
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

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Purpose: We updated the terminology in the field of pediatric lower urinary tract function.

Materials and Methods: Discussions were held of 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 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.

PREFACE

Background

Lower urinary tract function and malfunction in children is a field rife with semantic confusion. Different groups use different definitions of commonly used terms, such as enuresis, incontinence, OAB, treatment response, etc. Sometimes names applied to specific conditions are used interchangeably to denote general dysfunction and vice versa. This confusion partly reflects modern research, which has radically changed our views of 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 bed-wetting and findings such as incomplete voiding may be normal in the toddler and pathological in the school-age child. Maturation of the central nervous system is an important factor to consider when talking about incontinence in children but it has no basis in adult disease, whereas central nervous system alterations in the aging population are not relevant in childhood.

The ICCS, which is the global multidisciplinary organization for professionals involved with the pediatric LUT, has previously published guidelines to lessen this confusion¹ but recent advances in enuresis and incontinence research re-

quire clarification and modification of the terminology. This task is being fulfilled by the ICCS board.

We recognize and acknowledge the valuable contributions made by our late friend Dr. Kelm Hjälms, who participated in the preliminary preparation of this document, and by the ICS, which created guidelines for LUT terminology in adults.² We are also grateful for constructive criticism provided by other experts (Appendix 1).

Scope and Use 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 it is hopefully useful for the clinician, its main use will be in the research setting, where adherence to 1 terminology (ie this terminology) will make it easier to compare studies and decrease confusion among researchers. At future ICCS conferences submitted material will be required to use this terminology and we propose that groups publishing in this research field should include in their text the phrase, "Definitions conform to the standards recommended by the International Children's Continence Society except where specifically noted," or words to that effect.

Note that the current document in no way tells 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 article. It is the intent of the ICCS in the near future to develop guidelines in those fields aimed at specific abnormalities.

In this text symptoms are followed by investigational tools, signs, conditions and treatment parameters. Throughout the text the relevance of the entities in various age

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groups is stated. Appendix 2 lists the terminology for ano-rectal function since ano-rectal and LUT functions are inter-related. One can scarcely speak about one without mentioning the other. However, we recognize that the ICCS does not have the authority to prescribe changes in ano-rectal/gastro-intestinal terminology and, thus, only existing definitions and terminology are quoted in Appendix 2. Appendix 3 provides a short alphabetical list of the most commonly used entities defined in this document.

Underlying Principles

Certain general principles were continuously applied during the 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 of judgments. 4) Words that have been used for many years have become the vernacular and cannot be discarded without compelling reasons. 5) When possible and reasonable, pediatric terminology should follow the terminology for adults, as established by the ICS.² 6) 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 prove irrelevant in the future.

SYMPTOMS

Symptoms are classified according to their relation to the voiding and/or storage phase of bladder function. Symptom duration is irrelevant to the use of these terms. Incontinence is called incontinence even if it occurs just once.

Storage Symptoms

Increased or decreased voiding frequency. Estimates of voiding frequency are relevant from age 5 years and thereafter or from the attainment of bladder control. The observation that the child consistently voids 8 or more times daily denotes increased daytime frequency, whereas 3 or fewer voidings daily are called decreased daytime frequency. The rationale behind this choice of limits is 1) the observation that the number of voidings in continent children is between 3 and 5, and 7 times daily,^{3,4} and 2) the common experience that children with incontinence or other bladder complaints who void just 3 or 4 times daily are helped by going to the toilet more often. Note that in this article the word daytime is consistently used instead of diurnal. The latter term is ambiguous, in that it is sometimes used to denote all 24 hours of the day and night, and sometimes just the daytime hours.

