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Review Article

Update and summary of the EAU/ESPU paediatric guidelines on urinary tract infection in children

Michele Gnech [a,*], Anna Bujons [o], Christian Radmayr [n], Lisette 't Hoen [q], Guy Bogaert [c], Berk Burgu [m], Yazan F. Rawashdeh [b], Mesrur Selcuk Silay [p], Fardod O'Kelly [e], Josine Quaedackers [f], Niklas Pakkasjärvi [k,l], Allon van Uitert [h], Martin Skott [b], Uchenna Kennedy [g], Yuhong Yuan [i,j], Alexandra Zachou [r], Marco Castagnetti [d]

* Correspondence to: Michele Gnech,Department of Paediatric Urology, Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, Milan, Italy michele.gnech@policlinico.mi.it (M. Gnech) abujons76@gmail.com (A. Bujons) christian.radmayr@i-med.ac.at (C. Radmayr) l.thoen@erasmusmc.nl (L. 't Hoen) guy.bogaert@uzleuven.be (G. Bogaert) berkburgu@gmail.com (B. Burgu) yazan.rawashdeh@rm.dk (Y.F. Rawashdeh) selcuksilay@gmail.com (M.S. Silay) fardod.okelly@ucd.ie (F. O'Kelly) j.s.l.t.quaedackers@umcg.nl (J. Quaedackers) niklas.pakkasjarvi@gmail.com (N. Pakkasjärvi) Allon.vanUitert@radboudumc.nl (A. van Uitert) martinskott24@gmail.com (M. Skott) Uchenna.Kennedy@kispi.uzh.ch (U. Kennedy) yyuan@mcmaster.ca (Y. Yuan) marco.castagnetti@unipd.it (M. Castagnetti)

Keywords
Urinary tract infections; Diagnostics; Guidelines; Pediatrics; Children; EAU

Abbreviations
EAU, European Association of Urology; ESPU, European Society for Paediatric Urology; UTI, Urinary tract infection; LUTD, Lower urinary tract dysfunction; BBD, Bladder and bowel dysfunction; VUR, Vesicoureteral reflux; US, Ultrasound; MRI, Multimodal magnetic resonance imaging; DMSA, Dimercaptosuccinic acid; VCUG, Voiding cystourethrography; PIC, Positional Instillation of Contrast; *E. Coli*, *Escherichia Coli*; *Spp*, *Species plures*; RCT, Randomized Controlled Trials; CENTRAL, Cochrane Central Register of Controlled Trials; CFU, Colony-Forming Unit; CRP, C-Reactive Protein; ESBL, Extended-Spectrum Beta-Lactamase; NSAIDs, Nonsteroidal Anti-Inflammatory Drugs

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Summary

Background and objective
These guidelines aim to provide a practical approach for both diagnosis and management of urinary tract infections (UTI).

Objective
To highlight 2025 update of the Guidelines of the European Association of Urology (EAU) and the European Society for Paediatric Urology (ESPU) on UTI in children.

Methods
A structured literature review was performed for all relevant litterature from the last update (2021) up to 20th February 2024.

Key findings and limitations
UTIs represent the most common bacterial infections in children. The leading causative organism is *Escherichia* Coli (*E. Coli*), however, other bacteria have been increasing in prevalence, as has the prevalence of multiresistent E. Coli infections. UTIs can be classified in several ways including upper vs. lower urinary tract UTIs; febrile vs. non febrile UTIs; first vs. recurrent vs. breakthrough episode; typical vs. atypical. Urine samples for analysis can be collected by urine bag, clean catch, catheterization, or suprapubic aspiration. Methods for urinalysis include dipstick, microscopy and flow imaging analysis technology. Each collection and analysis method has its own advanatages and drawbacks. Microscopic urinalysis is recommended after a positive dipstick test. In terms of additional investigations, the Panel generally recommends a renal and bladder ultrasound after an initial febrile UTI, whereas additional investigations should be considered based on the characteristics of the patient and of the infection. A flow-chart is proposed. The cornerstone of UTI management is prompt antimicrobial therapy. The administration route should be chosen based on several variables. The agent should be chosen based on local antimicrobial sensitivity patterns,

[a]Department of Paediatric Urology, Fondazione IRCCS Ca' Granda, Ospedale Maggiore Policlinico, Milan, Italy
[b]Department of Urology, Section of Pediatric Urology, Aarhus University Hospital, Aarhus, Denmark
[c]Department of Urology, University of Leuven, Leuven, Belgium
[d]Pediatric Urology Unit, Bambino Gesù Children Hospital and Research Center, Rome, Italy
[e]Division of Paediatric Urology, Beacon Hospital Dublin & University College Dublin, Ireland
[f]Department of Urology, University Medical Center Groningen, Groningen, the Netherlands
[g]Department of Pediatric Urology, University Children's Hospital Zurich, Switzerland
[h]Department of Urology, Radboud University Medical Centre, Nijmegen, the Netherlands
[i]Department of Medicine, London Health Science Centre, London, Ontario, Canada
[j]Department of Medicine, McMaster University, Hamilton, Ontario, Canada
[k]Department of Pediatric Surgery, New Children's Hospital, Helsinki University Hospital, Helsinki, Finland
[l]Vaasa Central Hospital, University of Turku, Turku, Finland
[m]Department of Pediatric Urology, Ankara University School of Medicine, Ankara, Turkey
[n]Department of Urology, Medical University of Innsbruck, Innsbruck, Austria
[o]Division of Pediatric Urology, Urology Department Fundació Puigvert Universitat Autonòma Barcelona, Spain
[p]Division of Pediatric Urology, Department of Urology, Biruni University, Istanbul, Turkey
[q]Department of Pediatric Urology, Erasmus Medical Center, Rotterdam, the Netherlands
[r]Department of HIV and Sexual Health, Chelsea & Westminster Hospital, London, UK

