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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)

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Purpose: We updated the terminology in the field of pediatric lower urinary tract function. **Materials and Methods:** Discussions were held in the board of the International Children's Continence Society and an extensive reviewing process was done involving all members of the International Children's Continence Society, the urology section of the American Academy of Pediatrics, the European Society of Pediatric Urology, as well as other experts in the field. **Results and Conclusions:** New definitions and a standardized terminology are provided, taking into account changes in the adult sphere and new research results. *Neurourol. Urodynam. 26:90–102, 2007.*

Key words: enuresis; incontinence; terminology; urodynamics

PREFACE

Background

Lower urinary tract (LUT) function and malfunction in children is a field ripe with semantic confusion. Different authors use different definitions of commonly used terms such as enuresis, incontinence, overactive bladder (OAB), treatment response, etc. Sometimes, names applied to specific conditions have been used interchangeably to denote general dysfunction and vice versa. This confusion partly reflects modern research, which has radically changed our views upon these conditions during the last decades, and partly the fact that children are growing individuals who differ from adults. Many definitions that are adequate in adults are irrelevant in childhood, and vice versa. Thus, symptoms, such as bedwetting, and findings, such as incomplete voidings, may be normal in the toddler and pathological in the school-aged child. Maturation of the CNS is an important factor to consider when talking about incontinence in children but it has no basis in adult disease, whereas CNS alterations in the aging population are not relevant in childhood.

The International Children's Continence Society (ICCS), the global multidisciplinary organization for professionals involved in the pediatric LUT, previously published guidelines to lessen this confusion [Nørgaard et al., 1998], but recent advances in enuresis and incontinence research require clarification and modification of the terminology. This task is being fulfilled by the board of the ICCS.

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International Continence Society (ICS) which created guidelines for LUT terminology in adults [Abrams et al., 2002]. We are also grateful for constructive criticism provided by other experts.[1]

Scope and Usage of the Document

The aim of this document is to provide firm, unequivocal guidelines for the terminology of LUT function and malfunction in childhood. Although hopefully useful for the clinician, its main use will be in the research setting, where adherence to one terminology (i.e., this terminology) will make it easier to compare studies and reduce confusion among researchers. In future ICCS conferences, submitted material will be required to use this terminology and we propose that authors publishing in this research field include a phrase "definitions conform to the standards recommended by the International Children's Continence Society, except where specifically noted," or to the same effect, in the text.

Note that the present document in no way tells the researchers or clinicians what to do, only which words to use. Recommendations regarding good investigational practice and treatment are not within the scope of this study. It is the intention of the ICCS to develop guidelines in those fields, aimed at specific abnormalities, in the near future.

In this text symptoms will be followed by investigational tools, signs, conditions, and treatment parameters. Throughout the text the relevance of the entities in various age groups will be stated. At the end an appendix regarding terminology for anorectal function will be added, since anorectal and LUT function are interrelated; one can scarcely speak about the one without mentioning the other. However, we do recognize that the ICCS does not have the authority to prescribe changes in anorectal/gastrointestinal terminology, and thus only existing definitions and terminology will be quoted in this appendix. As a second appendix, a short alphabetical list of the most commonly used entities defined in this document is added.

Underlying Principles

Certain general principles have been continuously applied during creation of this terminology:

(1) The terms should be descriptive and not express theories or suppositions—however well-grounded they may be—regarding underlying pathogenesis.
(2) Terminology should be unambiguous.
(3) Words should be neutral and free from judgements.
(4) Words that have been used for many years have become the vernacular and cannot be discarded without compelling reasons.
(5) Whenever possible and reasonable pediatric terminology should follow the terminology for adults, as established by the ICS [Abrams et al., 2002].
(6) The definitions must make it possible to assign the correct descriptive term to the child without invasive or complicated investigations. A good case history and a bladder diary should usually suffice.
(7) The focus on the child as a growing, maturing individual should always be kept in mind.
(8) The division of patients into subgroups (such as OAB or voiding postponement) is less important than the measurement and declaration of relevant variables (such as daytime voiding frequency). The subgrouping process makes sharp boundaries out of biological continua, and the choice of subgrouping criteria makes us biased. Furthermore, these criteria may in the future prove irrelevant.

SYMPTOMS

Symptoms are classified according to their relation to the voiding and/or storage phase of bladder function. Duration of symptoms is irrelevant to the use of these terms; incontinence will be called incontinence even if it occurs just once.

Storage Symptoms

Increased or decreased voiding frequency. Estimates of voiding frequency are relevant from age 5 onwards or from the attainment of bladder control. The observation that the child consistently voids 8 or more times a day denotes increased daytime frequency, whereas three or less voidings per day is called decreased daytime frequency. The rationale behind this choice of limits is firstly the observation that the number of voidings in continent children is between 3–5 and 7 times daily [Hellström et al., 1990; Bloom et al., 1993], secondly the common experience that children with incontinence or other bladder complaints who void just three or four times per day are helped by going to the toilet more often. Note that in this document the word "day-time" is consistently used in stead of "diurnal," since the latter is ambiguous: it is sometimes used to denote all 24 hr of the day and night and sometimes just the day-time hours.

Caregivers may be unable to report voiding frequency until they have had a chance to observe the child at home, completing a bladder diary, a very important adjunctive measure to objectively assess this and other parameters. The relevance of these observations increases when interpreted in conjunction with fluid intake.

Incontinence. Incontinence (urinary incontinence) means uncontrollable leakage of urine; it can be continuous or intermittent.