Caregivers may be unable to report voiding frequency until they have had a chance to observe the child at home and complete a bladder diary, which is an important adjunctive measure to objectively assess this and other param-

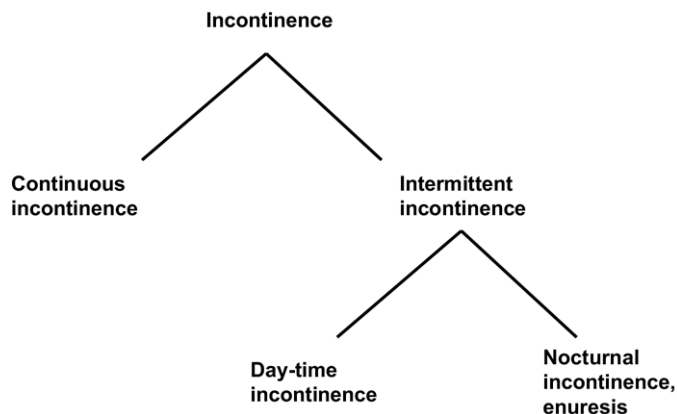
eters. The relevance of these observations increases when interpreted in conjunction with fluid intake.

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

Continuous incontinence means constant urine leakage, a phenomenon that is almost exclusively associated with congenital malformations, ie 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 they are dry between voidings.⁵ Intermittent incontinence is urine leakage in discrete amounts. It can occur during the day and/or at night, and it 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 daytime symptoms. Enuresis may be called nocturnal enuresis to add extra clarity but the ambiguous term diurnal enuresis is obsolete and should be avoided. Daytime incontinence is, of course, incontinence during the day. Children with combined daytime and nighttime wetting have dual diagnoses, namely daytime incontinence and nocturnal incontinence or enuresis. If the word diurnal is used instead of daytime, it should be made clear that only the waking portion of the 24 hours is denoted. For subdivisions of enuresis and daytime incontinence the reader is referred to the section on LUT conditions. The figure shows the terminology graphically.

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 age 5 years, whichever occurs first. Other symptoms of bladder sensation (sensation of bladder filling, etc) cannot reliably be elicited from the history and they are relevant in the cystometric setting only (see below).

Nocturia. Nocturia means that the child must awaken at night to void. The definition is relevant from the age of 5



Subdivision of urinary incontinence in children

years. Nocturia is common among school children⁶ and it is not necessarily indicative of LUT malfunction. Note that the term nocturia does not apply to children who awaken for reasons other than a need to void, for instance children who awaken after an enuretic episode.

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 age 7 years.

Pain during voiding is considered under other symptoms later in this document. The terms splitting or spraying, as used in adult terminology,² refer to the appearance of the urine stream and they are of little relevance in childhood, except in instances of meatal stenosis in circumcised boys.

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

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

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

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 it is regarded as physiological up to age 3 years 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 be fully aware of the purpose of the maneuvers but it is usually obvious to caregivers. Common maneuvers are standing on tiptoe, forcefully crossing the legs or squatting with the heel pressed into the perineum.⁷ The term is relevant from the attainment of bladder control or age 5 years.

Feeling of incomplete emptying. This term is self-explanatory. It 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 urine leakage immediately after voiding has finished. It is applicable after the attainment of bladder control or age 5 years. Vaginal reflux (see below) may produce this symptom.

Genital and LUT pain. Most kinds of genital and LUT pain that occur in adults may theoretically occur in childhood. However, in practice pediatric pain in this area is usually nonspecific and difficult to localize. Thus, it is not defined more specifically here.

TOOLS OF INVESTIGATION

The first and foremost tools for assessment of the LUT in childhood, namely history taking, observation and physical

examination, need not be more closely defined here since they are central to the craft of the physician regardless of which organ system is in focus. However, bladder diaries, voiding observations and urodynamic techniques require the specific terminology defined in this section. Appendix 4 lists these techniques. Questionnaires are also used, especially in the fields of child psychiatry and psychology.

For descriptions of urodynamic observations in children the ICS standardization is strictly followed.⁸ Only the paragraphs that are relevant in children are included in this report.