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and adjusted according to sensitivity-testing. Interventions can be considered to prevent UTI recurrence including chemoprophylaxis, non-antibiotic prophylaxis, and treatment of phimosis, bladder-bowel dysfunction and lower urinary tract dysfunction.

Conclusions and clinical implications

This paper is a summary of the 2025 updated (Table) of EAU/ESPU Guidelines and provides practical considerations for the management and diagnostic evaluation of UTI in children.

Introduction

This publication is a summary of the 2025 update of the chapter on urinary tract infections (UTI) in children of the European Association of Urology (EAU) and the European Society for Paediatric Urology (ESPU) Guidelines (https://uroweb.org/guidelines/paediatric-urology) (Table 1). The guidelines aim to provide a practical approach to the treatment of UTI based on risk analysis and selective indications for both diagnostics and management.

Method

Chapters of the EAU/ESPU Guidelines on Paediatric Urology are regularly updated, up to a maximum of 4 years intervals. The previous summary of these guidelines was published in 2021 [1]. An updated literature search was performed from the last update (2021) until February 20, 2024. The literature search was performed using the following databases: MEDLINE, Embase, and Cochrane Central Register of Controlled Trials (CENTRAL). Keywords related to UTI and children were combined using Boolean operators. Controlled vocabularies as well as free text words were searched; variations of root words were searched. The search included RCTs, non-randomized clinical trials, observational studies (prospective or retrospective), diagnostic accuracy studies, systematic reviews or meta-analyses. Conference abstracts, case series or case reports were excluded. Only publications written in English were included. The search strategy is provided as a supplement to the Guidelines Chapter (Appendix 1) and was designed to balance sensitivity and precision for guideline purposes. In total, 1071 citations were retrieved for screening.

The structured literature search was conducted by a research information specialist and reviewed by at least two Panel members. Relevant publications underwent a critical appraisal, and the chapter was updated based on new studies deemed important for clinical practice. The final version was discussed in regular panel meetings in plenary sessions. Conflicting data or gaps in the literature were addressed and resolved through panel consensus if necessary. Guidelines' recommendations are developed by expert panels to prioritize clinically significant care decisions. The strength of each recommendation is determined by several factors, including the balance between benefits and risks of different management strategies, the quality and certainty of the evidence, and the variability in patient values and preferences (Phillips, B. et al. Oxford Centre for Evidence-based Medicine Levels of Evidence. Updated by Jeremy Howick March 2009). Strong recommendations typically reflect high-quality evidence and/or a clear favorable balance of benefits over harms, with strong patient preference. Weak recommendations often

Table 1 Summary of changes compared to the version of 2021 Paediatric Urology Guidelines on UTI.

General	
Content and reference list have been updated based on the results of a systematic search of the literature published since the last release of the guidelines in 2021	
UTI classification has been modified	
2021:	2025:
Classification according to site: upper vs. lower UTI	Classification according to clinical presentation: febrile vs. non febrile
Classification according to severity	Classification according to episode: First, recurrent, breakthrough
Classification according to episode: First, recurrent, breakthrough	Classification according age and toilet-training status
Classification according to symptoms	Classification according to the clinical course: typical vs. atypical
Classification according to complicating factors	Classification according to urinary tract abnormalities
Diagnostic evaluation	
The section has been shortened and straightened making it more practical	
A section on blood tests has been added	
Flowcharts for UTI management and imaging after first UTI have been modified	
Management	
A paragraph on steroid adjuvant treatment has been added	
A paragraph about urinary diversion has been added	
New evidence about non-antibiotic prophylaxis and circumcision has been added	

indicate lower-quality evidence, an uncertain benefit-risk balance, or variability in patient preferences. [2] Additional information can be found in the general Methodology section online at the EAU website; https://uroweb.org/eau-guidelines/methodology-policies.

Results

Epidemiology

UTIs represent the most common bacterial infections in children [3]. The leading causative organism for UTIs is Escherichia Coli (*E. Coli*), however, other bacteria have been increasing in prevalence in both nosocomial and community-acquired infections [4]. In addition, over the last decades, the prevalence of beta-lactamase-resistant *E. Coli* has increased in both nosocomial and community-acquired UTIs [5].

The prevalence and characteristics of UTIs vary with patient factors such as age, sex, and circumcision status in males. For instance, UTI prevalence is higher in neonates, with a predominance in males; neonates more frequently have infections by organisms other than *E. Coli*, and a higher risk of urosepsis [6].