Continuous incontinence means constant urine leakage, a phenomenon almost exclusively associated with congenital

[1]Paul Abrams, David A Bloom, Richard Butler, Marc Cendron, Jonathan Evans, Tom de Jong, David Joseph, Ulla Sillén, and others.

malformations (i.e., ectopic ureter) or iatrogenic damage to the external urethral sphincter. This term, which replaces the term "total incontinence" is applicable to children of all ages, since even infants normally have a degree of cortical control over bladder emptying and are dry between voidings [Yeung et al., 1995]. Intermittent incontinence is the leakage of urine in discrete amounts. It can be during the day-time or at night or both, and is applicable to children who are at least 5 years old. Enuresis means intermittent incontinence while sleeping. Note that, in contrast with previous terminology, the terms (intermittent) nocturnal incontinence and enuresis are now synonymous. Thus, any type of wetting episode that occurs in discrete amounts during sleep is called enuresis. Furthermore, the symptom of bedwetting is called enuresis or (intermittent) nocturnal incontinence regardless of the presence or absence of concomitant day-time symptoms. Enuresis may be called nocturnal enuresis, to add extra clarity, but the ambiguous term "diurnal enuresis" is obsolete and should be avoided. Day-time incontinence is, of course, incontinence during day-time. Children with combined day-time and night-time wetting have dual diagnoses: day-time incontinence and nocturnal incontinence or enuresis. If the word "diurnal" is used instead of "day-time" it should be made clear that only the wakeful portion of the 24 hr is denoted. For subdivisions of enuresis and day-time incontinence the reader is referred to the section on LUT conditions below.

The terminology is illustrated graphically in Figure 1.

Urgency. Urgency means the sudden and unexpected experience of an immediate need to void. The term is not applicable before the attainment of bladder control or 5 years, whichever occurs first. Other symptoms of bladder sensation (sensation of bladder filling, etc.) cannot reliably be elicited from the history and are relevant in the cystometric setting only (see below).

Nocturia. Nocturia means that the child has to wake at night to void. The definition is relevant from the age of 5 years. Nocturia is common among school children [Mattsson, 1994] and is not necessarily indicative of LUT malfunction. Note that the term nocturia does not apply to children who wake up for reasons other than a need to void, for instance children who wake up after an enuretic episode.

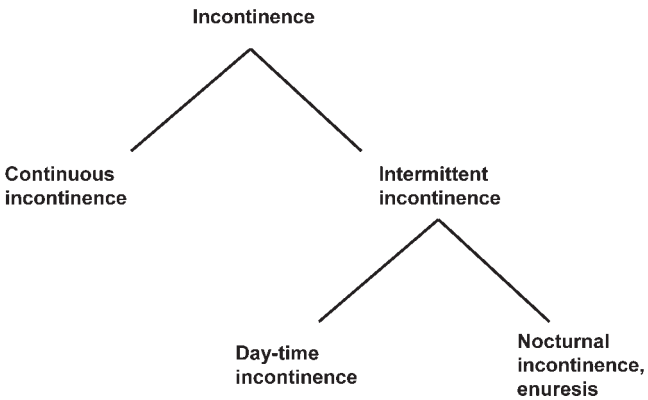

Fig. 1. Subdivision of urinary incontinence in children.

Voiding Symptoms

The absence of voiding symptoms reported by a child does not mean that there are no such symptoms; they may not reliably have been observed by a caregiver or reported by a child until about the age of 7.

Pain during voiding is considered under "Other Symptoms" later in this document. The terms splitting or spraying, as used in adult terminology [Abrams et al., 2002], refer to the appearance of the urine stream and are of very little relevance in childhood, except in instances of meatal stenosis in circumcised boys.

Hesitancy. Hesitancy denotes difficulty in initiation of voiding, or that the child has to wait a considerable period of time before voiding starts. The term is relevant from the attainment of bladder control or 5 years of age.

Straining. Straining means that the child applies abdominal pressure in order to initiate and maintain voiding. Straining, if observed, is relevant in all age groups.

Weak stream. This term is used for the observed ejection of urine with a weak force, and is relevant from infancy onwards.

Intermittency. Intermittency is the term applied when micturition occurs not in a continuous stream but rather in several discrete spurts. This may be described in all age groups but is regarded as physiological up to 3 years of age if not accompanied by straining.

Other symptoms

Holding maneuvers. These are observable strategies used to postpone voiding or suppress urgency. The child may or may not not be fully aware of the purpose of the maneuvers, but it is usually obvious to the care-givers. Common maneuvers are standing on tip-toes, forcefully crossing the legs or squatting with the heel pressed into the perineum [Vincent, 1966]. The term is relevant from the attainment of bladder control or 5 years of age.

Feeling of incomplete emptying. This term is self-explanatory and is not relevant before adolescence since younger children usually do not recognize and describe this symptom.

Post-micturition dribble. This term is used when the child describes involuntary leakage of urine immediately after voiding has finished. It is applicable after the attainment of bladder control or 5 years of age. Vaginal reflux (see below) may produce this symptom.

Genital and lower urinary tract pain. Most kinds of genital and LUT pain that occur in adults may theoretically occur in childhood, but in practice pediatric pain in this area is usually non-specific and difficult to localize and is thus not defined more specifically here.

TOOLS OF INVESTIGATION

The first and foremost tools in the assessment of the LUT in childhood—history-taking, observation and physical examination—need not be more closely defined here since they are central to the doctor's craft regardless of which organ system is in focus. Bladder diaries, voiding observations, and the urodynamic techniques, however, require the specific terminology defined in this section. The techniques are summarized in Table I. Questionnaires are also used, especially within the fields of child psychiatry and psychology.

For description of the urodynamic observations in children the ICS standardization is strictly followed [Abrams et al., 2003]. Only the paragraphs that are relevant for children are included in this report.

The Bladder Diary

The recording of voidings and bladder-related symptoms, at home under normal conditions, is crucial for the assessment of LUT function in childhood, and is relevant after attainment of bladder control or 5 years of age. Various protocols, kept for a variable number of days, have been used for this purpose. Also, many different names have been given to these protocols. We propose, in accordance with the ICS guidelines, that a full diagnostic protocol, in the research setting, be called bladder diary, and include the data listed in Table II. The extractable information is further defined in the Symptoms and Signs sections of this document. Less exhaustive protocols, such as those commonly used in treatment and follow-up, should be labeled frequency-volume charts.

Pad testing refers to the assessment of urine losses due to day-time incontinence by the repeated measurement of the weight of absorptive pads placed in the underwear. The term is applicable to incontinent children from age 5 and can be included in the bladder diary, but is seldom used in the pediatric setting. More relevant is the assessment of enuresis urine volumes by the measurement of diaper weight.