The Bladder Diary

The recording of voiding and bladder related symptoms at home under normal conditions is crucial for the assessment of LUT function in childhood and it is relevant after attainment of bladder control or age 5 years. Various protocols kept for a variable number of days have been used for this purpose. Also, many names have been given to these protocols. In accordance with ICS guidelines we propose that a full diagnostic protocol in the research setting should be called a bladder diary and include certain data (Appendix 5).⁹⁻¹¹ Extractable information is further defined in the symptoms and signs sections of this article. Less exhaustive protocols, such as those commonly used during treatment and followup, should be labeled frequency-volume charts.

Pad testing refers to the assessment of urine losses due to daytime incontinence by repeat measurement of the weight of absorptive pads placed in the underwear. The term is applicable to incontinent children from age 5 years. It can be included in the bladder diary but is seldom used in the pediatric setting. More relevant is the assessment of enuresis urine volume by the measurement of diaper weight.

Urine Flow 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 decide whether the child requires an invasive urodynamic investigation.

Flow/residual urine measurement 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 it is time consuming, this increases accuracy exponentially. If these first 2 measurements are dissimilar, a third measurement may be needed. Flow measurement is a cornerstone of diagnosis in children after toilet training. If available, the addition of pelvic floor EMG recordings increases the value of uroflow measurements.

Flow rate. Maximum flow rate is the most relevant variable when assessing bladder outflow. Sharp peaks in the flow curve are usually artifacts, and so maximum flow should be documented only at a peak level with a duration of at least 2 seconds.¹² In studies of normal children and adults a linear correlation has been found between maximum flow and the square root of voided volume.¹³ Thus, preliminary evaluation of the results of a flow measurement is possible. If the square of the maximum flow ($[\text{ml per second}]^2$) is equal to or exceeds voided volume in 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 the bladder outlet. In normal voiding the curve is smooth and bell-shaped. OAB may produce an explosive voiding contraction that appears in the flow measurement as a high amplitude curve of short duration, ie a tower-shaped curve. A child with organic outlet tract obstruction often has a low amplitude and rather even flow curve, that is a plateau-shaped curve. Similarly this may be the case when there is a tonic sphincter contraction during voiding. However, more commonly sphincter overactivity during voiding is seen as sharp peaks and troughs in the flow curve, that is as 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 case of an underactive or acontractile detrusor when contraction of the abdominal muscles creates the main force for bladder evacuation, the flow curve usually shows discrete peaks corresponding to each strain, separated by segments with zero flow, namely an 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 a certain terminology should be adopted, including bell, tower, plateau, staccato and interrupted. These appellations are not a guarantee to the underlying diagnostic abnormality, but rather they should serve as a guide to the existence of a specific condition.

Post-void residual urine. Today 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 bladder capacity, as often stated in adults, is not relevant in infants and children. Studies in healthy infants and toddlers have shown that they do not empty the bladder completely every time but they do so at least once during a 4-hour observation period.¹⁴ However, older children should be expected to habitually empty the bladder completely. The unavoidable delay of a few minutes after finishing voiding until ultrasonography results in bladder refilling with up to 5 ml, which is the upper value of residual urine not associated with urinary tract infection. A range of 5 to 20 ml may be associated with insufficient emptying, so that the examination should be repeated. More than 20 ml residual urine found on repetitive occasions indicates abnormal or incomplete emptying, provided that 1) there has not been any time delay exceeding 5 minutes from the end of voiding until ultrasonography is performed and 2) the child has not over ambitiously 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 or 2 ml from measured residual urine for every minute beyond 5.

Invasive Urodynamic Investigations: Cystometry

Urodynamic (cystometric) techniques. Urodynamic studies investigate the 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 suprapubic route is used, a minimal delay of 5 to 6 hours is needed between catheter insertion and urodynamic recording. If a transurethral catheter is

used, it must 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 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 because all infants and many children void without permission. Thus, the distinction between the filling and voiding phases can only be made later, when the curve is analyzed