UTI, renal scarring and underlying uropathy

Delayed UTI treatment can lead to permanent focal renal damage, known as renal scarring. The risk of renal scarring increases with the number of febrile UTIs, with an incidence of 2.8 % after a first febrile UTI, rising to 25.7 % after two febrile UTIs and 28.6 % after three or more febrile UTIs [7,8]. Multiple UTI episodes can also lead to an eventual significant loss of renal function and chronic renal failure [9]. Risk factors for recurrent UTIs include obesity, ethnicity, the presence of lower urinary tract disorders (LUTD) and/or bladder and bowel dysfunction (BBD), and any underlying urological conditions, particularly high grade vesicoureteral reflux (VUR) [10].

For further details on UTI and underlying uropathies, please refer to the specific chapters of the guidelines (https://uroweb.org/guidelines/paediatric-urology) or the corresponding summaries of the dedicated chapters on CLUTO and VUR [11,12].

Prompt treatment of UTI is important to prevent the development of renal damage. However, diagnosis is often uncertain, and misdiagnosis can lead to unnecessary treatment and medicalization of otherwise healthy children [13].

Presentation symptoms

UTI most commonly presents with systemic symptoms including fever, vomiting, lethargy and/or irritability. UTI is the cause of fever in 4.1–7.5 % of children who present to a paediatric clinic [14]. Neonates with severe UTIs can present with non-specific symptoms, such as failure to thrive, jaundice, or hyperexcitability, even in the absence of fever.

Particularly in older patients, UTI can present with lower urinary tract symptoms in the absence of fever.

Classification of UTIs

All UTIs can be classified into upper or lower urinary tract infections.

Lower UTIs (cystitis) are an inflammatory condition of the urinary bladder mucosa with specific signs and symptoms including dysuria, frequency, urgency, malodorous urine, enuresis, haematuria, and/or suprapubic pain.

Upper UTIs (pyelonephritis) involve a diffuse pyogenic infection of the renal pelvis and parenchyma with an abrupt onset. Clinical signs and symptoms include fever (>38 °C), chills, costovertebral angle or flank pain, and tenderness.

Clinically, UTIs are classified as febrile or non-febrile.

Febrile UTIs (fUTIs) typically involve the upper tract with a greater risk for renal damage. Non-febrile UTIs are infections generally limited to the lower urinary tract. A non-febrile UTI should be differentiated from asymptomatic bacteriuria, where there is a positive culture in an otherwise asymptomatic child.

A UTI can occur as an isolated single episode, sporadically with no obvious pattern, or as a recurring condition. Recurrent urinary tract infections are defined as at least three episodes of a UTI in 12 months, or at least two episodes in six months [15].

A breakthrough infection refers to a UTI in patients on antibacterial prophylaxis. Breakthrough UTIs are usually due to bacteria resistant to the antibiotic used for prophylaxis.

From an age perspective, UTIs can occur in infants, in children during the period of toilet training, in toilet-trained children, and finally in older children. Infants represent a critical group, as a UTI diagnosis can be difficult, the course severe, and the UTI may be the first sign of a previously unknown urinary tract abnormality. During the toilet training period, UTIs may occur as a result of temporary partial bladder control. These infections tend to be mild and generally tend not to recur. UTIs in toilet-trained children can suggest underlying LUTD/BBD.

Based on the clinical course, UTIs can be classified as either typical or atypical. Typical UTIs are caused by common bacteria, generally *E. Coli* which promptly responds to oral antibiotics in patients >1 year of age. In contrast, atypical UTIs are generally caused by bacteria other than *E. Coli* and/or multi-resistant bacteria and may require hospital admission for parenteral antibiotic treatment.

Diagnostic evaluation

Medical history

History taking should define the type of episode, first or recurring; possible history of urinary tract abnormalities including any urinary tract abnormality detected during prenatal US screening; prior operations; family history; and the presence of lower urinary tract symptoms (LUTS) and/or constipation.

Physical examination

Physical examination includes a general examination to exclude other causes of fever. Assessment of body weight and temperature, examination of the abdomen (constipation, palpable and tender kidney, or palpable bladder), flank, lower back (possible stigmata of spinal dysraphism or sacral agenesis) and genitalia (phimosis, labial adhesions, vulvitis, epididymo-orchitis) should be performed.

Urine sampling, analysis and culture

The technique used for obtaining urine for urinalysis and the culture method affect the rate of contamination, which influences result interpretation, particularly in early infancy [16]. Urine sampling should be performed prior to administration of any antimicrobial agent.

In older, toilet-trained children, after carefully retracting the foreskin and cleaning the glans penis in boys and spreading the labia and cleaning the peri-urethral area in girls, the use of a clean catch, especially midstream urine, is considered an acceptable technique for obtaining a reliable urine sample [17].

In neonates, infants and non-toilet-trained children, there are four main methods with varying rates of contamination and invasiveness, with respect to urine collection: Plastic bag, supra-pubic aspiration (SPA), clean-catch urine (CCU) collection and, bladder sampling via trans-urethral catheter.

Plastic bags applied to the genitalia is a commonly used method in clinical practice. However, this technique has high contamination rates, ranging from 18 % to 80 %, as reported in the literature [18]. On the other hand, SPA is most sensitive method to obtain an uncontaminated urine sample in this age group; but it is also the most invasive modality [19]. On balance, CCU collection and bladder sampling via trans-urethral catheter appears to have a good correlation with SPA being however, less invasive [20]. CCU is less invasive compared to catheterization, but is also more time consuming and less practical.

