfunction in CEPNL: an acontractile detrusor and/or stress urinary incontinence may be present. In diabetic neuropathy, detrusor overactivity can be seen in combination with the above.

**Inguinal protrusion***Sign*

Examination and differentiation of hernia from hydrocele or cyst of spermatic cord or groin lymph nodes.

**Insensible urinary incontinence***Symptom*

Complaint of urinary incontinence where the individual is aware of urine leakage but unaware of how or when it occurred.

**Insertion**

Surgery – Complication related

Putting in.

**Intercurrent pathology - ultrasound imaging (male)***Investigation*

Prostate volume (transrectal), tumor, hydronephrosis, scrotal abnormalities.

**Intermittency (Intermittent stream)***Symptom*

Complaint of urine flow that stops and starts on one or more occasions during one voiding episode.



### Intermittent catheterization (IC)

#### Conservative Management – General

Drainage of the bladder or a urinary reservoir with subsequent removal of the catheter mostly at regular intervals.

### Interpretation of Normality of Free Uroflowmetry (Female)

#### Investigation

Because of the strong dependency of urine flow rates on voided volume, they are best referenced to nomograms where the cutoff for abnormally slow (MUFR, AUFR) has been determined and validated, as under the 10th centile of the respective Liverpool nomogram. References to a specific urineflow rate as the lower limit of normal provided a specific volume has been voided require further validation studies.

### Interpretation of normality of free uroflowmetry (men)

#### Investigation

Because of the strong dependency of urine flow rates in men on voided volume and age, they are best referenced to nomograms where the cutoff for normality has been determined and validated. Ideally, abnormal uroflowmetry studies should be repeated.

### Interstitial Cystitis

#### Diagnosis

As for Bladder Pain Syndrome (BPS), i.e. Persistent or recurrent chronic pelvic pain, pressure or discomfort perceived to be related to the urinary bladder accompanied by at least one other urinary symptom such as an urgent need to void or urinary frequency, though with a known Hunner's lesion present. Pain, pressure or discomfort often increases with bladder filling.

### Intravaginal Devices

#### Conservative Management – Female

Intravaginal devices are intended to provide some support to the bladder neck and possibly some compression to the urethra, to correct urinary stress incontinence. These can be traditional tampons, pessaries, and contraceptive diaphragms and devices designed specifically to support the bladder neck (removable, reusable intravaginal ring or single-use disposable devices).

### Intravenous urography (IVU)

#### Imaging

This provides an anatomical outline of the urinary tract including a nephrogram prior to passage of the contrast to the calyces, renal pelvis, ureter and bladder.

### Intravesical pressure (Pves - cm H2O)

#### Investigation

The pressure within the bladder (as directly measured by the intravesical catheter)

### Intravesical prostatic protrusion (IPP) - ultrasound imaging (male)

#### Investigation

The distance from the bladder base until the tip of the prostate in the bladder lumen. It is recommended to fill the bladder with 100-200mLs of fluid in order to receive representative measurements; bladder filling over 400 mL will lower IPP values. The IPP measurement can be divided into three grades: grade I = 0-4.9 mm; grade II = 5-10 mm; grade III = > 10 mm. IPP grade III is associated with prostate-related BOO.

### Intrinsic sphincter deficiency (ISD)

#### Diagnosis

Very weakened urethral closure mechanism.

### Intrinsic sphincter deficiency (ISD) - Filling cystometry

#### Investigation

Very weakened urethral closure mechanism.

### Intussepation

#### Diagnosis

Full thickness invagination of the upper rectum without extrusion through the anus leading to interruption of flow of the fecal stream.

### Invagination

#### Surgery – Complication related

Vaginal mucosa folded and entrapped on itself, characterized by a fixed and tight area on examination.

### Invasive Urodynamics

#### Investigation

Any test that is invasive, as it involves insertion of one or more catheters or any other transducers into the bladder and/ or other body cavities, or insertion of probes or needles, for example for EMG measurement.

### Irritable Bowel Syndrome (IBS) - Functional (non-inflammatory)

#### Diagnosis

i. Recurrent episodes of abdominal pain. ii. Changes in frequency, form or consistency of the stool. iii. Sensation of incomplete evacuation, straining, fecal urgency. iv. Sensation of nausea, fatigue, fullness, vomiting. v. Recurrent abdominal pain or discomfort at least 3 days/month in the last 3 months associated with two or more of the following: 1. Improvement of pain with defecation. 2. Onset associated with change in frequency of stool. 3. Onset associated with a change in the form (appearance) of stool

## J

### Joint therapies

#### Conservative Management – Female

1. Mobilization: skilled passive movement of a skeletal joint including graded passive oscillations at the joint to improve joint mobility, e.g., movement of the coccyx. 2. Manipulation: a passive (for the patient) therapeutic movement, usually of small amplitude and high velocity, at the end of the available joint range. Manipulation is a sudden small thrust that is controlled by the clinician.

## L

### Labial thermistor

#### *Investigation*

Temperature measurement evaluated with a small metal clip attached to the labia minora and equipped with a sensitive thermistor.

### Laparoscopic Assisted Vaginal Hysterectomy

#### *Surgery – Female*

A laparoscopic approach is used to divide the three uterine pedicles (broad ligament, uterine vessels and uterosacral/cardinal). The uterus is removed vaginal with the vaginal vault oversewn laparoscopically.

### Laser Doppler imaging of genital blood flow

#### *Investigation*

An imager positioned close to the vulva allows the assessment of skin/mucosae microcirculation at a depth of up to 2-3 mm. This method has been used to assess response to sexual stimulation and correlated with subjective arousal. It has also led to a better understanding of microvascular differences in women with provoked vestibulodynia compared to asymptomatic controls.

### Leak point pressure

#### *Investigation*

The leak point pressure is the pressure (spontaneous or provoked) that has caused fluid to be expelled from the bladder at the moment that it is visible outside the urethra (may also be used for extra-urethral urine loss or stoma). This may be Abdominal, Cough or Valsalva LPP or Detrusor LPP. Provocation and pressure recording site ('type of LPP') should be reported.

### Levator defects/ trauma

#### *Sign*

Per-vaginal palpation for levator injury/defect/"avulsion".

### Lifestyle Modification for Pelvic Floor Dysfunction

#### *Conservative Management – Female*

Lifestyle modification is the application of interventions in the management of lifestyle-related health problems, e.g., change to a healthy diet and regular participation in physical activity and smoking cessation. The following lifestyle modifications may be applied to treat pelvic floor dysfunctions, either in combination with other therapies or as "stand alone" treatments.

1. Fluid consumption/restriction: fluid consumption is the intake of fluid over 24h. Fluid restriction is the limitation of fluid to a prescribed amount over a period of 24h. These measures are often undertaken as part of a bladder training process. 2. Dietary modification: an alteration or adjustment of food to treat bowel disorders (e.g., constipation and fecal incontinence) or urinary disorders (e.g., incontinence or urgency), for example, increasing fiber to treat constipation. The specifics of the dietary changes should be described. 3. Elimination diet: a form of dietary modification. A diet designed to detect what ingredient in the food causes symptoms in the patient, food items to which the patient may be sensitive are withdrawn separately and successfully from the diet until the item that causes the symptoms is discovered. This is used frequently in patients with fecal incontinence, urinary urgency and urinary urgency incontinence (bladder diet). Physical activity: any body movement produced by the skeletal muscles that results in a substantial increase above resting energy expenditure. Physical activity can be done at work, as transportation, as household and other chores, and as leisure time/sport and fitness activities.

### Localised Vulvar Pain Syndrome

#### *Symptom*

i. Vestibular pain syndrome—pain localized to one or more portions of the vulvar vestibule. ii. Clitoral pain syndrome—pain localized to or perceived in the clitoris.

### Low backache related to POP

#### *Symptom*

Complaint of low, sacral (or "period-like") backache associated temporally with pelvic organ prolapse (POP)

### Lower urinary tract symptom (LUTS)

#### *Symptom*

A symptom related to the lower urinary tract. It may originate from the bladder, urethra, prostate (men) and/or adjacent pelvic floor or pelvic organs, or at times be referred from similarly innervated anatomy e.g. lower ureter.

## M

### Magnetic resonance imaging - male - general comments

#### *Imaging*

MRI provides the opportunity to examine the soft tissue structures of the pelvic support apparatus. It is non-invasive, has excellent soft tissue contrast resolution without exposure to ionizing radiation and allows the study of function of pelvic floor structures under different dynamic conditions. Several anatomical landmarks used for pelvic measurements are also easily identified in MRI and most measurements are thus highly reproducible. T-weighting assists enhancement of fluid-filled structures.

### Magnetic resonance imaging - uses in female

#### *Imaging*

MRI provides the opportunity to examine the soft tissue structures of the pelvic support apparatus in toto. It is non-invasive, has excellent soft tissue contrast resolution without exposure to ionizing radiation and allows the study of function of pelvic floor structures under different dynamic conditions such as increased abdominal pressure during Valsalva. Several anatomical landmarks used for pelvic measurements are also easily identified in MRI and most measurements are thus highly reproducible. Currently the clinical value of these examinations is still under investigation with its impact on therapeutic decisions not yet fully evaluated.

### Magnetic Resonance Imaging in Urogynecology - Current Possible Measurements

#### *Imaging*



Bladder neck and cervical descent/mobility: . Position of bladder neck and cervix at rest and on Valsalva. Pubo-coccygeal line: A line extending from the inferior border of the pubic symphysis to the last joint of the coccyx. Bladder neck or cervical descent >2 cm below this line with straining indicates weakness of the pelvic floor. If alternative landmarks are used in scientific papers they should be clearly described.

(b) Intercurrent pelvic pathology: For example, fibroids, ovarian pathology. (c) Uterine version :Anteverted or retroverted; flexion at the isthmus. (d) Bladder abnormalities: For example, tumor; foreign body. (e) Urethral abnormality: For example, diverticulum. (f) Postoperative findings: For example, bladder neck mobility. (g) Pelvic floor measurements/levator defects: Assessment of the configuration of pelvic floor muscles, in particular, the levator ani. (h) Descent of pelvic organs

### **Magnetic resonance imaging (MRI) - current female applications**

#### *Imaging*

(i) Bladder neck and cervical descent / mobility: position of bladder neck and cervix at rest and on Valsalva; (ii) Intercurrent pelvic pathology: e.g. fibroids, ovarian pathology; (iii) Uterine version: anteverted or retroverted; flexion at the isthmus; (iv) Bladder abnormalities: e.g. tumor; foreign body; (v) Urethral abnormality: e.g. diverticulum; (vi) Postoperative findings: e.g. bladder neck mobility; (vii) Pelvic floor measurements / levator defects: assessment of the configuration of pelvic floor muscles, in particular, the levator ani; (ix) Descent of pelvic organs:

### **Magnetic resonance imaging (MRI) - male)**

#### *Imaging*

Excellent soft tissue contrast resolution looking for benign enlargement, cancer, cysts, prostate-rectal fistulae.

### **Magnetic resonance imaging (MRI) - (male) - current possible measurements**

#### *Imaging*

(1) Bladder abnormalities: e.g. tumor; foreign body, bladder wall abnormalities, intestine-vesical fistulae; (2) Urethral abnormality: e.g. diverticulum, recto-urethral fistulae. (3) Urethral sphincter length: prediction of post-prostatectomy incontinence; (4) Prostate abnormalities: e.g. benign enlargement, cancer, cysts, prostatorectal fistulae; (5) Intercurrent abnormalities: e.g. rectum - rectal dynamics are assessed during evacuation after adding ultrasound gel to the rectum. Anorectal and pelvic floor motion can be imaged providing pelvic images at rest and when the subject strains; (6) Congenital abnormalities: Detection of Mullerian duct remnants, aberrantly inserted ureters and duplicated pelvic structures; (7) Standardized MRI prostate imaging: PI-RADS – prostate imaging reporting and data system.

### **Magnetic Resonance Imaging (MRI) in Urogynecology**

#### *Imaging*

MRI provides the opportunity to examine the soft tissue structures of the pelvic support apparatus in toto. It is noninvasive, has excellent soft tissue contrast resolution without exposure to ionizing radiation, and allows the study of function of pelvic floor structures under different dynamic conditions such as increased abdominal pressure during Valsalva. Several anatomical landmarks used for pelvic measurements are also easily identified in MRI and most measurements are thus highly reproducible. Currently, the clinical value of these examinations is still under investigation with its impact on therapeutic decisions not yet fully evaluated.

### **Magnetic resonance Imaging (MRI -male) - Bladder abnormalities**

#### *Imaging*

Excellent soft tissue contrast resolution looking at bladder tumor, foreign body, bladder wall abnormalities, intestinal-vesical fistulae.

### **Magnetic resonance imaging (MRI -male) - Urethral abnormalities**

#### *Imaging*

Excellent soft tissue contrast resolution looking for urethral diverticula, para-urethral cysts, recto-urethral fistulae.

### **Magnetic Resonance Imaging (MRI) of the Pelvic Floor**

#### *Imaging*

Magnetic resonance imaging (MRI) of the pelvic floor: MRI allows the detection of ligamentous and muscular pelvic floor structures in fine detail. Although it does not use ionising radiation, it is a high cost technique. Static MRI relies on static sequences and high spatial resolution images, to delineate the passive and active elements of the pelvic organ support system. Most commonly, images are acquired in axial, sagittal and coronal planes. MRI has been proposed to be a useful method for diagnosing and staging POP. Several lines and levels of reference have been described in the literature. The most commonly used ones are either a line drawn from the inferior margin of the pubis symphysis to the last coccygeal joint (pubococcygeal line—PCL). in the sagittal plane, noted as midpubic line (MPL). Other applications of MRI are the assessment of the LAM morphology (size, thickness volume) and detection of LAM injuries/ defects/ ("avulsion").

### **Magnetic resonance imaging (MRI-male)**

#### *Imaging*

Excellent soft tissue contrast resolution looking for detection of mullerian remnants, aberrantly inserted ureters and duplicated pelvic structures.

### **Magnetic resonance imaging of the vulvar area**

#### *Imaging*

Evaluation of the increase in clitoral structure volume related to tissue engorgement occurring during arousal.

### **Magnetic stimulation**

#### *Conservative Management – Female*

Magnetic stimulation (or extracorporeal magnetic innervation): a pulsed magnetic technology developed for the transmission of nerve impulses that is aimed at causing PFM contraction. Patients receive therapy by sitting in a chair, which contains the device that produces the pulsing magnetic fields.

### **Main (Chief) complaint**

#### *Symptom*

The primary symptom that an individual states is the main reason for seeking medical advice.

### **Main sleep period**

#### *Sign*

The period from the time of falling asleep to the time of rising for the next day (as recorded on chart or diary).

### **Male Chronic Genital Pain Syndromes**

#### *Diagnosis*

Male genital pain syndromes are often associated with symptoms suggestive of lower urinary tract and sexual dysfunction. Common complaints: genital pain, uncomfortable urination, dysuria, sensation of residual urine, increased daytime frequency, slow stream, urgency, dyspareunia. Absence of infection, previous operations, or other obvious pathology.

### **Male examination - General principles.**

#### *Sign*

A comprehensive physical examination is done to seek potential influences on symptoms. It should include abdominal examination, focussing on the suprapubic area to detect an enlarged bladder, or other abdominal mass, and digital examination of the rectum (prostate) as well as examination of

the external genitalia, the perineum and lower limbs. The hernia orifices should also be evaluated. Penile lesions including meatal stenosis, phimosis and penile cancer must be excluded. If a neurological diagnosis is suspected, then a focused neurological examination with evaluation of perianal crude and pinprick sensations need to be tested. Also, the anal muscle tone can be assessed with finger in the rectum and asking the patient to squeeze.

#### **Male foreskin abnormalities**

##### **Sign**

. Tumor or infection (balanoposthitis i.e. inflammation of the glans penis and overlying foreskin).

. Phimosis: Partial or complete inability to retract the prepuce due to adhesion between the glans and the prepuce or a preputial ring.

Paraphimosis: Entrapment of the prepuce behind the glans.

#### **Male general (visual) observations**

##### **Sign**

(I) Mobility: generalized muscle strength and ability to ambulate independently or with assistance.

(ii) Skin: jaundice or pallor or skin irritation due to urinary loss.

(iii) Nutritional Status: cachexia (possible underlying malignancy); obesity (possible endocrine abnormality including metabolic syndrome).

(iv) Edema of genitalia and lower extremities: Possible cardiac decompensation, renal failure, nephrotic syndrome, or pelvic and/or retroperitoneal lymphatic obstruction.

#### **Manual defecatory assistance: External - perineal pressure or buttock separation.**

##### **Symptom**

Complaint of the need to press on the perineum or separate the buttocks to assist defecation.

#### **Manual defecatory assistance: Internal - anorectal digitation**

##### **Symptom**

Complaint of the need to use of fingers in the rectum to manually assist in evacuation of stool contents by scooping, stretching and/or stimulation.

#### **Manual Therapy (female)**

##### *Conservative Management – Female*

Manual therapy is a clinical approach utilizing skilled, specific hands-on techniques, including but not limited to, massage, manipulation or mobilization.

#### **Maximum cystometric capacity - filling cystometry (mL)**

##### *Investigation*

In individuals with normal sensation, this is the volume during filling cystometry when voiding can no longer be delayed.

#### **Maximum detrusor pressure (Pdet-max – unit: cm H2O) - pressure flow studies**

##### *Investigation*

Maximum registered detrusor pressure during voiding.

#### **Maximum urethral closure pressure (MUCP) - female**

##### *Investigation*

Maximum pressure in the UCPP, i.e. the maximum difference between the urethral pressure and the intravesical pressure.

#### **Maximum urethral pressure (MUP) - female**

##### *Investigation*

Maximum pressure in the UPP.

#### **Maximum urine flow rate (MUFR - mL/s) - Qmax**

##### *Investigation*

Maximum measured value of the urine flow rate (corrected for artefacts).

#### **Maximum voided volume**

##### **Sign**

Highest voided volume recorded during an assessment period of a frequency-volume chart (FVC).

#### **Mean maximum voided volume (functional capacity)**

##### **Sign**

Mean maximum voided volume in everyday activities (as recorded in chart or diary).

#### **Measurements of labial and vaginal oxygenation**

##### *Investigation*

A heated electrode and oxygen monitor are used to evaluate the arterial partial pressure of oxygen (PO<sub>2</sub>) transcutaneously. The temperature of the electrode is kept at a constant elevated temperature by an electric current. Increase in blood flow under the electrode results in more effective temperature dissipation (heat loss) with the result that more current is needed to maintain the electrode at its prefixed temperature. The changes in current provide an indirect measurement of blood flow during sexual stimuli. The electrode also monitors oxygen diffusion across the skin.

#### **Measuring Outcome in POP Surgery**

##### **Surgery – Female**

Measuring Outcome in POP surgeries: As per IUGA-ICS Report on outcome measures for POP surgery, every study evaluating POP surgery should report. (i) Perioperative data: i.e. blood loss, operating time, length of hospital stay, return to normal activities and complications. (ii) Subjective (patient-reported) outcomes: At its simplest level this can be reported as the presence or absence of vaginal bulge. Patient satisfaction and quality of life can be measured by validated instruments that cover prolapse, urinary, bowel and sexual function. (iii) Objective outcomes: POP-Q measurement generally and should be tabulated with absolute values and percentages to allow other studies to compare results. (iv) Secondary outcomes (e.g. lower urinary tract symptoms, stress urinary incontinence or bowel and sexual dysfunction) in their studies whenever possible.

#### **Median functional bladder capacity**

##### **Sign**

Median maximum voided volume in everyday activities (as per frequency-volume chart -FVC)

#### **Mesh**

##### **Surgery – Female**

A (prosthetic) network fabric or structure; open spaces or interstices between the strands of the net. The use of this term would be for POP surgery with synthetic materials.

#### **Mesh kit**

##### **Surgery – Female**

A set of articles or equipment utilised for POP surgery containing mesh with a system of trocars designed to achieve mesh fixation or allow mesh passage to or through specific areas within the pelvis.

#### **Mesh, Tape & Graft Surgery Complication - CTS Classification - Category (C) 1A - 3A**

##### **Surgery – Complication related**

1A–3A: Asymptomatic—Abnormal mesh finding These are generally phy-

sician-diagnosed at any episode of clinical care. It can be argued that the “abnormal prosthesis or graft finding” aspects of category 1A, in particular, aren’t really complications as the patient isn’t bothered by the potential problem. It may be, however, that the woman may not have engaged in an activity that is likely to provoke symptoms for herself, e.g. pain or bleeding during sexual intercourse (or for her partner), which would convert these complications to category 1B. 1Aa–3Aa: Asymptomatic—Abnormal mesh finding—No pain. The addition of an “a” specifies that the patient experiences no pain in association with the abnormal finding.

**Mesh, Tape & Graft Surgery Complication - CTS Classification - Category (C) 2**  
Surgery – Complication related  
Vaginal complication—(smaller) exposure: A smaller (1 cm or less) degree of vaginal epithelial separation is involved.

**Mesh, Tape & Graft Surgery Complication - CTS Classification - Category (C) 3**  
Surgery – Complication related  
Vaginal complication—(larger) exposure or extrusion: A larger degree (more than 1 cm) of vaginal epithelial separation or prosthesis or graft extrusion is involved.

**Mesh, Tape & Graft Surgery Complications - CTS Classification - Category (C) 1**  
Surgery – Complication related  
Vaginal complication—no epithelial separation: This incorporates the terms prominence (e.g. due to wrinkling or folding) or contraction (shrinkage). Also incorporated here is the palpation of mesh fibres.

**Mesh, Tape and Graft Complication - CTS Classification - Category (C) 1B - 3B**  
Surgery – Complication related  
1B–3B: Symptomatic—Unusual discomfort or pain; dyspareunia (for either partner). Bleeding or discharge may be possible symptoms. 1Bb–3Bb: Symptomatic—Provoked pain only (during vaginal examination) The addition of a “b” to the category code specifies that pain, provoked only during vaginal examination, is associated with the abnormal finding. 1Bc–3Bc: Symptomatic—Pain during sexual intercourse The addition of a “c” to the category code specifies that pain, provoked during sexual intercourse (patient only), is associated with the abnormal finding. 1Bd–3Bd: Symptomatic—Pain during physical activities The addition of a “d” to the category code specifies that pain, provoked during physical activities, is associated with the abnormal finding. 1Be–3Be: Symptomatic—Spontaneous pain: The addition of an “e” to the category code specifies that pain, spontaneously present (i.e. without physical activity), is associated with the abnormal finding.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Category 6**  
Surgery – Complication related  
Category 6: Skin and/or musculoskeletal complications: 6A: Asymptomatic: Physician-diagnosed complication at any episode of care. 6B: Symptomatic: For example, discharge, pain, lump. 6C: Infection from skin or musculoskeletal complication: Including sinus tract formation 6D: Abscess formation from skin or musculoskeletal complication.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Category (C) 1C - 3C**  
Surgery – Complication related  
1C–3C: Clinical Infection: This is always a possibility with a synthetic prosthesis or graft. Signs of local tenderness are suggestive with the combination of redness and a purulent discharge being more conclusive. 1C–3C (b–e): Infection—Pain. The addition of the letters “b” through to “e” specifies that pain (as defined in Table 3) is part or all of the infected abnormal finding.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Category (C) 4**

Surgery – Complication related

Category 4: Urinary tract compromise or perforation. This category class has been subdivided into:

4A: Small intraoperative defect: For example, bladder perforation. Such a complication does not generally create longer-term compromise for the bladder if recognized, prosthesis (graft) removed as indicated, defect oversewn (if necessary), and some minor precautions are taken, for example, short-term bladder drainage, with suitable antibiotics commenced. 4B: Other lower urinary tract (bladder or urethral) complication or compromise: This division would incorporate injuries causing longer-term bladder issues, for example, ongoing prosthesis or graft perforation, fistula, calculus around the prosthesis, or graft. This category also incorporates urinary retention directly related to the procedure requiring subsequent surgical intervention (apart from any form of bladder drainage). The time and site divisions relates to those for the surgical intervention. 4C: Ureteric or upper tract complication or compromise: This division is self-explanatory.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Category (C) 5**

Surgery – Complication related

Category 5: Rectal or Bowel compromise or perforation. This category class has been subdivided into:

5A: Small intraoperative defect: Such a complication may not generally be expected to cause compromise if the defect is recognized, prosthesis (graft) removed as indicated, defect oversewn (as necessary) with appropriate precautions taken, for example, short-term bowel rest is instituted with suitable antibiotics commenced. 5B: Rectal injury or compromise: This division would incorporate injuries causing longer-term rectal issues, for example, ongoing prosthesis (graft) perforation, fistula. 5C: Small or large bowel injury or compromise: This division would incorporate injuries causing longer-term bowel issues, for example, ongoing prosthesis (graft) perforation, fistula, obstruction. 5D: Abscess formation from bowel injury/compromise.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Category (C) 7**

Surgery – Complication related

Category 7: Patient compromise. This category recognizes that the patient might be brought into systemic danger with some of the complications in addition to any localized issue. 7A: Bleeding complication including hematoma: This division refers to any clinically diagnosed hematoma as well as those where blood transfusion or surgical intervention is a consideration. 7B: Major degree of resuscitation or intensive care: This division refers to significant hemodynamic or cardiopulmonary resuscitation directly related to the procedure, and/or patient transfer for management in intensive care facilities. 7C: Mortality: The insertion of the prosthesis, whilst not necessarily fatal at the time, has set in train further morbid events leading to mortality. N.B. Because of their systemic nature, 7B and 7C will not have a specific site division. They will be denoted 50.

**Mesh, Tape and Graft Surgery Complication - CTS Classification - Time Divisions**

Surgery – Complication related

The time (T) for the complication is when it is clinically diagnosed. This section incorporates four time periods, all of the possible episodes where clinical care might be given by the physician or sought by the patient. It might not always be possible to predict with any prosthesis or graft when complications might be more frequently seen. This would depend on the results of a procedure-specific surgical audit using the classification. The earliest time division (T1) might involve more insertion issues, whilst later divisions (T2–T4) might be biased towards healing abnormality issues. T1: Intraoper-

ative—48 hr: Insertion complications more likely. T2: 48 hr–2 months: Healing or infection complications more likely. T3: 2–12 months: Later healing abnormalities more likely. T4: Over 12 months: Late healing abnormalities and other mesh complications more likely.

### **Mesh, Tape and Graft Surgery Complications - CTS Classification - Category (C) 1D - 3D**

Surgery – Complication related

1D–3D: Abscess formation: This is a more serious possibility with a synthetic prosthesis or graft. 1D–3D (b–e): Infection—pain: The addition of the letters b through to e specifies that pain (as defined in Table 3) is part of the abnormal finding associated with abscess formation.

### **Mesh, Tape and Graft Surgery Complications - CTS Classification - Site Divisions**

Surgery – Complication related

The selection of these divisions incorporates the current sites where prosthesis or graft complications have been noted: S0: Systemic complications (no specific site): As mentioned earlier, category divisions 7B and 7C which are systemic complications will be denoted S0. S1: Vaginal: area of suture line: Perhaps the commonest site for prosthesis and graft complications from vaginal surgery is close to the vaginal suture line. S2: Vaginal: away from the vaginal suture line: As most suture lines would be midline, this would generally be lateral in the vagina. S3: Trocar passage: The passage of any sharp surgical instrument can cause damage along the path of insertion. This division incorporates any extraperitoneal, bladder, or rectal complication, but not intra-abdominal complications which are S5. S4: Other skin or musculoskeletal site: This division is relevant to any skin or musculoskeletal complications away from the sites of trocar entry or exit. Included might be cutaneous sinus or fistula formation. S5: Intra-abdominal: Included in this section would be bowel perforation or obstruction.