In accordance with the ICS definitions the physiological filling rate is defined as a filling rate less than the predicted maximum rate of urine production by the kidneys, ie body weight in kg divided by 4 and expressed in ml per minute.² A nonphysiological filling rate is defined as a filling rate greater than this predicted maximum. In children only physiological filling rates should be used. It must be mentioned that this wording is suboptimal since urine production of 3,600 ml during 24 hours in a 10 kg child is clearly not physiological in the true sense of the word. However, the physiological filling rate represents an acceptable filling rate during standard urodynamic investigations. Hjälmås proposed using a filling rate of 5% of expected bladder capacity, expressed in ml per minute.¹⁵

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. This is the technique of choice in pediatric urodynamics if time and equipment are available. If this is not feasible or practical, filling rates of 5% to 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 of bladder sensation are only applicable to older children and adolescents. Infants and young children are unable of indicating these different bladder sensations. A strong desire to void is probably the only sensation that some children can express.

During filling cystometry reduced bladder sensation is defined as decreased sensation throughout bladder filling and absent bladder sensation is defined as no bladder sensation. The 2 conditions can be observed in children with an underactive detrusor, formerly called lazy bladder. Whenever filling exceeds expected bladder capacity for age (see below under signs) and no sensation is reported, we can invoke the term reduced bladder sensation.

Nonspecific bladder sensations are sometimes observed in children. Holding maneuvers (see above) may be evidenced by toe curling and leg movements even in infants. When bladder filling creates pain in children, 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 OAB, is a urodynamic observation characterized by involuntary detrusor contractions that are spontaneous or provoked during the filling phase, involving a detrusor pressure increase of greater than 15 cm H₂O above baseline. In an adult with normal sensation urgency is likely to be experienced in conjunction with such detrusor contractions. In children reporting 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 term 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 in children in reporting bladder sensation adequately.

Bladder compliance describes the relationship between the change in bladder volume and change in detrusor pressure. Compliance is calculated by dividing the volume change (ΔV) by the change in detrusor pressure (Δp_{det}) during that change in bladder volume ($C = \Delta V / \Delta p_{det}$). It is expressed in ml/cm H₂O.

Bladder compliance is a complicated entity in pediatric practice for several reasons. 1) Compliance normally changes according to bladder volume and, thus, it varies with age. Therefore, compliance values should always be related to bladder capacity. 2) Detrusor pressure can be affected by the rate of bladder filling, and so slow rates are preferred in children, especially in infants. 3) There are no reliable reference values available for bladder compliance in infancy and childhood. A rule of thumb is that detrusor pressure 10 cm H₂O or less at expected bladder capacity for age is acceptable (see below). Because bladder volumes vary during early life with an increase from 30 ml at birth to approximately 300 ml as a teenager, compliance tends to increase with age. In young children and infants lower compliance values must be considered normal. More important than the numerical values of bladder compliance is the shape of the filling curve, ie if it is linear or nonlinear and, if nonlinear, in what way it deviates from linearity. Because of this confusion, it is recommended that the actual measurements should 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. Urethral closure pressure is rarely measured. At 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 increased abdominal pressure or detrusor overactivity. Although it is a rare condition, it has been described in children and was formerly called urethral instability.¹⁶

Urodynamic stress incontinence is noted during filling cystometry. It is defined as involuntary urine leakage during increased abdominal pressure in the absence of a detrusor contraction. Urodynamic stress incontinence is now the preferred term, not genuine stress incontinence. In children uro-

dynamic 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. Detrusor leak point pressure excludes any abdominal component to bladder emptying, such as straining, but it includes voluntary sphincter tightening during voiding. These are important definitions since high leak point pressure indicates that there is a risk of upper urinary tract damage. We propose that the term abdominal leak point pressure should be used instead 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 before toilet training the contraction need not be voluntarily initiated. For a given detrusor contraction the magnitude of the recorded pressure increase depends on 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 underactive bladder, is a contraction of decreased strength and/or duration, resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying within a normal time span. An acontractile detrusor demonstrates no contraction whatsoever during urodynamic studies. The 2 conditions can be observed in the clinical setting. They were formerly called lazy bladder but are now referred to as underactive bladder (see below).