Urinalysis. The most common methods used for urinalysis include dipstick, microscopy and flow imaging analysis technology.

Dipstick testing is appealing because it provides rapid results. Leukocyte esterase and nitrite are the most commonly tested markers. The conversion of dietary nitrates to nitrites by bacteria takes approximately 4 h in the bladder [20,21]. The sensitivity of using nitrite alone to screen febrile children under 2 years of age is low, and relevant UTIs can be missed. However, the specificity is high for children across all ages [22]. In febrile infants $<$90 days old, urine dipstick tests from CCU samples can be used for screening of UTIs when nitrites and leukocyte esterase are used in combination, with a sensitivity of 86 % and a specificity of 80 % [23].

In uncentrifuged urine microscopy test, a count of $>$10 WBC/μL has been demonstrated to be sensitive for UTI [24]. However, no significant difference was found between dipsticks and microscopy testing for UTI [25].

Flow imaging analysis technology is being used increasingly to classify particles in uncentrifuged urine specimens [26]. Counts of WBCs, squamous epithelial cells, and red cells correlate well with those found by manual counting [20].

In addition to these methods, urine biomarkers are currently under evalutation to distinguish UTIs from culture-negative pyuria [27–29].

Urine culture. Following negative results from dipstick, microscopic or automated urinalysis, urine culture is generally not recommended, especially if there is an alternative source of fever. If the dipstick result is positive, confirmation by urine culture is strongly recommended by the Panel.

The optimal colony-forming unit (CFU) cut-off for diagnosing a UTI remains controversial and varies according to the method used for urine sampling. In patients with a fUTI, $\geq 10^5$ CFU/mL can be expected. Urine cultures obtained from clean-catch, midstream, and catheterisation specimens can be considered positive with counts of 10^3–10^4 CFU/mL in a monoculture, and any counts obtained after suprapubic aspiration (SPA) should be considered significant. Mixed cultures are indicative of contamination. In febrile children under 4 months of age, a cut-off value of 10^3 CFU/mL can be used when clinical and laboratory findings are consistent, and a correct sampling method has been used [30].

A negative culture with the presence of pyuria may be due to incomplete antibiotic treatment, urolithiasis, or foreign bodies in the urinary tract, and infections caused by Mycobacterium tuberculosis or Chlamydia trachomatis.

Diagnostic evaluation and subsequent management of a febrile child with suspicion of UTI is summarized in Fig. 1.

Blood testing

Blood tests serve as a complementary tool for the diagnosis of UTI and are generaly performed only in patients requiring hospital admission. In cases of renal parenchymal involvement, a neutrophilic leukocytosis is expected, as is a rise in C-reactive protein. These markers are non-specific and several additional markers are under evaluation, but are not yet used in clinical practice [28,31]. In current clinical practice, the most specific blood marker of renal involvement is procalcitonin with a serum cut-off value $>$ 1.0 ng/mL having been shown predictive of acute pyelonephritis in young children [32]. In patients with febrile UTIs requiring admission, serum electrolytes and blood cell counts should also be evaluated.

Additional work-up

Imaging modalities in the acute phase of the infection should be differentiated from follow-up investigations recommended in patients following a first, or recurrent episode of UTI.

Ultrasound (US). The Panel recommends a renal and bladder ultrasound (US) in children with febrile UTIs to rule out urinary tract abnormalities. The investigation should be performed within 24 h in infants and acutely ill children, as these patients are typically hospitalised and may require urgent management. However, in children who do not require hospitalisation, renal US may be scheduled at a later date. In toilet-trained patients, US should be performed both before and after voiding to assess upper tract changes in relation to bladder filling and to measure post-void residual urine volumes, which can indicate underlying voiding dysfunction. An elevated post-void residual urine volume predicts the recurrence of UTIs in toilet-trained children [33]. US can also help in assessing the presence of fecal impaction [34]. When peri-renal or psoas abscesses or renal masses are seen on US, it is important to consider xanthogranulomatous