### **Micturating cystogram (MCU) - female**

*Imaging*

The principal use is the detection of vesico-ureteric reflux, some fistulae and diverticula.

### **Mid-perineal thickness (MPT)**

Surgery – Female

Thickness (cm) of the mid-perineum in the midline.

### **Mid-vaginal laxity (MVL - undisplaced - cm)**

Surgery – Female

Laxity of the vaginal mucosa (anterior traction) midpoint in the vagina super-posteriorly and in the midline with the vaginal vault held in an undisplaced position (similar to that after vault fixation).

### **Mid-vaginal laxity (MVL - undisplaced) - posterior colporrhaphy**

Surgery – Female

Laxity (cm) of the vaginal mucosa (anterior traction) midpoint in the vagina super-posteriorly and in the midline with the vaginal vault held in an undisplaced position (similar to that after vault fixation).

### **Miscellaneous Techniques for Bladder and Bowel Control**

*Conservative Management – Female*

Other techniques consist of doing something that takes the patient's mind off the condition. Distraction techniques utilized in urgency may include (but are not limited to) counting backward from 100 in 7s, reciting a poem, doing breathing exercises, reading or working. Urgency suppression techniques: are methods/maneuvers that are used to decrease the feeling of urgency, which may include, but are not limited to: distraction, PFM contraction, perineal pressure such as sitting on a hard chair, relaxation and

breathing, toe curling or plantar flexion of the ankle. Double voiding: the patient is taught to urinate, relax, and attempt to urinate again. Defecatory dynamics: is a postural and respiratory technique to aid defecation. The mechanics involves co-ordination of the diaphragm, abdominal and PFM, with the intent to maintain rectal support whilst releasing the anal outlet with sufficient expulsion to be effective. Bowel habit training: is aimed at establishing a regular, predictable pattern of bowel evacuation by patient teaching and adherence to a routine to achieve a controlled response to bowel urgency (modified from NICE guideline).

### **Mixed bladder outlet obstruction and detrusor underactivity (male -BOO-DU)**

*Diagnosis*

Urodynamically confirmed BOO occurring simultaneously with urodynamically confirmed DU in pressure-flow analyses.

### **Mixed detrusor overactivity and bladder outlet obstruction (male - DO-BOO)**

*Diagnosis*

Detrusor overactivity (filling cystometry) in the presence of bladder outlet obstruction (pressure-flow studies). This is a relatively common diagnosis.

### **Mixed detrusor overactivity with detrusor underactivity (male - DO-DU)**

*Diagnosis*

Urodynamically confirmed detrusor contractions during filling cystometry in combination with detrusor underactivity on pressure-flow.

### **Mixed neuronal lesion**

*Diagnosis*

This results from lesions of the neural pathway at different levels of the central nervous system concurrently.

### **Mixed storage and voiding dysfunction**

*Diagnosis*

(A) Bladder Outlet Obstruction and Detrusor Underactivity (BOO-DU): Urodynamic BOO occurring synchronous with urodynamic DU in pressure-flow analyses. (B) Detrusor Overactivity and Bladder Outlet Obstruction (DO-BOO): Urodynamic DO on filling cystometry in the presence of BOO on pressure-flow studies. (C) Detrusor Overactivity with Detrusor Underactivity (DO-DU)

Urodynamic DO on filling cystometry) in combination with urodynamic DU on pressure-flow studies. This diagnosis is intended to supersede the old expression “detrusor hyperactivity with impaired contractility” (DHIC) and detrusor overactivity with impaired contractility (DOIC). It is most common in the elderly group.

### **Mixed urinary incontinence (MUI)**

*Symptom*

Complaints of both stress and urgency urinary incontinence, i.e. involuntary loss of urine associated with urgency and also with effort or physical exertion including sporting activities or on sneezing or coughing.

### **Modified Manchester (Fothergill) Procedure**

Surgery – Female

This procedure combines anterior vaginal wall repair with amputation of the cervix and uterosacral ligament suspension with or without concurrent vaginal posterior wall repair.

### **(Modified) Manchester repair (Fothergill operation)**

Surgery – Female

This procedure combines anterior vaginal wall repair (colporrhaphy) with amputation of the cervix and uterosacral ligament suspension with or without concurrent vaginal posterior wall repair (colporrhaphy).

**Moschovitz procedure**

Surgery – Female

Concentric purse string suture(s) are placed around the cul-de-sac to include the posterior vaginal wall, pelvic side-walls and serosa of the sigmoid.

**Muscle Action Characteristics***Investigation*

The decrease in size of muscle fibers as a result of inactivity, illness or aging.

**Muscle Action Characteristics - Anatomic Cross-sectional Area***Investigation*

For an individual muscle, the largest cross-sectional area along the length of that muscle and 90° on the muscle length.

**Muscle Action Characteristics - Antagonistic Contraction***Investigation*

Contraction of muscle/ muscle groups with the opposite action to the desired action (activity that hinders the targeted muscle/ muscle group from contracting).

**Muscle Action Characteristics - Bulk***Investigation*

The absolute volume of a muscle measured using imaging techniques such as anatomical magnetic resonance imaging and ultrasound.

**Muscle Action Characteristics - Co-Contraction***Investigation*

Contraction of two or more muscles at the same time. Co-contraction of muscles can be synergistic (e.g., resulting in an augmentation of motor activity) or it could be counterproductive to normal function (e.g., contraction of antagonistic muscles resulting in abnormal movement or training other muscles instead of the targeted ones, e.g., training of gluteal muscles instead of the PFM).

**Muscle Action Characteristics - Coordination***Investigation*

Property of movement characterized by the smooth and harmonious action of groups of muscles working together to produce a desired motion.

**Muscle Action Characteristics - Exteroception***Investigation*

Sensory information from receptors in the skin registering touch, vibration, heat, and cold.

**Muscle Action Characteristics - Flexibility***Investigation*

The ability of a muscle to lengthen and allow one joint (or more than one joint in a series) to move through a range of motion. Loss of flexibility is defined as a decrease in the ability of a muscle to deform.

**Muscle Action Characteristics - Hypertrophy***Sign*

The increase in size (volume) of the muscle fibers.

**Muscle Action Characteristics - Maximum Voluntary Contraction (MVC)***Investigation*

The attempt to recruit as many fibers in a muscle as possible for the purpose of developing force. MVC of the pelvic floor can be assessed by vaginal palpation, manometers, and dynamometers.

**Muscle Action Characteristics - Maximum Voluntary Contraction (MVC)***Investigation*

The attempt to recruit as many fibers in a muscle as possible for the purpose of developing force. MVC of the pelvic floor can be assessed by vaginal palpation, manometers, and dynamometers.

**Muscle Action Characteristics - Motor Control***Investigation*

The ability of the nervous system to control or direct the muscles in purposeful movements and postural adjustment by selective allocation of muscle tension across appropriate joint segments.

**Muscle Action Characteristics - Muscle Power***Investigation*

The explosive aspect of strength; the product of strength and speed of movement (force×distance/time).

**Muscle Action Characteristics - Muscle Strength***Investigation*

Force-generating capacity of a muscle. It is generally expressed as maximal voluntary contraction measurements and as the one repetition maximum (1RM) for dynamic measurements.

**Muscle Action Characteristics - Physiological Cross-sectional Area***Investigation*

The total area of cross-section perpendicular to the muscle fibers.

**Muscle Action Characteristics - Proprioception***Investigation*

Sensory information from receptors of muscles, joints, capsules, and ligaments that provides information related to posture and movement.

**Muscle Action Characteristics - Submaximal contraction***Investigation*

All contractions without maximal effort, expressed as a percentage of one repetition maximum (1RM).

**Muscle Action Characteristics - Synergistic Contraction***Investigation*

The combination of several muscle actions that serve to optimally achieve a motor task.

**Muscle Action Characteristics - Local Muscle Endurance***Investigation*

The ability to sustain near maximal or maximal force, assessed by the time a patient is able to maintain a maximal static or isometric contraction, or the ability to repeatedly develop near maximal or maximal force determined by assessing the maximum number of repetitions the patient can perform at a given percentage of 1RM.

**Muscle contracture***Sign*

An involuntary shortening of a muscle. Clinically, a muscle cramp and contracture may appear similar; however, contractures are electrically silent.

**Muscle Cramp***Sign*

A painful involuntary muscle contraction that occurs suddenly and can be temporarily debilitating. Pain is intense and localized. It tends to occur when the muscle is in the shortened position and contracting, is generated by motor units, and displays a high firing rate (20–150Hz).



**Muscle Fasciculation***Investigation*

A single, spontaneous, involuntary discharge of an individual motor unit. The source generator is the motor unit or its axon, before its terminal branches. Fasciculations display an irregular firing pattern of low frequency (0.1–10Hz). Clinically, fasciculations are recognized as individual brief twitches. They may occur at rest or after muscle contraction and may last several minutes.

**Muscle Hypertonicity***Sign*

An increase in muscle tone related to the contractile or viscoelastic components that can be associated with either elevated contractile activity and/or passive stiffness in the muscle. The terms neurogenic hypertonicity and non-neurogenic hypertonicity are recommended to describe the diagnosis and inform management.

**Muscle Hypotonicity (female)***Sign*

A decrease in muscle tone related to the contractile or viscoelastic components that can be associated with either reduced contractile activity and/or passive stiffness in the muscle. The terms neurogenic hypotonicity and non-neurogenic hypotonicity are recommended to describe the diagnosis and inform management.

**Muscle spasm***Sign*

Persistent contraction of striated muscle that cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp. Spasms occur at irregular intervals with variable frequency and extent and over days or weeks may lead to a contracture.

**Muscle stiffness***Sign*

Resistance to deformation. Passive elastic stiffness is defined as the ratio of the change in the passive resistance or passive force ( $\Delta F$ ) to the change in the length displacement ( $\Delta L$ ) or  $\Delta F/\Delta L$ . The term should only be used if stiffness is measured quantitatively, such as with the use of instruments such as dynamometry or myotonometry.

**N****Native**

Surgery – Complication related  
Pertaining to birth; autologous.

**Native Surgery Complications (CTS Classification) - Category (C) 1**

Surgery – Complication related

Vaginal complication—no epithelial separation: This incorporates the terms prominence or excessive degrees of scarring or tethering.

**Native (tissue)**

Surgery – Female

Pertaining to birth - “in situ autologous”

**Native Tissue Surgery Complications - CTS Classification - Category 4**

Surgery – Complication related

Category 4: Urinary tract compromise or perforation: This category class has been subdivided into:

**Muscle Tension***Sign*

May have a similar meaning to tone and stiffness. Muscle tension can be increased or decreased because of exogenous factors such as the amount of pressure applied and endogenous factors such as thickness/cross-sectional area of the muscle itself, fluid present within the muscle (swelling, inflammation), position (e.g., standing versus sitting) or increased neural activity.

**Muscle tone***Sign*

State of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement. Muscle tone has two components: the contractile component, created by the low frequency activation of a small number of motor units, and the viscoelastic component, which is independent of neural activity and reflects the passive physical properties of the elastic tension of the muscle fiber elements and the osmotic pressure of the cells.

**Muscle Tone - Measurement (female)***Investigation*

There is no single tool that is able to measure all components of muscle tone. Some tools may be able to measure aspects of tone such as contractility, stiffness or elasticity. Instrumented methods may play a role in the valid and reliable evaluation of muscle tone, e.g., surface electromyography (sEMG), wire and concentric electromyography, dynamometry, real-time ultrasound, elastometry, myotonometry.

**Myalgia***Symptom*

Muscle pain. Pelvic floor myalgia (a symptom) may be present with or without a change in PFM tone (a sign).

**Myofascial Pain***Symptom*

Pain caused by the presence of trigger points within muscles or their fascia.

4A: Small intraoperative defect: e.g., bladder perforation. Such a complication does not generally create longer-term compromise for the bladder if the defect is recognised and oversewn (if necessary), and some minor precautions are taken, e.g., short-term bladder drainage, with suitable antibiotics commenced. 4B: Other lower urinary tract (bladder or urethral) complication or compromise: This division would incorporate injuries causing longer-term bladder issues, e.g., ongoing suture perforation, fistula, calculus around the suture. This category also incorporates urinary retention directly related to the procedure requiring subsequent surgical intervention (apart from any form of bladder drainage). The time and site divisions relates to those for the surgical intervention. 4C: Ureteric or upper tract complication or compromise: This division is self-explanatory.

**Native Tissue Surgery Complications - CTS Classification) - Category (C) 1D - 3D**

Surgery – Complication related

1D—3D: Abscess formation: This is a more serious possibility. 1D—3D (b–e): Infection—Pain The addition of the letters “b” through to “e” specifies that

pain (as defined in Table 3) is part of the abnormal finding associated with abscess formation.

#### **Native Tissue Surgery Complications - CTS Classification - Category (C) 1B - 3B**

Surgery – Complication related

1B—3B: Symptomatic—Unusual discomfort or pain; dyspareunia (for either partner). Bleeding or discharge may be possible symptoms. 1Bb—3Bb: Symptomatic—Provoked pain only (during vaginal examination) The addition of a “b” to the category code specifies that pain, provoked only during vaginal examination, is associated with the abnormal finding. 1Bc—3Bc: Symptomatic—Pain during sexual intercourse The addition of a “c” to the category code specifies that pain, provoked during sexual intercourse (patient only), is associated with the abnormal finding. 1Bd—3Bd: Symptomatic—Pain during physical activities: The addition of a “d” to the category code specifies that pain, provoked during physical activities, is associated with the abnormal finding. 1Be—3Be: Symptomatic—Spontaneous pain The addition of an “e” to the category code specifies that pain, spontaneously present (i.e., without physical activity), is associated with the abnormal finding.

#### **Native Tissue Surgery Complications - CTS Classification - Category (C) 1C - 3C**

Surgery – Complication related

1C—3C: Clinical Infection/Inflammation: Signs of local tenderness are suggestive with the combination of redness and a purulent discharge being more conclusive. The presence of granulation should be accepted as representing ongoing inflammation. 1C—3C (b–e): Infection Pain: The addition of the letters “b” through to “e” specifies that pain is part or all of the infected abnormal finding.

#### **Native Tissue Surgery Complications - CTS Classification - Category (C) 5**

Surgery – Complication related

Rectal or Bowel Perforation or Compromise: this is subdivided into: 5A: Small intraoperative defect: Such a complication may not generally be expected to cause compromise if the defect is recognized and oversewn (as necessary) with appropriate precautions taken, e.g., short term bowel rest is instituted with suitable antibiotics commenced. 5B: Rectal injury or compromise: This division would incorporate injuries causing longer-term rectal issues, e.g., ongoing suture perforation, fistula. 5C: Small or large bowel injury or compromise: This division would incorporate injuries causing longer-term bowel issues, e.g., ongoing suture perforation, fistula, obstruction. 5D: Abscess formation from bowel injury/compromise.

#### **Native Tissue Surgery Complications - CTS Classification - Category (C) 6**

Surgery – Complication related

Category 6: Skin and/or musculoskeletal complications: 6A: Asymptomatic: Physician-diagnosed complication at any episode of care. 6B: Symptomatic: e.g., discharge, pain, lump. 6C: Infection from skin or musculoskeletal complication: including sinus tract formation. 6D: Abscess formation from skin or musculoskeletal complication.

#### **Native Tissue Surgery Complications - CTS Classification - Category (C) 7**

Surgery – Complication related

Category 7: Patient compromise: This category recognizes that the patient might be brought into systemic danger with some of the complications in addition to any localized complication. 7A: Bleeding complication including hematoma: This division refers to any clinically diagnosed hematoma as well as those where blood transfusion or surgical intervention is a consideration. 7B: Major degree of resuscitation or intensive care: This division refers to significant hemodynamic or cardiopulmonary resuscitation directly related to the procedure, and/or patient transfer for management in intensive care

facilities. Included in this division is hematoma associated with sepsis, thus increasing patient compromise. 7C: Mortality: The native tissue surgery, whilst not necessarily fatal at the time, has set in train further morbid events leading to mortality. N.B. Because of their systemic nature, 7B and 7C will generally not have a specific site division. They will then be denoted S0.

#### **Native Tissue Surgery Complications - CTS Classification - Site Divisions S0 - S5**

Surgery – Complication related

SELECTION OF SITE (S) DIVISIONS: The selection of these divisions incorporates the current sites where complications have been noted: S0: Systemic complications (no specific site): As mentioned earlier, category divisions 7B (septic hematoma a possible exception) and 7C which are generally systemic complications will be denoted S0. S1: Vaginal: area of suture line: Perhaps the commonest site for complications from native tissue vaginal surgery is close to the vaginal suture line. S2: Vaginal: away from the vaginal suture line: As most suture lines would be midline, this would generally be lateral in the vagina. S3: Adjoining viscus: This division incorporates any extraperitoneal, bladder or rectal complication, but not intraabdominal complications which are S5. S4: Skin or musculoskeletal site: This division is relevant to any skin or musculoskeletal complications away from the sites of the primary wound. Included might be cutaneous sinus or fistula formation and deep muscle pain from suture fixation. S5: Intra-abdominal: Included in this section would be bowel perforation or obstruction.

#### **Native Tissue Surgery Complications - CTS Classification - Time (T) - T1 - T4**

Surgery – Complication related

The time (T) for the complication is when it is clinically diagnosed. This section incorporates four time periods, all of the possible episodes where clinical care might be given by the physician or sought by the patient. It might not always be possible to predict with any particular surgery when particular complications might be more frequently diagnosed. This would depend on the results of a procedure-specific surgical audit using the classification. The earliest time division (T1) might involve more perioperative issues, whilst later divisions (T2–T4) might be biased towards healing abnormality issues. T1: Intraoperative—48 hr: Perioperative complications clearly more likely. T2: 48 hr—2 months: Bleeding, infection or healing complications more likely. T3: 2 months—12 months: Later healing abnormalities more likely. T4: Over 12 months: Late healing abnormalities and other suture complications more likely.

#### **Native Tissue Surgery Complications (CTS Classification) - Category (C) 1**

Surgery – Complication related

Vaginal complication—no epithelial separation: This incorporates the terms prominence or excessive degrees of scarring or tethering.

#### **Native Tissue Surgery Complications (CTS Classification) - Category (C) 1A - 3A**

Surgery – Complication related

1A—3A: Asymptomatic - Abnormal finding. These are generally physician-diagnosed at any episode of clinical care. It can be argued that the “abnormal finding” aspects of category 1A, in particular, are not really complications, as the patient is not bothered by the potential problem. It may be, however, that the woman may not have engaged in an activity that is likely to provoke symptoms for herself, e.g. pain or bleeding during sexual intercourse (or for her partner), which would convert these complications to category 1B. 1Aa—3Aa: Asymptomatic—Abnormal finding The addition of an “a” specifies that the patient experiences no pain in association with the abnormal finding.

#### **Native Tissue Surgery Complications (CTS Classification) - Category (C) 2**

Surgery – Complication related

Vaginal complication—smaller epithelial separation or ulcer: A smaller (1 cm or less) degree of vaginal epithelial separation or ulcer formation is involved.

#### **Native Tissue Surgery Complications (CTS Classification) - Category (C) 3**

Surgery – Complication related

Vaginal complication—larger epithelial separation or ulcer or suture extrusion: A larger degree (more than 1 cm) of vaginal epithelial separation or ulcer formation or suture extrusion is involved.

#### **Native Tissue Surgery Complications (CTS Classification) - Category (C) 3**

Surgery – Complication related

Vaginal complication—larger epithelial separation or ulcer or suture extrusion: A larger degree (more than 1 cm) of vaginal epithelial separation or ulcer formation or suture extrusion is involved.

#### **Native Tissue Surgical Complications (CTS Classification) - Category (C) 1**

Surgery – Complication related

Vaginal complication—no epithelial separation: This incorporates the terms prominence or excessive degrees of scarring or tethering.

#### **Native Tissue Surgical Complications (CTS Classification) - Category (C) 2**

Surgery – Complication related

Vaginal complication—smaller epithelial separation or ulcer: A smaller (1 cm or less) degree of vaginal epithelial separation or ulcer formation is involved.

#### **Native Tissue Surgical Complications (CTS Classification) - Category (C) 3**

Surgery – Complication related

Vaginal complication—larger epithelial separation or ulcer or suture extrusion: A larger degree (more than 1 cm) of vaginal epithelial separation or ulcer formation or suture extrusion is involved.

#### **Need to immediately re-void (“encore” or “double” voiding)**

*Symptom*

Complaint that further voiding is necessary soon after passing urine (cessation of flow).

#### **Neural lesions**

*Diagnosis*

These are described according to the time of onset, risk of neurological progression, completeness and neurological level. The extent of loss of neurological function depends on which part(s) of the nervous system is affected. Relevant diagnoses (see separate descriptions) are (i) Spinal Shock Phase; (ii) Suprapontine Lesion (SPL); (iii) Suprasacral cord/pontine lesion (SSL); (iv) Sacral Spinal Cord Lesion (SSCL); (v) Infrapontine (cauda equine and peripheral nerves) lesion (CEPNL); (vi) Mixed Neuronal Lesion.

#### **Neurogenic**

*Diagnosis*

Occurs in the presence of relevant neurological pathology ONLY.

#### **Neurogenic acontractile detrusor - pressure flow studies**

*Investigation*

No visible detrusor contraction during voiding attempt in a man with evidence of a neurological disorder (either visible or measurable neurological deficit or history of neurological disease). This should replace the term “areflexia”.

#### **Neurogenic detrusor overactivity - compound**

*Investigation*

A phasic detrusor contraction with a subsequent increase in detrusor and

base pressure with each subsequent contraction occurs during filling cystometry in the setting of a clinically relevant neurologic disease.

#### **Neurogenic detrusor overactivity - general**

*Investigation*

Involuntary detrusor muscle contractions occur during filling cystometry in the setting of a clinically relevant neurologic disease.

#### **Neurogenic detrusor overactivity - high pressure**

*Investigation*

A phasic, terminal, sustained or compound high maximal detrusor overactivity with high detrusor pressure occurs during filling cystometry in the setting of a clinically relevant neurologic disease. The investigator may consider whether such contractions might be potentially detrimental to the patient's renal function and/or health.

#### **Neurogenic detrusor overactivity - phasic**

*Investigation*

Phasic detrusor muscle contractions (characteristic waveform) occur during filling cystometry in the setting of a clinically relevant neurologic disease. These may or may not lead to urinary incontinence.

#### **Neurogenic detrusor overactivity - sustained**

*Investigation*

Continuous detrusor muscle contractions (without returning to the detrusor resting pressure) occur during filling cystometry in the setting of a clinically relevant neurologic disease.

#### **Neurogenic detrusor overactivity - terminal**

*Investigation*

Involuntary detrusor muscle contractions occur near or at the maximum cystometric capacity, in the setting of a clinically relevant neurologic disease. These contractions generally cannot be suppressed resulting in urinary incontinence or even reflex bladder emptying (reflex voiding).

#### **Neurogenic detrusor overactivity incontinence**

*Investigation*

Incontinence due to detrusor muscle contractions during filling cystometry in the setting of clinically relevant neurologic disease.

#### **Neurogenic detrusor overactivity (NDO)**

*Diagnosis*

In men and women with LUT/PF symptoms (more commonly storage symptoms) detrusor muscle contractions occur during filling cystometry in the setting of a clinically relevant neurologic disorder.

#### **Neurogenic (secondary) detrusor overactivity**

*Investigation*

Detrusor overactivity and evidence (history; visible or measurable deficit) of a relevant neurological disorder

#### **Neurological assessment of female sexual dysfunction**

*Investigation*

Related to intact sensation, neurological innervation is important for arousal and orgasm. Peripheral neuropathy or central nervous system disorders (eg, diabetic neuropathy, spinal cord injury) may lead to anorgasmia and decreased arousal. Different approaches can be used to evaluate motor and sensory neurological function.

1. Functional magnetic resonance imaging: Investigation of neural activa-



tion in anatomically localized cerebral regions evaluated through monitoring subtle changes in regional cerebral blood flow that occur with activation of the neurons. These patterns of activation and deactivation are used to examine the cerebral and cognitive response to sexual stimulation; 2: Quantitative sensory testing: Assessment of the sensitivity by applying different stimuli (light touch, pressure, temperature, or vibration) using an ascending or descending method in order to evaluate the detection threshold. These methods can be used to evaluate different vulvovaginal sites including the clitoris, labia minora, and majora as well as vaginal and anal margins; 3: Reflex examination: Evaluating sacral arc integrity, the bulbocavernosus reflex can be elicited by squeezing the clitoris and assessing the contraction of the anal sphincter. The external anal reflex is tested by repetitive pricking delivered to perianal skin and observing anal sphincter contraction. Latencies can also be evaluated by stimulating the nerve and evaluating muscle response through a needle electrode.

#### Neurological examination (female)

##### Sign

For patients with possible neurogenic lower urinary tract or pelvic floor dysfunction, there should be particular note of those neurological signs related to S2-4, but these should be complemented by a more general neurological examination as indicated.

#### Neurological examination (male)

##### Sign

- . Overall neurological status: abnormalities of speech, gait as well as upper and lower extremity dexterity should be noted as they may indicate a neurological cause for the urological symptoms. Neuropathy may impact also on management options.
- . Level of neurologic abnormality: can occasionally be localized by the pattern of sensory or motor deficit noted during physical examination using a dermatome map.
- . Penile, scrotal, or perianal sensory deficits: may indicate damage or injury to sacral roots or nerves. Reflex testing in the genital area may also be performed. The most important of these is the Bulbospongiosus reflex (BSR).
- . Bulbospongiosus reflex (BSR) - a reflex contraction of the striated muscle of the pelvic floor (anal sphincter) and the bulbo-spongiosus muscle that occurs in response to various stimuli in the perineum or genitalia.
- . Cremasteric reflex: contraction of the ipsilateral cremaster muscle, drawing the testis upwards, when the upper inner aspect of the thigh is stroked longitudinally.

#### Neuromuscular Electrical Stimulation Parameters

##### Conservative Management – Female

Neuromuscular electrical stimulation parameters: 1. Pulse frequency (or rate): the number of pulse cycles that are generated per unit of time (seconds). This is reported in hertz (Hz). 2. Pulse width: the determined period of time elapsing from the beginning to the end of one pulse cycle, usually expressed in microseconds or milliseconds. 3. Current amplitude: the magnitude of current relative to the isoelectric baseline, expressed in amperes (A). The current amplitude of therapeutic electrical stimulators ranges from micro- to milliamps. 4. Train: the continuous series of pulse cycles over time, usually lasting seconds. For example, a train of impulses may be the results of successive pulse cycles delivered at 50Hz for a duration of 5s. 5. Train ramp-up time and ramp-down time: ramp-up time is the time elapsed from the onset (or baseline) to the plateau current amplitude (or maximum) of the train, whereas ramp-down time is the time elapsed from the plateau current amplitude to zero baseline. 6. Duty cycle (D): the ratio of ON time to the summation of ON time + OFF time, expressed as a percentage ( $\text{duty cycle} = (\text{ON}) / (\text{ON} + \text{OFF time}) \times 100$ , e.g., a duty cycle of 20 % is calculated when the ON and OFF times equal 10 and 40s respectively. 7. Impedance (electric resistance): the opposition of our biological tissues to the flow of an elec-

trical current. Measured in ohms and designated as Z. 8. Evoked potentials: electrical potentials recorded from the nervous system following a delivered stimulus.

