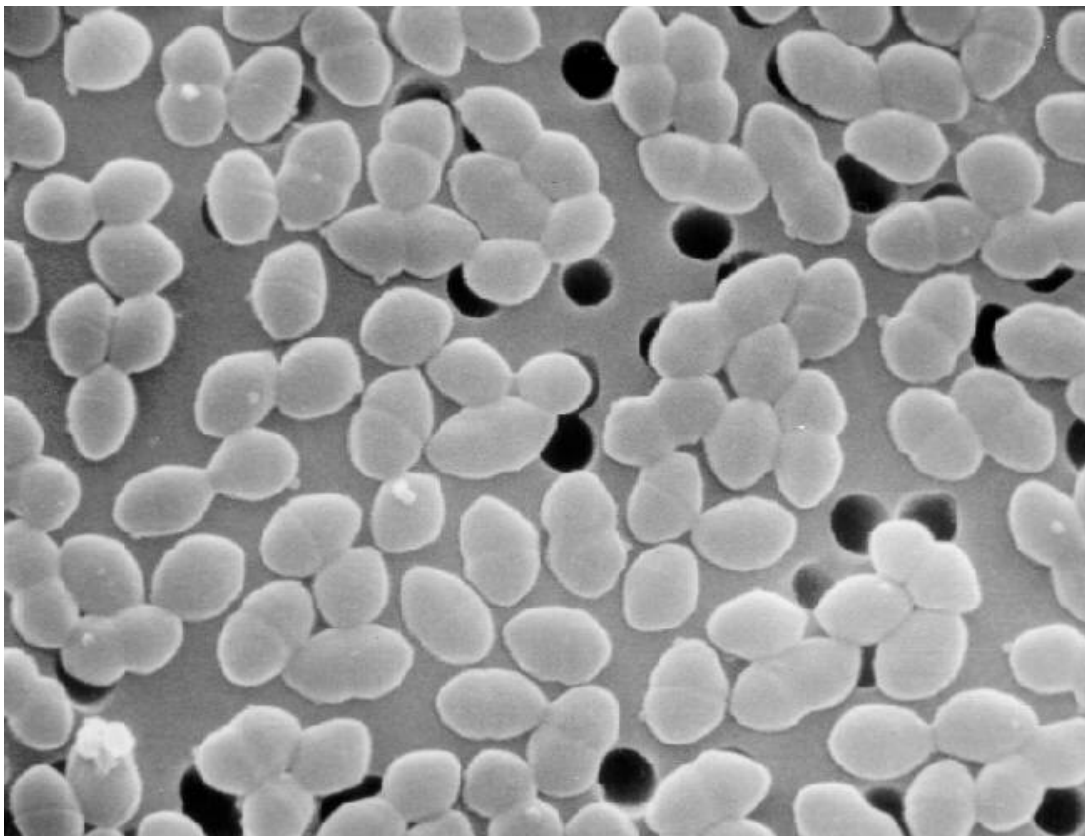


Urinary Tract Infection in Children — Symptoms and Causes

[See online here](#)

Urinary tract infections are very common in children, especially those presenting to the emergency department with fever. The diagnosis is usually made based on urinalysis confirmation of the condition in young children presenting with fever, or on the presence of bacteriuria in children old enough to present with urinary tract infection symptoms such as dysuria. Antibiotic therapy is indicated for the treatment of urinary tract infections in children.



Definition of Urinary Tract Infection in Children

Urinary tract infection (UTI) is one of the most common pediatric infections. It distresses the child, concerns the parents, and may cause permanent kidney damage. Prompt diagnosis and effective treatment of a febrile UTI may prevent acute discomfort and, in patients with recurrent infections, kidney damage. Urinary tract infections are caused by different **bacterial etiologies** and cause **inflammation of the lower urinary tract** in a child. Children can develop [acute cystitis](#), or the infection can ascend through the [ureters](#). Ascending urinary tract infections can present with **pyelonephritis**.

The two broad clinical categories of UTI are pyelonephritis (upper UTI) and cystitis (lower UTI). The most common causative organisms are bowel flora, typically gram-negative rods. *Escherichia coli* is the organism that is most commonly isolated from pediatric patients with UTIs; however, other organisms that gain access to the urinary tract may cause infection, including fungi (*Candida* species) and viruses.