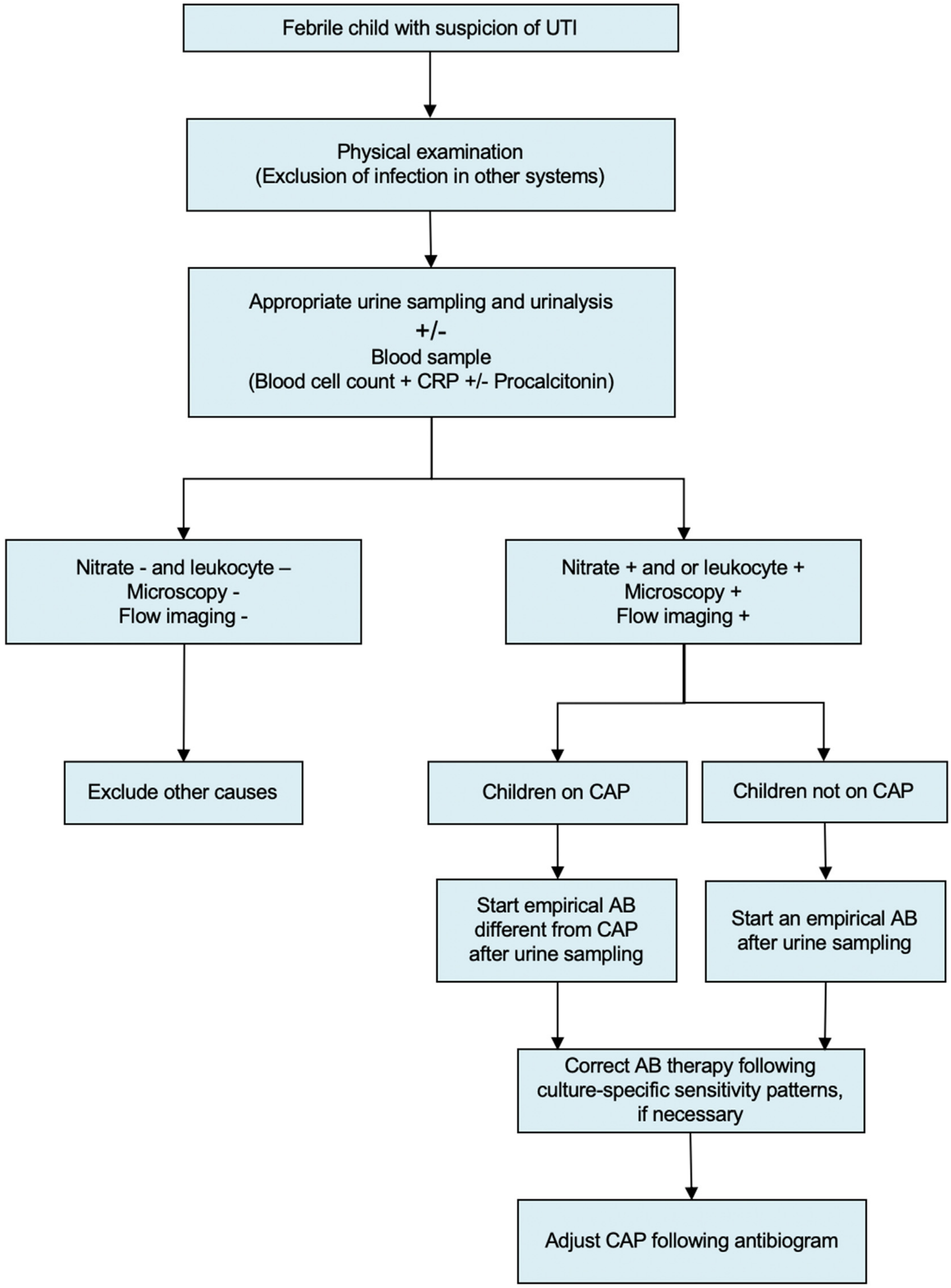

Fig. 1 Diagnostic evaluation and subsequent management of a febrile child with suspicion of UTI. CRP = C-reactive protein; AB = antibiotic; CAP: continous antibiotic propyilaxis.

pyelonephritis, and subsequent CT scan is recommended [35].

Radionuclide scanning. The dimercaptosuccinic acid (DMSA) scan is the most accurate method to localize UTIs in the renal parenchyma and assess renal scarring. To evaluate renal involvement, a DMSA scan should be performed within days of a febrile UTI (acute or early DMSA), where pyelonephritis appears as a perfusion defect within the kidney. Acute DMSA scans are nowadays generally avoided in favour of follow-up DMSA scans, performed at least six months from the infection, which can detect persistent scaring [36].

Multimodal magnetic resonance imaging. Diffusion-weighted multimodal magnetic resonance imaging (MRI) has also been shown to accurately diagnose acute pyelonephritis while avoiding radiation burden [37], This investigation however, is not considered standard practice at present.

Voiding cystourethrography/urosonography (VCUG). Voiding cystourethrography (VCUG) is the preferred imaging method to detect VUR [11]. Performing a VCUG soon after a UTI, once sterile urine is confirmed, does not result in significant morbidity [38]. Harmonic voiding urosonography, which avoids radiation exposure, can be an alternative to standard VCUG, though it does not provide urethral imaging [39].

In order to limit the number of patients undergoing a VCUG, the top-down approach has been proposed [8]. VCUG is recommended in the following cases: (1) first febrile UTI in infants under 12 months, regardless of ultrasound results; (2) recurrent febrile UTI, abnormal ultrasound, or presence of an abnormal DMSA in a top-down approach; (3) atypical UTI at any age, regardless of ultrasound results. The diagnostic flowchart recommended by the Panel is depicted in Fig. 2.

For patients with recurrent febrile UTIs and an abnormal DMSA, but no VUR on standard VCUG, Positional Instillation of Contrast (PIC) cystography, which uses endoscopic instillation of contrast near the ureteral orifice, may also be an option to detect reflux [40].

Management

The cornerstone of UTI management is prompt antimicrobial therapy. Delaying treatment for more than 48–72 h in children with febrile UTIs increases the risk of renal scarring [41]. Supportive treatment may be required in severely ill patients and temporary urinary diversion should be considered on a case by case basis [40]. The requirement for surgical procedures, such as cutaneous ureterostomy or nephrectomy, during the acute phase is exceptional. After the treatment of the infection, it is crucial to address any LUTD/BBD, if present [32,42].