#### Night-time

##### Sign

The individual's main daily period of sleep. It commences at the time of falling asleep and concludes when the individual decides to no longer attempt to sleep and rise for the next day (ideally recorded on chart or diary).

#### Night-time (urinary) frequency

##### Sign

Total number of night-time voids irrespective of sleep, i.e. the number of voids recorded from the time the individual goes to bed with the intention of sleeping till the time the individual wakes with the intention of rising.

#### Nociceptive pain

##### Symptom

Pain which arises from actual or threatened damage to non-neural tissue and is due to the activation of nociceptors.

#### Nocturia

##### Symptom

The number of times urine is passed during the main sleep period. Having woken to pass urine for the first time, each urination must be followed by sleep or the intention to sleep. This should be quantified using a bladder diary.

#### Nocturia

##### Sign

The number of times an individual passes urine during their main sleep period, from the time they have fallen asleep up to the intention to rise from that period. This is derived from the bladder diary.

#### Nocturia - General Advice

##### Conservative Management – General

General lifestyle advice, e.g. reducing caffeine and alcohol intake, and limiting excessive liquid/food volume intake before bedtime, can in some cases be sufficient to elicit a satisfactory response. However, care should be taken not to impose a general fluid restriction as this could have serious consequences in patients with undiagnosed diabetes insipidus. Patients should be encouraged to return to their doctor for further evaluation if they are not content with the results after their initial advice.

#### Nocturia related to Bladder Storage

##### Investigation

Reduced functional bladder capacity (e.g. significant post void residual); Reduced nocturnal bladder capacity Detrusor overactivity; Neurogenic (e.g. multiple sclerosis); Non-neurogenic Bladder hypersensitivity Bladder outlet obstruction with post void residual urine; Urogenital ageing.

#### Nocturia related to Sleep Disorders

##### Investigation

Insomnia Obstructive and central apnoea syndrome; Periodic legs syndrome; Restless legs syndrome Parasomnias; Sleep disorders related to medical diseases, e.g. chronic obstructive lung disease, cardiac diseases etc; Sleep disorders related to neurological diseases, e.g. Alzheimer's, Parkinson's and nocturnal epileptic seizures.

#### Nocturnal

##### Sign

Occurring or active at night.

**Nocturnal defecation***Symptom*

Complaint of interruption of sleep one or more times because of the need to defecate.

**Nocturnal enuresis***Symptom*

Complaint of involuntary voiding that occurs at night during the main sleep period (i.e. bedwetting)

**Nocturnal (night-time) polyuria***Sign*

Increased proportional production of urine during the night-time compared with the 24 hour urine volume. Nocturnal polyuria index (NPI) is most commonly used definition (night-time urine volume/24 hour urine volume) x 100%.

- 33% in elderly e.g. > 65 years.
- >20% in younger individuals
- 20 - 33% in “middle age”

**Nocturnal polyuria***Symptom*

Complaint of passing large volumes of urine at night-time (during the main sleep period).

**Nocturnal polyuria***Sign*

Excessive production of urine during the individual's main sleep period. Should be quantified using a bladder diary.

**Nocturnal polyuria - Causes***Sign*

Water diuresis: Circadian defect in secretion or action of antidiuretic hormone Primary (Idiopathic). Secondary: (Excessive evening intake of fluid, caffeine, alcohol); Solute/water diuresis • Congestive heart failure • Auto-nomic dysfunction • Sleep apnoea syndrome • Renal insufficiency • Oestrogen deficiency.

**Nocturnal urine volume***Sign*

Total volume of urine produced during the individual's main sleep period. This includes the first void of the morning. Should be quantified using a bladder diary.

**Non coital sexual pain***Symptom*

Pain induced by non coital stimulation.

**Non- specific (atypical) bladder filling sensation (bladder dyesthesia)***Symptom*

The individual reports no specific bladder filling sensation, but may perceive, for example, abdominal fullness, vegetative symptoms (nausea, vomiting faintness), urethral sensations or spasticity as bladder filling awareness.

**Non-coital sexual pain***Symptom*

Pain induced by non-coital stimulation.

**Non-Functioning Pelvic Floor Muscles***Sign*

(Modified from Messelink et al, 2005): A situation in which there is no PFM action measurable either on instruction to contract (inability) or as the absence of an automatic response to an increase in intraabdominal pressure. This condition can be based on any pelvic floor symptom and on the sign of a non-contracting or non-relaxing pelvic floor.

**Non-functioning Pelvic Floor Muscles***Diagnosis*

A situation in which there is no pelvic floor muscle action palpable. This condition can be based on any pelvic floor symptom and on the sign of a non-contracting, non-relaxing pelvic floor.

**Non-functioning pelvic floor muscles (female)***Sign*

Pelvic floor muscles where there is no voluntary action palpable.

**Non-inflammatory anorectal pain***Symptom*

Complaint of blunted anorectal pain, as opposed to sharp stinging or burning type of pain (proctalgia fugax, Levator ani syndrome, pudendal neuralgia)

**Non-invasive Urodynamics***Investigation*

All urodynamics done without the insertion of catheters: e.g. uroflowmetry, PVR, penile compression-release test, penile cuff, condom catheter, or sonography.

**Non-neurogenic acontractile detrusor - pressure flow studies***Investigation*

No visible detrusor contraction during voiding attempt in a man without evidence of a neurological disorder.

**Non-neurogenic (secondary) detrusor overactivity (DO) - filling cystometry***Investigation*

An identifiable possible non-neurological cause exists for involuntary detrusor contraction(s) during bladder filling. e.g. functional (obstruction); pathology stone, tumor (e.g. carcinoma in situ), UTI.

**Non-specific (atypical) bladder filling sensation (bladder dyesthesia)***Symptom*

Complaint of abnormal bladder filling sensation such as the perception of vague abdominal bloating, vegetative symptoms (nausea, vomiting, faintness) or spasticity. It differs from normal bladder filling sensation or pain, pressure or discomfort of the bladder.

**Non-specific bladder awareness***Symptom*

The individual reports no specific bladder sensation, but may perceive, for example, abdominal fullness, vegetative symptoms, urethral sensations or spasticity as bladder filling awareness or a sign of bladder fullness.

**Non-specific bladder awareness - Filling cystometry***Investigation*

Perception of bladder filling as abdominal fullness, vegetative symptoms (nausea, vomiting, faintness), spasticity or other “non-bladder” awareness, in the setting of a clinically relevant neurologic disorder (e.g. incomplete spinal cord lesion).

### Non-Standard (Urodynamic) Tests

#### Investigation

ICS Standard Urodynamic Testing (ICS-SUT) may be supplemented with EMG, with imaging, with continuous urethral pressure(s) and/ or with urethral pressure profile measurement. Cystometry may be done via a suprapubic catheter (specify supplements).

### Normal bladder filling sensation.

#### Symptom

The individual is aware of bladder filling and increasing sensation up to a strong desire to void.

### Normal desire to void - filling cystometry

#### Investigation

The feeling that leads the individual to void at the next convenient moment, but voiding can be delayed if necessary.

### Normal detrusor activity/function - filling cystometry

#### Investigation

There is little or no change in detrusor pressure with filling or any provocative activities.

### Normal detrusor contractile function - pressure flow studies.

#### Investigation

Normal voiding is achieved by an adequate continuous detrusor contraction that leads to complete bladder emptying within a normal time span.

### Normal detrusor function (female)

#### Investigation

Normal voiding in women is achieved by an initial (voluntary) reduction in intraurethral pressure (urethral relaxation). This is generally followed by a continuous detrusor contraction that leads to complete bladder emptying within a normal time span. Many women will void successfully (normal flow rate and no PVR) by urethral relaxation alone, without much of a rise in detrusor pressure. The amplitude of the detrusor contraction will tend to increase to cope with any degree of bladder outflow obstruction.

### Normal Pelvic Floor Muscles

#### Diagnosis

A situation in which the pelvic floor muscles can voluntarily and involuntarily contract and relax. Voluntary contraction will be normal or strong and voluntary relaxation complete. Involuntary contraction and relaxation are both present.

### Normal pelvic floor muscles (female)

#### Sign

Pelvic floor muscles which can voluntarily and involuntarily contract and relax.

### Normal urethral closure mechanism (female)

#### Investigation

A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.

### Normal urethral closure pressure - Filling cystometry

#### Investigation

A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.

### Normal urethral function during voiding - pressure flow studies (male +/- VCU, EMG)

#### Investigation

The urethra opens and is continuously relaxed to allow micturition at a normal pressure and urine flow and results in complete emptying. The voiding is prompted by a detrusor contraction and simultaneous relaxation of the smooth and striated sphincters of the urethra and pelvic floor muscles.

### Normal urethral function during voiding (female)

#### Investigation

The urethra opens and is continuously relaxed to allow micturition at a normal pressure, urine flow and PVR.

### No-touch technique intermittent catheterization

#### Conservative Management – General

This was introduced as an easier way for the patient to perform self-intermittent catheterization with a ready-to-use catheter (pre-lubricated catheter, usually a hydrophilic catheter). A pull-in aid or special packages are used to handle the catheter without directly touching the sliding surface of the hydrophilic catheter.

## O

### Obstetric Anal Sphincter Injuries (OASIS)

#### Diagnosis

OASIS are reported to occur in 0.5–14% of vaginal deliveries (2.9–19% of primiparous vaginal deliveries). It has previously been shown in a prospective study that about one third of OASIS can be diagnosed 8 weeks after delivery by endoanal ultrasound alone. As these were not identified clinically, the injuries were believed to be “occult.” However, it has subsequently been proven that such injuries are not necessarily occult but in fact undiagnosed due to lack of expertise of midwives and doctors. Training in diagnosis and management of perineal trauma has been shown to be suboptimal and dedicated hands-on courses have shown significant improvements in diagnosis and classification of OASIS. Sultan therefore proposed a more descriptive classification of OASIS that has now been accepted internationally to support consistency in reporting. To avoid underestimation of the injury,

if there is uncertainty regarding the full extent of the injury it should be classified as the greater degree, for example, if one is unsure as to whether an injury is a Grade 3a or 3b it should be classified as 3b. This classification also has clinical relevance as it ensures increased vigilance for internal sphincter injuries that are best repaired soon after delivery as persistent internal sphincter defects are associated with fecal incontinence. Examination techniques to improve detection of these injuries and avoiding pitfalls in diagnosis have been described in detail.

### Obstructed Defecation Syndrome

#### Diagnosis

Obstructed defecation: incomplete evacuation of fecal contents from rectum due to physical blockage of the fecal stream during defecation attempts. It includes symptoms such as straining to defecate, sensation of blockage, digitation, and splinting. Constipation due to slow transit, irri-

table bowel syndrome, Hirschsprung's disease, megarectum, anismus are not within the remit of this standardization document. Associated features of obstructed defecation are: 1: Rectocele: Bulge in posterior vaginal wall associated with herniation of anterior wall of the rectum; 2: Enterocoele/sigmoidocoele: Bulge of upper wall of vagina associated with herniation of peritoneal sac and small bowel (enterocoele) or sigmoid colon (sigmoidocoele). 3: Intussusception: Full thickness invagination of the upper rectum without extrusion through the anus leading to interruption of flow of the fecal stream; 4: Internal mucosal prolapse: Mucosal prolapse of the anterior, posterior, or circumferential mucosal layer. 5: External rectal prolapse: Full thickness rectal prolapse outside the anal canal.

#### **Obstructed intercourse (female)**

##### *Symptom*

Vaginal intercourse is difficult or not possible due to obstruction by genital prolapse or shortened vagina.

#### **Obstructed intercourse (male)**

##### *Symptom*

Complaint that vaginal intercourse is not possible due to perceived obstruction. Whilst this may be a partner issue, it can occur in cases of penile curvature (Peyronie's disease) or penile carcinoma.

#### **"Occult" urodynamic stress incontinence**

##### *Diagnosis*

Where the diagnosis of urodynamic stress incontinence is only made when co-existent pelvic organ prolapse (POP) is reduced.

#### **Opening Time**

##### *Investigation*

The time elapsed from initial rise in pressure to the onset of flow. This is the initial isovolumetric contraction period of micturition. It reflects the time taken for the fluid to pass from the point of pressure measurement to the uroflow transducer. Flow measurement delay should be taken into account when measuring the opening time.

#### **Orgasmic urinary incontinence (female)**

##### *Symptom*

Urinary incontinence at orgasm.

#### **Outcome measurement in POP surgeries - objective outcomes**

##### *Surgery – Female*

POP-Q measurement generally and should be tabulated with absolute values and percentages to allow other studies to compare results.

#### **Outcome measurement in POP surgeries - perioperative data**

##### *Surgery – Female*

These data include blood loss, operating time, length of hospital stay, return to normal activities and complications.

#### **Outcome measurement in POP surgeries - subjective (patient reported outcomes)**

##### *Surgery – Female*

At its simplest level this can be reported as the presence or absence of vaginal bulge. Patient satisfaction and quality of life can be measured by validated instruments that cover prolapse, urinary, bowel and sexual function.

#### **Outcomes measurement in POP surgeries - secondary outcomes**

##### *Surgery – Female*

For example, lower urinary tract symptoms, stress urinary incontinence or bowel and sexual dysfunction in their studies whenever possible.

#### **Outcomes of Female Pelvic Floor Surgery - Economic Evaluation / Cost Analysis**

##### *Surgery – Female*

Despite considerable cost, sparse cost-effectiveness data exists related to POP surgery. Investigators are encouraged to include economic analyses in their studies whenever possible. Economic evaluation techniques provide systematic methods of comparing the costs and consequences of clinical and other health sector interventions. Cost-utility analysis (CUA), a form of cost-effectiveness analysis (CEA), is by far the most commonly used and requires quantifying the effects of interventions on both morbidity and mortality. In a CUA, benefits are measured in units of health gain (or loss), most commonly using quality-adjusted life-years (QALYs) and combined with estimates of cost to create a ratio of incremental costs to incremental consequences (e.g., "incremental cost per QALY"). QALYs are usually calculated using a generic health status measure, such as Short Form (SF)36 or Euro-QOL EQ-5D, which can be used with a standard set of health state values or by other measures of utility, such as the standard gamble or time-trade off technique. These incremental cost effectiveness ratios (ICERs) enable comparison of competing interventions on the basis of the cost at which they create improvements in health-related quality-of-life. In economic evaluations, it is important to consider the perspective (e.g., patients, hospital, third-party payer, government and society) of the evaluation, as this will have significant influence on which costs should be included in the analysis. For example, the perspective of the analysis will influence whether it should include both direct and indirect costs. Direct medical costs typically relate to the intervention and the immediate impact of the intervention on the health system: e.g., personnel costs/time (physician, nurse, technician), diagnostic and laboratory tests, hospital costs, treatment costs (drugs, operating room time, etc.), treatment of side effects and outpatient visits. Indirect costs will be of more relevance to a patient and/or societal perspective (e.g., loss of productivity, time lost from work, loss of service to family and community and premature mortality) and are often more difficult to quantify and to put a monetary value on.

#### **Outcomes of Female Pelvic Floor Surgery - Patient Reported Outcomes**

##### *Surgery – Female*

The primary patient reported outcome should be subjective and would usually be the absence of a bulge. This can be regarded as a "subjective cure" and can be recorded as part of a symptom scale. Details of validated questionnaires for patient reported outcomes can be found on ICI's website. To adhere with the SMART criteria, patient/subjective outcomes should be defined at a specific time interval and classified on a 7-point Likert scale (i.e. very much better, moderately better, a little better, no change, slightly worse, moderately worse, very much worse) such as the Patient Global Impression of Improvement (PGI-I) scale.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Complications**

##### *Surgery – Female*

Complications specifically related to prostheses and grafts and native tissues should be reported as per the IUGA-ICS classifications of complications directly related to the insertion of prostheses and grafts or the use of native tissue in female pelvic floor surgery. These classifications both use the CTS Classification System: (C) Category of complication. (T) Time the complication was diagnosed in relation to primary surgery. (S) Site of the complication. There are seven Categories with subdivisions of (A–D). For the majority of complications, this would mean: (A) Asymptomatic, (B) Symptomatic, (C) Infection, (D) Abscess. For complications involving bowel or bladder injury or patient compromise, variations in the pattern of the increasing index of severity exist: e.g., Category 5: rectal or bowel injury (both classifications) (A) Small intraoperative defect; (B) rectal injury or compromise; (C) small

or large bowel injury or compromise; (D) abscess. Studies, in particular of a specific surgical procedure, should have a procedure-specific list of complications using the CTS Classification Systems as part of the reporting. Only in this way can the nature and chronology of possible complications be determined (in relation to time of surgery) and at which sites they might most commonly occur. Note is also made of the generic Clavien-Dindo complication classification which consists of four severity grades of complications. This has been modified to include a fifth category. Grade IV IC/ICU organ or system dysfunction (a: single organ; b: multi-organ dysfunction) Grade V Death. Grade I requires no treatment; Grade II requires drug therapy; Grade III requires a procedure or intervention (a: in local; b: general anesthesia).

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Demographics**

##### **Surgery – Female**

The reporting of minimum demographics in POP surgery should include: A. Age, B. Parity, C. Body mass index (BMI), D. Menopause status, E. Hormone replacement (HRT) usage, F. Prior hysterectomy, G. Prior POP surgery, H. Prior continence surgery, I. Chronic cough, J. Chronic constipation, K. Smoking

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Objective Outcomes**

##### **Surgery – Female**

Objective outcomes (e.g., POPQ) should be tabulated with percentages achieving each level to allow studies to compare results, as definitions of success will vary among studies (see below). This report does not attempt to provide a definition for success and failure, as these are unknown. However, authors should report data on the leading edge of the prolapse for each site (e.g. patients who achieve points 1 and 0 postoperatively having had prolapse greater than 1 or 0 before surgery). These data, which may help identify the level of anatomical restoration that leads to improvement in symptoms, should be reported separately. When possible, raw data should be provided for POPQ, quality of life measures and all primary symptoms. These should be reported in separate tables, which can be published as supplementary material in the electronic (online) version rather than the printed version.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting of Methodological Data**

##### **Surgery – Female**

General Criteria: The following should be defined: A. Inclusion criteria. B. Exclusion criteria. C. Recruitment time span. D. Flow diagram including: (i) Number of patients evaluated. (ii) Number suitable for inclusion. (iii) Number agreed to participate. (iv) Clear documentation accounting for all patients' progress throughout the study period. Comparative Studies: A. Clear explanation of patient allocation to treatment groups. B. Allocation concealment from surgeon and/or patient. C. Randomized trials: explanation of randomization process. D. Stratification of associated issues utilized such as concomitant continence surgery or hysterectomy. Interventions: A. Clear documentation of interventions performed, experience level of surgeons and number of interventions performed prior to study commencement. B. Criteria for performing concomitant surgery. Evaluation Process: A. Who performed the evaluation and the training received. B. Were reviewers and/or participants blinded. C. Evaluation tools: were validated, patient-completed assessments standardized. D. Evaluation timeline: i. Very early (up to 3 months). ii. Early (up to 1 year). iii. Intermediate (12–36 months). iv. Late (3–5 years). v. Very late (>5 years). Power Analysis: Details of the assumptions made in the power calculation, estimate of the type 1 error and sample size should be reported.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting of Patients' Preoperative Goals and Expectations**

##### **Surgery – Female**

To date, few studies have provided data on patients' preoperative goals and

expectations. These might have advantages over objective measures of outcome. With this in mind, goals should be reported using SMART criteria. The aim of the SMART criteria is to help clinicians review and confirm the utility of the chosen endpoint and how it will relate to other studies and reports. Criteria comprise: Specific Defining goal (for POP: absence of bulge). Measurable validated symptom scale or objective measure such as the POPQ appropriate relevant to improving patient lifestyle realistic achievable by treatment Timely For example at 6 months/2 years. The following is an example of good and poor reporting of patient expectations and outcomes, using the SMART Schema: Good example: "The absence of bother from a vaginal bulge as measured using a defined tool at 2 years." This statement has Specific, Measurable, Appropriate, Realistic, and Timely attributes. Poor example: "Feeling perfect" when followed-up. "Perfect" is not specific (OB compared with absence of bulge), is less measurable (because it is difficult to define), has no defined timepoint and is not appropriate or relevant to the surgery as many factors define "perfect." Definitions relating to the SMART criteria should be derived from the symptoms the researchers feel are important. When designing a study, the symptoms should be listed and then SMART should be applied. Authors should use this as a checklist to ensure that the methodology is sound and relevant.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting of Randomized Controlled Trials**

##### **Surgery – Female**

There are already accepted standards for reporting RCTs such as the CONSORT (Consolidated Standards of Reporting Trials) which requires detailed information provided by authors to reviewers with a checklist added as an appendix. However, many studies fail to provide complete descriptions of critical information.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Patient Satisfaction**

##### **Surgery – Female**

Patient satisfaction can be measured using qualitative measures, such as a patient-defined measure or a validated instrument (PGL-I scale). Qualitative assessment can include Expectations, Goal setting, Goal achievement and Satisfaction (EGGS). Again these should be in accordance with the SMART acronym. The number of pre-specified goals and the number achieved post-operatively should be recorded and reported for responsiveness and reliability of goal achievement.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Perioperative Data**

##### **Surgery – Female**

Perioperative data includes blood loss (ml) and/or hemoglobin change, operating time, length of hospital stay, return to normal daily activities and complications.

#### **Outcomes of Female Pelvic Floor Surgery - Reporting Postoperative Pain**

##### **Surgery – Female**

Pain associated with surgical complications is addressed separately in the IUGA-ICS classifications of complications of female pelvic floor surgery. The addition of a letter (a to e), as part of a subclassification to the CTS Classification System, specifies the presence of pain as part or all of the abnormal finding or complication and the grade in terms of the presence and severity of symptoms.

(a) Asymptomatic or no pain. (b) Provoked pain only (during vaginal examination). (c) Pain during sexual intercourse. (d) Pain during physical activities. (e) Spontaneous pain.

Additional information on pain may include "permanent or temporary" and "severity" as measured by impact on quality of life and treatment required (e.g., simple oral analgesia, compound analgesia, opiates, referral and management by pain team or further surgery).



### Outcomes of Female Pelvic Floor Surgery - Reporting Quality of Life

#### Surgery – Female

Appropriate and fully validated quality of life instruments should be used to cover prolapse, urinary, bowel and sexual function. New questionnaires can be included when they have demonstrated good psychometric properties (i.e., validity, reliability and responsiveness) in women with POP. It is important to verify that the questionnaire has been validated in the language of the trial investigator(s).

### Outcomes of Female Pelvic Floor Surgery - Reporting Secondary Outcomes

#### Surgery – Female

Secondary outcomes to be reported include an assessment of other symptoms known to be associated with prolapse: Lower urinary tract symptoms (LUTS): Overactive bladder, stress urinary incontinence (either pre-existing or de-novo) and voiding dysfunction. Bowel dysfunction: Obstructed defecation, feeling of incomplete emptying, constipation and digitation. Sexual dysfunction: Dyspareunia, loss of libido, abstinence due to prolapse symptoms and change in sexual satisfaction. Authors should report numbers of all patients who are sexually active with and without pain, pre and post-intervention. All participants in trials should be accounted for pre- and post-intervention. De novo/new onset symptoms (if not previously reported): LUTS, sexual dysfunction, pain and bowel dysfunction. Backache: Backache is a common presenting symptom, the resolution of this may be an important outcome.

### Outcomes of Female Pelvic Floor Surgery - Reporting Systematic Reviews and Meta-Analyses

#### Surgery – Female

Due to the lack of consistent descriptions of critical information reported from RCTs, a new instrument, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), has been introduced to evaluate systematic reviews and meta-analyses. The aim of the PRISMA statement is to give authors an evidence-based minimum set of items to improve the reporting of systematic reviews and metaanalyses in POP issues. Other standards include the Standards for the Reporting of Diagnostic (STARD) accuracy studies, and STROBE (STrengthening the Reporting of OBServational studies in Epidemiology). Researchers should quote which standard they adopt and reference accordingly.

## P

### Pad testing

#### Sign

For individuals with urinary (fecal) incontinence symptoms, the quantification of the amount of urine (feces) lost over the duration of testing, by measuring the increase in the weight of the pads (weighed pre- and post-testing) used. This may give a guide to the severity of incontinence. Different durations from a short (1 hour) test to a 24 and 48-hour tests have been used with provocation varying from normal everyday activities to defined regimens.

### Pad testing

#### Sign

For individuals with urinary (fecal) incontinence, the quantification of the amount of urine (feces) lost over the duration of testing, by measuring the increase in the weight of the pads (weighed pre-and post-testing).

### Pain

#### Symptom

### Outcomes of Female Pelvic Floor Surgery - Timelines for Reporting

#### Surgery – Female

Timelines should be described chronologically, as outlined below, using the classification above. Of note, these timescales are different to those described in the classifications of complications reports related to female pelvic floor surgery using either prosthesis and meshes or native tissue. I. Very early (up to 3 months). II. Early (up to 1 year). III. Intermediate (12–36 months). IV. Late (3–5 years). V. Very late (>5 years).

### Overactive bladder (OAB, Urgency) syndrome

#### Symptom

Urinary urgency, usually accompanied by increased daytime frequency and/or nocturia, with urinary incontinence (OAB-wet) or without (OAB-dry), in the absence of urinary tract infection or other detectable disease.

### Overactive Pelvic Floor Muscles

#### Diagnosis

A situation in which the pelvic floor muscles do not relax, or may even contract when relaxation is functionally needed for example during micturition or defecation. This condition is based on symptoms such as voiding problems, obstructed defecation, or dyspareunia and on signs like the absence of voluntary pelvic floor muscle relaxation.

### Overactive pelvic floor muscles (female)

#### Sign

Pelvic floor muscles which do not relax, or may even contract when relaxation is functionally needed, for example, during micturition or defecation.

### Overflow fecal incontinence

#### Symptom

Complaint of involuntary loss of stool due to an overfull rectum or fecal impaction.

### Overflow urinary incontinence.

#### Symptom

Complaint of urinary incontinence in the symptomatic presence of an excessively (over-) full bladder (no cause identified).

A variably unpleasant sensation. It may be described as pressure or discomfort by the patient. Pain should be characterized by site, type, frequency, duration, precipitating and relieving factors.

### Pain

#### Symptom

A subjective phenomenon described as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain should be characterized by site, type, frequency, duration, precipitating and relieving factors. NB: The word pain comes from the Latin “poena” meaning a fine or a penalty.

### Pain - filling cystometry

#### Investigation

The complaint of pain during filling cystometry is abnormal. Its site, character and duration should be noted.

### Pain - Neurobiology

#### Symptom

Alterations in gut and bladder motility, visceral perception and central processing of pain and motor function due to abnormalities in the visceral and central nervous systems may account for the symptoms.

### **Pain - psychology**

#### *Symptom*

Pain is modulated by cognitive factors and emotional experience, memory, attention and context represented in descending modulation of pain, affecting pain experience from moment to moment and longer term. Pain has an impact on many aspects of daily life, affecting mood, sleep, relationships and activities. Therefore, attention to the psychological aspects of pain is an important part of effective assessment and treatment.