Uroflow Measurements

Measurement of urine flow and residual urine (with ultrasound) as a stand-alone examination is by far the most common procedure in pediatric urodynamic practice. To a large degree, the results of the flow/residual examination will decide whether the child will require invasive urodynamic investigation.

Flow/residual in a child should be repeated again at the same setting in a well-hydrated child, to ensure that a reasonable volume of urine is expelled with each micturition. Even if time-consuming, this increases the accuracy exponentially. If these first two measurements are dissimilar, a third may be needed. Flow measurement is a cornerstone of diagnosis in children after toilet training. If available, the addition of pelvic floor EMG recordings increase the value of the uroflow measurements.

Flow rate. Maximum flow rate is the most relevant variable when assessing bladder outflow. Sharp peaks in the flow curve are

TABLE I. Summary of Urodynamic Instruments in Childhood

Instrument	Age	Data
Bladder diary	From 5 years	Voided volumes
		Voiding frequency
		Urine output
		Symptom (leakage, etc.) frequency other data (see table 2)
Uroflow + residual	From 5 years	Voided volume
		Curve shape
		Urine flow rate
		Residual urine
Cystometry	All ages	Detrusor pressure and activity
		Cystometric bladder capacity compliance
		Sphincter competence and activity other data (see specific section)
4 hr voiding observation	Infancy	Voided volumes
		Voiding frequency
		Residual urine
		Observation of symptoms

TABLE II. The Bladder Diary; Data to Be Included and Information That Can Be Extracted

Data to be included	Duration of documentation*	Information that can be extracted
Voidings: timing and volumes	Minimum 48 hr (including nocturia volumes)	Voiding frequency. Day-time urine output (if no or small amounts of incontinence urine, or pad-testing performed). 24 hr urine output (if no enuresis or enuresis volumes measured). Average voided volume. Maximum voided volume
Nocturia episodes	14 nights	Nocturia frequency
Day-time incontinence episodes	14 days	Incontinence frequency
Enuresis episodes	14 nights	Enuresis severity
Enuresis urine volumes[a]	7 nights	Presence or absence of nocturnal polyuria
Other LUT symptoms	14 days	Symptom frequency
Fluid intake: volume, timing, and type of fluid[b]	Minimum 48 hr	24 hr fluid intake. Fluid intake pattern
Bed-time, wake-up time[c]	14 days	Time spent in bed
Bowel movements[d]	14 days	Defecation frequency
Encopresis[d]	14 days	Encopresis severity

*The minimum time required represents a compromise between what has been scientifically validated and what is deemed practically feasible without undue risk for non-compliance and study drop-outs.
[a]Measurement of enuresis volumes implies the measurement of the weight of diapers or bedclothes, and can be omitted if no assessment of urine output is deemed necessary.
[b]Since [urine output = fluid intake − perspiratio insensibilis] fluid intake data are necessary for good interpretation of urine output.
[c]Recommended but not mandatory.
[d]Necessary whenever encopresis or any symptom of constipation is present.

usually artifacts, so maximum flow should be registered only at a peak level with a duration of at least 2 sec [Schäfer et al., 2002]. In studies of normal children and adults, a linear correlation has been found between maximum flow and the square root of voided volume [Szabo and Fegyvernski, 1995]. Thus, a preliminary evaluation of the results of a flow measurement is possible. If the square of the maximum flow [(ml/sec)^2] is equal to or exceeds the voided volume (ml), the recorded maximum flow is most probably within the normal range.

Flow curve shape. The precise shape of the flow curve is determined by detrusor contractility, any abdominal straining, and by the bladder outlet. In normal voiding, the curve is smooth and bell-shaped. The OAB may produce an explosive voiding contraction that appears in the flow measurement as a high-amplitude curve of short duration, that is, a tower-shaped curve. A child with organic outlet tract obstruction will often have a low-amplitude and rather even flow curve; a plateau-shaped curve. Similarly, this may be the case when there is a tonic sphincter contraction during voiding. More commonly however, sphincter overactivity during voiding will be seen as sharp peaks and troughs in the flow curve, an irregular or staccato flow curve. This is labeled as a continuous but fluctuating flow curve. To qualify for the staccato label, the fluctuations should be larger than the square root of the maximum flow rate. Finally, in the case of an underactive or acontractile detrusor, when contraction of the abdominal muscles creates the main force for bladder evacuation, the flow curve will usually display discrete peaks corresponding to each strain separated by segments with zero flow, the interrupted or fractionated flow curve. To avoid confusion due to a multitude of terms regarding the shape of the flow curve, the ICCS suggests that the following terminology be adopted: bell, tower, plateau, staccato, and interrupted. These appellations are not a guarantee to the underlying diagnostic abnormality but rather should serve as a guide to the existence of a specific condition.

Post-void residual urine. Nowadays, residual urine is assessed by ultrasonography after a uroflow measurement. In the diagnostic setting real time ultrasound equipment is preferred. The lowest acceptable limit of 10% of the bladder capacity, often stated for adults, is not relevant for infants and children. Studies in healthy infants and toddlers have shown that they do not empty their bladders completely every time but do so at least once during a 4 hr observation period [Jansson et al., 2000]. Older children should, however, be expected to habitually empty their bladders completely. The unavoidable delay of a few minutes after finishing voiding until ultrasonography will result in bladder refilling with up to 5 ml which is the upper value of residual not associated with UTI. A range of 5–20 ml may be associated with insufficient emptying, so the examination should be repeated. More than 20 ml of residual found on repetitive occasions indicates abnormal or incomplete emptying, provided that (1) there has not been any time delay exceeding 5 min from the end of voiding until ultrasonography is performed, and (2) the child has not overambitiously delayed micturition and thus achieved a state of bladder fullness in excess of what is normal for him or her. The case of a longer time delay can be compensated for by subtracting 1–2 ml from the measured residual for every minute beyond 5.