Administration route of antibacterial therapy

The choice between oral and parenteral therapy should be based on: patient age, clinical suspicion of urosepsis, illness severity, refusal of fluids, food and/or oral medication, vomiting, diarrhoea, non-compliance, and complicated pyelonephritis (e.g., urinary obstruction).

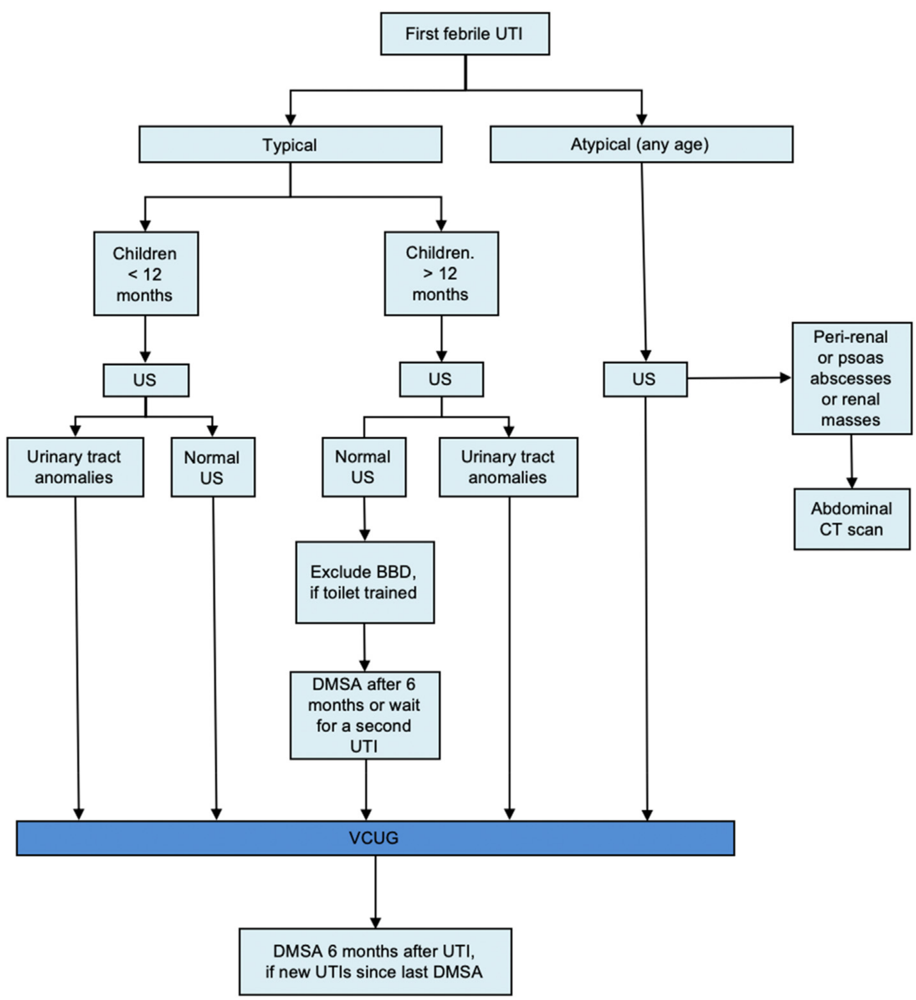

Fig. 2 Diagnosis strategy for first febrile UTI. UTI = urinary tract infection; VUR = vesicoureteral reflux; i.v. = intravenous.

Adjustment of antimicrobial agents
The selection of an appropriate agent is based on local antimicrobial sensitivity patterns, and should later be adjusted according to sensitivity-testing of the isolated uropathogen [20]. Awareness of local resistance patterns is crucial, as these can vary significantly between countries, regions, and even hospitals. The patient's previous urine culture results should also be considered in the decision-making. The daily antibiotic dosage depends on the child's age, weight, and renal and liver function. It is important to note that not all available antibiotics are approved by national health authorities, particularly for use in infants.

Reports of UTIs caused by extended-spectrum ß-lactamase-producing Enterobacteriaceae (ESBL) in children are increasing. Several risk factors for UTIs caused by ESBL-producing and non-*E. Coli* bacteria have been identified, including a history of infection, recent hospitalisation, short-term antibiotic exposure, and prophylaxis [43].

See Fig. 1 for a flow-chart.

Duration of therapy
The duration of antibiotic therapy should be determined by the nature of the UTI, with simple cystitis generally requiring shorter courses, while febrile and complicated infections may necessitate longer treatment [20]. The Short Course Therapy for Urinary Tract Infections (SCOUT) randomized trial demonstrated that a five-day course of oral antibiotics was non-inferior to a ten-day course for the treatment of uncomplicated UTIs in children, supporting the use of shorter regimens when clinically appropriate. However, febrile UTIs still require longer courses to reduce the risk of recurrence and renal complications [44].

However, a simple cystitis can be treated with three to five days of antibiotics [45]. No significant difference in recurrent UTIs and re-hospitalisation were found between seven day parenteral treatment and longer regimens for bacteraemic UTIs in younger infants [46]. In young infants a short course of parenteral treatment with early conversion to oral antibiotics may be considered [47]. The exclusive use of oral therapy with a third-generation cephalosporin (e.g., cefixime or ceftibuten) has been demonstrated to be equivalent to the usual two to four days intravenous therapy followed by oral treatment [48—51]. Similar data have been shown for amoxicillin-clavulanate [52]. If ambulatory therapy is chosen, adequate surveillance, medical supervision and if necessary, adjustment of therapy must be guaranteed. In the initial phase of therapy, close contact with the family is advised [53].