### **Pain (during) - Filling cystometry**

#### *Investigation*

The complaint of pain during filling cystometry is abnormal. Its site, character and duration should be noted.

### **Pain during straining/defecation (female)**

#### *Symptom*

Complaint of pain during defecation or straining to defecate.

### **Pain Evaluation and Measurement**

#### *Investigation*

Pain rating(s) are essential in patient evaluation including: baseline and ongoing regular evaluation of severity, quality of life, questions about thoughts, emotions and behavior associated with the pain (questionnaires). Pain measurement: one of the most commonly used tools is the visual analogue scale (VAS), which is a 10cm line from "0" no pain to "10" extreme pain. Pain evaluation involves additional pain mapping by identifying pain generators through diagnostic procedures. These include EMG, Q-tip touch sensitivity testing, trigger point injections, nerve blocks and imaging.

### **Pain experience**

#### *Symptom*

According to the most common views, pain constitutes the internal perception of bodily damage. It is unknown whether chronic pelvic pain syndromes (CPPS) are primarily an abnormal perception of a normal stimulus or a normal perception of an abnormal physiologic sensory stimulus.

### **Painful bladder syndrome**

#### *Symptom*

Painful bladder syndrome is the complaint of suprapubic pain related to bladder filling, accompanied by other symptoms such as increased daytime and night-time frequency, in the absence of proven urinary infection or other obvious pathology.

### **Paraphimosis**

#### *Sign*

Entrapment of the prepuce behind the glans usually due to a preputial ring.

### **Paravaginal repair - open, laparoscopic, robotic**

#### *Surgery – Female*

Extraperitoneal bilateral reattachment of the lateral edge of the damaged fascia to the Arcus Tendineus Fasciae Pelvis (alt: white line).

### **Paruresis ('bashful' or 'shy' bladder)**

#### *Symptom*

Complaint of the inability to initiate voiding in public (i.e. voiding in the presence of other persons) despite there being no difficulty in private.

### **Passive fecal incontinence (female)**

#### *Symptom*

Fecal soiling without sensation or warning or difficulty wiping clean.

### **Passive fecal leakage (female)**

#### *Symptom*

Involuntary soiling of liquid or solid stool without sensation or warning or difficulty wiping clean.

### **Passive (insensible) fecal incontinence.**

#### *Symptom*

Complaint of involuntary soiling of liquid or solid stool without sensation or warning.

### **Patient Preparation and Information in advance of Invasive Urodynamics**

#### *Investigation*

Although evidence indicates that urodynamics is generally well tolerated, studies have examined pain and embarrassment, using a variety of questionnaire methods. Younger patients have been identified as a group that may experience more pain and apprehension associated with depression, anxiety and/or bladder pain syndrome. Effectiveness of patient information leaflets requires comprehensibility and communicative effectiveness. However, reports analysing existing information conclude that this is of poor quality. Studies to develop a detailed explanatory leaflet, which were used in a double-blind randomized controlled trial to conclude that 'leaflet' or 'no leaflet' intervention had a disappointing satisfaction outcome. Poor understanding of the test has been associated with lack of satisfaction with care and with, for example, the perception that the investigation in itself is therapeutic. Some evidence exists that information leaflets about urodynamic investigations are too difficult for patients to understand.

Young adults and patients with a bladder pain syndrome may have a relatively negative experience with urodynamic investigation. Conflicting evidence exists about which precise information is helpful to give to patients before urodynamic testing to reduce distress. Effective communication is an expectation in modern healthcare, so that patients become actively engaged in the test and their care delivery. A leaflet with a minimum set of items would facilitate informed decision making. Good information before and during the test increases a patient's acceptance and confidence, and will reduce confusion. Although in the absence of good evidence, that an explanatory leaflet about urodynamic investigation with sufficient information, which uses clear, unambiguous wording will be appreciated by the majority of patients.

### **Pelvic Congestion Syndrome**

#### *Symptom*

i. Pressure, heaviness, dull aching pain in the pelvis and/or in the back. ii. Dysmenorrhea.

### **Pelvic electrical stimulation**

#### *Conservative Management – General*

This is the application of electrical current to stimulate the pelvic viscera or their nerve supply.

### **Pelvic Floor**

#### *Conservative Management – General*

The term pelvic floor relates to the compound structure, which closes the bony pelvic outlet. The term pelvic floor muscles refers to the muscular layer of the pelvic floor. The pelvic floor consists of different layers, the most cranial being the peritoneum of the pelvic viscera and the most caudal being the skin of vulva, scrotum and perineum. The middle layers of the pelvic floor are made up of predominantly muscular tissue. Apart from the pure pel-

vic floor muscles, fibro-muscular and fibrous elements, like the endo-pelvic fascia are found in this layer. Different well recognizable muscles together form the muscular layer of the pelvic floor: levator ani, striated urogenital sphincter, external anal sphincter, ischiocavernosus and bulbospongiosus. All these muscles are working together to seal the lower aspect of the pelvic cavity. Urethra, vagina, and rectum pass through the pelvic floor and are surrounded by the pelvic floor muscles. The pelvic bones are the structures to which the muscular layer is attached.

### **Pelvic Floor - Voluntary Contraction**

#### *Sign*

Voluntary contraction of the pelvic floor muscles means that the patient is able to contract the pelvic floor muscles on demand. A contraction is felt as a tightening, lifting and squeezing action under the examining finger. A voluntary contraction can be absent, weak, normal or strong.

### **Pelvic floor assessment in female sexual dysfunction - Pelvic floor manometry**

#### *Investigation*

Measurement of resting pressure or pressure rise generated during contraction of the PFM using a manometer connected to a sensor which is inserted into the urethra, vagina, or rectum. Pelvic floor manometric tools measuring pressure in either mmHg, hPa, or cmH<sub>2</sub>O can be used to assess resting pressure, maximal squeeze pressure (strength), and endurance.

### **Pelvic Floor Dynamometry**

#### *Investigation*

A dynamometer is an instrument that measures power or force. Pelvic floor dynamometry: Measurement of PFM resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina. Dynamometry measures force in Newton units (N=1 kgxm/s (sq)).

### **Pelvic Floor Function - General**

#### *Conservative Management – General*

The function of the pelvic floor is to support the pelvic organs. The function of the pelvic floor muscles is performed by contraction and relaxation. In its resting state, the pelvic floor gives support to the pelvic organs. Whether the support function is normal depends on the anatomical position of the muscles on the activity of the pelvic floor muscles at rest (active support) and on the integrity of the fascia (passive support). During intra-abdominal pressure rise, the pelvic floor muscles must contract to maintain the support function of the pelvic floor. A contraction of the pelvic floor muscles results in a ventral and cranial movement of the perineum, and an upward movement of the pelvic organs together with an anterior movement caused primarily by the vaginal and rectal parts of the levator ani. When the pelvic floor muscles contract the urethra closes, as do the anus and the vagina. This contraction is important in preventing involuntary loss of urine or rectal contents. For women it can also function as a defense mechanism against sexual intercourse. For maintaining continence, it is also important to realize that detrusor activity is inhibited by pelvic floor muscle contraction.

### **Pelvic Floor Manometry**

#### *Investigation*

A manometer is a device for measuring pressure. Pelvic floor manometry: measurement of resting pressure or pressure rise generated during contraction of the PFM using a manometer connected to a sensor, which is inserted into the urethra, vagina or rectum. Pelvic floor manometric tools measure pressure in mmHg, hPa or cmH<sub>2</sub>O. Conversion of data to the international standard unit of measurement (hPa) is recommended. Perineometer: the first PFM vaginal pressure device connected to a manometer developed by Kegel.

### **Pelvic Floor Muscle - Pain Assessment (female)**

#### *Investigation*

Pain evaluation consists of baseline and ongoing regular evaluation of severity, quality of life, thoughts, emotions, and behavior associated with the pain (via direct consultation or questionnaires) and investigations to identify well-defined/ confusable/non-pain syndromes. 1. Pain measurement: pain can only be measured subjectively. Patient-reported outcome measures include: a) Numerical rating scale (NRS), from 0 (no pain) to 10 (extreme pain), with half-points marked. b) Visual analogue scale (VAS), a 10-cm line with the same labels at the ends. c) A simple verbal rating scale can be used, e.g., "none," "mild," "moderate," "severe." 2. Pain mapping: identifying pain generators through diagnostic procedures such as questionnaires, digital palpation, EMG, quantitative sensory threshold measurement, trigger point injections, nerve blocks, and imaging. a) Questionnaires: several pain questionnaires can be used in the evaluation of musculoskeletal pain in the pelvis; the choice will be determined by which is most appropriate to the presenting pelvic floor dysfunction: McGill Pain Questionnaire, Pelvic Floor Distress Inventory (PFDI), Female Sexual Function Index, Female Sexual Distress Scale, Pelvic Pain and Urgency/Frequency Questionnaire. b) Pain chart/body map: a simple line drawing of an outline of the front and back (or relevant body part) of the human body, onto which the patient sketches or ticks or marks areas of bodily pain to demonstrate the site and extent of perceived pain; c) Pain checklist: a list of anatomical locations from which the patient selects sites that are relevant to her complaint.

### **Pelvic floor muscle assessment in female sexual dysfunction - general comments**

#### *Investigation*

Assessment of pelvic floor muscle (PFM) function involves evaluating the tone, strength, endurance, coordination, reflex activation during rises in intra-abdominal pressure as well as the capacity to properly relax this musculature. These muscles are involved in sexual function as PFM contraction occurs during arousal and intensifies with orgasm and PFM tone is related to vaginal sensation. Superficial PFM such as the bulbospongiosus and ischiocavernosus are also involved in erection of the clitoris by blocking the venous escape of blood from the dorsal vein. Thus, reduction in PFM strength and endurance has been related to lower sexual function. Likewise, PFM hypotonicity may be related to vaginal hypoesthesia, anorgasmia and urinary incontinence during intercourse while hypertonicity may lead to dyspareunia.

### **Pelvic floor muscle assessment in female sexual dysfunction - Pelvic floor dynamometry**

#### *Investigation*

Measurement of PFM resting and contractile forces using strain gauges mounted on a speculum (a dynamometer), which is inserted into the vagina. Dynamometry measures force in Newton (N). Several parameters such as tone, strength, endurance, speed of contraction and coordination can be evaluated.

### **Pelvic floor muscle assessment in female sexual dysfunction - Pelvic floor electromyography (EMG)**

#### *Investigation*

The recording of electrical potentials generated by the depolarization of PFM fibers. Intra-muscular EMG consists in the insertion of a wire or needle electrode into the muscle to record motor unit action potentials while surface EMG requires electrodes placed on the skin of the perineum or inside the urethra, vaginal or rectum. EMG amplitude at rest and contraction can be recorded.

### **Pelvic floor muscle assessment in female sexual dysfunction - Pelvic floor ultrasound imaging**

#### *Investigation*



Evaluation of PFM morphology at rest, during maximal contraction and Val-salva. Several parameters pertaining to assess the bladder neck and anorectal positioning and hiatus dimensions can be measured.

### **Pelvic Floor Muscle Contraction - Repetition and Set**

#### *Conservative Management – Female*

Repetition: the completion of a whole cycle from the starting position, through the end of the movement, and back to the start e.g. one PFM contraction with relaxation. Set: the number of times the desired number of repetitions is performed e.g., three sets of 12 PFM contractions

### **Pelvic Floor Muscle Dyssynergia**

#### **Sign**

Incoordination of the PFM and another muscle group during a functional activity, for example, the pelvic floor muscles may not relax appropriately during micturition or defecation.

### **Pelvic floor muscle endurance (female)**

#### **Sign**

The ability to sustain near maximal or maximal force, assessed by the time one is able to maintain a maximal static or isometric contraction, or ability to repeatedly develop near maximal or maximal force determined by assessing the maximum number of repetitions one can perform at a given percentage of 1 RM (one-repetition maximum).

### **Pelvic Floor Muscle Exercises - Kegels**

#### *Conservative Management – Female*

A PFM contraction or PFM exercise. This term is named after Arnold Kegel, an American gynecologist who first described the clinical effect of PFMT in the late 1940s. ICS recommends the use of the term PFMT (not the word Kegels) to refer to exercises that specifically target the PFM.

### **Pelvic floor muscle hypertonicity (female)**

#### **Sign**

A general increase in muscle tone that can be associated with either elevated contractile activity and/or passive stiffness in the muscle. As the cause is often unknown the terms neurogenic hypertonicity and non-neurogenic hypertonicity are recommended.

### **Pelvic floor muscle hypotonicity (female)**

#### **Sign**

A general decrease in muscle tone that can be associated with either reduced contractile activity and/or passive stiffness in the muscle. As the cause is often unknown the terms neurogenic hypotonicity and nonneurogenic hypotonicity are recommended.

### **Pelvic Floor Muscle Injury (PFMI)**

#### **Sign**

On clinical palpation, PFMI is diagnosed when one or more of the following is present: a) A discontinuity of the puborectalis muscle at its attachment to the inferior pubic ramus; b) A distance of >3.5 finger widths between the two sides of puborectalis muscle insertion; c) A gap in the continuity of the pubovisceral muscle between the pubic rami and the ano-rectum.

### **Pelvic Floor Muscle Injury (PFMI) - Detection by Magnetic Resonance Imaging (MRI)**

#### *Imaging*

PFM injury: can represent a full spectrum, from disruption of a single fascicle, to complete disruption of the muscle origin. At present, there is no

universally accepted system for the diagnosis and evaluation of the extent of the injury. Essentially, abnormalities are judged to have occurred when the morphology of the pubococcygeal portion of the levator ani muscle deviates from what is seen in normal nulliparous women. Several groups have studied and defined levator damage on MRI when one or more of the following is present: absence of pubococcygeal muscle fibers in at least one 4-mm section, or two or more adjacent 2-mm sections in both the axial and the coronal planes. The degree of injury can be assessed based on the amount of muscle involved in the injury, with reasonable repeatability among different examiners in a single group. More than half the expected muscle bulk is associated with the presence of POP.

### **Pelvic Floor Muscle Injury (PFMI) - Ultrasound detection**

#### *Imaging*

PFMI is diagnosed on ultrasound when at least one of the following is present: a) Undetected puborectalis-to-ipsilateral sidewall attachment on any of the three central slices (full avulsion); b) Undetected puborectalis-to-ipsilateral sidewall attachment on at least one slice (partial avulsion); c) A levator-urethra gap (LUG) of greater than 2.5cm. PFM position in the pelvis: can be measured in the sagittal plane in relation to defined landmarks, and may be related to PFM dysfunction (elevated or descended pelvic floor). Hiatal dimension: is the cross-sectional area of the pelvic floor/levator hiatus, including anteroposterior and transverse distances.

### **Pelvic floor muscle (PFM) function (male) - contractile function**

#### **Sign**

- . Voluntary contractility: the individual is able to contract the PFM on demand. A contraction is felt as a tightening, lifting and squeezing action under/around the finger.
- . Strength: Force-generating capacity of a muscle. It is generally expressed as maximum voluntary contraction.
- . Endurance: the ability to sustain near maximal or maximal force, assessed by the time a patient is able to sustain a maximal static or isometric contraction.
- . Repeatability: the ability to repeatedly develop near maximal or maximal force, determined by assessing the maximum number of repetitions the patient can perform before detectable decline in force. Record number of contractions in a row.
- . Co-contraction: contraction or activation of two or more muscles at the same time. Identify which muscles are co-contracting and whether the co-contraction is synergistic.
- . Relaxation ability: return of the PFM to its original resting tone following the voluntary contraction. Also includes the ability to maintain PFM relaxation in anticipation of or during any type of touch.

### **Pelvic floor muscle (PFM) function (male) - Diagnoses related to PFM examinations**

#### **Sign**

- . Overactive pelvic floor muscles: Pelvic floor muscles which do not relax, or may even contract when relaxation is functionally needed, for example, during voiding or defecation.
- . Underactive pelvic floor muscles: Pelvic floor muscles which cannot voluntarily contract when instructed to do so or when required.

### **Pelvic floor muscle (PFM) function (male) - Examinations at rest**

#### **Sign**

- . Myalgia: provoked by palpation. Levator muscle pain/tenderness may be elicited by palpation of these muscles via rectal examination.
- . Tender point: Tenderness to palpation at a specific soft tissue body site.
- . Tone: state of the muscle, usually defined by its resting tension, clinically determined by resistance to passive movement. Muscle tone has two com-

ponents, the contractile component and the viscoelastic component. Muscle tone may be altered in the presence or absence of pain.

- . Increased PFM tone (non-neurogenic hypertonicity): increased tone in a patient without an intercurrent neurological diagnosis.

- . Decreased PFM tone (non-neurogenic hypotonicity): decreased tone in a patient without an intercurrent neurological diagnosis.

- . Symmetry: if examining in the left lateral, there will be a gravity effect and the dependent side will have a different feel to the upper side and appear as asymmetrical. This may affect PFM tone. Not so common in men.

- . PFM injury: e.g. palpable anal sphincter gap though overall not common unlike women.

#### **Pelvic floor muscle (PFM) function (male) - General**

##### **Sign**

The following signs of PFM function may be assessed via the perineum (visual or tactile examination) or per rectum (digital palpation) examination. Digital rectal examination (DRE) may be less useful in male urinary dysfunctions where the urethral sphincter, inaccessible to DRE, has a more important role.

#### **Pelvic floor muscle (PFM) function (male) - Perineal examination**

##### **Sign**

When the patient is asked to cough or bear down, the perineum should only show limited downward movement; ventral movement may occur because of the guarding actions of the pelvic floor muscles.

- Perineal elevation: This is the inward (ventro-cephalad) movement of the perineum and anus. Look for testicular lift and penile retraction. These need to be checked against movement of the scrotum and the whole penis. Correct movement occurs with the PFM only: the shaft of the penis draws in and the testes lift in a cephalad direction. These movements may be better visualized in standing than supine position.

- Perineal descent: This is the outward (dorso-caudal) movement of the perineum and anus.

#### **Pelvic Floor Muscle Relaxation**

##### **Conservative Management – General**

Pelvic floor muscle relaxation following contraction results in a reduction in the support given to the urethra, vagina and anus. The perineum and the pelvic organs return to their anatomical resting position. The pelvic floor muscles must relax in order to remove the passive continence mechanisms, thereby favoring normal micturition. The same is true for relaxation before and during defecation, allowing the anorectal angle to become obtuse, favoring rectal emptying

#### **Pelvic floor muscle strength (female)**

##### **Sign**

Force-generating capacity of a muscle. It is generally expressed as maximal voluntary contraction measurements and as the one-repetition maximum (1RM) for dynamic measurements.

#### **Pelvic floor muscle tenderness (female)**

##### **Sign**

Occurrence of the sensation of pain or painful discomfort of the pelvic floor muscles elicited through palpation.

#### **Pelvic floor muscle tone (female)**

##### **Sign**

In normally innervated skeletal muscle, tone is created by “active” (contractile) and “passive” (viscoelastic) components clinically determined by resistance of the tissue against stretching or passive movement.

#### **Pelvic Floor Muscle Training**

##### **Conservative Management – Female**

Exercise to improve PFM strength, endurance, power, relaxation or a combination of these parameters.

#### **Pelvic Floor Muscle Training - Biofeedback Training**

##### **Conservative Management – Female**

Feedback: is sensory information that is available as the result of an activity that a person has performed. It can be provided by an intrinsic source (from within the individual), or an extrinsic source (from the clinician), and can occur concurrently with the activity or post-activity, e.g., verbal information from the clinician to the patient during or following PFM assessment. Biofeedback: is the use of an external sensor to give an indication with regard to bodily processes, usually with the purpose of changing the measured quality. It is an adjunctive therapy.

#### **Pelvic Floor Muscle Training - Detraining**

##### **Conservative Management – Female**

Cessation of training, but also planned or unplanned reduced volume or intensity of training.

#### **Pelvic Floor Muscle Training - Dilator Therapy**

##### **Conservative Management – Female**

Dilator therapy: a conical or cylindrically shaped device (made of an inert material) inserted intravaginally or intra-anally, with the aim of increasing the flexibility or elasticity of the soft tissues via application of a prolonged elongation or stretch. Dilators may also be used as a desensitizer device, to reduce fear, anxiety or pain associated with vaginal touch and in conjunction with vaginismus or sexual pain. When combined with EMG, dilators can be used to train PFM relaxation during penetration. Dilators may also be used to increase the tolerance of skin to sliding when the dilator is moved in and out.

#### **Pelvic Floor Muscle Training - Dose-response issues related to exercise training**

##### **Conservative Management – Female**

1. Dose-response: amount/volume of training and its effect on the speed and degree of the effect of the training program. 2. Frequency of exercise: the number of activity sessions per day, week, or month. 3. Duration of exercise: the unit of time (number of seconds/ minutes) of activity in each repetition or session, e.g., a 10-s PFM contraction. It also refers to the length of the whole training period (intervention), e.g., 3/6 months. 4. Intensity: the amount of resistance used or the effort associated with the physical activity. For strength training, it is often expressed as a percentage of one repetition maximum: 1RM (the maximum load a person can lift once), e.g., 70 % of maximum. 5. Session/bout: the block of time devoted to the training, e.g., a 1-h session.

#### **Pelvic Floor Muscle Training - EMG assessment of PFM**

##### **Conservative Management – Female**

Electromyography assessment of PFM consists of the use and interpretation of the surface EMG recording of a muscle for rehabilitation purposes should be done cautiously, recognizing that the main goal is the qualitative description of the muscle activation pattern, and not a qualitative diagnosis.

1. Baseline muscle activity: amount of microvolts generated by the target muscle during rest. 2. Peak microvolts: the highest EMG amplitude achieved. 3. Slow recruitment: slow initiation of muscle activation contraction. 4. Slow de-recruitment or slow latency to return to baseline: slow relaxation of the muscle contraction. 5. Inconsistent resting baseline: variation of baseline between contractions, between sets, or between days may be related to a change in patient symptoms, e.g., hypertonic PFM. 6. Excessive accessory

muscle contraction: increased amplitude in accessory muscles often resulting in cross talk and is indicative of poor isolation of target muscle contraction.

#### **Pelvic Floor Muscle Training - EMG Biofeedback Unit Instrumentation**

##### *Conservative Management – Female*

1. EMG signal amplitude: number of microvolts ( $\mu\text{V}$ ) a muscle is generating. EMG biofeedback units can deliver either the actual amount of EMG activity in  $\mu\text{V}$  or an average  $\mu\text{V}$  value. 2. Artifact: extraneous information non-recognizable in the EMG signal from sources other than the target muscle such as the environment or other body functions. 3. Cross talk: muscle activity from nearby muscles that can artificially increase EMG amplitude; a type of artifact. 4. Dual-channel EMG: use of two channels to monitor two separate muscles or muscle groups at the same time, such as the PFM and abdominal muscles, with the goal of either promoting synergist activity or reducing EMG activity of one muscle while increasing the other. 5. Band pass: limits muscle fiber frequencies that are monitored and displayed in the EMG tracing.

#### **Pelvic Floor Muscle Training - EMG Training of PFM**

##### *Conservative Management – Female*

1. Up-training: EMG biofeedback training to increase the EMG activity of a hypotonic muscle with low EMG activity. 2. Down-training: EMG biofeedback training to decrease EMG activity and relax muscles.

#### **Pelvic Floor Muscle Training - Facilitation Technique**

##### *Conservative Management – Female*

Any method of increasing recruitment/response of a non-responding muscle. In the case of non-contractile or very weak PFMs, this may include a quick stretch of the PFM, with tapping or stretching the PFM digitally. An overflow effect from a strong contraction of a nearby synergistic muscle (e.g. external rotators) may also assist facilitation or recruitment of PFMs.

#### **Pelvic Floor Muscle Training - Functional Training**

##### *Conservative Management – Female*

Functional training consists of training for tasks of daily living and self-care activities, e.g., squatting to train quadriceps and gluteal muscles. 1. Functional PFM training: training and exercises that incorporate a correct PFM contraction into activities of daily living such as lifting, transferring out of bed, or sneezing. A PFM contraction before a rise in intraabdominal pressure, e.g., a cough ("the Knack") is part of functional PFM training. 2. Coordination training: the ability to use different parts of the body together smoothly and efficiently. Related to PFM training, coordination training means PFM contraction with other muscles or other muscle groups, e.g. respiratory muscles. 3. Functional mobility training: an intervention directed at improving the physical ability to perform a daily task. For voiding/defecation, this may include: gait training, transfer training, stair training, and other mobility training to improve speed and safety in reaching the toilet.

#### **Pelvic Floor Muscle Training - Individualized, Supervised, Group and Home**

##### *Conservative Management – Female*

1: Individualized PFMT: an individual PFM program aimed at improving the specific deficiencies in PFM structure or function based on assessment of the woman's ability to contract the PFM. 2: Supervised PFMT: a PFMT program taught and monitored by a health professional/clinician/instructor. 3: Group PFMT: PFMT conducted in an exercise class. Class participation may occur with or without previous individualized PFM instruction. Home training: home PFM exercise program: an unsupervised PFMT program, which the individual performs at home.

#### **Pelvic Floor Muscle Training - Isometric/Static Contraction**

##### *Conservative Management – Female*

A muscular action during which no change in the length of the total muscle or joint angle takes place.

#### **Pelvic Floor Muscle Training - Isotonic or eccentric contraction**

##### *Conservative Management – Female*

Isotonic contraction: A muscular action during which the tension developed by the muscle remains almost constant while the muscle shortens. Eccentric contraction: a muscular action in which the muscle lengthens in a controlled manner.

#### **Pelvic Floor Muscle Training - Local Muscle Endurance Training**

##### *Conservative Management – Female*

Training with a low load and a high number of repetitions or holding the contraction over time.

#### **Pelvic Floor Muscle Training - Maintenance Training**

##### *Conservative Management – Female*

A program designed to prevent loss of the previous level of functioning.

#### **Pelvic Floor Muscle Training - Muscle Power Training**

##### *Conservative Management – Female*

All training with the aim of generating power; can be close to maximal contraction training and/or rapid contractions.

#### **Pelvic Floor Muscle Training - Overload**

##### *Conservative Management – Female*

A situation in which the body is required to perform exercise beyond that to which the neuromuscular system is accustomed during routine activities. Training adaptation occurs in response to a progressive "overload". Progressive overload: the gradual increase in stress placed upon the body during exercise training.

#### **Pelvic Floor Muscle Training - Relaxation Training**

##### *Conservative Management – Female*

Relaxation: the ability to control muscle activity such that muscles not specifically required for a task are quiet and those that are required are fired at the minimal level needed to achieve the desired results. Relaxation can be considered a motor skill in itself because the ability to reduce muscle firing is as important to control as the generation of firing. a) General relaxation technique: a technique that involves the whole body, with the aim of effecting a global relaxation, including a decrease in the skeletal and smooth muscles, a decrease in the heart rate and respiration rate and an increase in parasympathetic activity. General relaxation techniques can also be used aimed at relaxing local muscles. b) Progressive muscular relaxation (also known as Jacobsen's technique): monitoring tension in each specific muscle group, by contracting, then relaxing the tension, with attention paid to the contrast between tension and relaxation. This type of relaxation is also termed "contract-relax." c) Meditation: a practice of concentrated focus upon a sound, object, visualization, the breath, movement, or attention itself to increase awareness of the present moment, reduce stress, promote relaxation, and enhance personal and spiritual growth. d) Mindfulness: intentionally bringing one's attention to the internal and external experiences occurring in the present moment. Mindfulness is often taught through a variety of meditation exercises. e) EMG relaxation techniques: techniques to decrease EMG muscle activity or activation through a methods, including a conscious effort to relax.