Note that the highest detrusor pressure during voiding is not identical to detrusor pressure during maximum urine flow. These values are different between infants and older children, and between males and females.

In infants and children urethral function during voiding is most often measured by pelvic floor EMG recording using primarily skin electrodes. This method provides only an estimate of urethral and pelvic floor function but for diagnostic purposes in the pediatric setting it is usually sufficient. More precise function may be achieved 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 (see below). Detrusor-sphincter dyssynergia, which is applicable in patients with neurogenic bladder disturbance, is the cystometric observation of a detrusor voiding contraction

concurrent with an involuntary contraction of the urethra 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, ie the normal guarding reflex.

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

Four-Hour Voiding Observation

The 4-hour voiding observation is a new, scientifically validated technique used to evaluate bladder function in infancy.¹⁷ The method implies continuous observation of a freely moving infant with frequent ultrasound measurement of bladder filling and residual urine after each voiding. Voided volumes may also be measured by weighing diapers.

Signs

Signs related to voided volume. The ICS and ICCS recommend that voided volume should replace the nebulous term functional bladder capacity.² 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 EBC. EBC is estimated by the formula, $[30 + (\text{age in years} \times 30)]$ in ml.^{18,19} This formula is useful up to age 12 years, after which age EBC is level at 390 ml. EBC is compared to the maximum voided volume (with the addition of residual urine, if present and known), as recorded in a bladder diary. Maximum voided volume is considered small or large if found to be less than 65% or greater than 150% of EBC, respectively (Appendix 6).

Residual urine. Residual urine is the amount of urine left in the bladder immediately after voiding. The term is useful at all ages. As mentioned above in more detail, normal residual urine volume is zero, while 20 ml or more on repeat measurements is pathological. Values between these 2 measurements represent a borderline zone.

Signs related to urine output. Normal urine output is difficult to define in childhood due to great intra-individual and interindividual variation, and to a lack of large-scale investigations.²⁰ While awaiting such investigations, we propose that polyuria should be defined as a 24-hour urine output of more than 2 l/m^2 body surface area. This is applicable in children of all ages.

Nocturnal urine output excludes the last voiding before sleep but includes the first voiding in the morning. In children with enuresis urine voided during sleep is collected in diapers and the change in diaper weight is measured. Nocturnal polyuria is a term relevant mainly in children with nocturnal enuresis.²¹ It is defined in this patient group as a nocturnal urine output exceeding 130% of EBC for the age of the child. The rationale for this definition is that a high nocturnal urine output is only relevant if judged in relation to the bladder. According to this definition nocturnal polyuria obviously results in nocturia or enuresis. However, because of the necessary arbitrariness of this definition, we strongly recommend that group studying these matters should report nocturnal urine output and EBC or the ratios

between them, rather than merely defining children as having polyuria or nonpolyuria.

We realize that some children with high 24-hour urine output for renal or endocrinological reasons may still fail to qualify for the above definition of nocturnal polyuria if the bladder has accommodated and become large. However, in these children the classification of polyuria into nocturnal or diurnal is of little clinical relevance.

CONDITIONS

Enuresis

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

Subgroups. With the growing awareness that children with enuresis differ regarding comorbidity, treatment response and pathogenesis a plethora of various subgrouping strategies has been invented.^{22–24} It is not yet clear if these strategies may prove clinically relevant. Therefore, with the exceptions given below the ICCS will not provide guidelines for this.

There is ample evidence that children with enuresis who have concomitant symptoms of LUT malfunction differ clinically, therapeutically and pathogenetically from children without such symptoms.²⁵ Therefore, an unequivocal and universal subgrouping into monosymptomatic and non-monosymptomatic enuresis on these grounds is essential. The previous subdivision based on the presence or absence of concomitant daytime incontinence alone is deemed inadequate since other daytime symptoms may also be indicative of disturbed LUT function. The new subdivision is as follows. It is recommended that all groups whose studies of enuresis are published should make this subdivision of their patient material.