Children with bacteremia did not show significant clinical differences with non-bacteremic infants, but did receive longer parental treatment [54].

For the majority of children, the pathogenesis is related to ascending infection due to a pre-existing uropathy, especially VUR or urinary obstruction. Initial management consists of broad-spectrum antibiotics with good tissue penetration [55].

Adjunct steroid treatment
Adjuvant dexamethasone treatment, by modulating the immune response, has been hypothesized to reduce kidney scarring after acute pyelonephritis in children. A multicenter, prospective, double-blind, placebo-controlled, randomized clinical trial demonstrated no difference in either duration of UTI or in the presence of renal scars on a DMSA perfromed 6 months after the infection, between patients receiving a 3-day course of either intravenous dexamethasone 0.30 mg/kg/day twice daily, or placebo [56].

Temporary urinary diversion
Temporary bladder drainage via a transurethral catheter or a suprapubic catheter might be required in case of failure to respond to treatment with suitable antibiotics within 72 h. It can offer some advantages in selected patients with urinary tract abnormalities, underlying medical conditions, poor urine flow, abdominal or bladder mass, elevated creatinine leves, significant kidney damage and septicaemia. Drainage of infected urine may prevent progression to renal abscess formation, and preserve renal function. In patients affected by refractory UTIs unresponsive to antibiotic treatment and concomitant obstructive uropathy, temporary urinary diversion may be considered via a ureteral stent or a nephrostomy tube.

Monitoring
With successful treatment, urine usually becomes sterile after 24 h, and leukocyturia normally disappears within three to four days. Normalisation of body temperature can be expected within 24—48 h following the commencement of therapy in 90 % of cases. In patients with prolonged fever and those failing to respond, treatment-resistant uropathogens or the presence of congenital uropathy or acute urinary obstruction should be considered. Repeated US examination is recommended in these cases.

Routine urine culture following treatment completion is not recommended in asymptomatic children, as there is no strong evidence supporting its utility in clinical practice.

Measures to prevent UTI recurrences

Recurrent UTIs are problematic as the symptoms are bothersome to children, and recurrent febrile UTIs increase the risk of developing renal scarring [7]. Therefore, it is important to prevent recurrent UTIs.

Chemoprophylaxis
Continous antibiotic prophylaxis (CAP) is frequently prescribed to prevent UTIs and UTI recurrences in children (Table 2). However, the evidence about its efficacy is conflicting, and the long-term use of small doses of antibiotics carries the concen of the development of antimicrobial resistances [57,58]. Additionally, CAP has not been found to reduce newly acquired renal damage in children after the first or second UTI [58]. A reduction in UTIs and subsequent renal scarring, instead, has been demonstrated in patients with anatomical abnormalities of the urinary system [57,58]. A prospective multi-center study identified that a ureteral diameter of 7 mm or greater is associated with a higher risk of UTIs, suggesting that these patients may benefit from CAP [59]. Therefore, the panel recommends chemoprophylaxis in patients with evidence of megaureter during the first year of life. A reduction in recurrent UTIs was observed alslo in children with LUTD/

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Table 2 Drugs for antibacterial prophylaxis[a].

Substance	Prophylactic dosage (mg/kg bw/d)	Limitations in neonates and infants
Trimethoprim[b]	2	Not recommended under 6 weeks of age
Trimethoprim	1–2	Not recommended under two months of age
Sulfamethoxazole	10–15	
Sulfamethoxazole	1–2	Until three months of age
Nitrofurantoin[b]	1–2	Not recommended under two months of age
Cefaclor	10	No age limitations
Cefixim	2	Preterms and newborns

[a] Reproduced with permission from the International Consultation on Urological Diseases (ICUD), International Consultation on Urogenital Infections, 2009. Copyright© by the European Association of Urology [60].
[b] Substances of first choice are nitrofurantoin and trimethoprim. In exceptional cases, oral cephalosporin can be used.

BBD and VUR receiving CAP. In the former, chemoprophylaxis may be particularly beneficial while awaiting for the treatment of LUTD to become effective. Regarding VUR, instead, it is apparent that not every VUR patient requires CAP [11]. CAP has been shown to reduce the recurrence of UTIs and the risk of renal scarring in children with high-grade VUR [11,58].

Non-antibiotic prophylaxis
The most investigated non-antibiotic prophylactic measures, to prevent UTI recurrence in children, are cranberry products and probiotics. In a recent systematic review and meta-analysis of randomized controlled trials, both these interventions reduced the risk of UTI recurrence if compared with placebo in children with normal urinary tracts [61]. At least one RCT supports the efficacy of probiotics in preventing recurrent UTIs, although findings remain limited and further research is required [62,63].

Other supplements, such as Vitamine A, E, and D, are under evalutation [63–65] but none can be considered at present for routine use in clinical practice.

Phimosis
When a physiologic phimosis is present in boys with a UTI, the use of steroid cream can significantly reduce recurrent UTIs [64]. Circumcision reduces UTI recurrences, particularly in patients with PUV and VUR [65,66].