INVASIVE URODYNAMIC INVESTIGATIONS; CYSTOMETRY

Urodynamic (Cystometric) Techniques

Urodynamic studies investigate filling and emptying phases of bladder function. Note that in the pediatric setting specific adaptations, regarding staff training, environment, parental support etc., must be made to make the whole examination child-friendly. If the supra-pubic route is used, a minimal delay of 5–6 hr is needed between catheter insertion and urodynamic recording. If a transurethral catheter is used it needs to be of as small a diameter as possible, since a large catheter can cause outflow obstruction, especially in small boys.

The word cystometry is commonly used to describe the urodynamic investigation during the filling phase of the micturition cycle. The filling phase starts when filling commences and ends when the patient and urodynamicist decide that "permission to void" has been given. Such precision may not be feasible in pediatric practice, as all infants and many children void without permission. The distinction between the filling and voiding phases can thus only be made afterwards when the curve is analyzed.

In accordance with the ICS definitions physiological filling rate is defined as a filling rate less than the predicted maximum rate of urine production by the kidneys, that is, body weight in kg divided by 4 expressed as ml/min [Abrams et al., 2002]. Non-physiological filling rate is defined as a filling rate greater than this predicted maximum. In children only physiologic filling rates should be used. It has to be remarked that this wording is suboptimal, since a urine production of 3,600 ml during 24 hr is, for a 10 kg child, clearly not physiological in the true sense of the word. Physiological filling rate does, however, constitute an acceptable filling rate during standard urodynamic investigations. Hjälmås proposed using a filling rate of 5% of the expected bladder capacity, expressed as ml/min [Hjälmås, 1988].

The use of natural fill (ambulatory) cystometry provides true physiologic filling rate and offers a more accurate representation of bladder activity than traditional cystometry. This is the technique of choice in pediatric urodynamics, if time and equipment are available. If this is not feasible or practical then filling rates of 5–10% of known or predicted capacity may be used.

Bladder storage function should be described in terms of bladder sensation, detrusor activity, bladder compliance, and bladder capacity.

Bladder Sensation During Filling Cystometry

The ICS definitions on bladder sensation are only applicable to older children and adolescents. Infants and young children are unable to indicate these different bladder sensations. A strong desire to void is probably the only sensation that some children can express.

Reduced bladder sensation is defined, during filling cystometry, as diminished sensation throughout bladder filling, and absent bladder sensation as no bladder sensation. Both conditions can be observed in children with an underactive detrusor (formerly called lazy bladder). Whenever the filling exceeds expected bladder capacity for age (see under Signs, below) and no sensation is reported we can invoke the term reduced bladder sensation.

Non-specific bladder sensations are sometimes observed in children. Holding maneuvers (see above) may be evidenced by toe curling and leg movements even in infants. Whenever bladder filling creates pain in children the filling should be stopped.

Detrusor Function During Filling Cystometry

Normal detrusor function allows bladder filling with little or no change in pressure, and without involuntary phasic contractions despite provocation. Thus, in infants and children any detrusor activity observed before voiding is considered pathological.

Detrusor overactivity—not to be confused with the OAB—is a urodynamic observation characterized by involuntary detrusor contractions, spontaneous or provoked, during the filling phase, involving a detrusor pressure rise of greater than 15 cm H_2O above baseline. In an adult patient with normal sensation, urgency is likely to be experienced in conjunction with such detrusor contractions. In children the reporting of the sensation of urgency is less reliable. Detrusor overactivity may also be qualified, when possible, according to cause, into neurogenic detrusor overactivity when there is a relevant neurological condition—this term replaces the term "detrusor hyperreflexia"—or idiopathic detrusor overactivity when there is no defined cause. The term detrusor overactivity replaces the previous "detrusor instability."

Bladder Capacity and Compliance During Filling Cystometry

In infants and children the difference between cystometric capacity and maximum cystometric capacity is less relevant given the difficulties for children in reporting bladder sensation adequately.

Bladder compliance describes the relationship between change in bladder volume and change in detrusor pressure. Compliance is calculated by dividing the volume change (ΔV) by the change in detrusor pressure ($\Delta pdet$) during that change in bladder volume ($C = \Delta V/\Delta pdet$). It is expressed in ml/cm H_2O.

Bladder compliance is a complicated entity in pediatric practice, for several reasons. First, compliance normally changes according to bladder volume, and thus varies with age. Therefore, compliance values should always be related to bladder capacity. Second, detrusor pressure can be affected by rate of bladder filling so slow rates are preferred in children, especially in infants. Third, there are no reliable reference

values available for bladder compliance in infancy and childhood. A rule of thumb is that detrusor pressure of 10 cm H_2O or less at the expected bladder capacity for age (see below) is acceptable. As bladder volumes vary during early life with an increase from 30 ml at birth to approximately 300 ml as a teenager, the compliance tends to increase with age. In young children and infants lower compliance values have to be considered normal. More important than the numerical values of bladder compliance, is the shape of the filling curve, that is, if it is linear or non-linear, and if non-linear in what way it deviates from linearity. Because of this confusion it is recommended that the actual measurements be provided in all scientific publications.

Urethral Function During Filling Cystometry

Urethral function in children is usually assessed by pelvic floor EMG using skin or (less commonly) needle electrodes. The urethral closure pressure is rarely measured. For centers that use pressure measurements the ICS definitions are applicable.

Urethral relaxation incontinence is defined as leakage due to urethral relaxation in the absence of raised abdominal pressure or detrusor overactivity. Although a rare condition, it has been described in children and was formerly called urethral instability [Vereecken and Proesmans, 2000].

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. Urodynamic stress incontinence is now the preferred term to "genuine stress incontinence." In children urodynamic stress incontinence is a rare condition seen almost exclusively in some girls with uropathy and neuropathy.

Abdominal leak point pressure is the intravesical pressure at which urine leakage occurs due to increased abdominal pressure in the absence of a detrusor contraction. The detrusor leak point pressure excludes any abdominal component to bladder emptying such as straining but includes voluntary tightening of the sphincter during voiding. These are important definitions, since a high leak point pressure indicates that there is a risk for upper urinary tract damage. We propose that the term abdominal leak point pressure be used in stead of the term "valsalva leak point pressure," which carries the same meaning.