Epidemiology

The incidence of urinary tract infections in children is **very high**. Approximately, 2.4% of children in the United States develop urinary tract infections per year. The risk of developing symptomatic urinary tract infections in the first year of life is the highest.

Approximately, 7% of infants who develop a **fever** end up diagnosed with a urinary tract infection as the cause of their fever. The prevalence of fever in febrile infants is highest in those younger than 3 months and in infants aged between 6 and 12 months.

The risk of urinary tract infections in the first three months of life seems to be higher in **uncircumcised boys**. Additionally, the risk of urinary tract infections in boys is higher compared to girls in the first year of life. After that, girls become more likely to develop urinary tract infections, similar to adults.

Finally, the risk of urinary tract infections among female infants seem to be higher in **white girls** compared to African American female infants.

- Infection of the bladder (cystitis) or kidney (pyelonephritis).
- Site of infection is harder to clinically determine in infants (confocal exam).
- 7% of febrile infants.

1% of asymptomatic infants and adolescents have bacteria on their urine.

Etiology of Urinary Tract Infections in Children

The most common causative organism for urinary tract infections in children is **E. coli**. In addition to *E. coli*, other bacterial pathogens have also been implicated in the pathology of urinary tract infections in children including **Klebsiella**, **Proteus**, and **Enterococcus**. **Group B streptococcus** is responsible for urinary tract infections in neonates.

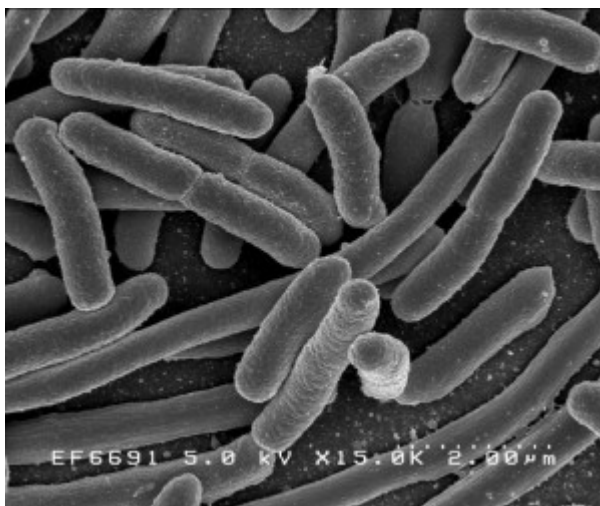


Image: "Escherichia coli: Scanning electron micrograph of Escherichia coli, grown in culture and adhered to a cover slip." by Rocky Mountain Laboratories, NIAID, NIH. License: [Public Domain](#)

Children can also develop **fungal urinary tract infections** due to **Candida** infestation or **viral hemorrhagic cystitis** caused by **adenovirus**.

Children who receive **antibiotic therapy** for other indications, those with **structural urinary tract abnormalities**, and those who have **constipation** are at an increased risk of developing urinary tract infections. Male **circumcision** decreases the risk of urinary tract infections in boys significantly, especially in the first three months of life.

Risk factors

- Constipation
- History of vesicoureteral reflux (**VUR**) or another underlying nephropathy
- Dysfunctional voiding (e.g. neuropathic bladder)
- Young age higher risk than older
- Female sex (after 3 months of age)
- Sexual activity in adolescents

Pathophysiology of Urinary Tract Infections in Children

The previously-mentioned organisms are known as **uropathogens**. This is due to their ability to colonize the urinary tract despite the shear forces of urination. They adhere very well to the epithelium lining of the **urethra and bladder**, where they can proliferate and grow. Eventually, they can cause inflammation of the urinary bladder, cystitis, and symptoms arise.