### **Pelvic Floor Muscle Training - Resistance**

#### *Conservative Management – Female*

Resistance: the amount of force opposing a movement. Resistance devices: any object used to increase resistance to contraction, e.g., hand weights. Vaginal resistance device: objects inserted into the vagina or rectum that are inflated or spring-loaded devices to increase resistance to contraction.

### **Pelvic Floor Muscle Training - Strength Training**

#### *Conservative Management – Female*

Training with high resistance (close to maximal contractions) and few repetitions with the aim of increasing muscle volume and neural adaptations.

### **Pelvic Floor Muscle Training - Stretching**

#### *Conservative Management – Female*

Stretching (also referred to as flexibility training when the method is used on skeletal muscles where increased range of motion over the joints is the aim): the application of an external force to muscle and connective tissue to elongate it in the direction opposite to its shortened position. This can be done parallel or perpendicular to the muscle fiber direction. For the PFM this can be applied as a widening of the levator hiatus in the axial plane (latero-laterally) via a digit or use of a dilator, or a caudal movement (via a straining/bearing down maneuver) in the sagittal plane.

### **Pelvic Floor Muscle Training - Vaginal Cones**

#### *Conservative Management – Female*

Weighted vaginal cones: objects of different shapes, sizes, and weights, which are inserted into the vagina above the level of the PFM with the aim of providing sensory biofeedback and load on the PFM to increase muscle recruitment and strength.

### **Pelvic Floor Muscles - Involuntary Contraction**

#### *Sign*

Involuntary contraction of the pelvic floor muscles is the contraction that takes place preceding an abdominal pressure rise, such as due to a cough, to prevent incontinence. An involuntary contraction can be absent or present.

### **Pelvic Floor Muscles - Involuntary Relaxation**

#### *Sign*

Involuntary relaxation of the pelvic floor muscles is the relaxation that takes place when the patient is asked to strain as if defecating. An involuntary relaxation can be absent or present.

### **Pelvic Floor Muscles - Non-Contracting Pelvic Floor**

#### *Sign*

Involuntary relaxation of the pelvic floor muscles is the relaxation that takes place when the patient is asked to strain as if defecating. An involuntary relaxation can be absent or present.

### **Pelvic Floor Muscles - Non-contracting, Non-relaxing pelvic floor**

#### *Sign*

Non-contracting, non-relaxing pelvic floor means that during palpation, there is neither a palpable contraction nor a palpable relaxation of the pelvic floor muscles.

### **Pelvic Floor Muscles - Non-relaxing Pelvic Floor**

#### *Sign*

Non-relaxing pelvic floor means that during palpation, there is no palpable voluntary or involuntary relaxation of the pelvic floor muscles.

### **Pelvic Floor Muscles - Voluntary Relaxation**

#### *Sign*

Voluntary relaxation of the pelvic floor muscles means that the patient is

able to relax the pelvic floor muscles on demand, after a contraction has been performed. Relaxation is felt as a termination of the contraction. The pelvic floor muscles should return at least to their resting state. Voluntary relaxation can be absent, partial or complete

### **Pelvic floor spasm (female)**

#### *Sign*

The presence of contracted, painful muscles on palpation and elevated resting pressures by vaginal manometry. This persistent contraction of striated muscle cannot be released voluntarily. If the contraction is painful, this is usually described as a cramp. Pelvic floor myalgia (a symptom) may be present with or without a change in PFM tone (a sign).

### **Pelvic organ**

#### *Surgery – Female*

This refers most commonly to the uterus and/or the different vaginal compartments and their neighboring organs such as bladder, rectum or bowel.

### **Pelvic organ prolapse - definition of sign**

#### *Sign*

The descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix) or the apex of the vagina (vaginal vault or cuff scar after hysterectomy). The presence of any such sign should be correlated with relevant POP symptoms. Most commonly, this correlation would occur at the level of the hymen or beyond.

### **Pelvic organ prolapse - diagnosis**

#### *Diagnosis*

This diagnosis (i) by symptoms and clinical examination, assisted by any relevant imaging, involves the identification of descent of one or more of the anterior vaginal wall (central, paravaginal or combination cystocele), posterior vaginal wall (rectocele), the uterus (cervix) or the apex of the vagina (vaginal vault or cuff scar) after hysterectomy. The presence of any such sign should correlate with relevant POP symptoms.

### **Pelvic organ prolapse - related radiology**

#### *Imaging*

Defecography demonstrates normal anatomy of the anorectum as well as disorders of rectal evacuation. With barium paste inserted rectally prior to defecation, measurement of the anorectal angle is allowed with evidence of the presence, size or emptying of any rectocele. Enterocoeles, rectal intussusception and mucosal prolapse might be diagnosed as well as a spastic pelvic floor (anismus).

### **Pelvic Organ Prolapse - Signs**

#### *Sign*

All examinations for POP should be performed with the woman's bladder empty (and if possible an empty rectum). An increasing bladder volume has been shown to restrict the degree of descent of the prolapse. The choice of the woman's position during examination, e.g. left lateral (Sims), supine, standing or lithotomy is that which can best demonstrate POP in that patient and which the woman can confirm as the maximal extent she has perceived e.g. by use of a mirror or digital palpation. The degree of prolapse may be worse after a lengthy time in the upright position.

### **Pelvic organ prolapse (anatomical definition of sign of POP)**

#### *Sign*

The descent of one or more of the anterior vaginal wall, posterior vaginal

wall, uterus (cervix) or vaginal vault (cuff scar after hysterectomy). The presence of any such sign should be correlated with relevant POP symptoms.

#### **Pelvic organ prolapse (POP) - examination**

##### **Sign**

All examinations for POP should be performed with the woman's bladder empty (and if possible an empty rectum). An increasing bladder volume has been shown to restrict the degree of descent of the prolapse. The choice of the woman's position during examination, e.g. left lateral (Sims), supine, standing or lithotomy is that which can best demonstrate POP in that patient and which the woman can confirm as the maximal extent she has perceived e.g. by use of a mirror or digital palpation. The degree of prolapse may be worse after a lengthy time in the upright position

#### **Pelvic organ prolapse (POP) surgery - complications**

##### **Surgery – Female**

Complications related to POP native tissue repairs and surgeries using prostheses/grfts/mesh have been classified separately according to joint IUGA/ICS recommendations. The sorting system used in both documents utilizes specific category (C), time (T) and site (S) taxonomy together referred to as the CTS classification system. Classification is aided by on line calculators: <http://www.ics.org/complication> or <http://www.ics.org/ntcomplication>.

#### **Pelvic organ prolapse (POP) surgery - further surgery**

##### **Surgery – Female**

Any subsequent procedure relating to the primary surgery: (i) primary surgery in a different (new) site/compartments; (ii) repeat surgery in the same site/compartments for POP symptom recurrence; (iii) surgery for complications e.g. mesh exposure, pain, infection, hemorrhage; (iv) surgery for non-POP-related issues usually urinary incontinence.

#### **Pelvic organ prolapse (POP) surgery - objective outcomes.**

##### **Surgery – Female**

POP-Q measurement should be tabulated with absolute values and percentages to allow other studies to compare results.

#### **Pelvic organ prolapse (POP) surgery - perioperative data**

##### **Surgery – Female**

Blood loss, operating time, length of hospital stay, return to normal activities and complications.

#### **Pelvic organ prolapse (POP) surgery - primary surgery**

##### **Surgery – Female**

First procedure required for treating POP in any compartment.

#### **Pelvic organ prolapse (POP) surgery - secondary outcomes**

##### **Surgery – Female**

Lower urinary tract symptoms, stress incontinence, or bowel and sexual dysfunction to be included in studies whenever possible.

#### **Pelvic organ prolapse (POP) surgery - subjective (patient-reported) outcomes**

##### **Surgery – Female**

At its simplest level, this can be reported as the presence or absence of a vaginal bulge. Patient satisfaction and quality of life can be measured by validated instruments that cover prolapse, urinary, bowel and sexual function.

#### **Pelvic organ prolapse (POP) symptoms**

##### **Symptom**

Complaints by a woman in reference to the position (descent) of her pelvic organs. Symptoms are generally worse at the times when gravity might make the prolapse worse (e.g. after long periods of standing or exercise) and

better when gravity is not a factor, e.g. lying supine. Prolapse may be more prominent at times of abdominal straining, e.g. defecation.

#### **Pelvic organ prolapse (POPQ) - stage 0**

##### **Sign**

No prolapse is demonstrated.

#### **Pelvic organ prolapse (POPQ - Stage I)**

##### **Sign**

Most distal portion of the prolapse is more than 1cm above the level of the hymen.

#### **Pelvic organ prolapse (POPQ - Stage II)**

##### **Sign**

The most distal portion of the prolapse is situated between 1cm above the hymen and 1cm below the hymen.

#### **Pelvic organ prolapse (POPQ - stage III)**

##### **Sign**

The most distal portion of the prolapse is more than 1cm beyond the plane of the hymen but everted at least 2cm less than the total vaginal length.

#### **Pelvic organ prolapse (POPQ - Stage IV)**

##### **Sign**

Complete eversion or eversion at least within 2cm of the total length of the lower genital tract is demonstrated.

#### **Pelvic organ prolapse (POPQ - Stage O)**

##### **Sign**

.No prolapse is demonstrated

#### **Pelvic pain - female**

##### **Symptom**

Complaint of pain perceived to arise in the pelvis, not associated with symptoms suggestive of lower urinary tract, sexual, bowel or gynaecological dysfunction.

#### **Pelvic pain (male)**

##### **Symptom**

Complaint of pain, pressure or discomfort related to the pelvis but not clearly related to the bladder, urethra, scrotum or perineum.

#### **Pelvic Pain Syndrome**

##### **Symptom**

Pelvic pain syndrome is the occurrence of persistent or recurrent episodic pelvic pain associated with symptoms suggestive of lower urinary tract, sexual, bowel or gynecological dysfunction. There is no proven infection or other obvious pathology.

#### **Pelvic pressure (female)**

##### **Symptom**

Complaint of increased heaviness or dragging in the suprapubic area and/or pelvis.

#### **Penetration urinary incontinence**

##### **Symptom**

Urinary incontinence at penetration (penile, manual or sexual device)

#### **Penetration urinary incontinence (female)**

##### **Symptom**

Urinary incontinence at penetration (penile or sexual device).



**Penile glans and shaft examination****Sign**

- . Penile plaque: palpation of node or plaque in the tunica usually on the dorsal aspect (perhaps related to Peyronie's disease).
- . Lichen sclerosus: tight foreskin, cracking and bleeding.

**Penile pain with intercourse (male dyspareunia)****Symptom**

Complaint of any penile discomfort occurring during intercourse - may be caused by penile disease, vaginal anatomy (e.g. vaginal tightening, scarring or prosthesis exposure), and/or may relate to various positions with intercourse causing impingement on the uterine cervix.

**Percutaneous Electrical Nerve Stimulation****Conservative Management – Female**

Percutaneous electrical nerve stimulation: a therapeutic modality that stimulates peripheral sensory nerves performed with a (few) needle electrode(s) that are placed in close proximity to the area to stimulate. Percutaneous neuromuscular electrical stimulation (e.g. posterior TNS) is a peripheral neuromodulation technique, in which the posterior tibial nerve is electrically stimulated three finger breadths above the medial malleolus, via insertion of a percutaneous needle electrode. This is coupled with an adhesive reference surface electrode placed near to the needle. This intervention is offered to patients with OAB.

**Perforation**

Surgery – Complication related

Abnormal opening into a hollow organ or viscus.

**Perianal examination (female)****Sign**

- (i) Excoriation: perianal excoriation, skin rashes.
- (ii) Soiling: perianal fecal soiling or vaginal fecal soiling.
- (iii) Discharge: perianal or vaginal bloody or mucus discharge.
- (iv) Gaping anus: non-coaptation of anal mucosa at rest.
- (v) Scars, sinuses, deformities, condylomata, papillomata, hematoma.
- (vi) Deficient perineum/cloacal-like defect: A spectrum of tissue loss from the perineal body and rectovaginal septum with variable appearance. There can be a common cavity made up of the anterior vagina and posterior rectal walls or just an extremely thin septum between the anorectum and vagina.
- (vii) Others described individually: anal fissure, hemorrhoids, anorectal prolapse, fistula-in-ano, recto-vaginal fistula, anorectal/ vaginal/perineal fistula.

**Perianal itching/pruritus ani****Symptom**

Complaint of an itchy anus.

**Perineal abnormalities (female)****Sign**

Scars, sinuses, deformities, condylomata, papillomata, hematoma.

**Perineal body (PB)****Sign**

This is measured from the posterior margin of the hymen to the mid-anal opening.

**Perineal descent (female)****Sign**

Excessive dorsocaudal movement of the vulva, perineum, and anus, for example, during coughing, Valsalva or straining.

**Perineal descent (male)****Sign**

This is the outward (dorso-caudal) movement of the perineum and anus (when the individual is asked to cough or bear down).

**Perineal elevation (female)****Sign**

Inward (ventrocephalad) movement of the vulva, perineum, and anus during, for example, PFM contraction.

**Perineal elevation (male)****Sign**

This is the inward (ventro-cephalad) movement of the perineum and anus. Look for testicular lift and penile retraction. These need to be checked against movement of the scrotum and the whole penis. Correct movement occurs with the PFM only: the shaft of the penis draws in and the testes lift in a cephalad direction. These movements may be better visualized in standing than supine position.

**Perineal examination (male)****Sign**

- . This is generally performed with the patient in the lateral supine or in the lithotomy position.
- . Perianal dermatitis: Skin infection at the perineum around the anus, usually associated with faecal incontinence or diarrhoea.
- . Fissures: A break or tear in the skin of the perineum, anal sphincter or distal rectum usually associated with anal pain.

**Perineal gap (PG)**

Surgery – Female

Thinned out medial area (cm) between Moynihan forceps placed bilaterally where the labia minora meet the perineum.

**Perineal length (PL)**

Surgery – Female

Distance from posterior margin of vestibule to anterior anal verge.

**Perineal measurements - perineal length****Sign**

Distance from posterior margin of vestibule to anterior anal verge.

**Perineal pain (female)****Symptom**

Complaint of pain felt between the posterior fourchette (posterior lip of the vaginal introitus) and the anus.

**Perineal pain (male)****Symptom**

Complaint of pain, pressure or discomfort felt on the surface or in the depth of the tissue between the scrotum and the anus.

**Perineal Pain Syndrome****Symptom**

Perineal pain syndrome is the occurrence of persistent or recurrent episodic perineal pain, which is either related to the micturition cycle or associated with symptoms suggestive of urinary tract or sexual dysfunction. There is no proven infection or other obvious pathology.

**Perineocele****Sign**

Bulge in the perineum associated with herniation of the anterior wall of the rectum.

**Perineorrhaphy - commencement position (PCT)**

Surgery – Female

Where is Level III, the perineorrhaphy is commenced, e.g. hymen, mid-vestibule, posterior margin of vestibule.

**Perineorrhaphy - depth (PD)**

Surgery – Female

Depth of the excised perineum.

**Perineorrhaphy - mid-perineal thickness (MPT)**

Surgery – Female

Thickness (cm) of the mid-perineum in the midline.

**Perineorrhaphy - perineal gap (PG)**

Surgery – Female

Thinned out medial area (cm) between Moynihan forceps placed bilaterally where the labia minora meet the perineum.

**Perineorrhaphy - width (PW)**

Surgery – Female

Width of the excised perineum.

**Pessaries - General***Conservative Management – Female*

Pessaries are intravaginal devices used to try to restore the prolapsed organs to their normal position and hence to relieve symptoms. Vaginal pessaries can be broadly divided into two types: support pessaries (ring, ring with support, Gehrung, Hodge, shelf) and space-filling pessaries (donut, Gellhorn, cube, inflatable).

**Phimosis**

Sign

Partial or complete inability to retract the prepuce due to adhesion between the glans and the prepuce or a preputial ring.

**Physiotherapy for Female Pelvic Floor Dysfunction***Conservative Management – Female*

Physiotherapy involves “using knowledge and skills unique to physiotherapists” and “is the service only provided by, or under the direction and supervision of, a physiotherapist”. Adherence: is the extent to which a client/patient’s behavior corresponds to the agreed treatment protocol and/or regime as recommended by their healthcare provider. It does not refer to the intervention itself; rather, the patient’s commitment to undertaking the behavioral change to adhere to the intervention.

Compliance: is the extent to which a client/patient’s behavior matches, or complies with their healthcare provider’s recommended treatment protocol and/or regime.

**Pictorial stool chart**

Sign

It is a pictorial chart of stool consistencies. The “Bristol stool chart” seems to have widespread face validity and recognition and is useful in conversations with patients about their stool consistency, despite little validation work. It has not been validated as an outcome measure and a reported change in category may not represent sufficient degree of precision for use as a trial end point.

**Pneumaturia***Symptom*

Complaint of the passage of gas (or air) from the urethra during or after voiding.

**Polyuria**

Sign

Excessive production of urine. It has been defined as >40mls urine/kg body weight during 24 hours or 2.8 litres (70 kg individual).

**Polyuria - Causes**

Sign

Diabetes mellitus: Insulin dependent (Type I); Insulin independent (Type II). Diabetes insipidus: Pituitary, Renal, Gestational, Primary polydipsia (psychogenic, dipsogenic or iatrogenic).

**Polyuria (global symptom)***Symptom*

Complaint that the urine excretion volume over 24 hours is noticeably larger than the previous excretion.

**POP - anterior vaginal wall (compartment) prolapse***Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the anterior vaginal wall (compartment).

**POP - posterior vaginal wall (compartment) prolapse***Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the posterior vaginal wall (compartment).

**POP - uterine/ cervical prolapse***Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the uterus or uterine cervix.

**POP - vaginal vault (cuff scar) prolapse***Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the vaginal vault (cuff scar after hysterectomy).

**POPQ - anterior vaginal wall - Point Aa**

Sign

A point located in the middle of the anterior vaginal wall three (3) cm proximal to the external urethral meatus. By definition, the range of position of Point Aa relative to the hymen is -3 to +3cm.

**POPQ - anterior vaginal wall - Point Ba**

Sign

A point that represents the most distal (i.e., most dependent) position of any part of the upper anterior vaginal wall from the vaginal cuff or anterior vaginal fornix to Point Aa. By definition, Point Ba is at -3cm in the absence of prolapse and would have a positive value equal to the position of the cuff (Point C) in women with total uterine prolapse or post-hysterectomy vaginal eversion.

**POPQ - defined points**

Sign

The anatomic position of the six defined points (two on the anterior vaginal wall, two in the superior vagina, and two on the posterior vaginal wall) for measurement should be centimeters (cm) above or proximal to the hymen (negative number) or cm below or distal to the hymen (positive number) with the plane of the hymen being defined as zero (0). For example, a cervix that protruded 3 cm distal to the hymen would be + 3 cm. All points are measured on maximal straining (except total vaginal length).

**POPQ - fixed point of reference****Sign**

The hymen is the fixed point of reference used throughout the POP-Q system of quantitative prolapse description.

**POPQ - Genital hiatus****Sign**

The genital hiatus (GH) is measured from the middle of the external urethral meatus to the posterior margin of the hymen.

**POPQ - Perineal body****Sign**

The perineal body (PB) is measured from the posterior margin of the hymen to the mid-anal opening.

**POPQ- Posterior vaginal wall - Point Bp****Sign**

A point that represents the most distal (i.e., most dependent) position of any part of the upper posterior vaginal wall from the vaginal cuff or posterior vaginal fornix to Point Ap. By definition, Point Bp is at -3 cm in the absence of prolapse and would have a positive value equal to the position of the cuff in a woman with total post-hysterectomy vaginal eversion.

**POPQ - recording measurements****Sign**

Intraoperative measurements with traction can be quite different than measurements made during Valsalva in clinic, both in regards to cervical location and the vaginal walls. Measurements directly after removing a vaginal pessary are unreliable and will tend to understage the degree of prolapse.

**POPQ - Superior vagina - Point D****Sign**

A point that represents the location of the posterior fornix in a woman who still has a cervix. It is included as a point of measurement to differentiate suspensory failure of the uterosacral-cardinal ligament “complex” from cervical elongation. When the location of Point C is significantly more positive than the location of Point D, this is indicative of cervical elongation which may be symmetrical or eccentric. Point D is omitted in the absence of the cervix.

**POPQ - Superior vaginal - Point C****Sign**

A point that represents either the most distal (i.e., most dependent) edge of the cervix or the leading edge of the vaginal cuff (hysterectomy scar) after total hysterectomy.

**POPQ - Total vaginal length****Sign**

The total vaginal length (TVL) is the length of the vagina (cm) from the posterior fornix to hymen when Point C or D is reduced to its full normal position.

**POPQ- Posterior vaginal wall - Point Ap****Sign**

A point located in the midline of the posterior vaginal wall three (3) cm proximal to the hymen. By definition, the range of position of Point Ap relative to the hymen is -3 to +3 cm.

**POP-related vaginal bleeding, discharge, infection.****Symptom**

Complaint of vaginal bleeding, discharge or infection related to dependent ulceration of uterine and/or vaginal prolapse.

**Position-dependent voiding - female****Symptom**

Complaint of having to take specific positions to be able to void spontaneously or to improve bladder emptying, (female) e.g. leaning forwards or backwards on the toilet seat or voiding in a semi-standing position.

**Position-dependent voiding - male****Symptom**

Complaint of having to adopt specific positions to be able to void spontaneously or to improve bladder emptying, e.g. needing (men) to void in a seated position.

**Possible Intercurrent Diagnoses of POP****Diagnosis**

(i) Urodynamic stress incontinence: Involuntary leakage of urine during filling cystometry, associated with increased intraabdominal pressure, in the absence of a detrusor contraction. In the circumstances where this diagnosis is only made when the POP is reduced, the additional term “occult” is appropriate. (ii) Detrusor overactivity: The occurrence of involuntary detrusor contractions during filling cystometry. (iii) Bladder oversensitivity: Increased perceived bladder sensation during bladder filling with: an early first desire to void; an early strong desire to void, which occurs at a low bladder volume; a low maximum cystometric bladder capacity. No abnormal increases in detrusor pressure are noted. (iv) Detrusor underactivity and Acontractile detrusor.

**Possible Prolapse-related Diagnoses****Diagnosis**

(i) Voiding dysfunction: A diagnosis by symptoms and urodynamic investigations is defined as abnormally slow and/or incomplete micturition, based on abnormal slow urine flow rates and/or abnormally high post void residuals, ideally on repeated measurement to confirm abnormality. Voiding cystometry can be required to determine the cause of the voiding dysfunction. (ii) Recurrent urinary tract infections (UTI): A diagnosis by clinical history assisted by the results of diagnostic tests involves the determination of the occurrence of at least three symptomatic and medically diagnosed urinary tract infections (UTI) over the previous 12 months. One possible POP-related cause is a chronically elevated postvoid residual. (iii) Defecatory dysfunction: A diagnosis by clinical history assisted, at times, by the results of diagnostic tests involving the confirmation of abnormal or difficult function in the initiation, passage or completion of defecation. (iv) Sexual dysfunction: A diagnosis by clinical history (including specific questionnaires) involving the confirmation of abnormal function and/or difficulty with sexual intercourse.

**Post coital pain (female)****Symptom**

Pain after intercourse such as vaginal burning sensation or pelvic pain.

**Post-coital LUT symptoms (female)****Symptom**

Such as acute cystitis, worsened urinary frequency or urgency, dysuria, suprapubic tenderness.

**Post-defecatory soiling****Symptom**



Complaint of soiling occurring after defecation.

#### **Posterior colporrhaphy - mid-vaginal laxity (MVL - undisplaced)**

Surgery – Female

Laxity (cm) of the vaginal mucosa (anterior traction) midpoint in the vagina supero-posteriorly and in the midline with the vaginal vault held in an undisplaced position (similar to that after vault fixation).

#### **Posterior colporrhaphy - posterior vaginal vault descent (PVVD)**

Surgery – Female

Descent of the posterior vaginal vault (on traction) towards the anterior perineum (perineal gap). Subtract from the total posterior vaginal length (TPVL) the distance from the inferiorly displaced vaginal vault to the anterior perineum.

#### **Posterior colporrhaphy - recto-vaginal fascial laxity (RVFL - cm)**

Surgery – Female

Laxity in the recto-vaginal fascia (anterior traction) midpoint in the vagina supero-posteriorly (mucosa opened) and in the midline with the vaginal vault held in an undisplaced position.

#### **Posterior vaginal repair (colporrhaphy) - mesh or graft reinforcement**

Surgery – Female

A structural addition or inclusion used to give additional strength in function. It should be noted whether the graft is biologic, absorbable synthetic or permanent synthetic.

#### **Posterior vaginal repair (colporrhaphy) - native tissue**

Surgery – Female

Repair the vagina by excision and suturing the edges of any defect. Midline fascial plication represents the commonest procedure, involving dissection under the full thickness of the vaginal epithelium followed by central plication of the pre-rectal fascia over the rectum and excision of “excess” vaginal wall skin.

#### **Posterior vaginal vault descent (PVVD) - posterior colporrhaphy**

Surgery – Female

Descent of the posterior vaginal vault (on traction) towards the anterior perineum (perineal gap). Subtract from the total posterior vaginal length (TPVL) the distance from the inferiorly displaced vaginal vault to the anterior perineum.

#### **Posterior Vaginal Vestibule**

Sign

Posterior hymenal ring to anterior perineum (posterior margin of vestibule).

#### **Posterior vaginal wall (compartment) prolapse**

Sign

Observation of descent of the posterior vaginal wall. Commonly, this would represent rectal protrusion into the vagina (rectocele). Higher stage posterior vaginal wall prolapse after prior hysterectomy will generally involve some vaginal vault (cuff scar) descent and possible enterocele formation. Enterocele formation can also occur in the presence of an intact uterus.

#### **Posterior vaginal wall (compartment) prolapse**

*Diagnosis*

Diagnosis by symptoms and clinical examination, assisted at times by any relevant imaging (i.e. clinically evident) descent of the posterior vaginal wall (compartment).

#### **Post-micturition incontinence**

*Symptom*

Complaint of a further involuntary passage of urine following the completion of voiding

#### **Post-micturition leakage**

*Symptom*

Complaint of a further involuntary passage of urine following the completion of micturition.

#### **Postoperative de novo dyspareunia**

*Symptom*

Dyspareunia first reported after surgery or other interventions.

#### **Postoperative de novo sexual dysfunction symptoms**

*Symptom*

New onset symptoms of sexual dysfunction (not previously reported before surgery).

#### **Postoperative findings - ultrasound imaging (male)**

*Imaging*

Post-prostatectomy (urethral shape), male sling position, artificial sphincter - placement of cuff and reservoir, bulking agents.

#### **Postural urinary incontinence**

*Symptom*

Complaint of urinary incontinence during change of posture or position, e.g. from supine or seated to standing.

#### **Post-void residual (PVR)**

*Investigation*

Volume of urine left in the bladder at the completion of voiding.

