**URINARY TRACT INFECTION IN CHILDREN**

**Urinary tract infections (UTIs)** are among the most frequent infections in children and, their occurrence may result in a progressive loss of renal function, either in association with renal dysplasia or recurrent episodes of pyelonephritis.

**Definition and classification**

From a practical standpoint, symptomatic UTI can be classified as UTI involving the renal parenchyma (acute pyelonephritis [APN]) and not involving the kidneys (cystitis). Although in clinical practice the term febrile UTI is frequently used interchangeably with APN, fever in the context of a UTI is not always associated with renal involvement.[2](https://www.analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#bib0010)

On the other hand, a UTI is considered recurrent if a patient experiences 2 or more episodes of APN, 1 episode of APN and 1 or more episodes of cystitis or 3 or more episodes of cystitis in a single year. Lastly, a UTI is considered atypical if it is associated with sepsis, an abdominal or vesical mass or elevation of serum creatinine, if there is no response to treatment within 48–72 hours or if it is caused by an organism other than extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli*.

**Etiology**

 *Escherichia coli* is the most common organism, accounting for up to 85% to 90% of UTIs. *Klebsiella*, *Proteus*, *Enterococcus*, and *Enterobacter* species are other common causative organisms. *Proteus*spp is associated with renal stone formation, and organisms such as *Pseudomonas*spp, *Staphylococcus aureus*, and group B *Streptococcus* are usually associated with CAKUT, genitourinary surgery, catheterization, or recent antibiotic use. Enterococci are a common cause of catheter-associated UTIs.Hematogenous spread to the urinary system can occur in newborns and children with immunodeficiency. Group B *Streptococcus*,*Candida* spp, *Staphylococcus aureus*, and salmonellae can spread through the hematogenous route and cause pyelonephritis.

**Epidemiology**

Prevalence rates of UTI vary by gender, age, race, and circumcision status. UTIs affect 8.4% of girls and 1.7% of boys before 7 years of age.

The incidence of UTI peaks during infancy for females and males, around the time of toilet training, and at the beginning of sexual activity in girls.

The significant risk factors of UTI in children are female sex, younger age, white race, uncircumcised infant boy, duration of fever, high-grade vesicoureteral reflux (VUR), previous history of UTIs, CAKUT, bowel and bladder dysfunction (BBD), spinal dysraphism and indwelling bladder catheterization. Additional risk factors in older children and adolescents are sexual activity, pregnancy, the presence of kidney stones, immune deficiency, and diabetes.

Approximately 7% of infants with a fever may have an underlying UTI as the cause.Females younger than 1 year of age and uncircumcised male infants younger than 3 months of age have the highest prevalence of UTI. Uncircumcised febrile male infants younger than 3 months of age have a 20% risk of UTI, compared to a 2.4% risk of circumcised male infants.

**CLINICAL PRESENTATION**

 **Newborns** with a UTI may have no symptoms other than a fever. Sometimes they do not eat well or grow well, are sluggish (lethargic), vomit, or have diarrhea. Newborns may develop a serious bodywide infection from an untreated UTI.

**Infants and children under age 2 years** with a UTI may have fever, vomiting, diarrhea, abdominal pain, or foul-smelling urine.

**Children over age 2 years** with a UTI usually have the typical symptoms of a bladder or kidney infection similar to adults.

Children with [bladder infections](https://www.msdmanuals.com/home/kidney-and-urinary-tract-disorders/urinary-tract-infections-utis/bladder-infection) (cystitis) usually have pain or burning during urination, a need to urinate frequently and urgently, and pain in the bladder region. They may have difficulty urinating or holding urine ([urinary incontinence](https://www.msdmanuals.com/home/children-s-health-issues/urinary-incontinence-in-children/urinary-incontinence-in-children)). Urine may smell foul.

Children with [kidney infections](https://www.msdmanuals.com/home/kidney-and-urinary-tract-disorders/urinary-tract-infections-utis/kidney-infection) (pyelonephritis) typically have pain in the side or back over the affected kidney, high fever, chills, and a general feeling of illness (malaise).

Children who have urinary tract abnormalities may have a mass in the abdomen, enlarged kidneys, an abnormal opening to the urethra, or possible deformities in the lower spine. Children who do not have a forceful stream of urine may have a blockage in one of the tubes that transports urine from the kidneys to the bladder (ureters) or may not be able to control their bladder because of a nerve problem.

**Older children** — Symptoms of UTI in older children may include fever, urinary symptoms (dysuria, urgency, frequency, incontinence, macroscopic hematuria), and abdominal pain. The constellation of fever, chills, and flank pain is suggestive of pyelonephritis in older children. Occasionally, older children may present with short stature, poor weight gain, or hypertension secondary to renal scarring from unrecognized UTI earlier in childhood. Suprapubic tenderness and costovertebral angle tenderness may be present on examination of older children with UTI.