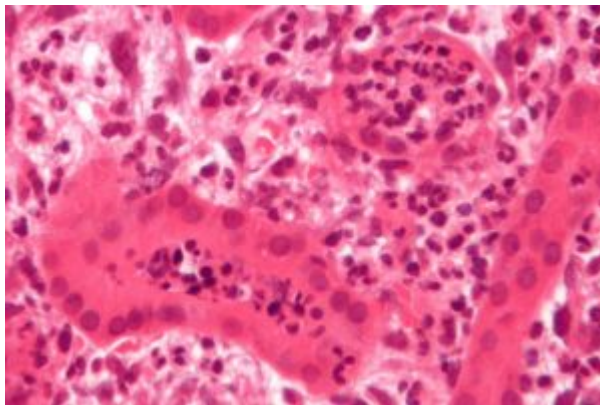


Image: "Very high magnification micrograph of acute pyelonephritis. H&E stain. Kidney biopsy." by Nephron - Own work. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

The pathogens responsible for urinary tract infections in children can also gain access to the **bloodstream** and cause **bacteremia**. If this happens, patients can develop **pneumonia** or **meningitis**.

Hematogenous spread of the uropathogens is more common in infants than in older children. The organisms can also ascend to the **kidneys** and cause **pyelonephritis**, especially in children with **urinary reflux disease** or **urinary structural abnormalities**.

Urine in the proximal urethra and urinary bladder is normally sterile. Entry of bacteria into the urinary bladder can result from turbulent flow during normal voiding, voiding

dysfunction, or catheterization.

More rarely, the urinary tract may be colonized during systemic bacteremia (sepsis); this usually happens in infancy. Pathogens can also infect the urinary tract through direct spread via the fecal-perineal-urethral route.

Clinical Presentation of Urinary Tract Infections in Children

The clinical presentation of urinary tract infections in children can be different according to the patient's **age**. Neonates and very young infants usually present with **non-specific symptoms** like **fever**, poor feeding, vomiting and irritability. This group of patients usually do not have any signs suggestive of urinary tract infections; therefore, as part of the routine workup for fever in this group of patients, a **urinalysis** should be performed to exclude urinary tract infections as the cause of fever.

Infants aged between 2 months and 2 years also present with non-specific symptoms, such as fever, vomiting, poor-feeding, and irritability. In addition to that, this group of children can start having **more specific symptoms**, such as abdominal pain or strong-smelling urine. Again, this group of children are usually diagnosed with urinary tract infections based on the routine workup for fever instead of the classical clinical picture.

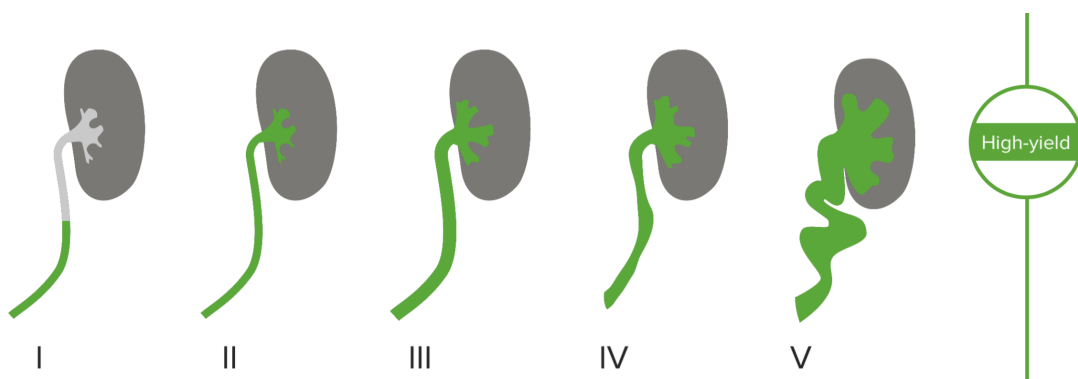
Older children start developing more specific signs and symptoms of urinary tract infections including fever, vomiting, lower abdominal pain, increased urinary frequency, urgency and painful **micturition**.

Older children who develop ascending urinary tract infections such as **pyelonephritis** are usually more toxic, can develop a loss of appetite and complain of flank pain or back pain; therefore, the diagnosis of urinary tract infection in this group of patients is usually based on clinical assessment supported by **laboratory investigations**.

Adolescents usually present with more typical symptoms, such as **dysuria**, urgency and urinary frequency. Additionally, in this group of patients, fever might be absent. This group of patients can be sexually active; therefore, workup for **sexually transmitted diseases** might be indicated.

Infants who develop **recurrent pyelonephritis** are more likely to have structural urinary tract abnormalities or vesicoureteral reflux disease.