#### **Post-void residual (PVR - abdominal) - ultrasound imaging**

*Imaging*

Volume = width (left to right) x depth (anterior to posterior) x length (cranial to caudal) x 0.52 (mL)

#### **Post-void residual (PVR - female) - assessment of normality**

*Investigation*

Quoted upper limits of normal reflect accuracy of measurement. Studies using “immediate” PVR measurement by ultrasound (within 60 seconds of voiding) suggest an upper limit of normal of 30ml. Studies using urethral catheterization (generally 5 - 10min delay) quote higher upper limits of 50ml or 100ml. An isolated finding of a raised PVR requires confirmation before being considered significant.

#### **Post-void residual (PVR - female - conditions for measurement)**

*Investigation*

PVR reading is erroneously elevated by delayed measurement due to additional urine production (1-14 mL/min). Ultrasonic techniques (transvaginal, translabial most accurately) allow immediate (within 60 s of voiding) measurement and possible repeat measurement. A short plastic female catheter provides the most effective drainage for PVR measurement by catheterization.

#### **Post-void residual (PVR - male) - assessment of normality**

*Investigation*

Upper limits in normal community dwelling men without LUTS are age dependent with studies reporting a cut-off value of 10-30 mL. There are no adequate currently available data from which to quote expected/typical

ranges of PVR in men with symptoms of lower urinary tract dysfunction. Such studies would need to reflect the accuracy of measurement, including whether the PVR measurement is “immediate” (e.g. by ultrasound) or by urethral catheterization (unless also “immediate”). In the absence of such studies, our consensus view (D’Ancona, Haylen et al.) is that a PVR (ultrasound) over 50mL, following double voiding, might prompt the suspicion of voiding dysfunction.

#### **Post-void residual (PVR - male) - Conditions for measurement**

##### *Investigation*

PVR reading is erroneously elevated by delayed measurement due to additional renal input (1-14mL/min) into the bladder. Ultrasonic techniques allow immediate (within 60 seconds of micturition) measurement to minimize the error. Immediate insertion of a transurethral catheter for bladder drainage can still provide an effective and accurate PVR measurement. All urethral catheters, however, may not be of equal drainage efficacy. Ultrasound PVR measurement should ideally be repeated at least once if PVR is present. An overdistended rather than “comfortably full” bladder might lead to a falsely elevated initial PVR, assessed further by repeat voiding/ repeat PVR.

#### **Postvoiding detrusor contraction - pressure flow studies**

##### *Investigation*

An increase in detrusor pressure (Pdet) following the cessation of urinary flow.

#### **Post-voiding incontinence**

##### *Symptom*

Complaint of a further involuntary passage (incontinence) of urine or dribbling following the completion of voiding.

#### **Post-voiding symptom**

##### *Symptom*

Lower urinary tract symptom experienced after voiding.

#### **Post-voiding urgency**

##### *Symptom*

Complaint of persistent urgency post-voiding.

#### **Premature ejaculation**

##### *Symptom*

Complaint of a persistent or recurrent pattern of too rapid achievement of ejaculation during partnered sexual activity, i.e. before the individual wishes it.

#### **Premicturition pressure**

##### *Investigation*

The pressure recorded immediately before the initial isovolumetric contraction.

#### **Pressure flow studies - detrusor opening pressure (cm H2O)**

##### *Investigation*

Detrusor pressure recorded immediately before the initial isovolumetric contraction.

#### **Pressure-flow studies**

##### *Investigation*

Pressure volume (urinary flow) relationship of the bladder during voiding. It begins when the “permission to void” is given and ends when the individual considers voiding has finished. Measurements to be recorded should be: detrusor pressure (Pdet); abdominal pressure (Pabd) with detrusor pressure (Pdet) calculated. Urine flow rate (mL/s) should also be recorded.

#### **Pressure-flow studies - acontractile detrusor**

##### *Investigation*

The detrusor cannot be observed to contract (i.e. no increase in Pdet) during pressure-flow studies resulting in failure to void. Limited voiding may occur by straining. May be neurogenic (evidence of a neurological disorder) or non-neurogenic (no evidence of a neurological disorder).

#### **Pressure-flow studies - delayed relaxation of the urethral sphincter (? neurogenic)**

##### *Investigation*

Impaired and hindered relaxation of the urethral sphincter during voiding attempt resulting in delay of urine flow.

#### **Pressure-flow studies - detrusor pressure at end flow (pdet-ef - cm H2O)**

##### *Investigation*

Detrusor pressure recorded at the end of urine flow.

#### **Pressure-flow studies - detrusor pressure at maximum flow (Pdet.qmax - cm H2O)**

##### *Investigation*

Detrusor pressure recorded at maximum urinary flow rate.

#### **Pressure-flow studies - detrusor underactivity (DU)**

##### *Investigation*

Low detrusor pressure or short detrusor contraction time, usually in combination with a low urine flow rate resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within a normal time span.

#### **Pressure-flow studies - flow delay - unit: s)**

##### *Investigation*

The time elapsed from initial rise in pressure to onset of flow. It reflects the time necessary for the fluid to pass from the point of pressure measurement to the uroflow transducer.

#### **Pressure-flow studies - initiated reflex bladder emptying (?neurogenic)**

##### *Investigation*

An artificially elicited LUT reflex comprised of various manoeuvres (exogenous stimuli) performed by the patient or the therapist, resulting in complete or incomplete bladder emptying.

#### **Pressure-flow studies - maximum detrusor pressure (Pdet-max -cm H2O)**

##### *Investigation*

Maximum registered detrusor pressure during voiding.

#### **Pressure-flow studies - neurogenic detrusor underactivity**

##### *Investigation*

Low detrusor pressure or short detrusor contraction time, usually in combination with a low urine flow rate, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within a normal time span in the setting of a clinically relevant neurologic disease.

#### **Pressure-flow studies - non-relaxing urethral sphincter (? neurogenic)**

##### *Investigation*

A non-relaxing, obstructing urethral sphincter resulting in reduced urine flow.

#### **Pressure-flow studies - normal detrusor contractile function.**

##### *Investigation*

Normal voiding in an individual is achieved by an adequate continuous detrusor contraction that leads to complete bladder emptying within a normal time span.

**Pressure-flow studies - postvoiding detrusor contraction (cm H2O)***Investigation*

An increase in detrusor pressure (Pdet) following the cessation of urinary flow.

**Pressure-flow studies - urethral opening pressure (Pdet-uo - cm H2O)***Investigation*

Detrusor pressure recorded at the onset of measured flow.

**Pressure-flow studies (male +/- VCU, EMG) - detrusor sphincter dyssynergia (DSD)***Investigation*

Dyscoordination between detrusor and smooth or striated sphincter function during voiding due to a neurological abnormality (i.e. detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscle).

**Pressure-flow studies (male +/- VCU, EMG) - dysfunctional voiding***Investigation*

This is characterized an intermittent and/or fluctuating urine flow due to inadequate or variable relaxation generally of the external sphincter during voiding in neurologically normal men.

**Pressure-flow studies (male +/- VCU,EMG) - abnormal urethral function during voiding.***Investigation*

The urethral sphincter(s) do not relax completely or they are (temporarily) contracted during voiding, resulting in increased detrusor pressure. Bladder emptying may be incomplete (PVR present).

**Pressure-flow studies (male +/- VCU,EMG) - bladder outlet obstruction (BOO)***Investigation*

The generic term for mechanical obstruction during voiding. It is a reduced urine flow rate with an increased detrusor pressure. PVR can be present.

**Pressure-flow studies (male +/- VCU,EMG) - normal urethral function during voiding.***Investigation*

The urethra opens and is continuously relaxed to allow micturition at a normal pressure and urine flow and results in complete bladder emptying. The voiding is prompted by a detrusor contraction and simultaneous relaxation of the smooth and striated sphincters of the urethra and pelvic floor muscles.

**Prevention of Pelvic Floor Dysfunction***Conservative Management – Female*

Prevention is the act of preventing or decreasing the risk of disease or disability. Activities that are directed toward slowing or stopping the occurrence of both mental and physical illness and disease, minimizing the effects of a disease or impairment on disability, or reducing the severity or duration of an illness. 1. Primary prevention: prevention of the development of disease in a susceptible or potentially susceptible population through such specific measures as general health promotion efforts. 2. Secondary prevention: efforts to decrease the duration of illness, reduce the severity of diseases, and limit the sequelae through early diagnosis and prompt intervention. 3. Tertiary prevention: efforts to limit the degree of disability and promote rehabilitation and restoration of function in patients/clients with chronic and irreversible diseases.

**Primary and Further Surgery**

Surgery – Female

The following standardized terminology is proposed for surgical trials and clinical audit:

A. Primary Surgery: This indicates the first procedure required for the treatment of POP in any compartment. B. Further Surgery: Provides a global term for the number of subsequent procedures the patient undergoes, directly or indirectly, relating to the primary surgery. Further surgery per se should not be interpreted as a measure or failure as the definitions of success and failure will be defined within the context of the individual study. Further surgery is subdivided into: I. Primary prolapse surgery/different site: a prolapse procedure in a new site/compartment following previous surgery (e.g., anterior repair following previous posterior repair). II. Repeat surgery: a repeat operation for prolapse arising from the same site. Where combinations of procedures arise, such as new anterior repair plus further posterior repair, these should be reported separately as primary anterior repair and repeat posterior repair. III. Surgery for complications: mesh exposure or extrusion, pain, or patient compromise such as hemorrhage (see Complications section). IV. Surgery for non-POP related conditions: subsequent surgery for stress urinary incontinence or fecal incontinence.

**Primary enuresis***Symptom*

Complaint of intermittent incontinence that occurs during periods of sleep that has been present lifelong.

**Procidentia***Sign*

Complete eversion of the vagina and uterus (Stage IV utero-vaginal prolapse)

**Proctoscopy (anoscopy)***Investigation*

The inspection of the anal canal to identify anal fissure, fistula, or hemorrhoids as a cause of anal symptoms.

**Prolapse***Symptom*

A falling, slipping or downward displacement of a part or organ (Latin: Prolapsus - "a slipping forth")

**Prolapse (pelvic organ) symptoms***Symptom*

A departure from normal sensation, structure or function experienced by the woman in reference to the position of her pelvic organs. Symptoms are generally worse at the times when gravity might make the prolapse worse (e.g. after long periods of standing or exercise) and better when gravity is not a factor e.g. lying supine. Prolapse may be more prominent at times of abdominal straining e.g. defecation.

**Prominence**

Surgery – Complication related

Parts that protrude beyond the surface (e.g. due to wrinkling or folding with no epithelial separation).

**Prosthesis**

Surgery – Female

A fabricated substitute to assist a damaged body part or to augment or stabilise a hypoplastic structure.

**Provocative Manoeuvres***Investigation*

Provocative manoeuvres are defined as techniques used during urodynam-

ics in an effort to provoke detrusor overactivity, for example, rapid filling, use of cooled or acid medium, postural changes and hand washing.

### **Pudendal neuralgia**

#### **Sign**

Elicited or described by the patient as burning vaginal and vulva pain (anywhere between the anus and the clitoris) with tenderness over the course of the pudendal nerve.

### **Pudendal pain (neuralgia)**

#### *Symptom*

Complaint of pain, pressure or discomfort in one or more areas innervated by the pudendal nerve (possible inflammation or entrapment of the pudendal nerve and involving its dermatome).

## **Q**

### **Q-Tip Testing**

#### **Sign**

Measurement of urethral axial mobility at rest and straining to assess degree of mobility.

## **R**

### **Radiological imaging (male) - defecography (evacuation proctography)**

#### *Imaging*

This demonstrates the anatomy of the anorectum as well as disorders of rectal evaluation. Barium paste is inserted prior to defecation over a translucent commode.

### **Radiological imaging (male) - intravenous urography (IVU)**

#### *Imaging*

Conventional X-ray or CT, this study provides an anatomical outline of the upper urinary tract, ureters and bladder as well as an evaluation of renal function by excretion of contrast media. Calcification may be shown in kidneys, ureter, bladder, seminal vesicles or vasa.

### **Radiological imaging (male) - retrograde +/- antegrade urethrography**

#### *Imaging*

Unidirectional or combined contrast imaging is used to visualize the urethral lumen, to diagnose strictures and diverticula and to stage urethral trauma.

### **Radiological imaging (male) - videocystourethrography (VCU)**

#### *Imaging*

Synchronous radiological screening of the bladder and urethra allowing direct observation of bladder events, the position and conformation of the bladder neck in relation to the pubic symphysis, diverticula of the bladder and urethra, recto-urethral fistulae and vesico-ureteric reflux.

### **Radiological imaging (male) - Videourodynamics (pressure-flow studies)**

#### *Imaging*

A functional test of the lower urinary tract in which pressure, capacity and flow data are simultaneously combined with real-time imaging of the lower and upper urinary tract.

### **Radiological imaging (male) - voiding (micturitional) cystourethrography**

#### *Investigation*

Imaging of the bladder neck, urethra and prostate during voiding looking for vesico-ureteric reflux, vesical or urethral fistulae, vesical or urethral diverticulae, strictures and the level of obstruction e.g. bladder neck or prostate.

### **Rate of Nocturnal Urine Production**

#### **Sign**

Nocturnal urine volume / time asleep (i.e. night). Measured in mL/min.

### **Receptive anal intercourse**

#### *Symptom*

Having a penis penetrating one's anus.

### **Receptive urethral intercourse**

#### *Symptom*

Having a penis penetrating one's urethra (urethral coitus).

### **Rectal (and prostate) examination (male)**

#### **Sign**

Digital rectal examination (DRE) is recommended as part of the physical examination. Generally done with the patient standing and bent over the examining table, or with the patient in the left lateral knees bent position, or in the lithotomy position. DRE is usually pain-free.

. Anal examination: This can detect the following findings in the anal sphincter or distal rectum:

- Benign diseases: hemorrhoids, fissure, anal sphincter injury, levator discomfort or pain.
- Possible malignant diseases: anal, distal rectal and prostate carcinoma.
- Anal tone: increased or decreased anal sphincter tone might suggest similar changes in the urinary sphincter and may indicate neurologic disease.
- Anal stricture: a circumscribed narrowing or stenosis of the anal canal.

. Prostate gland characteristics: size, symmetry, firmness, nodules, and its relation to the pelvic sidewall and rectum can be assessed. The gland is about the size of a walnut and has a consistency similar to that of the contracted thenar eminence of the thumb.

. Prostate nodularity and/or firmness – May indicate possible abnormality requiring further investigation.

. Prostate tenderness: prostate palpation, as part of a DRE, is usually pain-free. Pain with prostatic palpation is variable though if present, it may be helpful in differentiating prostate/pelvic pain syndromes.

. Rectal examination (circumferential): this might lead to the detection of non-urolological diseases such as rectal carcinoma, fistula and fecal impaction.

### **Rectal bleeding/mucus**

#### *Symptom*

Complaint of the loss of blood or mucus per rectum.

### **Rectal digitation**

#### *Symptom*

Use of fingers in the rectum to manually assist in the evacuation of stool contents.

### **Rectal Dynamics - Attempted defecation and balloon expulsion**

#### *Investigation*

Patients with symptoms of prolapse and elderly patients with a history of constipation who present with passive incontinence should be thoroughly examined for the presence of a full thickness rectal prolapse. Patients are asked to strain as they would to pass stools whilst on a toilet or commode and given enough time to reproduce the prolapsing lump before examination. Expulsion of a water-filled balloon can be used in the assessment of constipated patients. The ability to expel the balloon within 1min may be a useful tool in demonstrating the absence of pelvic floor dyssynergia.

### **Rectal Dynamics - Rectal Impedance Planimetry**

#### *Investigation*

These studies are the preserve of research institutions rather than clinical practice. The rationale is to calculate the diameter or cross sectional area of an intra rectal bag during a distension sequence. Impedence planimetry measures the cross sectional area which enables the circumferential wall tension to be calculated.

### **Rectal dynamics (female) - Rectal Compliance**

#### *Investigation*

Rectal compliance is the term that describes the relationship between pressure and volume, reflecting the ability of the rectum to act as a reservoir and is assessed using a barostat. Inflating the bag within the rectum prior to the recording inflation protocol, known as conditioning, has been shown to improve the precision of compliance testing. Typically, compliance figures between 4 and 11 mmHg/ml are quoted as the normal range.

### **Rectal examination (female)**

#### *Sign*

Observations can include: (i) Anal sphincter tone and strength: Assessment on digital examination, as good or poor in the absence of any quantitative assessment; (ii) Anal sphincter tear: May be recognized as a clear "gap" in the anal sphincter on digital examination; (iii) Confirm presence or absence of rectocele: and if possible, differentiate from enterocele. Diagnose perineal body deficiency; (iv) Confirm presence or absence of fecal impaction; (v) Other rectal lesions: Intussusception, rectovaginal fistula or tumor; (vi) Anal lesions; Hemorrhoids, fissure; (vii) Other perianal lesions: Anocutaneous fistula.

### **Rectal Irrigation**

#### *Conservative Management – Female*

Rectal irrigation is the use of liquid solutions given by enema to remove material from the rectum.

### **Rectal musculature - Endoanal ultrasonography**

#### *Imaging*

(1) Internal anal sphincter - The caudal continuation of the circular smooth muscle of the rectum forms the internal anal sphincter, which terminates caudally in a clearly defined edge, at a variable distance from the anal verge. (2) Longitudinal muscle - Comprises smooth muscle cells continuous with the outer layer of the rectal wall, and striated muscle from various pelvic floor muscles. The longitudinal muscle lies between the internal and external anal sphincters in the inter-sphincteric space. (3) External anal Sphincter – It is made up of striated muscle and surrounds the longitudinal muscle forming the outer border of the inter-sphincteric space. The external sphincter is divided into deep, superficial and subcutaneous parts, with the deep and subcutaneous parts of the sphincter forming rings of muscle. Between them, elliptical fibres from the superficial part

of the external anal sphincter run anteriorly from the perineal body to the coccyx posteriorly.

(4) Puborectalis - is formed from the most anterior fibres of the pubococcygeus muscle. This forms a sling pulling the rectum forward.

### **Rectal prolapse**

#### *Symptom*

Complaint of external protrusion of the rectum (differentiation on subsequent examination between rectal mucosal prolapse and full thickness rectal wall prolapse which includes muscle and serosal layers.

### **Rectocele**

#### *Sign*

Bulge in posterior vaginal wall associated with herniation of anterior wall of the rectum. An aspect of posterior vaginal wall (compartment) prolapse.

### **Recto-vaginal fascial laxity (RVFL - cm) - posterior colporrhaphy**

#### *Surgery – Female*

Laxity of the rectovaginal fascia (anterior traction) midpoint in the vagina super-posteriorly (mucosa opened) and in the midline with the vaginal vault held in an undisplaced position.

### **Rectovaginal fistula**

#### *Sign*

Is a communication from the rectum to the vagina.

### **Recurrent urinary tract infection - diagnosis (female)**

#### *Diagnosis*

This diagnosis by clinical history assisted by the results of diagnostic tests involves the determination of the occurrence of at least three symptomatic and medically diagnosed urinary tract infection (UTI) over the previous 12 months.

### **Recurrent Urinary Tract Infections (female)**

#### *Diagnosis*

This diagnosis by clinical history assisted by the results of diagnostic tests involves the determination of the occurrence of at least three symptomatic and medically diagnosed UTIs over the previous 12 months.

### **Recurrent urinary tract infections (UTI - female)**

#### *Symptom*

A history of at least three symptomatic and medically diagnosed UTI in the previous 12 months. The previous UTI(s) should have resolved prior to a further UTI being diagnosed.

### **Recurrent urinary tract infections (UTIs - male)**

#### *Symptom*

A history of at least two symptomatic and medically diagnosed UTIs in the previous 12 months. The previous UTI(s) should have resolved prior to a further UTI being diagnosed.

### **Reduced bladder filling sensation**

#### *Symptom*

Complaint that the sensation of bladder filling is less intense or occurs later in filling than previously experienced.

### **Reduced bladder sensation - Filling cystometry**

#### *Investigation*

Bladder sensation perceived to be diminished during filling cystometry.

**Reduced bladder sensation - filling cystometry***Investigation*

Bladder sensation perceived to be diminished during filling cystometry.

**Reduced compliance (storage dysfunction - RCSD) incontinence***Diagnosis*

Urinary incontinence directly related to the RCSD.

**Reduced compliance storage dysfunction (RCSD)***Diagnosis*

In individuals with lower urinary tract symptoms, more commonly storage symptoms, when there is a non-phasic (at times linear or exponential) rise in detrusor pressure during filling cystometry with generally reduced capacity indicating reduced compliance.

**Reflex bladder triggering**

Conservative Management – General

This comprises various manoeuvres performed by the patient or the therapist to elicit reflex bladder emptying by exteroceptive stimuli (relating to, being, or activated by stimuli received from outside the bladder).

**Related**

Surgery – Complication related

Connected

**Repeat Cystometry***Investigation*

There is no convincing evidence that the clinical diagnosis on the basis of the first cystometry is often changed on repetition of the test. There is no definite evidence that immediate repetition of an adequately performed urodynamic test 'for confirmation' is required. ICS does not recommend routine immediate repetition of invasive urodynamics 'for confirmation' if the test was technically adequate, has been considered representative, and has

answered the clinical question. ICS recommends immediate repetition of the test when doubt exists as to whether the test has answered the clinical question. ICS recommends repetition of a urodynamic test when technical errors and artefacts have been observed at immediate post test analysis.

**Retention with overflow***Diagnosis*

Involuntary loss of urine directly related to an excessively full bladder in retention.

**Retrograde urethrocytography and voiding cystourethrography***Imaging*

Unidirectional or combined contrast imaging of the urethra in a patient in the 30 degree oblique position to visualize the lumen, mainly to diagnose urethral strictures or diverticula. It is also of use to diagnose and stage urethral trauma.

**Retroverted uterus***Sign*

The axis of the uterus is directed backwards towards the hollow of the sacrum, away from its anteverted position overlying the bladder. Cervix is noted in/towards the anterior fornix with fundus perhaps palpable in the posterior fornix.

**Rigid sigmoidoscopy***Investigation*

This is a bedside test to inspect the rectal mucosa with no bowel preparation.

## S

**Sacral spinal cord lesion (SSCL)***Diagnosis*

This is a neurological lesion in the sacral spinal cord. Neurogenic lower urinary tract dysfunction in SSCL: findings include acontractile detrusor with or without decreased bladder compliance and usually with impaired sphincter activity.

**Sacrocolpopexy - open, laparoscopic, robotic**

Surgery – Female

Suspension of the cervix (and usually vagina) utilizing mesh or graft to the anterior longitudinal ligament usually at the level of the sacral promontory. This procedure tends to be performed as an adjunct following subtotal hysterectomy for advanced utero-cervical prolapse.

**Sacrocolpopexy - open, laparoscopic, robotic**

Surgery – Female

Suspension of the vagina utilizing mesh or graft to the anterior longitudinal ligament usually at the level of the sacral promontory.

**Sacrohysteropexy - open, laparoscopic, robotic**

Surgery – Female

Suspension of the cervix (with or without additional vaginal attachment) utilizing mesh or graft to the anterior longitudinal ligament usually at the

level of the sacral promontory. This tends to be performed for women who are keen to preserve their uterus.

**Sacrospinous Colpopexy (SSC)**

Surgery – Female

Fixation of the vaginal vault to the sacrospinous ligament: (a) Unilateral or bilateral procedure. (b) Anterior or posterior approach. (c) Permanent or absorbable suture and number of 'bites' taken. (d) Type of suture placement device employed. (e) Direct vision or with the use of a specific instrument (tactile feedback).

**Sacrospinous hysteropexy**

Surgery – Female

Fixation of the uterus to the sacrospinous ligament (SSL). Variations: (i) unilateral or bilateral; (ii) anterior or posterior approach; (iii) permanent or absorbable stitches; (iv) number of sutures; (v) direct vision or with use of a specific instrument (tactile feedback).

**Scarred vagina - postoperative***Symptom*

Perception by the partner of a "stiff" vagina or a foreign body (stitches, mesh exposure, mesh shrinkage).

**Scheduled Voiding Regimes in Female Pelvic Floor Dysfunction**

Conservative Management – Female



Toileting on a fixed schedule around the patient's normal voiding pattern, which includes a progressive voiding schedule using relaxation and distraction techniques for urgency suppression. Scheduled voiding regimes have been categorized as: bladder training, timed voiding, habit training, and prompted voiding.

**Bladder training:** In the past, bladder training has also been referred to as bladder drill, bladder discipline, bladder re-education, and bladder retraining. It consists of a program of patient education, along with a scheduled voiding regimen with gradually adjusted voiding intervals. Specific goals are to correct faulty habit patterns of frequent urination, improve control over bladder urgency, prolong voiding intervals, increase bladder capacity, reduce incontinent episodes, and restore patient confidence in controlling bladder function. Timed voiding: is a passive toileting assistance program, initiated and maintained by caregivers for patients who cannot participate in independent toileting. It is a fixed voiding schedule.

**Habit training:** consists of a toileting schedule matched to the individual's voiding patterns based on their voiding diary. The toileting schedule is assigned to fit a time interval that is shorter than the person's normal voiding pattern and precedes the time period when incontinent episodes are expected.

**Prompted voiding:** is used to teach people to initiate their own toileting through requests for help and positive reinforcement from caregivers, often done in combination with a scheduled voiding regimen, typically every 2h.

### **Scrotal examination**

#### *Sign*

**Normal:** The scrotum is a loose sac containing the testes and spermatic cord structures. The epididymis is palpable applied to the posterior surface of the testis as a ridge although occasionally it is sited on the anterior surface.

**. Inflammation:** The epididymis may be swollen and tender, and if severe, the inflammatory process may involve the whole scrotal content (i.e. testis and epididymis [epididymo-orchitis]) and the scrotal skin as well.

**. Cystic dilatations of the epididymis:** (epididymal cysts or spermatocele) and hydroceles (fluid collections between the visceral tunica albuginea and parietal layer of the testicular peritoneum) - usually benign. The examination of these structures would be generally non-tender and without pain.

**. Inguinal bulge:** Examination and differentiation of hernia from hydrocele or cyst of spermatic cord or groin lymph nodes. (Use of transillumination may assist though ultrasound is generally diagnostic).

### **Scrotal pain**

#### *Symptom*

Complaint of pain, pressure or discomfort felt in and around the scrotum. It may be localized to the testis, epididymis, cord structures or scrotal skin.

### **Scrotal pain syndrome**

#### *Symptom*

Scrotal pain syndrome is the occurrence of persistent or recurrent episodic scrotal pain which is associated with symptoms suggestive of urinary tract or sexual dysfunction. There is no proven epididymo-orchitis or other obvious pathology.

### **Sensation of anorectal blockage - female**

#### *Symptom*

Complaint suggestive of anorectal obstruction.

### **Sensory symptoms (female)**

#### *Symptom*

A departure from normal sensation or function, experienced by the woman during bladder filling. Normally, the individual is aware of increasing sensation with bladder filling up to a strong desire to void.

### **Separation**

Surgery – Complication related

Physically disconnected (e.g. vaginal epithelium).

### **Sexual activity urinary incontinence**

#### *Symptom*

Complaint of urinary incontinence associated with or during sexual activity (nb coital urinary incontinence [female] and sexual arousal incontinence [male]).

### **Sexual arousal (female) - vascular assessment**

#### *Investigation*

Sexual arousal results in increased blood flow allowing genital engorgement, protrusion of the clitoris and augmented vaginal lubrication through secretion from the uterus and Bartholin's glands and transudation of plasma from engorged vessels in the vaginal walls. Several instruments are available to measure blood flow during sexual stimulation. Inadequate vasculogenic response may be related to psychological factors as well as vascular compromise due to atherosclerosis, hormonal influence, trauma or surgery.