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

Note also that, in contrast to the previous ICCS document,¹ bedwetting in a child with concomitant daytime incontinence is still called enuresis (or nocturnal incontinence), although it belongs to the nonmonosymptomatic 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.²⁶ Otherwise the term primary enuresis should be used.

Daytime Conditions

The classification of daytime LUT conditions, especially conditions with daytime incontinence as a central symptom, is less straightforward than that of enuresis. The overlap between conditions is considerable, borderline cases are com-

mon and the pathogenetic rationale for the grouping of various symptom complexes into specific conditions is often not fully evidence based. Furthermore, there is often evolution with time. For example, a child may start with urge incontinence, continue through voiding dysfunction and voiding postponement, and end with an underactive bladder.

To lessen this confusion and provide grounds for precise definitions with greater pathogenetic and clinical relevance the ICCS advises researchers studying these children to assess and document 4 parameters in their patients, namely 1) incontinence (presence or absence and symptom frequency), 2) voiding frequency, 3) voided volumes and 4) fluid intake.

This is more important than subgrouping 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.

OAB and urge incontinence. We agree with the current adult urology community practice of dropping the nebulous term bladder instability² and replacing it with OAB. The subjective hallmark of OAB is urgency and, thus, children with this symptom can be said to have an OAB. Incontinence is often also present, 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 pathogenetic significance, especially when fluid intake is not considered. 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, thus, it is a term that is applicable to many children with OAB.

Voiding postponement. Children with daytime incontinence who are observed by their parents and/or caregivers to habitually postpone micturition, often in specific situations, using holding maneuvers are said to experience 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 of increasing voiding intervals and at the same time decreasing incontinence. The rationale for the delineation of this entity lies in the observation that these children often experience psychological comorbidity or behavioral disturbances.²⁷

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 increase intra-abdominal pressure to initiate, maintain or complete voiding, ie straining. The children often produce an interrupted pattern on uroflow measurement and they 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 repeat uroflow measurements show curves with a staccato pattern or unless verified by invasive urodynamic investigation. Note that

the term describes malfunction during the voiding phase only. It says nothing about the storage phase. The use of this expression to denote any kind of disturbed LUT function²⁸ leads to confusion and is strongly discouraged. Dysfunctional voiding means dysfunction during voiding. Of course, it is entirely possible for a child to experience dysfunctional voiding as well as storage symptoms such as incontinence.

Obstruction. Children with a mechanical or functional, static or phasic impediment to urine outflow during voiding are said to experience LUT obstruction. It is characterized by increased detrusor pressure and a decreased urine flow rate. Different types of LUT obstruction in children are now easy to describe and quantify using videourodynamic techniques.²⁹

Stress incontinence. Stress incontinence is the leakage of small amounts of urine at exertion or at increased intra-abdominal pressure for various reasons. It is rare in neurologically normal children. It 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 in whom detrusor contractions may be provoked by, for instance increased intra-abdominal pressure. The term mixed incontinence, applied in 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 occurring within 10 minutes after normal voiding, are said to experience 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. The term giggle incontinence should not be used in these cases.

Extraordinary daytime urinary frequency. This term applies to children who void often and with small volumes during the daytime only. Daytime voiding frequency is at least once hourly 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 age of the child. 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 of the LUT. However, we find it useful to list comorbid conditions that are relevant and important to consider for researchers studying the LUT in children. The conditions include constipation and encopresis (Appendix 2), urinary tract infection, asymptomatic bacteriuria, vesicoureteral reflux, neuropsychiatric conditions (at-

tention deficit hyperactivity disorder, oppositional defiant disorder, etc), learning disabilities and disorders of sleep (sleep apneas and parasomnias).

TREATMENT

Definitions of Treatment Methods

Treatment in its widest sense refers to any intervention that may or is done with the intent 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 repeat uroflow measurements, are also parts of treatment.