Pressure Flow Studies; Cystometric Evaluations During the Voiding Phase

Although pressure flow-relationships can be evaluated in infants and children these measurements are rarely made because of their low clinical relevance in this age group.

Normal voiding is achieved by a continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in the absence of obstruction. Needless to say, in children prior to toilet training, the contraction need not be voluntarily initiated. For a given detrusor contraction, the magnitude of the recorded pressure rise will depend on the outlet resistance. This definition can be applied to older children and adolescents. In infants high detrusor pressures during voiding can be normal.

Detrusor underactivity—not to be confused with an underactive bladder—is 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. An acontractile detrusor demonstrates no contraction whatsoever during urodynamic studies. Both conditions can be observed in the clinical setting and were formerly called "lazy bladder," but now referred to as underactive bladder (see below).

Note that the highest detrusor pressure during voiding (P_{max}) is not identical to the detrusor pressure during maximal urine flow (PQ_{max}) and that these values are different between infants and older children, and between males and females.

In infants and children urethral function during voiding will most often be measured by pelvic floor EMG recording using primarily skin electrodes. This method provides only a rough estimate of urethral and pelvic floor function, but for diagnostic purposes in the pediatric setting it is usually sufficient. More precise function may be obtained by needle electrodes positioned in the sphincter with an analysis of individual motor unit action potentials seen on an oscilloscopic screen.

Dysfunctional voiding is a urodynamic entity characterized by an intermittent and/or fluctuating uroflow rate due to involuntary intermittent contractions of the striated muscle of the external urethral sphincter or pelvic floor during voiding, in neurologically normal individuals. It is an entirely different term from the term "voiding dysfunction" which is a generalized name that has been popularized to denote any abnormality related to bladder filling and/or emptying (see Preface). The latter terminology should not be used. Dysfunctional voiding is described under Conditions below. Detrusor sphincter dyssynergia—applicable in patients with neurogenic bladder disturbance—is the cystometric observation of a detrusor voiding contraction concurrent with an involuntary contraction of the urethral and/or periurethral striated muscle. Occasionally, the urinary flow ceases. This must be distinguished from an involuntary detrusor contraction with a simultaneous increase in sphincter EMG activity, that is, the normal guarding reflex.

In short, dysfunctional voiding is a term applied to neurologically intact children and requires uroflow measurements, whereas detrusor sphincter dyssynergia is used only in the neuropathic setting and requires invasive urodynamics.

FOUR HOURS VOIDING OBSERVATION

Four hours voiding observation is a new, scientifically validated technique used for the evaluation of bladder function in infancy [Holmdahl et al., 1996]. The method implies the continuous observation of the freely moving infant with frequent

ultrasound measurement of bladder filling and residual urine after each voiding. Voided volumes may also be measured by the weighing of diapers.

SIGNS

Signs Related to Voided Volumes

The ICS and ICCS recommend that voided volume should replace the nebulous term "functional bladder capacity" [Abrams et al., 2002]. This choice of wording underlines the fact that voided volumes vary greatly under normal conditions and reflect bladder function more than anatomy. However, we still need a standard for comparison, and this standard is termed "*expected bladder capacity*" (EBC). EBC is estimated by the formula [30 + (age in years × 30)] ml, [Hjälmås, 1976; Koff, 1983] a formula that is useful up to 12 years of age, after which age EBC is level at 390 ml. The EBC is compared to the maximum voided volume (with addition of residual urine, if present and known) as recorded in a bladder diary. The maximum voided volume is considered small or large, respectively, if found to be <65% or >150% of the EBC[2].

Residual Urine

Residual urine is the amount of urine left in the bladder immediately after voiding. The term is useful in all ages. As mentioned above in more detail, normal residual urine volume is 0; 20 ml or more—on repeated measurements—is pathological and values between these two represent a borderline zone.

Signs Related to Urine Output

Normal urine output is difficult to define in childhood, due to great intra- and interindividual variation and to a lack of large-scale investigations [Mattsson and Lindström, 1994]. Awaiting such investigations we propose that polyuria be defined as a 24 hr urine output of more than 2 L per square meter body surface area. This is applicable to children of all ages.

Nocturnal urine output excludes the last voiding before sleep but includes the first voiding in the morning. In enuretic children, urine voided during sleep is collected in diapers and the change of diaper weight is measured. Nocturnal polyuria is a term relevant mainly in children suffering from nocturnal enuresis [Rittig et al., 1989] and is defined in this patient group as a nocturnal urine output exceeding 130% of EBC for the child's age. The rationale for this definition is that a high nocturnal urine output is only relevant if judged in relation to the bladder. Nocturnal polyuria, according to this definition, will obviously result in nocturia or enuresis. However, because of the necessary arbitrariness of this definition we strongly recommend authors studying these matters report nocturnal urine output and EBC, or the ratios between them, rather than merely defining the children as polyuric or non-polyuric.

We realize that some children with very high 24 hr urine output, for renal or endocrinological reasons, may still fail to qualify for the above definition of nocturnal polyuria if their bladders have accommodated and become very large. In these children, however, the classification of polyuria into nocturnal or diurnal is of very little clinical relevance.

CONDITIONS

Enuresis

As mentioned in the Symptoms section, enuresis is synonymous to intermittent nocturnal incontinence and means incontinence in discrete episodes while asleep. Enuresis (or nocturnal incontinence) is both a symptom and a condition.

Subgroups. With the growing awareness that enuretic children differ regarding comorbidity, treatment response, and pathogenesis, a plethora of various subgrouping strategies has been invented [Watanabe and Azuma, 1989; Nevéus et al., 2000; Aceto et al., 2003]. It is not, yet, clear if these strategies will prove clinically relevant, and the ICCS will therefore—with the exceptions given below—not provide guidelines for this.