### **Sexual arousal incontinence**

#### *Symptom*

Complaint of involuntary loss of urine during sexual arousal, foreplay and/or masturbation.

### **Sexual diaries (female)**

#### *Investigation*

A daily log of sexual thoughts, activities; supported by the US FDA as a primary outcome measure for the efficacy of interventions to improve sexual function.

### **Sexual dysfunction (female)**

#### *Diagnosis*

A diagnosis by clinical history (including specific questionnaires) and examination, involving the confirmation of abnormal function and/or difficulty with sexual intercourse.

### **Sexual event logs**

#### *Investigation*

Record individual sexual events or activities. Each event is classified as a "sexually satisfying event (SSE)" or not. Event logs record individual events rather than activities on a daily basis.

### **Sexual Function Questionnaires - (SFQ)**

#### *Investigation*

1. Pelvic floor condition specific sexual function measures: A validated sexual function measure which is developed to include concepts relevant to women with pelvic floor dysfunction. 2. Generic sexual function measures: A validated measure that was developed to evaluate sexual function but does not contain items relevant to pelvic floor dysfunction such as coital incontinence or vaginal looseness.

#### **EXAMPLES:**

. ICIQ-FLUTSsex (BFLUTS) (International Consultation on Continence Questionnaire Female Lower Urinary Tract ICIQ-VS (International Consultation of Incontinence Questionnaire -Vaginal Symptoms).

. GRISS (The Golombok-Rust Inventory of Sexual Satisfaction);

. ICIQ-VS (International Consultation of Incontinence Questionnaire -Vaginal Symptoms);

. PISQ (Pelvic Organ Prolapse Urinary Incontinence Sexual Questionnaire;

. PISQ-12 (short form version of the PISQ-31;

. PISQ IR (IUGA- revised version of the PISQ;

. FSFI (Female Sexual Function Index);

- . SFQ (Sexual Function Questionnaire);
- . SQOL-F (Sexual Quality Of Life-Female).

### Shortened vagina

#### *Symptom*

Perception of a short vagina expressed by the woman or her partner.

### Shortened vagina (postoperative)

#### *Symptom*

Perception of a short vagina expressed by the women or her partner (following surgical intervention).

### Simplified POPQ

#### *Sign*

This is based on the POP-Q with similar ordinal staging but with only four points measured instead of nine. There is no Stage 0; it is combined with Stage 1. It is performed in the dorsal lithotomy position with patient forcefully bearing down, performing Valsalva or coughing: (i) Four points used: (i) Anterior vaginal segment: point Ba (estimated around 3cm proximal to hymenal remnants); (ii) Posterior vaginal segment: point Bp (estimated around 3cm proximal to hymenal remnants); (iii) Cervix point C; (iv) Apex/posterior fornix: point D (non-hysterectomized); point C (hysterectomized). Staging I, II, III, IV.

### Sinus tract formation

#### *Surgery – Complication related*

(Localized) formation of a fistulous tract towards vagina or skin, where there is no visible implant material in the vaginal lumen or overlying skin.

### Situational types of urinary incontinence - neurogenic

#### *Symptom*

Giggle incontinence or incontinence associated with epileptic seizures, sphincter denervation in cauda equina and in the Onuf's nuclei lesions in multiple system atrophy.

### Slow (urinary) stream

#### *Symptom*

Complaint of a urinary stream perceived as overall slower than previous performance or in comparison with others.

### Soft-tissue Therapies

#### *Conservative Management – Female*

1. Touch desensitisation: the manipulation of the soft tissues of the body for the purpose of affecting the nervous, muscular, respiratory, and circulatory systems. 2. Massage: the manipulation of the soft tissues of the body for the purpose of affecting the nervous, muscular, respiratory, and circulatory systems. 3. Abdominal massage: therapist or self-directed massage of the abdominal wall with the aim of stimulating peristalsis and relieving the symptoms of constipation. Generally, the technique follows the ascending, transverse, and descending colon to aid emptying. The effect may be mechanical or sensory. 4. Myofascial release techniques: the use of deep friction and stroking of the fascia of the body to improve the ability of the fascia to deform and move within the body. 5. Skin rolling: a manual technique in which skin is pulled away from the underlying structures and elongated in various directions. 6. Scar massage: a specific application of soft-tissue mobilization to an adherent scar. 7. Perineal massage: intravaginal massage by the woman, her partner or the clinician. Technique includes alternating downward and sideward pressure, using thumb and forefinger and a natural oil, with the aim of stretching and elongating the tissue in preparation for vaginal childbirth, or for treatment of adherent scarring in the perineum. 8. Transverse friction: the operator's fingertip is placed on the exact site of the lesion and rubbed firmly across the direction of the fibers of the affected tissue.

9. Thiele's massage: per-rectal digital massage of the levator ani, sweeping lengthwise along the muscle fibers. Massage is begun lightly, and pressure is increased as tenderness decreases. 10. TrP treatment: (sometimes called myofascial trigger point treatment): soft-tissue mobilization specifically targeting trigger points and may include ischemic pressure, massage, myofascial release, electrotherapy, ultrasound, laser, spray and-stretch, injection (a variety of chemicals including local anesthetic, botox or steroids), dry needling (insertion of a solid needle into the TrP), and stretching.

### Soiling (female)

#### *Sign*

Perianal fecal soiling or vaginal fecal soiling.

### Somatic pain

#### *Symptom*

Pain which arises from bone, joints, muscles, skin or connective tissue and is normally aching or throbbing and well localized.

### Spinal shock phase

#### *Diagnosis*

This is usually temporary following acute neurologic insult or SCI that is characterized by loss of sensory, motor and reflex activity below the level of injury. Neurological lower urinary tract dysfunction in Spinal Shock is usually a temporary complete painless urinary retention.

### Splinting (female)

#### *Symptom*

Support perineum or buttocks manually (usually with thumb or fingers) to assist in evacuation of stool content.

### Splinting/digitation due to POP

#### *Symptom*

Complaint of the need to digitally replace the prolapse or to otherwise apply manual pressure e.g. to the vagina or perineum (splinting), or to the vagina or rectum (digitation) to assist voiding or defecation.

### Spraying (splitting) of urinary stream

#### *Symptom*

Complaint that the urine passage is a spray or split rather than a single directional stream.

### Sterile intermittent catheterization

#### *Conservative Management – General*

Complete sterile setting including genital skin antisepsis, sterile gloves, forceps, gown and mask.

### Storage dysfunction (SD)

#### *Diagnosis*

Those diagnoses related to abnormal changes in bladder sensation, detrusor pressure or bladder capacity during filling cystometry.

### Storage symptom

#### *Symptom*

A lower urinary tract symptom during the bladder storage phase.

### Storage symptoms

#### *Symptom*

Lower urinary tract symptoms occurring during the bladder storage phase.

### Straining to defecate

#### *Symptom*

Complaint of the need to make an intensive effort (by abdominal straining



or Valsalva) or to use abdominal massage to either initiate, maintain or improve defecation.

#### **Straining to void**

##### *Symptom*

Complaint of the need to make an intensive effort to either initiate, maintain or improve voiding or the urinary stream.

#### **Stranguria**

##### *Symptom*

Complaint of voiding which is slow, difficult and spasmodic (at times “drop by drop”), usually associated with pain.

#### **Stress fecal incontinence (SFI)**

##### *Symptom*

Complaint of involuntary loss of feces on effort or physical exertion including sporting activities, or on sneezing or coughing.

#### **Stress incontinence on prolapse reduction (occult or latent stress incontinence)**

##### *Sign*

Stress incontinence only observed after reduction of co-existent pelvic organ prolapse (POP).

#### **Stress urinary incontinence**

##### *Symptom*

Complaint of involuntary loss of urine on effort or physical exertion including sporting activities, or on sneezing or coughing.

#### **Stress urinary incontinence (clinical stress leakage)**

##### *Sign*

Observation of involuntary leakage from the urethral orifice synchronous with effort or physical exertion, or on sneezing or coughing.

#### **Strong desire to void - Filling cystometry**

##### *Investigation*

The persistent desire to void without the fear of leakage.

#### **Superficial (introital) dyspareunia**

##### *Symptom*

Complaint of pain or discomfort on vaginal entry or at the vaginal introitus.

#### **Suprapontine lesion (SPL)**

##### *Diagnosis*

This is a neurological lesion above the pons (forebrain or midbrain). Neurogenic lower urinary tract dysfunction in SPL: there is a reflex contraction of

the detrusor with impaired cerebral regulation and central inhibition and usually synergistic voiding/bladder emptying.

#### **Suprasacral spinal cord/ pontine lesion (SSL)**

##### *Diagnosis*

This is a neurological lesion in the suprasacral spine and/or pons. Neurogenic lower urinary tract dysfunction in SSL: detrusor overactivity (DO) and DO incontinence are common, with or without detrusor-sphincter dyssynergia (DSD), often resulting in a significant post-void residual (PVR) and a “high pressure” bladder.

#### **Surgery Type and Operated Compartment**

##### *Surgery – Female*

(a) Primary surgery: indicates the first procedure required for treating POP in any compartment. (b) Further surgery: provides a term for any subsequent procedure relating to primary surgery. Further surgery is subdivided into: Primary surgery in a different (new) site/compartment. Repeat surgery in the same site/compartment for POP symptom recurrence. Surgery for complications e.g. mesh exposure, pain, infection or hemorrhage. Surgery for non-POP-related conditions usually urinary or fecal incontinence.

#### **Suture hysteropexy - laparoscopic, robotic**

##### *Surgery – Female*

The plicated uterosacral ligaments are resutured to the cervix.

#### **Symptom**

##### *Symptom*

Any morbid phenomenon or departure from the normal in structure, function or sensation, possibly indicative of a disease or health problem. Symptoms are either volunteered by, or elicited from the individual, or may be described by the individual's partner or caregiver.

#### **Symptoms of sexual dysfunction**

##### *Symptom*

Complaint of abnormal sensation and/or function experienced by the individual during sexual activity.

#### **Symptoms of sexual dysfunction (female)**

##### *Symptom*

A departure from normal sensation and/or function experienced by a woman during sexual activity.

## **T**

#### **Tape (Sling)**

##### *Surgery – Female*

A flat strip of synthetic material. The use of this term would be for incontinence surgery with synthetic materials.

#### **Tender Point**

##### *Sign*

Tenderness to palpation at soft-tissue body sites.

#### **Tenderness**

##### *Sign*

Sensation of discomfort with or without pain; discomfort elicited through palpation indicates unusual sensitivity to pressure or touch.

#### **Tenesmus**

##### *Symptom*

Complaint of an urgent desire to evacuate the bowel accompanied by involuntary straining and the passage of little fecal matter.

**Tenesmus (female)***Symptom*

A desire to evacuate the bowel, often accompanied by pain, cramping, and straining, in the absence of feces in the rectum.

**Terminal dribbling (dribble)***Symptom*

Complaint that during the final part of voiding there is noticeable slowing of the flow to drops or a tricking stream.

**Thermal Modalities***Conservative Management – Female*

Cold treatment/cryotherapy: Cold treatment is the application of ice for therapeutic purposes. It is used in the initial management of acute musculo-skeletal injuries, to decrease edema through vasoconstriction and to reduce secondary hypoxic injury by lowering the metabolic demand of injured tissues. Heat treatment (moist or dry): Heat treatment consists of the application of heat to a body part, with the aim of relieving pain and/or stiffness. It is usually applied when an injury is older than 48h.

**Thermography or thermal imaging of the genital area***Imaging*

Evaluation of genital temperature using a camera detecting infrared radiation from the skin during sexual stimulation. This method has been correlated with subjective arousal.

**Tight vagina***Symptom*

Introital narrowing: vaginal entry is difficult or impossible (penis or sexual device). Vaginal narrowing: decreased vaginal calibre.

**Tight vagina (postoperative)***Symptom*

(i) Introital narrowing: vagina entry is difficult or impossible (penis or sexual device).  
(ii) Vaginal narrowing: decreased vaginal calibre. These are de novo postoperative findings.

**Time to maximum urine flow rate (tQmax - unit: s)***Investigation*

Elapsed time from the onset of urine flow to maximum urine flow.

**Tissue***Surgery – Female*

A collection of similar cells and the intercellular substances surrounding them.

**Tissue***Surgery – Complication related*

A collection of similar cells and the intercellular substances surrounding them.

**Total colectomy***Surgery – Female***U****Ulcer***Surgery – Complication related*

Total excision of the vagina in a woman with no uterus and vaginal eversion.

**Total vaginal length (TVL)***Sign*

This is the length of the vagina (cm) from posterior fornix to hymen with the posterior fornix reduced to its full normal position.

**Transcutaneous electrical nerve stimulation (TENS)***Conservative Management – General*

This is electrical stimulation of the nerves through intact skin to modulate function and induce therapeutic response of the LUT.

**Transurethral Catheter for Urodynamics***Investigation*

ICS standard invasive urodynamics is done with the thinnest possible (6-7F) transurethral double or triple lumen catheter or a suprapubic catheter.

**Trigger Point (TrP)***Sign*

A tender, taut band of muscle that can be painful spontaneously or when stimulated. The taut band is electrically silent.

**Trocar***Surgery – Female*

A surgical instrument with either a pyramidal, conical or needle-type cutting or dissecting point.

**Trophic***Sign*

Promoting cellular growth, differentiation, and survival. This is the normal status of an organ, tissue or cell with regard to nutrition, size, number, form, and function. Atrophic urogenital tract is usually well-estrogenized.

**Twenty-four (24) hour (urinary) frequency***Sign*

Total number of daytime and night-time micturitions during a specified 24-hour period.

**Twenty-four (24) hour urine volume***Sign*

Summation of all urine volumes during a specified 24-hour period. The first void after rising is discarded and the 24-hour period begins at the time of the next void and is completed by including the first void, after rising, the following day.

**Twenty-four (24) hour voided volume***Sign*

Total volume of urine voided in a 24 hour period. (1st void to be discarded; 24 hours begins at the time of the next void).

A lesion through the skin or a mucous membrane resulting from loss of tissue, usually with inflammation.

### Ultrasound applications in male LUT/PF dysfunction

#### Imaging

(1) Post void residual (see separate heading); (2) Intercurrent abnormalities: prostate volume (transabdominal, intraabdominal, retroperitoneal or intrapelvic tumor, hydronephrosis); (3) Bladder abnormalities: tumor, foreign body, overdistension, stones; (4) Detrusor wall thickness (see separate heading); (5) Ultrasound estimated bladder weight (UEBW); (6) Intravesical prostatic protrusion (IPP): See separate heading; (7) Urethral abnormality: diverticulum, urethral stenosis, degree and depth of spongiofibrosis; (8) Postoperative findings: post-prostatectomy (urethral shape), male sling position, artificial urinary sphincter placement of cuff and reservoir, bulking agents; (9) Prostate ultrasound: determination of prostate and transition zone volume, prostate shape and visualization of the prostate parenchyma for calcifications, cysts, abscesses or enlargement.

### Ultrasound imaging - post-void residual (PVR - abdominal)

#### Imaging

Volume = width (left to right) x depth (anterior to posterior) x length (cranial to caudal) x 0.52 (mL)

### Ultrasound imaging - uses (female)

#### Imaging

(i) Bladder neck descent / mobility/ opening including position of bladder neck at rest and on Valsalva; (ii) Post void residuals; (iii) Intercurrent pelvic pathology: e.g. Uterine and adnexal pathology; (iv) Uterine version: Anteverted or retroverted; flexion at level of isthmus; (v) Bladder abnormalities: e.g. tumor; foreign body; (vi) Urethral abnormality: e.g. diverticulum; (vii) Postoperative findings: e.g. bladder neck position and mobility, position of meshes, tapes or implants; (viii) Pelvic floor / levator defects: Bladder neck elevation during pelvic floor contraction; (ix) Descent of pelvic organs: Visualization of descent of the bladder, uterine cervix and rectum during Valsalva and coughing.

### Ultrasound imaging (female) - 3D imaging of ballooning of the genital hiatus

#### Imaging

The presence of ballooning of the genital hiatus (= excessive distensibility of the levator hiatus) on Valsalva manoeuvre has also been associated to the severity of urogenital prolapse. An area of more than 25 cm<sup>2</sup>, 30 cm<sup>2</sup>, 35 cm<sup>2</sup> and 40 cm<sup>2</sup> has been defined as mild, moderate, marked and severe ballooning respectively.

### Ultrasound imaging (female) - 3D imaging of levator ani trauma

#### Imaging

The presence of levator ani trauma has been postulated to be associated to an increased risk of pelvic organ prolapse. This can be evaluated using a tomographic ultrasound imaging assessment of the levator ani muscles.

### Ultrasound imaging (female) - 3D of female urethra

#### Imaging

3D imaging of the rhabdosphincter overcomes the limits of MRI and two-dimensional (2D) ultrasound imaging that incorrectly measure the urethral sphincter volume using mathematical formulas based upon assumptions that the shape of the urethra is similar to that of an ellipse. Since the urethral shape is neither elliptical nor spherical, but rather an atypical geometric shape, equations should not be used.

### Ultrasound imaging (female) - combined with urodynamics

#### Imaging

Synchronous ultrasound screening of the bladder and/or urethra and measurement of the bladder and abdominal pressure during filling and voiding cystometry.

### Ultrasound imaging (female) - prolapse related - 3D (modalities)

#### Imaging

(i) Endovaginal ultrasound imaging may inadvertently compress tissues thus distorting the anatomy; (ii) Transanal ultrasound approach requires an expensive and dedicated transducer, and it is a more uncomfortable and embarrassing test for the woman. Its most common clinical indication is the assessment of sphincter integrity following obstetric trauma. (iii) Translabial/transperineal approach overcomes the limitations of endovaginal and transrectal techniques providing minimal pressure on local structures and it is least likely to alter surrounding anatomy.

### Ultrasound imaging (female) - prolapse related 3D evaluations

#### Imaging

The following pelvic floor abnormalities can be evaluated: (i) trauma (injury/damage) of the levator ani muscle (LAM); (ii) excessive distensibility of the puborectalis muscle and levator hiatus ("ballooning"); (iii) pathologies of the anterior vaginal compartment like urethral diverticula; (iv) bladder tumours or foreign bodies (sling, mesh, bulking agents); (v) Polypropylene meshes: highly echogenic and thus easily identified in the coronal and axial plane, unless they are obscured by vaginal prolapse; (vi) Periurethral bulking agents, used as a continence procedure, can also be depicted with 3D pelvic floor ultrasound.

### Ultrasound imaging (female) - prolapse related clinical applications

#### Imaging

(i) Bladder neck descent/mobility. The position of the bladder neck at rest and on Valsalva; (ii) Urethral funnelling: i.e., opening of the proximal third of the urethra during coughing or on Valsalva; (iii) Post void residual: Several formulas have been described in the literature to measure the bladder volume by ultrasound. An early formula [(h x d x w) x 0.7] has been demonstrated to give reproducible results with a percentage error of 21%; (iv) Bladder abnormalities: e.g. tumor, foreign body; (v) Urethral abnormality: e.g. diverticulum; (vi) Intercurrent uterine and/or pelvic abnormality: dependent on probe range; (vii) Postoperative findings: e.g., bladder neck position and mobility, position of meshes, tapes, or implants; (viii) Descent of pelvic organs: visualization of descent of the bladder, uterine cervix, and rectum during Valsalva and coughing; (ix) Assessment of voluntary pelvic floor muscle contractility; (x) Pelvic floor/levator ani muscle defect and hiatal ballooning; (xi) Ultrasound measurements of bladder and detrusor wall thickness, and ultrasound estimated bladder weight (UEBW) are potential noninvasive clinical tools for assessing the lower urinary tract. UEBW is higher in women with overactive bladder and detrusor overactivity.

### Ultrasound imaging (male) - anal endosonography (AES)

#### Imaging

Looking for: Anal sphincter defects

### Ultrasound imaging (male) - bladder abnormalities

#### Imaging

Tumor, foreign, overdistension, stones, diverticulum.

### Ultrasound imaging (male) - bladder wall thickness (BWT)

#### Imaging

Distance from outer border of the mucosa to the outer border of the adventitia on the anterior bladder wall with a linear 7.5MHz linear array in a bladder filled over 250ml.

### Ultrasound imaging (male) - detrusor wall thickness (DWT)

#### Imaging

Measured from the inner border of the mucosa to the inner border or the

adventitia at the anterior bladder using linear 7.5MHz array in bladder filled over 250ml. Over 2mm points to BOO.

### **Ultrasound imaging (male) - intercurrent pathology**

#### *Imaging*

Prostate volume (transrectal), tumor, hydronephrosis, scrotal abnormalities.

### **Ultrasound imaging (male) - intravesical prostatic protrusion (IPP)**

#### *Investigation*

The distance from the bladder base until the tip of the prostate in the bladder lumen.

### **Ultrasound imaging (male) - postoperative findings**

#### *Imaging*

Post-prostatectomy (urethral shape), male sling position, artificial sphincter - placement of cuff and reservoir, bulking agents.

### **Ultrasound imaging (male) - prostatic volume (transrectal)**

#### *Imaging*

Prostatic volume = Anteroposterior (cm) x transverse (cm) x transrectal (cm)

### **Ultrasound imaging (male) - urethral abnormality**

#### *Imaging*

Diverticulum, stenosis, degree and depth of spongiofibrosis.

### **Ultrasound imaging modalities (female)**

#### *Imaging*

(i) Perineal: Curved array probe applied to the perineum. This term incorporates transperineal and translabial ultrasound; (ii) Introital: Sector probe applied to the vaginal introitus; (iii) Transvaginal (T-V): Intravaginal curvilinear, linear array or sector scanning; (iv) Transabdominal (T-A): Curvilinear scanning applied to the abdomen.

### **Ultrasound imaging modalities (Male)**

#### *Imaging*

Transrectal (linear array or sector); transabdominal (curved or linear array); perineal (curved array); scrotal (curved array).

### **Ultrasound imaging sites (male)**

#### *Imaging*

Renal, bladder, prostate, scrotum urethra, ano-rectum

### **Ultrasound in Urogynecology**

#### *Imaging*

Ultrasound has become an increasingly frequent adjunct investigation in urogynecology and female urology both in the office and in the urodynamic laboratory.

### **Ultrasound in Urogynecology - Current Routine Possible Uses**

#### *Imaging*

(a) Bladder neck descent/mobility/opening: Position of bladder neck at rest and on Valsalva.

N.B: Ideally the Valsalva should be standardized but it is appreciated that at present a reliable non-invasive method is lacking. Consensus has not been reached on criteria for excessive bladder neck mobility nor the relationship of this finding to a diagnosis of urodynamic stress incontinence. Position of bladder neck during pelvic floor contraction. Retrovesical angle (RVA): that is, angle between proximal urethra and trigonal surface of the bladder. Urethral rotation: that is, rotation of the proximal urethra on Valsalva. Angle gamma: that is, angle defined by lines from the infero-posterior symphyseal margin to the bladder neck at rest and on Valsalva. Urethral funneling: that

is, opening of the proximal third of the urethra during coughing or on Valsalva. Urine loss: full urethral opening during coughing, Valsalva, bladder contraction, or micturition.

(b) Postvoid residuals; (c) Intercurrent pelvic pathology: for example, uterine and adnexal pathology. (d) Uterine version: Anteverted or retroverted; flexion at level of isthmus; (e) Bladder abnormalities: for example, tumor, foreign body; (f) Urethral abnormality: for example, diverticulum; (g) Postoperative findings: For example, bladder neck position and mobility, position of meshes, tapes, or implants; (h) Pelvic floor/levator defects: Bladder neck elevation during pelvic floor contraction. (i) Descent of pelvic organs: Visualization of descent of the bladder, uterine cervix, and rectum during Valsalva and coughing.

### **Ultrasound in Urogynecology - Modalities in Current Routine Clinical Use**

#### *Imaging*

(a) Perineal: Curved array probe applied to the perineum. This term incorporates transperineal and translabial ultrasound. (b) Introital: Sector probe applied to the vaginal introitus. (c) Transvaginal (T-V): Intravaginal curvilinear, linear array, or sector scanning. (d) Transabdominal (T-A): Curvilinear scanning applied to the abdomen.

### **Ultrasound in Women - 3D and 4D**

#### *Imaging*

The potential of 3D ultrasound in urogynecology and female urology is currently being researched with validated applications likely to be included in future updates of this report and/or separate ultrasound reports. Applications with the most current research include: (i) major morphological abnormalities such as levator defects and (ii) excessive distensibility of the puborectalis muscle and levator hiatus ("ballooning"<sup>40</sup>). The additional diagnostic potential of 4D (i.e., the addition of movement) ultrasound awaits clarification by further research.

### **Underactive Pelvic Floor Muscles**

#### *Diagnosis*

A situation in which the pelvic floor muscles cannot voluntarily contract when this is appropriate. This condition is based on symptoms such as urinary incontinence, anal incontinence or pelvic organ prolapse, and on signs like no voluntary or involuntary contraction of the pelvic floor muscles.

### **Underactive pelvic floor muscles (female)**

#### *Sign*

Pelvic floor muscles which cannot voluntarily contract when this is appropriate.

### **Urethral caruncle**

#### *Sign*

Small eversion of the urethral urothelium, generally involving the posterior lip.

### **Urethral closure mechanism - incompetent (female)**

#### *Investigation*

Leakage of urine occurs during activities which might raise intra-abdominal pressure in the absence of a detrusor contraction.

### **Urethral closure mechanism - normal (female)**

#### *Investigation*

A positive urethral closure pressure is maintained during bladder filling, even in the presence of increased abdominal pressure, although it may be overcome by detrusor overactivity.

### **Urethral closure mechanism - urethral relaxation incompetence ("urethral instability") - female**

#### *Investigation*

Leakage due to urethral relaxation in the absence of raised abdominal pressure or a detrusor contraction.

### **Urethral closure mechanism - urodynamic stress incontinence (female)**

#### *Investigation*

This is the involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

### **Urethral closure pressure profile (UCPP) - female**

#### *Investigation*

The relevant pressure is the urethral closure pressure (urethral pressure minus the intravesical pressure).

### **Urethral discharge**

#### *Symptom*

Seepage of mucus, pus or blood from the urethral meatus.

### **Urethral diverticulum**

#### *Sign*

The presence of a sac opening from the urethra. It might be suspected by a lump or tenderness along the line of the urethra or external urethral discharge on urethral massage.

### **Urethral examination (male)**

#### *Sign*

Palpation: along the ventral aspect of the penis and inferiorly into the perineum to detect fibrosis, lumps or tenderness along the shaft. Tenderness: suggestive of urethral or periurethral inflammation, often secondary to a urethral stricture or sexually transmitted disease. Meatal stenosis: narrowing changes of the distal urethra; post-infection, post-surgery.

### **Urethral function during voiding - dysfunctional voiding**

#### *Investigation*

This is characterized by an intermittent and/or fluctuating flow rate due to involuntary intermittent contractions of the peri-urethral striated or levator muscles during voiding in neurologically normal women. This type of voiding may also be the result of an acontractile detrusor (abdominal voiding) with electromyography (EMG) or video-urodynamics required to distinguish between the two entities.

### **Urethral function during voiding - normal (female)**

#### *Investigation*

The urethra opens and is continuously relaxed to allow micturition at a normal pressure, urine flow and PVR.