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

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

Urotherapy. Urotherapy means nonsurgical, nonpharmacological treatment for LUT malfunction. Thus, it is synonymous with the term LUT rehabilitation, which is frequently used in the adult sphere.² It encompasses a 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 noninterventive and it includes certain components, namely 1) information and demystification, that is explanation about normal LUT function and in what way the particular child deviates from normal, 2) instruction about what to do about it, ie regular voiding habits, sound voiding posture, avoiding holding maneuvers, etc, 3) life-style advice regarding fluid intake, the prevention of constipation, etc, 4) documentation of symptoms and voiding habits using bladder diaries or frequency-volume charts, and 5) support and encouragement via regular followup by the caregiver.

Specific interventions used in the urotherapeutic setting are defined in the same way as that published by the ICS.² Thus, they are 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, a type of psychotherapy including a wide array of cognitive and behavioral modification techniques. However, the term cognitive behavioral therapy should not be used indiscriminately and without defining which techniques to be used.

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. However, in the research setting 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 among future studies. For more in-depth discussions of parameters of success and treatment outcome other texts can be consulted.^{30,31}

Three basic principles should be recognized by researchers. 1) Assessment of treatment outcome must be based on pretreatment baseline documentation of symptom frequency. 2) Actual symptom frequency during baseline and treatment should be shown. This gives more information than the grouping of children into responders and nonresponders. 3) Different responses during and after cessation of treatment must be clear. The latter may sometimes reflect cure but the former never reflects it.

When children must be grouped together in subgroups with varying degrees of treatment response for reasons of comparison, it is suggested that the grouping should be done as shown below. Percents shown reflect the decrease in symptom frequency, ie a decrease in the number of wet nights weekly.

Initial success. Nonresponse is defined as a 0% to 49% decrease, partial response is defined as a 50% to 89% decrease, response is defined as a 90% or greater decrease and full response is defined as a 100% decrease or less than 1 symptom occurrence monthly.

Long-term success. Relapse is defined as more than 1 symptom recurrence monthly, continued success is defined as no relapse in 6 months after the interruption of treatment and complete success is defined as no relapse in 2 years after the interruption of treatment.

APPENDIX 1

Other experts

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

APPENDIX 2

Encopresis and functional fecal incontinence

Urinary and fecal incontinence often coexist in different combinations. Therefore, it is advisable to focus on comorbidity and describe any type of nocturnal enuresis, daytime urinary incontinence and fecal incontinence. In other words, 1 child might have 3 conditions and diagnoses at the same time and each 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 are provided but not of signs and symptoms. Definitions are provided in accordance with other specialties, such as pediatric gastroenterology and child psychiatry, dealing with children with these disorders.³²

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

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

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

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

(appendix continued)

APPENDIX 2 continued

Encopresis

According to the ICD-10³³ and the DSM-IV³⁴ encopresis is defined as voluntary and involuntary passage of feces in inappropriate places in a child 4 years or older after organic causes have been ruled out. It must occur at least once monthly 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.

In the subtype encopresis with constipation (synonyms: encopresis with constipation and overflow incontinence [DSM-IV], retentive encopresis and functional retentive [or constipation associated] fecal incontinence) encopresis and constipation are present.

In the subtype encopresis without constipation (synonyms: encopresis without constipation and overflow incontinence [DSM-IV], functional non-retentive [or nonconstipation associated] fecal incontinence and solitary encopresis) encopresis but no constipation is present.

Soiling is a confusing and poorly defined term that should not be used in view of established international definitions of encopresis (ICD-10 and 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 that of the North American Society for Pediatric Gastroenterology and Nutrition: "a delay or difficulty in defecation, present for two or more weeks and sufficient to cause distress to the patient."³⁵

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 Rome-II criteria.³⁶ Only 5% of all cases of constipation are due to organic causes and 95% are functional. For research purposes it is best to describe defecation frequency as well as all associated signs and symptoms.