There is ample evidence that enuretic children with concomitant symptoms of LUT malfunction differ clinically, therapeutically, and pathogenetically from children without such symptoms [Butler and Holland, 2000]; an unequivocal and universal subgrouping into monosymptomatic and non-monosymptomatic enuresis on these grounds is therefore essential. The previous subdivision on the basis of the presence or absence of concomitant day-time incontinence alone is deemed inadequate, since other day-time symptoms may also be indicative of disturbed LUT function. The new subdivision is as follows, and it is recommended that all authors publishing studies on enuresis make this subdivision of their patient material.

Enuresis in children without any other LUT symptoms (nocturia excluded), and without a previous history of bladder dysfunction, is defined as monosymptomatic enuresis. Other children with enuresis and any other LUT symptoms are said to suffer from non-monosymptomatic enuresis. LUT symptoms relevant for this definition are the following: increased/decreased voiding frequency, day-time incontinence, urgency, hesitancy, straining, weak stream, intermittency, holding maneuvers, feeling of incomplete emptying, post-micturition dribble, and genital or LUT pain.

[2]Note, however, that the above formula was not acquired from a population-based study of completely normal children, and EBC should therefore not be regarded as "normal" maximal voided volume. Strictly speaking, normal maximal voided volume is not known. The formula is chosen for practical purposes, for simplicity and because it is widely known and used.

Note also that, in contrast to the previous ICCS document [Nørgaard et al., 1998], bedwetting in a child with concomitant day-time incontinence is still called enuresis (or nocturnal incontinence), although it belongs to the non-monosymptomatic variety.

If a subdivision is made according to the onset of enuresis, the term secondary enuresis should be reserved for children who have had a previous dry period of at least 6 months [von Gontard et al., 1999]. Otherwise the term primary enuresis should be used.

Day-Time Conditions

The classification of day-time LUT conditions—especially conditions with day-time incontinence as a central symptom—is less straight-forward than that of enuresis. The overlap between conditions is considerable, borderline cases are common and the pathogenetic rationale for the grouping of various symptom complexes into specific conditions is often not fully evidence-based. Furthermore, there is often an evolution over time; for example, the child may start with urge incontinence, continue through voiding dysfunction and voiding postponement and end up with an underactive bladder.

To lessen this confusion, and provide grounds for precise definitions with greater pathogenetical and clinical relevance, the ICCS advises researchers studying these children to assess and document the following four parameters in their patients:

(1) Incontinence (presence or absence, and symptom frequency)
(2) Voiding frequency
(3) Voided volumes
(4) Fluid intake

This is more important than the subgrouping of the children into the various recognized syndromes listed below. Obviously, the conditions including incontinence are applicable from the age at which bladder control is attained, or 5 years.

Overactive bladder, urge incontinence. We agree with the current adult urology community practice of dropping the nebulous term "bladder instability" [Abrams et al., 2002] and replacing it with OAB. The subjective hallmark of OAB is urgency, and children who suffer from this symptom can thus be said to suffer from an OAB. Incontinence is often present as well, as is increased voiding frequency, but these symptoms are not necessary prerequisites for the use of the term OAB. The reason for not including increased voiding frequency is that it is not at all clear if it carries any clinical or pathogenetical significance—especially when fluid intake is not taken into account. Children with OAB usually have detrusor overactivity, but this label cannot be applied to them without cystometric evaluation (see above). Urge incontinence simply means incontinence in the presence of urgency, and is thus a term that is applicable to many children with OAB.

Voiding postponement. Children with day-time incontinence who are observed by their parents and/or caregivers to habitually postpone micturition, often in specific situations, using holding maneuvers are said to suffer from voiding postponement. This is often associated with a low micturition frequency and a feeling of urgency due to a full bladder. Some children have learned to restrict fluid intake as a method for increasing voiding intervals and at the same time reducing incontinence. The rationale for the delineation of this entity lies in the observation that these children often suffer from psychological comorbidity or behavioral disturbances [Lettgen et al., 2002].

Underactive bladder. The old entity "lazy bladder" is now replaced by the neutral term underactive bladder. This term is reserved for children with low voiding frequency and a need to raise intra-abdominal pressure to initiate, maintain, or complete voiding, that is, straining. The children often produce an interrupted pattern on uroflow measurement, and are usually found to qualify for the term detrusor underactivity if examined with invasive urodynamics.

Dysfunctional voiding. The child with dysfunctional voiding (this phrasing is preferred instead of "voiding dysfunction") habitually contracts the urethral sphincter during voiding. The term cannot be applied unless repeated uroflow measurements have shown curves with a staccato pattern—or if verified by invasive urodynamic investigation. Note that the term describes malfunction during the voiding phase only, it says nothing about the storage phase. The usage of this expression to denote any kind of disturbed LUT function [Hellerstein and Linebarger, 2003], leads to confusion and is strongly discouraged. Dysfunctional voiding means dysfunction during voiding. Of course it is entirely possible for a child to suffer from both dysfunctional voiding and storage symptoms such as incontinence.

Obstruction. Children with a mechanical or functional, static or phasic, impediment to urine outflow during voiding are said to suffer from LUT obstruction. It is characterized by increased detrusor pressure and a reduced urine flow rate. Different types of LUT obstruction in children are now fairly easy to describe and quantify using video-urodynamic techniques [Coombs et al., 2005].

Stress incontinence. Stress incontinence is the leakage of small amounts of urine at exertion or raised intra-abdominal pressure for various reasons. It is rare in neurologically normal children, and should be differentiated from incontinence in children who have postponed micturition and do not get to the toilet in time, and wetting in children with OAB where detrusor contractions may be provoked by, for instance, raised

intra-abdominal pressure. The term mixed incontinence, applied for patients with combined urge incontinence and stress incontinence, is also rare in childhood.

Vaginal reflux. Toilet-trained prepubertal girls who experience incontinence in moderate amounts consistently occuring within 20 min after normal voiding are said to suffer from vaginal reflux, if no underlying mechanism other than vaginal entrapment of urine is obvious. This is not associated with other LUT symptoms.

Giggle incontinence. Giggle incontinence is a rare syndrome in which apparently complete voiding occurs specifically during or immediately after laughing. Bladder function is normal when the child is not laughing. The condition is to be carefully differentiated from the much more common situation when a child with OAB, voiding postponement or underactive bladder experiences leakage during sudden lapses of concentration such as during laughter, for instance. The term giggle incontinence should not be used in these cases.