**Table 1. Signs and symptoms of UTI in infants and children with UTI.**

| **Age group** | **Signs and symptoms** |
| --- | --- |
|  |  | **Most common** | **↔** | **Least common** |
| Infants younger than 3 months  |   | FeverVomitingLethargyIrritability  | Poor feeding Failure to thrive  | Abdominal or suprapubic painJ aundice Haematuria Foul-smelling and/or cloudy urine  |
| Infants and children, 3 months or older  | Preverbal  | Fever  | Abdominal or suprapubic painLumbar painVomitingPoor feeding  | Lethargy Irritability Haematuria Foul-smelling and/or cloudy urine Failure to thrive  |
|   | Verbal  | FrequencyDysuria  | Changes to continenceAbdominal or suprapubic painLumbar pain  | Fever Malaise Vomiting Haematuria Foul-smelling and/or cloudy urine  |

**CLINICAL EVALUATION**

**History** — The history of the acute illness should include documentation of the height and duration of fever, urinary symptoms (dysuria, frequency, urgency, incontinence), abdominal pain, suprapubic discomfort, back pain, vomiting, recent illnesses, antibiotics administered, and, if applicable.

The *past medical history* should include risk factors for UTI, including:

●Chronic urinary symptoms – Incontinence, lack of proper stream, frequency, urgency, withholding maneuvers (suggestive of bladder dysfunction)

●Chronic constipation

●Previous UTI or previous undiagnosed febrile illnesses in which urine culture was not obtained

●Vesicoureteral reflux (VUR)

●Family history of frequent UTI, VUR, and other genitourinary abnormalities

●Antenatally diagnosed renal abnormality

*The past medical history* should also include information about chronic sequelae of UTI, including:

●Poor growth

●Elevated blood pressure

**Physical examination**  in the child with suspected UTI include:

●Documentation of blood pressure and temperature; temperature ≥39°C is associated with renal scarring; elevated blood pressure may be an indication of chronic or recurrent UTI

●Growth parameters; poor weight gain and/or failure to thrive may be an indication of chronic or recurrent UTI

●Abdominal examination for tenderness; suprapubic tenderness is associated with UTI

●Abdominal examination for mass (eg, enlarged bladder or enlarged kidney secondary to urinary obstruction, palpable stool in colon); urinary obstruction and constipation predispose to UTI

●Assessment of suprapubic and costovertebral tenderness, a sign of acute UTI

●Examination of the external genitalia for anatomic abnormalities

●Evaluation of the lower back for signs of occult myelomeningocele, which may be associated with a neurogenic bladder and recurrent UTI

●Evaluation for other sources of fever; another source of fever decreases the risk of UTI, but does not eliminate it altogether.

**LABORATORY EVALUATION**

**Rapidly available tests**

**Dipstick analysis** — Dipstick tests are convenient, inexpensive, and require little training for proper usage; they may be the only test available in some settings. However, they will likely miss some children with UTI (at best they are 88 percent sensitive).

●Leukocyte esterase – Positive leukocyte esterase on dipstick analysis is suggestive of UTI. However, a positive leukocyte esterase test does not always signal a true UTI because white blood cells (WBCs) may be present in the urine in other conditions (eg, Kawasaki disease).

●Nitrite – A child with a positive nitrite test is likely to have a UTI. The nitrite test is highly specific, with a low false-positive rate. However, false-negative tests are common because urine needs to remain in the bladder for at least four hours to accumulate a detectable amount of nitrite. Thus, a negative nitrite test does not exclude a UTI .

Table 2.

**Urine sample collection methods. Advantages, drawbacks and indications.**

|  | **Positive urine culture** | **Advantages** | **Drawbacks** | **Indication** |
| --- | --- | --- | --- | --- |
| Clean catch  | ≥50,000–100,000 CFU/mL of a pathogen[a](https://analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#tblfn0005)  | - Acceptable validity indicators- Non-invasive- Simple  | - Risk of contamination depending on hygiene and sterile technique  | All children with bladder continence[\*](https://analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#tblfn0010)  |
| Perineal bag  | Not recommended for urine culture samples  | - Non-invasive- Simple  | - High false positive rate (>50%–60%)- Needs confirmation if results are positive  | Useful for initial screening in non-urgent cases in children without bladder continence  |
| Catheter  | ≥10,000 CFU/mL of a pathogen[a](https://analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#tblfn0005)  | High sensitivity and specificity  | - Invasive- Risk of urethral trauma- Some risk of contamination(10%–26%)  | Confirmation method in children without bladder continence and initial method in urgent cases [\*\*](https://analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#tblfn0015)  |
| Suprapubic aspiration  | Any amount of growth  | Gold standard  | - Invasive- Variable success (30%–70%)- Ideally, guided by ultrasound  | Confirmation method in children without bladder continence and initial method in urgent cases [\*\*](https://analesdepediatria.org/en-update-spanish-clinical-practice-guideline-articulo-S234128792400200X#tblfn0015)  |

CFU, colony-forming units; UTI, urinary tract infection.

a

Diagnosis with a lower bacterial count is possible if the symptoms and other findings support it.

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In children without bladder continence, collection of a midstream urine sample during spontaneous voiding is preferred for initial or confirmatory testing, with acceptable validity indicators.