### **Urethral function during voiding (female) - bladder outlet obstruction**

#### *Investigation*

This is the generic term for obstruction during voiding. It is a reduced urine flow rate and/or presence of a raised PVR and an increased detrusor pressure. It is usually diagnosed by studying the synchronous values of urine flow rate and detrusor pressure and any PVR measurements. A urethral stricture or obstruction due to higher degrees of uterovaginal prolapse or obstructed voiding after stress incontinence procedures are amongst possible causes.

### **Urethral function during voiding (female) - detrusor sphincter dyssynergia**

#### *Investigation*

This is incoordination between detrusor and sphincter during voiding due to a neurological abnormality (i.e. detrusor contraction synchronous with

contraction of the urethral and/or periurethral striated muscle). This is a feature of neurological voiding disorders. Neurological features should be sought. Videocystourethrography is generally valuable to conclude this diagnosis.

### **Urethral function during voiding (voiding urethrocystometry) - female**

#### *Investigation*

This technique may assist in determining the nature of urethral obstruction to voiding. Pressure is recorded in the urethra during voiding. This may be at one specific point e.g. high pressure zone or it may be measured as a profile. A voiding urethral pressure profile (VUPP) uses a similar technique to that described above for the UPP measured during bladder filling. Simultaneous intravesical pressure measurement is required. Localization of the site of the intraurethral pressure measurement is desirable.

### **Urethral meatal abnormalities (male)**

#### *Sign*

- . Hypospadias: Refers to the urethral meatus sited on ventral surface of the penis, either congenital or acquired, proximal to its normal position on the tip of the glans. External urethral meatus may be on the glans penis (glandular hypospadias), sulcus (coronal hypospadias), shaft (penile hypospadias), scrotum (scrotal hypospadias) or perineum (perineal hypospadias).
- . Epispadias: Refers to the urethral meatus sited on dorsal surface of the penis, either congenital or acquired, proximal to its normal position on the tip of the glans.
- . Neoplastic or inflammatory lesions within the fossa navicularis.
- . Post-hypospadias/epispadias repair: including post-urethroplasty urethral fibrosis: palpated near the meatus or in the penile shaft.
- . Postoperative fistula: Urine is visible at or near the incision lines.

### **Urethral mucosal prolapse**

#### *Sign*

Prolapse, generally circumferential and larger, of the distal urethral urothelium.

### **Urethral opening pressure (Pdet-uo – unit: cm H<sub>2</sub>O) - pressure flow studies**

#### *Investigation*

Detrusor pressure recorded at the onset of measured flow (consider time delay – usually under 1 s).

### **Urethral pain**

#### *Symptom*

Complaint of pain, pressure or discomfort felt in the urethra before, during and/or after voiding and the individual indicates the urethra as the site.

### **Urethral pain syndrome**

#### *Symptom*

Urethral pain syndrome is the occurrence of recurrent episodic urethral pain usually on voiding, with daytime frequency and nocturia, in the absence of proven infection or other obvious pathology.

### **Urethral Plugs**

#### *Conservative Management – Female*

Urethral plugs are containment products aimed at blocking urine leakage.

### **Urethral pressure - intraluminal (female)**

#### *Investigation*

This is the fluid pressure needed to just open a closed urethra.

### **Urethral pressure measurement (female)**

#### *Investigation*

Urethral pressure and urethral closure pressure are idealized concepts which represent the ability of the urethra to prevent leakage. Urethral pressure is currently measured by a number of different techniques which don't tend to have consistent results, either between methods or for a single method. For example the effect of catheter rotation will be relevant when urethral pressure is measured by a catheter mounted transducer. Urethral pressure might, nonetheless, be measured: (i) at rest, with the bladder at a given volume; (ii) During coughing or straining; (iii) During the process of voiding.

#### **Urethral pressure profile - functional profile length (female)**

##### *Investigation*

The length of the urethra along which the urethral pressure exceeds intravesical pressure in women.

#### **Urethral pressure profile - functional profile length (on stress) - female**

##### *Investigation*

The length over which the urethral pressure exceeds the intravesical pressure on stress.

#### **Urethral pressure profile - pressure "transmission" ratio (female)**

##### *Investigation*

This is the increment in urethral pressure on stress as a percentage of the simultaneously recorded increment in intravesical pressure. For stress profiles obtained during coughing, pressure transmission ratios can be obtained at any point along the urethra. If single values are given, the position in the urethra should be stated. If several transmission ratios are defined at different points along the urethra, a pressure transmission "profile" is obtained. During "cough profiles", the amplitude of the cough should be stated if possible.

#### **Urethral pressure profile (UPP) - female**

##### *Investigation*

This is a graph indicating the intraluminal pressure along the length of the urethra: (i) Resting UPP: The bladder and subject are at rest; (ii) Stress UPP: Defined applied stress (e.g. cough, strain, Valsalva).

#### **Urethral pressure profile (UPP) - methodology (female)**

##### *Investigation*

All systems are zeroed at atmospheric pressure. For external transducers, the reference point is the superior edge of the symphysis pubis. For catheter mounted transducers, the reference point is the transducer itself. Intravesical pressure should be measured to exclude a simultaneous detrusor contraction. Methodology should be noted including: patient position; catheter type; transducer orientation; fluid and rate of infusion (if fluid-filling system); bladder volume; rate of catheter withdrawal.

#### **Urethral prolapse**

##### *Symptom*

Complaint of a "lump" at the external urethral meatus.

#### **Urethral relaxation incompetence ("urethral instability") - female**

##### *Investigation*

Leakage due to urethral relaxation in the absence of raised abdominal pressure or a detrusor contraction.

#### **Urgency**

##### *Symptom*

Complaint of sudden, compelling desire to pass urine which is difficult to defer.

#### **Urgency - filling cystometry**

##### *Investigation*

Sudden, compelling desire to void which is difficult to defer.

#### **Urgency urinary incontinence**

##### *Sign*

Observation of involuntary leakage from the urethral orifice associated with the individual reporting the sensation of a sudden, compelling desire to void.

#### **Urgency urinary incontinence (UUI)**

##### *Symptom*

Complaint of involuntary loss of urine associated with urgency.

#### **Urinary Catheters**

##### *Conservative Management – Female*

Urinary catheters are small tubes inserted via the urethra or into the bladder suprapubically, to allow the drainage of urine. Catheters are made of plastic, latex, teflon or silicone, and may be impregnated with antiseptic or antibiotic solution. 1. Self-catheterization: a procedure performed intermittently to empty the bladder by inserting a catheter into the urethra when normal voiding is not possible or if the bladder cannot be emptied completely. If a caregiver undertakes this procedure it is usually a sterile procedure; if a patient undertakes it, it is termed "self-catheterization" and is generally a clean rather than a sterile procedure.

#### **Urinary incontinence**

##### *Symptom*

Complaint of involuntary loss of urine.

#### **Urinary incontinence**

##### *Sign*

Observation of involuntary loss of urine on examination.

#### **Urinary incontinence signs**

##### *Sign*

All examinations for the evaluation of urinary incontinence are best performed with the individual's bladder comfortably full.

#### **Urinary incontinence symptoms**

##### *Symptom*

Involuntary loss of urine experienced during the bladder storage phase.

#### **Urinary retention**

##### *Symptom*

Complaint of the inability to empty the bladder completely.

#### **Urinary Tract Infection**

##### *Symptom*

Scientific diagnosis of a UTI is the finding of microbiological evidence of significant bacteriuria and pyuria usually accompanied by symptoms such as increased bladder sensation, urgency, frequency, dysuria, urgency urinary incontinence, and/or pain in the lower urinary tract.

#### **Urine flow**

##### *Investigation*

Urethral passage of urine. Pattern of urine flow may be: continuous - no interruption to urine flow; intermittent - urine flow is interrupted.

#### **Urine flow rate (UFR - mL/s)**

##### *Investigation*

Volume of urine expelled via the urethra per unit time.



**Urodynamic clinical sequence of testing (female)***Investigation*

This generally involves a woman attending with a comfortably full bladder for free (no catheter) uroflowmetry and post-void residual (PVR) measurement prior to filling cystometry and pressure-flow studies.

**Urodynamic clinical sequence of testing (male)***Investigation*

This generally involves a man attending with a comfortably full bladder for free (no catheter) uroflowmetry and post-void residual urine volume (PVR) measurement prior to filling cystometry and pressure-flow study.

**Urodynamic stress incontinence - Filling cystometry***Investigation*

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

**Urodynamic stress incontinence (female)***Diagnosis*

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

**Urodynamic Stress Incontinence (female)***Diagnosis*

The diagnosis by symptom, sign, and urodynamic investigations involves the finding of involuntary leakage during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

**Urodynamic stress incontinence (USI) - filling cystometry***Investigation*

Involuntary leakage of urine during filling cystometry, associated with increased intra-abdominal pressure, in the absence of a detrusor contraction.

**Urodynamic studies***Investigation*

These usually take place in a special clinical room (urodynamic laboratory) and involve (artificial) bladder filling with a specified liquid (ICS recommends physiological saline solution or X-ray contrast if video studies) at a specified rate.

**Urodynamics***Investigation*

Measurement of physiological parameters relevant to the function of the lower urinary tract.

**Uroflowmetry (female) - ideal conditions***Investigation*

For free (or spontaneous - no catheter) uroflowmetry, all studies should be performed in a completely private uroflowmetry room. Most modern uroflowmeters have a high degree of accuracy (+/- 5%) though regular calibration is important.

**Uroflowmetry (female) - interpretation of normality***Investigation*

Because of the strong dependency of urine flow rates in women on voided volume, they are best referenced to nomograms (e.g. Liverpool nomograms) where the cutoff for abnormally slow maximum (MUFR) and average (AUFR) urine flow rates has been determined and validated as under the 10th centile.

**Uroflowmetry (male) - ideal conditions***Investigation*

Ideally, all free uroflowmetry studies should be performed in a completely private uroflowmetry room. Most modern uroflowmeters have a high degree of accuracy (+/- 5%) though regular calibration is important.

**Uroflowmetry (male) - interpretation of normality***Investigation*

Because of the strong dependency of urine flow rates in men on voided volume and age, they are best referenced to nomograms where the cutoff for normality has been determined and validated.

**Urogenital aging: genitourinary syndrome of menopause***Sign*

(i) Pallor/erythema: pale genital mucosa; (ii) Loss of vaginal rugae: vaginal rugae flush with the skin; (iii) Tissue fragility/fissures: genital mucosa that is easily broken or damaged; (iv) Vaginal petechiae: is a small (1–2 mm) red or purple spot on the skin, caused by a minor bleed (from broken capillary blood vessels); (v) Urethral eversion: urethral epithelium turned outside the lumen; (vi) Urethral prolapse: complaint of a lump at the external urethral meatus; (vii) Loss of hymenal remnants: absence of hymenal remnants; (viii) Prominence of urethral meatus vaginal canal shortening and narrowing: Introital retraction.

**Uterine / cervical prolapse***Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the uterus or uterine cervix.

**Uterine / cervical prolapse***Diagnosis*

Clinically evident (symptoms, clinical examination, assisted at times by any relevant imaging) descent of the uterus or uterine cervix.

**Uterine retroversion***Sign*

The axis of the uterus is directed backwards towards the hollow of the sacrum, away from its anteverted position overlying the bladder. Cervix is noted in/towards the anterior fornix with the fundus perhaps palpable in the posterior fornix.

**Uterine/cervical prolapse***Sign*

Observation of descent of the uterus or uterine cervix.

**Uterosacral ligament plication - open, laparoscopic, robotic***Surgery – Female*

Transverse plication of the uterosacral ligaments to obliterate the cul-de-sac. Successive sutures are placed into the medial portion of one ligament, into the back wall of the vagina and into the medial border of the opposing ligament.

**Uterosacral (USL) Ligament vaginal vault fixation - intraperitoneal***Surgery – Female*

Intraperitoneal USL ligament plication to support the vaginal vault. This is usually associated with posterior wall fascial reconstruction and possible excision and closure of enterocele.

**Uterosacral (USL) vaginal vault fixation - extraperitoneal***Surgery – Female*

Extraperitoneal plication of the uterosacral ligaments to support the vaginal

vault. This is usually combined with posterior vaginal wall fascial reconstruction with or without enterocele closure and/or excision.

## V

### Vaginal agglutination

#### Sign

Where the walls of the vagina are stuck together.

### Vaginal Anatomical Levels

#### Sign

(i) Level I: Uterine cervix (if present) and/or upper 2.5cm of vagina. (ii) Level II: Mid-vagina from distal end of Level I to hymen. (iii) Level III (vaginal vestibule): Vaginal entrance (Latin: “vestibulum”- “a space at the entrance of a canal”) from hymenal ring to just below the clitoris anteriorly (anterior vestibule), labia minora laterally and anterior perineum posteriorly (posterior margin of vestibule).

### Vaginal and clitoral duplex doppler ultrasound.

#### Investigation

The anatomical integrity of clitoral structures and the changes in clitoral and labial diameter associated with sexual stimulation can be evaluated in B mode. Movement of the blood relative to the transducer can be expressed as measurement of velocity, resistance, and pulsatility. Blood flow in arteries irrigating the clitoris and the vagina are more commonly assessed during sexual stimulation.

### Vaginal bulging

#### Symptom

Complaint of a “bulge” or “something coming down” towards or through the vaginal introitus. The woman may state she can either feel the bulge by direct palpation or see it with the aid of a mirror.

### Vaginal digitation

#### Symptom

Use of thumb or fingers in the vaginal to assist in evacuation of stool.

### Vaginal dryness

#### Symptom

Complaint of reduced vaginal lubrication or lack of adequate moisture in the vagina.

### Vaginal eversion

#### Sign

Complete version of the vagina is Stage IV vaginal prolapse.

### Vaginal examination

#### Sign

Examination for vaginal length and mobility, presence of scarring and/or pain, and estrogenization. The location of any vaginal pain should be noted.

### Vaginal feces

#### Symptom

Complaint of passage of feces per vagina.

### Vaginal flatus

#### Symptom

Complaint of passage of flatus per vaginam.

### Vaginal hysterectomy

#### Surgery – Female

Removal of the uterus and cervix vaginally.

### Vaginal hysterectomy - with adjunctive McCall culdoplasty

#### Surgery – Female

Culdoplasty sutures incorporate the uterosacral ligaments into the posterior vaginal vault to obliterate the cul-de-sac and support and suspend the vaginal vault after vaginal hysterectomy.

### Vaginal laxity

#### Symptom

Feeling of vaginal looseness.

### Vaginal length - anterior vaginal length

#### Sign

Anterior hymenal ring to anterior vaginal vault (anterior cervicovaginal junction or anterior cuff post-hysterectomy).

### Vaginal length - total posterior vaginal length

#### Sign

Posterior vaginal vault to posterior margin of vestibule (anterior perineum - cm), i.e., Levels I, II and III posteriorly.

### Vaginal length - total vaginal length

#### Sign

Posterior vaginal vault to hymen (cm), i.e., Levels I and II posteriorly.

### Vaginal Levels - Level I

#### Sign

Uterine cervix (if present) and/or upper 2.5 cm of vagina.

### Vaginal Levels - Level II

#### Sign

Mid-vagina from distal end of Level I to hymen.

### Vaginal Levels - Level III (vaginal vestibule)

#### Sign

Vaginal entrance (Latin: “vestibulum” = “space at the end of the canal”). From hymenal ring to just below the clitoris anteriorly (anterior vestibule), labia minora laterally and anterior perineum posteriorly (posterior margin of vestibule).

### Vaginal Lubricants

#### Conservative Management – Female

Vaginal lubricants are pharmacological preparations aimed at reducing friction during coital or any other sexual activity and thereby alleviating dyspareunia, or at reducing discomfort associated with a clinical (per vaginum or per rectum) examination. Pharmacological preparations and natural plant-based oils may be used.

### Vaginal Pain Syndrome

#### Symptom

Vaginal pain syndrome is the occurrence of persistent or recurrent episodic vaginal pain which is associated with symptoms suggestive of urinary tract



or sexual dysfunction. There is no proven vaginal infection or other obvious pathology.

#### **Vaginal pessary - general**

##### *Conservative Management – Female*

A device that is inserted into the vagina to provide structural support to one or more of the descending vaginal compartments, i.e. the uterus, anterior vaginal wall (and bladder), posterior vaginal wall (and rectum) and/or vaginal vault (with or without small intestine) after a prior hysterectomy.

#### **Vaginal pessary - space filling pessaries**

##### *Conservative Management – Female*

Doughnut; cuboid; Gellhorn; inflatable; shelf (similar to a Gellhorn but asymmetric).

#### **Vaginal pessary - support pessaries**

##### *Conservative Management – Female*

Ring pessary with or without central support; Gehrung, Hodge pessaries.

#### **Vaginal photoplethysmography**

##### *Investigation*

A tampon shape intravaginal probe equipped with an incandescent light that projects toward the vaginal walls is inserted; the amount of light that reflects back to the photosensitive cell provides a measure of vaginal engorgement which can be expressed as vaginal blood volume or vaginal pulse amplitude depending on the mode of recording. Likewise, labial and clitoral photoplethysmography can also be evaluated.

#### **Vaginal trachelectomy for cervical stump prolapse (previous subtotal hysterectomy)**

##### *Surgery – Female*

The cervical stump is removed in an identical fashion to the initial steps of a vaginal hysterectomy.

#### **Vaginal Trachelectomy for Cervical Stump Prolapse**

##### *Surgery – Female*

(Previous subtotal hysterectomy) The cervical stump is removed in an identical fashion to the initial steps of a vaginal hysterectomy.

#### **Vaginal vault (cuff scar) prolapse**

##### *Sign*

Observation of descent of the vaginal vault (cuff scar after hysterectomy).

#### **Vaginal vault (cuff scar) prolapse**

##### *Diagnosis*

Clinically evident (symptoms, signs or any relevant imaging) descent of the vaginal vault (cuff scar after hysterectomy).

#### **Vaginal vault (cuff scar) prolapse**

##### *Diagnosis*

Diagnosis by symptoms and clinical examination, assisted at times by any relevant imaging (i.e. clinically evident) descent of the vaginal vault (cuff scar after hysterectomy).

#### **Vaginal vestibule - Anterior**

##### *Sign*

Vaginal entrance from the hymenal ring to just below the clitoris anteriorly.

#### **Vaginal vestibule - posterior**

##### *Sign*

Posterior hymenal ring to anterior perineum (posterior margin of vestibule).

#### **Vaginal wind**

##### *Symptom*

Passage of air from vagina (usually accompanied by sound).

#### **Vaginismus**

##### *Symptom*

Recurrent or persistent spasm of vaginal musculature that interferes with vaginal penetration.

#### **Vascular assessment of female sexual dysfunction - labial thermistor**

##### *Investigation*

Temperature measurement evaluated with a small metal clip attached to the labia minora and equipped with a sensitive thermistor.

#### **Vascular assessment of female sexual dysfunction - Laser Doppler imaging of genital blood flow**

##### *Investigation*

An imager positioned close to the vulva allows the assessment of skin/mucosae microcirculation at a depth of up to 2-3mm. This method has been used to assess response to sexual stimulation and correlated with subjective arousal. It has also led to a better understanding of microvascular differences in women with provoked vestibulodynia compared to asymptomatic controls.

#### **Vascular assessment of female sexual dysfunction - Magnetic resonance imaging of the genito-pelvic area**

##### *Investigation*

Evaluation of the increase in clitoral structure volume related to tissue engorgement occurring during arousal.

#### **Vascular assessment of female sexual dysfunction - Measurements of labial and vaginal oxygenation**

##### *Investigation*

A heated electrode and oxygen monitor are used to evaluate the arterial partial pressure of oxygen (PO<sub>2</sub>) transcutaneously. The temperature of the electrode is kept at a constant elevated temperature by an electric current. Increase in blood flow under the electrode results in more effective temperature dissipation (heat loss) with the result that more current is needed to maintain the electrode at its prefixed temperature. The changes in current provide an indirect measurement of blood flow during sexual stimuli. The electrode also monitors oxygen diffusion across the skin.

#### **Vascular assessment of female sexual dysfunction - Thermography or thermal imaging of the genital area**

##### *Investigation*

Evaluation of genital temperature using a camera detecting infrared radiation from the skin during sexual stimulation. This method has been correlated with subjective arousal.

#### **Vascular assessment of female sexual dysfunction - vaginal and clitoral duplex Doppler ultrasound**

##### *Investigation*

The anatomical integrity of clitoral structures and the changes in clitoral and labial diameter associated with sexual stimulation can be evaluated in B mode. Movement of the blood relative to the transducer can be expressed as measurement of velocity, resistance, and pulsatility. Blood flow in arteries irrigating the clitoris and the vagina are more commonly assessed during sexual stimulation.

#### **Vascular assessment of female sexual dysfunction - vaginal photoplethysmography**

##### *Investigation*

A tampon shape intravaginal probe equipped with an incandescent light that projects toward the vaginal walls is inserted; the amount of light that reflects back to the photosensitive cell provides a measure of vaginal engorgement which can be expressed as vaginal blood volume or vaginal pulse amplitude depending on the mode of recording. Likewise, labial and clitoral photoplethysmography can also be evaluated.

### **Videocystourethrography (VCU - female)**

#### *Imaging*

Synchronous radiological screening of the bladder and measurement of the bladder and abdominal pressure during filling and voiding cystometry. When indicated for complex cases, VCU allows direct observation of the effects of bladder events, the position and conformation of the bladder neck in relation to the pubic symphysis, bladder neck closure during rest and stress, diverticula of the bladder and urethra, vesico-vaginal and urethro-vaginal fistulae, vesico-ureteric reflux and voiding events.

### **Videourodynamics**

#### *Investigation*

Functional test of the lower urinary tract where filling cystometry and pressure-flow studies are combined with real-time imaging of the lower urinary tract.

### **Videourodynamics**

#### *Imaging*

A functional test of the lower urinary tract in which pressure, capacity and flow data are simultaneously combined with real-time imaging of the upper and lower urinary tract. It is a dynamic study with function, during bladder filling and emptying. It is a kinetic technique that records morphological and functional changes of the lower urinary tract as a function of time. This feature distinguishes this technique from the static images obtained by cystography. It is a technique that is applied simultaneously with conventional urodynamic studies.

Image acquisition for the urinary tract can be performed with X-rays (fluoroscopy) or by ultrasound. Although in a strict sense, the "video" prefix refers to the recording of the images and not to their acquisition.

### **Visceral pain**

#### *Symptom*

Pain which arises from visceral organs, with involvement of the organ capsule with aching, and is localized. There is obstruction of hollow viscus, causing intermittent cramping, which is poorly localized.

- i. Nociceptive: direct injury or lesion of an internal organ such as: bladder stone, surgical injury.
- ii. Inflammatory: acute/chronic inflammation of an internal organ such as urinary tract infection, pelvic inflammatory disease, colitis, endometriosis.
- iii. Neuropathic: primary lesion of visceral nerves such as neuritis following mesh placement.

### **Voided Percentage (Void%)**

#### *Investigation*

The numerical description of the voiding efficacy or efficiency which is the proportion of bladder content emptied. Calculation:  $[(\text{volume voided} / \text{volume voided} + \text{PVR}) * 100]$ .

### **Voided volume (VV - mL)**

#### *Investigation*

Total volume of urine expelled via the urethra during a single void.

### **Voiding cystometry**

#### *Investigation*

This is the pressure volume relationship of the bladder during micturition. It begins when the "permission to void" is given by the urodynamicist and ends when the woman considers her voiding has finished. Measurements to be recorded should be the intravesical, intra-abdominal, and detrusor pressures and the urine flow rate.

### **Voiding cystourethrography - male**

#### *Imaging*

Imaging of the bladder neck, urethra and prostate during voiding. The principal use is determining the site of any obstruction e.g. bladder neck or prostate. It can detect vesico-ureteric reflux, vesical or urethral fistulae, vesical or urethral diverticula and strictures.

### **Voiding dysfunction - acute on chronic retention**

#### *Diagnosis*

To an individual with chronic retention goes into acute retention and is unable to void.

### **Voiding dysfunction - retention with overflow**

#### *Diagnosis*

Involuntary loss of urine directly related to an excessively full bladder in retention.

### **Voiding dysfunction (female)**

#### *Diagnosis*

(A diagnosis by symptoms and urodynamic investigations is defined as) abnormally slow and/or incomplete micturition, based on abnormally slow urine flow rates and/or abnormally high post-void residuals, ideally on repeated measurement to confirm abnormality. Pressure-flow studies can be required to determine the cause of the voiding dysfunction.

### **Voiding dysfunction (male)**

#### *Diagnosis*

Abnormally slow and/or incomplete emptying, manifest as an abnormally slow urine flow rate and/or an abnormally high post-void residual, with confirmation by pressure-flow studies (including any related imaging).

### **Voiding dysfunction (male) - acute urinary retention**

#### *Diagnosis*

No urine is able to be passed despite the man having a full bladder, which on examination is painfully distended, and readily palpable or percussible.

### **Voiding dysfunction (male) - chronic retention of urine**

#### *Diagnosis*

Generally (but not always) painless and palpable or percussible bladder, where there is a chronic high postvoid residual and the man experiences slow urine flow and the sense of incomplete bladder emptying. Overflow incontinence and impaired renal function and/or hydronephrosis can occur in advanced cases.

### **Voiding symptoms**

#### *Symptom*

Lower urinary tract symptoms experienced during the voiding phase (experienced during micturition).

### **Voiding time (VT - unit: s)**

#### *Investigation*

Total duration of micturition, i.e. included interruptions. When voiding is completed without interruption, voiding time is equal to flow time.

**Voiding urethrocystometry - urethral function during voiding (female)***Investigation*

This technique may assist in determining the nature of urethral obstruction to voiding. Pressure is recorded in the urethra during voiding. This may be at one specific point e.g. high pressure zone or it may be measured as a profile. A voiding urethral pressure profile (VUPP) uses a similar technique to that described above for the UPP measured during bladder filling. Simultaneous intravesical pressure measurement is required. Localization of the site of the intraurethral pressure measurement is desirable.

**Vulval agglutination***Sign*

Labial lips fused.

**Vulval examination***Sign*

Possible abnormalities include cysts, other tumours, atrophic changes, or lichen sclerosis.

**Vulval gaping***Sign*

Non-coaptation of vulva at rest, commonly associated with increased size of genital hiatus.

**Vulval pain***Symptom*

Complaint of pain felt in and around the vulva.

**Vulval pain syndrome***Symptom*

Vulval pain syndrome is the occurrence of persistent or recurrent episodic vulval pain, which is either related to the micturition cycle or associated with symptoms suggestive of urinary tract or sexual dysfunction. There is no proven infection or other obvious pathology.

**Vulvar agglutination***Sign*

Labial lips stuck together.

**Vulvar gaping***Sign*

Non-coaptation of vulva at rest, commonly associated with increased size of genital hiatus.

**Vulvar pain***Symptom*

Complaint of pain felt in and around the vulva.

**Vulvodynia***Symptom*

Vulvar pain of at least 3 months' duration, without clear identifiable cause, which may have potential associated factors

**Vulvo-vaginal hyperaesthesia***Sign*

Increased vulvo-vaginal sensitivity to touch, pressure, vibration or temperature.

**Vulvo-vaginal hypoesthesia***Sign*

Reduced vulvo-vaginal sensitivity to touch, pressure, vibration or temperature.