Extraordinary daytime urinary frequency. This term applies to children who void very often and with very small volumes during the daytime only. Daytime voiding frequency is at least once per hour and average voided volumes are less than 50% of EBC (usually much smaller). Incontinence is not a usual or necessary ingredient in the condition and nocturnal bladder behavior is normal for the child's age. The term is applicable from the age of daytime bladder control or 3 years.

COMORBIDITY

It is not the task of the ICCS to suggest definitions and terminology for areas outside the LUT. We do, however, find it useful to list comorbid conditions that are relevant and important to take into account for researchers studying the LUT in children. These include the following:

Constipation and encopresis (see Appendix, below!)
Urinary tract infection
"Asymptomatic" bacteriuria
Vesico-ureteral reflux
Neuropsychiatric conditions (ADHD, oppositional defiant disorder, etc.)
Learning disabilities
Disorders of sleep (sleep apneas, parasomnias)

TREATMENT

Definitions of Treatment Methods

Treatment, in its widest sense, refers to any intervention that may—or is done with the intention to—alleviate symptoms or eradicate a disturbance. Obviously, this definition is almost circular. The point is that treatment starts when a caregiver first sees a patient. Even parts of the examination, such as the completion of a bladder diary or repeated uroflow measurements, are parts of treatment as well.

This document conveys definitions and guidelines regarding terminology alone. Recommendations for therapy will be the subject of future communications.

We strongly advise writers not to use terms such as "standard therapy" or "maintenance therapy" without defining what they include in these concepts.

Pharmacological therapy, surgical therapy. Obviously, this means any therapy based on drugs or surgery.

Alarm treatment. Alarm treatment is therapy based on a device that gives a strong sensory signal—usually, but not necessarily, acoustic—immediately upon the occurrence of incontinence. It can be used during day- or night-time, although the latter usage is more common.

Urotherapy. Urotherapy means non-surgical, non-pharmacological treatment of LUT malfunction. It is thus synonymous to the term LUT rehabilitation, frequently used in the adult sphere [Abrams et al., 2002]. It encompasses a very wide field, incorporating many therapies used by urotherapists and other health-care professionals. This rehabilitation approach and the therapies mentioned above are certainly not mutually exclusive. Urotherapy can be divided into standard therapy and specific interventions.

Standard urotherapy is non-interventional, and includes the following components:

(1) Information and demystification. Explanation about normal LUT function and in what way the particular child deviates from normal.
(2) Instruction about what to do about it; that is, regular voiding habits, sound voiding posture, avoiding holding maneuvers, etc.
(3) Life-style advice. Advice regarding fluid intake, prevention of constipation, etc.
(4) Registration of symptoms and voiding habits, using bladder diaries or frequency-volume charts.
(5) Support and encouragement via regular follow-up by the care-giver.

Specific interventions used in the urotherapeutic setting are defined in the same way as that published by the ICS [Abrams et al., 2002], and are thus only mentioned in passing here. They include various forms of pelvic floor training, behavioral modification, biofeedback, electrical stimulation, and catheterization

Urotherapy can include elements of cognitive behavioral therapy (CBT)—a type of psychotherapy including a wide array of cognitive and behavioral modification techniques—but the term CBT should not be used indiscriminately and without defining which techniques to be employed.

Definitions of Treatment Outcome

In the clinical situation the affected child and family obviously are the ones to decide about the appropriate criteria for treatment success. In the research setting, however, a uniform standard is necessary, so that studies and treatment options can be compared with each other. The only aim of this document is to facilitate comparison between future studies. For more in-depth discussions of parameters of success and treatment outcome other texts can be consulted [Butler, 1991; Butler et al., 2004].

Three basic principles should be recognized by researchers:

(1) Assessment of treatment outcome must be based on pre-treatment baseline registration of the frequency of symptoms.
(2) The actual symptom frequency during baseline and treatment should be shown. This gives more information than the grouping of children into responders and non-responders.
(3) The different responses during and after cessation of treatment must be clear. The latter may sometimes reflect cure, the former never.

When children need to be grouped together in subgroups with varying degrees of treatment response, for reasons of comparison, it is suggested that the grouping be done as shown below. Percentages shown reflect the reduction of symptom frequency (i.e., reduction of the number of wet nights per week, for instance).

Initial success.

- Non-response: 0–49% reduction.
- Partial response: 50–89% reduction.
- Response: 90% reduction or more.
- Full response: 100% reduction or less than one symptom occurrence per month.

Long-term success.

- Relapse: more than one symptom recurrence per month.
- Continued success: no relapse in 6 months after interruption of treatment.
- Complete success: no relapse in 2 years after interruption of treatment.

ABBREVIATIONS

CBT	cognitive behavioral therapy
CIC	clean intermittent catheterisation
CNS	central nervous system
EBC	expected bladder capacity
ICS	International Continence Society
ICCS	International Children's Continence Society
LUT	lower urinary tract
OAB	overactive bladder
UAB	under-active bladder

APPENDIX 1: ENCOPRESIS AND FUNCTIONAL FECAL INCONTINENCE

Both urinary and fecal incontinence often co-exist in different combinations. It is therefore advisable to focus on comorbidity and describe any type of nocturnal enuresis, day-time urinary incontinence, and fecal incontinence. In other words, one child might have three different conditions (and diagnoses) at the same time and each one should be named. General and unspecific terms such as "elimination syndrome" should be avoided for these combined disorders.

It is not the aim of this appendix to provide a full standardization of relevant terminology for encopresis and functional fecal incontinence. Therefore, only definitions of the main conditions, but not of signs and symptoms are provided. The definitions are provided in accordance to other specialties (such as pediatric gastroenterology and child psychiatry) dealing with children with these disorders (1).

Fecal incontinence is an umbrella term encompassing any sort of deposition of feces in inappropriate places—both functional and organic.

Anal incontinence is a general term including both inappropriate passage of feces and of flatulence—both functional and organic.