Grading reflux



Diagnostic Workup for Urinary Tract Infections in Children

The diagnosis of urinary tract infections in children is based on the presence of **white blood cells** in urinalysis with or without the isolation of bacteria in the urine. If the **isolation of bacteria** is possible, the finding of at least 50,000 colony-forming units per ml of a single uropathogen is diagnostic of urinary tract infections in children. This is per the American Academy of Pediatrics criteria for the diagnosis of urinary tract infection in children aged 2 months to 2 years.

Urinalysis sensitivity in neonates and young infants was questionable in the past, but, according to a recent study, the sensitivity of the test is good.

Urinalysis

- 98% sensitive
- 65% specific
- Elements of a UA:
 - WBC count
 - RBC count
 - Leukocyte esterase
 - Nitrites (**very specific!**)

The collection of a urine sample for urinalysis might be challenging in children. Children who have control over urination can provide a **mid-stream urine specimen**, but younger children and infants are unable to do so. Urine specimen collection in that group of younger children is possible by either **suprapubic aspiration** or **urethral catheterization**. Children with fever who have a normal urinalysis or a normal urine dipstick should undergo a **urinary culture test** to exclude urinary tract infections.

Patients with **lower urinary tract infections** are unlikely to have **leukocytosis** on a complete blood count. On the other hand, patients who are feverish and who are at risk of having **pyelonephritis** should undergo a **complete blood count** to look for leukocytosis. **Renal function testing** is also indicated as **electrolyte imbalance** is common in severe cases of urinary tract infections.

Specific imaging modalities for urinary tract infections should not be routinely performed in infants and young children presenting with acute cystitis for the first time. Patients who do not respond to initial therapy, those who have recurrent ascending urinary tract infections or those presenting with an abdominal mass might need **advanced imaging** to exclude possible **structural urinary tract abnormalities**.

Never culture a bag urine

No blood test is diagnostic of a UTI

Treatment of Urinary Tract Infections in Children

The treatment of urinary tract infections in children can be challenging as the decision to admit the patient for inpatient care versus outpatient treatment

can be troublesome. Patients who present with a competent caregiver, those who can return to the healthcare provider facility in case of emergency, and those who are not **dehydrated** can be managed at home if they are not toxic or severely ill.

Hospitalization is necessary for the following patients with UTI:

- Patients who are toxemic or septic.
- Patients with signs of urinary obstruction or significant underlying disease.
- Patients unable to tolerate adequate oral fluids or medications.
- Infants younger than 2 months with febrile UTI (presumed pyelonephritis).
- All infants younger than 1 month with suspected UTI, even if not febrile.

Treat febrile UTI as pyelonephritis and consider parenteral antibiotics and hospital admission for these patients.

Patients who are septic, those with other comorbidities, children who are unable to take oral medicine, or neonates, should be treated in an inpatient setting. **Intravenous ceftriaxone** might be a reasonable option in these cases.

Patients younger than two weeks should also receive **ampicillin** and **gentamicin** due to the high risk of **group B streptococcus** and **listeria monocytogenes** infections.

Children who will be managed in an outpatient setting might receive **sulfamethoxazole** and **trimethoprim** or **amoxicillin** and **clavulanic acid**. Both of these options are reasonable and provide good coverage against the most common uropathogens. **Nitrofurantoin** is suitable for lower urinary tract infections; therefore, patients who have a fever, lower back pain, or flank pain, i.e. signs suggestive of pyelonephritis, should not receive nitrofurantoin.

Prevention of Urinary Tract Infections

Antibiotic prophylaxis

Many studies have failed to show reductions in the incidence of recurrent UTIs with the use of antibiotic prophylaxis. Several of those studies, however, did not have sufficient statistical power to detect differences, or did not have stringent definitions of UTI and inclusion criteria.

A meta-analysis of a selected subset of high-quality, randomized, controlled trials concluded that long-term antibiotics reduce the risk of more symptomatic infections. The benefit is small, however, and must be weighed against the likelihood that future infections may be with bacteria that are resistant to the antibiotic administered.

Until evidence-based guidelines about the use of suppressive antibacterial therapy after an initial febrile UTI are available, use of antibiotic prophylaxis is based on expert opinion. Antibiotic prophylaxis is more often recommended for children with high-grade reflux (grade 3-5).

References

[Pediatric urinary tract infections](#) via nih.gov

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Notes