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Depending on availability and technical skills and the age and condition of the patient. Provide adequate sedation and analgesia for the procedure.

**Microscopic exam**

●**Standard microscopy** – In standard microscopy, a centrifuged sample of unstained urine is examined for WBCs and bacteria. When performed in this way, pyuria is defined as ≥5 WBC/high power field (hpf) and bacteriuria as the presence of any bacteria per hpf.

**Urine culture** — Urine culture is the standard test for the diagnosis of UTI.

For the latter, which remains the gold standard, the reference standard for UTI diagnosis is a single uropathogen cultured from a specimen obtained at specific concentrations: >103or 1,000 colony-forming units (CFU)/mL for a specimen from suprapubic aspiration (SPA); >104 or 10,000 CFU/mL for a catheter specimen; or >105 or 10,000 CFU/mL for a ‘clean-catch’, midstream specimen.

**Other laboratory tests**

●Markers of inflammation –Erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and procalcitonin (PCT) are indicators of an acute inflammatory process.

●Serum creatinine – Measurement of serum creatinine is not routinely necessary in children with suspected UTI. However, we suggest that serum creatinine be measured in children with a history of multiple UTI and suspected renal involvement.

●Blood culture – Bacteremia occurs in 4 to 9 percent of infants with UTI. Fever in bacteremic infants with UTI persists, on average, one day longer than in nonbacteremic infants with UTI.

**IMAGING**

**Ultrasonography** — Kidney and bladder ultrasonography (KBUS) is a noninvasive test that can demonstrate the size and shape of the kidneys, the presence of duplication and dilatation of the ureters, and the existence of gross anatomic abnormalities.

**Indications** — Given the potentially large benefit of detecting malformations in a small number of children and the low risk of harm, we suggest KBUS for the following children:

●Children younger than two years of age with a first febrile UTI

●Children of any age with recurrent febrile UTIs

●Children of any age with a UTI who have a family history of kidney or urologic disease, poor growth, or hypertension

●Children who do not respond as expected to appropriate antimicrobial therapy

However, prenatal ultrasonography is often performed after 30 to 32 weeks of gestation – a time at which the urinary tract is fully developed; we may elect not to perform KBUS (in children of any age) if prenatal ultrasonography that was performed at a reputable center was normal and the study results are accessible.

**Voiding cystourethrogram** — The voiding cystourethrogram (VCUG) is the test of choice to establish the presence and degree of VUR. VUR is the retrograde passage of urine from the bladder into the upper urinary tract. It is an important risk factor for kidney scarring.

**Indications**

●Children of any age with two or more febrile UTIs, **or**

●Children of any age with a first febrile UTI **and**:

•Any anomalies on kidney ultrasound, **or**

•The combination of temperature ≥39°C (102.2°F) and a pathogen other than *E. coli*, **or**

•Poor growth or hypertension

**Renal scintigraphy** — Renal scintigraphy using [technetium Tc-99m succimer](https://www.uptodate.com/contents/technetium-tc-99m-succimer-pediatric-drug-information?topicRef=5991&source=see_link) (dimercaptosuccinic acid [DMSA]) can be used to detect acute pyelonephritis and kidney scarring in the acute and chronic settings, respectively . DMSA is injected intravenously, and uptake by the kidney is measured two to four hours later. Areas of decreased uptake represent pyelonephritis or scarring.

**Management**

*Recommendations*

* In the case of a well-founded suspicion of febrile UTI, early initiation of antibiotherapy is recommended. *Grade of recommendation: C*.
* In children with febrile UTI without known obstructive uropathy and without symptoms of severe infection, oral antibiotherapy is recommended. *Grade of recommendation: A*.
* In children with VUR grade III to V, antibiotherapy should be initiated via the intravenous route. *Grade of recommendation: B*.
* In children aged less than 2–3 months or with suspected uropathy, signs of sepsis, refractory vomiting or dehydration, antibiotherapy should be initiated via the intravenous route. *Grade of recommendation:* √.



**Antibiotic prophylaxis**

*Recommendations*

* Local antimicrobial resistance patterns should be taken into account when considering prophylaxis, and selection of the agents with the narrowest-possible spectrum is recommended, with administration of one fourth to one third of the dose at night. *Grade of recommendation:* √.
* In patients with recurrent UTI and no structural abnormalities or with low-grade VUR, prophylaxis with cranberry extract should be contemplated. *Grade of recommendation: B*.

**FOLLOW-UP**

Recurrent UTI is a risk factor for kidney scarring, and the risk of kidney scarring is substantially increased with the second febrile UTI. Identification of children at risk for recurrent febrile UTI and treatment of bowel and bladder dysfunction that predisposes many children to UTI may be more important than identifying anatomic or functional genitourinary abnormalities after the first febrile UTI in preventing kidney scarring. Primary care follow-up for infants and young children who have had a febrile UTI should include regular monitoring of height, weight, and blood pressure.

**Prognosis**

The majority of children with UTI have no long-term sequelae. Prediction of long-term sequelae in children with UTI remains difficult.

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