Chronic constipation has been defined by the Paris Consensus on Childhood Constipation Terminology Group by the occurrence of 2 or more of the following characteristics during the last 8 weeks): fewer than 3 bowel movements weekly, greater than 1 episode of fecal incontinence weekly, 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 withholding behaviors and/or painful defecation.³⁷

Functional fecal retention consists of repetitive attempts to avoid defecation because of fears associated with defecation. Consequently a fecal mass accumulates in the rectum. It is defined by the passage of large diameter stools and retentive posturing for at least 12 weeks.³⁶ This term is deemed redundant by the Paris Consensus on Childhood Constipation Terminology Group because it is included in the definition of chronic constipation.³⁶

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 for micturition and for defecation.

APPENDIX 3

Alphabetical 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: 3 or fewer voidings per day.

Daytime voiding frequency, increased: 8 or more voidings per day.

Detrusor overactivity: the observation during cystometry of involuntary detrusor contractions during the filling phase. This 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 decreased 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, ie synonymous with (intermittent) nocturnal incontinence. The term is used regardless of whether daytime incontinence or other lower urinary tract symptoms is also present. Nocturnal may be added for extra clarity.

(appendix continued)

APPENDIX 3 continued

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

Enuresis, nonmonosymptomatic: enuresis in a child with (other) lower urinary tract symptoms, such as daytime 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, as calculated via the formula, [30 + (age in years × 30)] in 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, which indicates malformation or iatrogenic damage.

Incontinence, intermittent: leakage of urine in discrete portions during the day and/or night.

Incontinence, nocturnal: see enuresis.

Overactive bladder: the condition afflicting patients experiencing urgency symptoms. It replaces the term bladder instability.

Polyuria, nocturnal: nocturnal urine output exceeding 130% of expected bladder capacity. See above.

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

Underactive bladder: the condition afflicting patients with low voiding frequency and the need to increase intra-abdominal pressure to void. It replaces the term lazy bladder.

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

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

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

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

APPENDIX 4

Urodynamic instruments in children

Instrument	Age	Data
Bladder diary	From 5 years	Voided volumes Voiding frequency Urine output Symptom (leakage, etc) frequency Other data (Appendix 5)
Uroflow and 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-Hour voiding observation	Infancy	Voided volumes Voiding frequency Residual urine Observation of symptoms

APPENDIX 5

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 hours (including nocturia volumes)	Voiding frequency Daytime urine output (if no or small amounts of incontinence urine, or pad testing performed) The 24-hour urine output (if no enuresis or enuresis volumes measured) Average voided volume Maximum voided volume

(appendix continued)

APPENDIX 5 continued

Data to be Included	Duration of Documentation*	Information That Can be Extracted
Nocturia episodes	14 Nights	Nocturia frequency
Daytime incontinence episodes	14 Days	Incontinence frequency
Enuresis episodes	14 Nights	Enuresis severity
Enuresis urine volumes†	7 Nights	Presence or absence of nocturnal polyuria
Other LUT symptoms	14 Days	Symptom frequency
Fluid intake volume, timing and type of fluid intake‡	Minimum 48 hours	The 24-hour fluid intake Fluid intake pattern
Bedtime and awakening time§	14 Days	Time spent in bed
Bowel movements	14 Days	Defecation frequency
Encopresis	14 Days	Encopresis severity

* Compromise between what is scientifically validated⁹⁻¹¹ and what is deemed practical without undue risk of noncompliance and study dropout.
† Implies measurement of weight of diapers or bedclothes and can be omitted if no urine output assessment is deemed necessary.
‡ Since urine output equals fluid intake minus insensible perspiration, these data are needed for good urine output interpretation.
§ Recommended but not mandatory.
|| Needed when encopresis or any constipation symptom is present.

APPENDIX 6

Maximum voided volume formula

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

Abbreviations and Acronyms

DSM	=	Diagnostic and Statistical Manual of Mental Disorders
EBC	=	expected bladder capacity
EMG	=	electromyography
ICCS	=	International Children's Continence Society
ICD	=	International Classification of Diseases
ICS	=	International Continence Society
LUT	=	lower urinary tract
OAB	=	overactive bladder

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