Organic fecal incontinence results from neurologic, structural, or other organic causes.

Functional fecal incontinence can be used as a synonym for encopresis.

Encopresis: According to the ICD-10 (2) and the DSM-IV (3), encopresis is defined as both voluntary and involuntary passage of feces in inappropriate places in a child aged 4 years or older, after organic causes have been ruled out. It has to occur at least once per month for a duration of 6 months (ICD-10) or 3 months (DSM-IV).

Primary encopresis denotes that the longest clean interval was shorter than 6 months.

Secondary encopresis is defined by a relapse after a clean period of 6 months or longer without signs or symptoms

Encopresis with constipation (Synonyms: encopresis with constipation and overflow incontinence (DSM-IV); retentive encopresis; functional retentive (or constipation-associated) fecal incontinence): In this subtype, both encopresis and constipation are present.

Encopresis without constipation (Synonyms: encopresis without constipation and overflow incontinence (DSM-IV); functional non-retentive (or non-constipation-associated) fecal incontinence; solitary encopresis): In this subtype, encopresis but no constipation are present.

Soiling is a confusing and ill-defined term that should not be used in view of established international definitions of encopresis (ICD-10, DSM-IV) or functional fecal incontinence.

Constipation: There are no good definitions of constipation. It cannot be defined by a low defecation frequency alone, but requires additional signs and symptoms such as painful defecation, palpable abdominal masses, formed stool masses during rectal examination, abdominal pain and typical ultrasound findings such as enlarged rectal diameters and retrovesical impressions. Typical definitions include those by the North American Society for Pediatric Gastroenterology and Nutrition: "a delay or difficulty in defecation, present for 2 or more weeks, and sufficient to cause distress to the patient" (4).

Functional constipation is defined by "scybalous, pebble-like, hard stools for a majority of stools; by firm stools two or less times per week; and by the absence of structural, endocrine or metabolic disease" according to the Rome-II-criteria (6). Only 5% of all cases of constipation are due to organic causes, 95% are functional. For research purposes, it is best to describe the defecation frequency as well as all associated signs and symptoms.

Chronic constipation has been defined by the PACCT-group (5) by the occurrence of two or more of the following characteristics (during the last 8 weeks): <3 bowel movements per week; >1 episode of fecal incontinence per week; large stools in the rectum or palpable on abdominal examination; passing of stools so large that they may obstruct the toilet; display of retentive posturing and with-holding behaviors; painful defecation.

Functional fecal retention consists of repetitive attempts to avoid defecation because of fears associated with defecation. Consequently, fecal mass accumulates in the rectum. It is defined by the passage of large diameter stools and retentive posturing for at least 12 weeks (6). This term is deemed redundant by the PACCT-group, as it is included in the definition of chronic constipation (6).

Toilet refusal syndrome occurs in children who use the toilet for micturition, but insist on using a diaper for defecation.

Toilet phobia is an isolated phobia in children who fear using the toilet both for micturition and for defecation.

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APPENDIX 2: ALPHABETIC LIST OF COMMONLY USED TERMS DEFINED IN THE ICCS TERMINOLOGY

This list is neither complete nor detailed, but is expected to be useful as a quick reference list for terms that are not rare or self-explanatory.

Bladder diary: a standard chart to be completed by the child or family, used for evaluation of bladder function and including data regarding at least voided volumes, voiding frequency, fluid intake, nocturia, enuresis, and incontinence episodes.

Daytime voiding frequency, decreased: three or less voidings per day.

Daytime voiding frequency, increased: eight or more voidings per day.

Detrusor overactivity: the observation—during cystometry—of involuntary detrusor contractions during the filling phase. Replaces the term "detrusor instability."

Detrusor-sphincter dyssynergia: the cystometric observation of a detrusor voiding contraction concurrent with an involuntary contraction of the urethra.

Detrusor underactivity: the cystometric observation of a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying.

Dysfunctional voiding: the habitual contraction of the urethral sphincter during voiding, as observed by uroflow measurements.

Enuresis: intermittent incontinence of urine while sleeping, that is, synonymous to (intermittent) nocturnal incontinence. The term is used regardless of whether day-time incontinence or other lower urinary tract symptoms is also present or not. "Nocturnal" may be added for extra clarity.

Enuresis, monosymptomatic: enuresis in a child without any (other) lower urinary tract symptoms.

Enuresis, non-monosymptomatic: enuresis in a child with (other) lower urinary tract symptoms, such as day-time incontinence, urgency, holding maneuvers, etc.

Enuresis, primary: enuresis in a child who has previously been dry for less than 6 months.

Enuresis, secondary: enuresis in a child who has previously been dry for at least 6 months.

Expected bladder capacity: age-related expected maximum voided volume, calculated via the formula [30 + (age in years × 30)] ml, and used as a standard for comparisons.

Frequency–volume chart: a chart to be completed by the child or family, used for evaluation of bladder function but not including all data required of a bladder diary (see above).

Incontinence, continuous: continuous leakage of urine, not in discrete portions. Indicates malformation or iatrogenic damage.

Incontinence, intermittent: leakage of urine in discrete portions, during day, night or both.

Incontinence, nocturnal: see enuresis.

Overactive bladder: the condition afflicting patients experiencing urgency symptoms. Replaces the term "bladder instability."

Polyuria, nocturnal: a nocturnal urine output exceeding 130% of the expected bladder capacity (see above).

Residual urine: urine left in the bladder after voiding. Residual urine in excess of 5–20 ml indicates incomplete bladder emptying.

Underactive bladder: the condition afflicting patients with a low voiding frequency and the need to raise intra-abdominal pressure to void. Replaces the term "lazy bladder."

Urge incontinence: incontinence in patients experiencing urgency, that is, incontinence in children with overactive bladder.

Voided volume: voided volume at micturition, as documented in a bladder diary. Replaces the term "bladder capacity."

Voided volume, maximum: the largest voided volume, as documented in a bladder diary. Replaces the term "functional bladder capacity."

Voiding postponement: incontinence in the presence of habitual holding maneuvers.

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