Bladder and bowel dysfunction (BBD) and lower urinary tract disorders (LUTD)
BBD and LUTD are significant risk factors that every toilet-trained child presenting with UTIs should be screened for [67]. Normalizing micturition disorders or bladder overactivity is essential to reduce the rate of UTI recurrence. If there are signs of BBD during infection-free periods, further diagnosis and effective treatment are strongly recommended [68]. BBD can also occur in pre-toilet-trained children, particularly as prolonged voiding intervals and constipation. While voiding intervals may not be explicitly treatable, constipation should be managed at any age, as it is a known risk factor for UTI recurrence. A multidisciplinary approach is strongly recommended [67].

Limitations of present guildelines

While the present guidelines represent a summary of the best available evidence available to date, the scientific literature on UTIs remains limited. Lack of robust prospective RCTs limits the level of evidence and thus the

Table 3 Summary of evidence for the management of UTI in children.

Summary of evidence	LE
Urinary tract infection represents the most common bacterial infection in children less than 2 years of age. The incidence varies depending on age and sex.	1b
UTIs, particularly if febrile and/or recurrent can cause renal scarring.	1b
UTI are classified according to upper and low urinary tract involvement, clinical presentation, episode, severity, age and toilet training status, clinical course, and associated urinary tract abnormalities.	2b
Urinalysis by dipstick yields rapid results, but it should be used with caution and in a clinical context. Microscopic investigation is the standard method of assessing pyuria after centrifugation.	2a
The number of colony forming units (cfu) in the urine culture can vary, however, any colony count of one organism indicates a high suspicion for UTI.	2b
Prompt treatment of febrile UTIs reduces the risk of developing renal scarring	1b
Due to increasing resistance numbers good antibiotic stewardship should guide the choice of antibiotics, taking into account local resistance patterns, previous urine cultures (when available) and clinical parameters.	2a
Preventive measures against recurrent UTIs include chemoprophylaxis, cranberries, probiotics.	1b
Some studies suggest potential benefits of vitamin A, E, and D supplements, in preventing UTIs.	2a
Treatment of bladder and bowel dysfunction and lower urinay tracy dysfunction reduces the risk of UTI recurrences.	1b

Table 4 Summary of recommendations for the management of UTI in children.

Recommendations	Strength rating
Take a detailed medical history, assess clinical signs and symptoms and perform a physical examination in the evaluation of children suspected of having a urinary tract infection (UTI).	Strong
Use bladder catheterisation or suprapubic bladder aspiration to collect urine for urinalysis and cultures in non toilet-trained children.	Strong
Use clean catch urine for screening for UTI in non toilet-trained children.	Weak
Do not use plastic bags for urine sampling in non-toilet-trained children.	Strong
Use midstream urine in toilet-trained children for analysis and culture.	Strong
Perform renal and bladder US within 24 h in infants with febrile UTI and acutely ill children to check for abnormalities of the urinary tract.	Strong
Consider VCUG in the follow-up of patients developing febrile UTI <1 year of age, with atypical infections, with recurrent infections, or with ultrasound abnormalities.	Weak
Consider a DMSA scan at least 6 month after a febrile UTI to assess kidney function and the presence of renal scars.	Weak
Treat febrile UTIs with four to seven day courses of oral or parenteral therapy.	Strong
Choose parenteral therapy in severely ill patients or if oral treatment is not tollerated.	Strong
Start empirical antibiotic therapy for complicated febrile UTI	Strong
Consider urinary drainage in patients with UTIs unresponsive to antibiotic treatment.	Weak
Offer antibacterial prophylaxis in patients at risk of recurrent UTIs.	Strong
Consider dietery supplementation as an alternative or add-on preventive measure in selected cases.	Weak
Offer treatment for phimosis to patiens with underlying urological conditions.	Weak
Assess bladder and bowel dysfunction and lower urinary tract function in any toilet-trained child with febrile and/or recurrent UTI and treat it.	Strong

strength of guidelines for managing UTIs in children is generally low. Furthermore the Panel strongly emphasizes that UTI management should take into consideration the presence or absence of underlying causes and comorbidity.

Moreover, the lack of robust prospective RCTs limits the strength of the established guidelines for managing UTIs. The scientific literature on UTIs remains limited, and thus, the level of evidence is generally low.

Conclusion/summary update

A summary of changes compared to the version of 2021 Paediatric Urology Guidelines on UTI is reported in Tables 1,3 and 4 report the summary of evidence and recommendations for the management of UTI in children.

Patient summary

In this summary and update of the EAU/ESPU Guidelines we provide practical considerations for the management and diagnostic evaluation of urinary tract infection.

Take home message

This update of the EAU/ESPU Guidelines on urinary tract infection in children emphasises the importance of prompt antimicrobial therapy after diagnosis of UTI. The agent should be chosen based on local antimicrobial sensitivity patterns, and adjusted according to sensitivity-testing.

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Conflicts of interest

All members of the Paediatric Urology Guidelines Panel have provided disclosure statements on all relationships that they have that might be perceived to be a potential source of a conflict of interest. This information is publicly accessible through the European Association of Urology website: http://www.uroweb.org/guidelines/.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpurol.2025.06.016.

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