

## Urinary tract infection in children

The diagnosis of urinary tract infection (UTI) in young children is important as it may be a marker for urinary tract abnormalities. UTI is the most common bacterial infection in children under 2 years old. UTI presents atypically in neonates and may be associated with life-threatening sepsis.

### Definitions<sup>[1]</sup> <sup>[2]</sup>

**Lower urinary tract infection:** a UTI involving the bladder and urethra.

**Upper urinary tract infection:** a UTI involving the renal pelvis and/or kidney (pyelonephritis). The National Institute for Health and Care Excellence (NICE) advises that clinically an upper UTI should be assumed if there is bacteriuria and fever of 38°C or higher, or if there is a fever lower than 38°C with loin pain/tenderness and bacteriuria.

**Undifferentiated urinary tract infection:** a UTI where it is not possible to distinguish between the two conditions above.

**Recurrent urinary tract infection:**

- Two or more episodes of UTI with acute upper UTI (acute pyelonephritis); or
- One episode of UTI with acute upper UTI plus one or more episodes of UTI with lower UTI (cystitis); or
- Three or more episodes of UTI with lower UTI.

See also the article on [Recurrent Urinary Tract Infection](#).

**Asymptomatic bacteriuria:** the presence of bacteria in an appropriately collected sample of urine, without the presence of symptoms.

**Atypical urinary tract infection:** NICE defines this as a UTI where there are any of the following features:

- Seriously ill.
- Poor urine flow.
- Abdominal or bladder mass.
- Raised creatinine.
- Septicaemia.
- Failure to respond to treatment with suitable antibiotics within 48 hours.
- Infection with non-*E. coli* organisms.

## Classification<sup>[3]</sup>

UTI may be classified by:

- **Site:** upper or lower as above
- **Severity:** simple or severe UTI, where severe UTI would include a fever of 39°C or more, the feeling of being ill, persistent vomiting and moderate or severe dehydration.
- **Episode:** first or recurrent. Recurrent UTI may be subclassified into three groups:
  - Unresolved infection: subtherapeutic level of antimicrobial, non-compliance with treatment, malabsorption, resistant pathogens.
  - Bacterial persistence: may be due to a nidus for persistent infection in the urinary tract. Surgical correction or medical treatment for urinary dysfunction may be needed.
  - Re-infection: each episode is a new infection acquired from periurethral, perineal or rectal flora.
- **Symptoms:** asymptomatic or symptomatic bacteriuria.
- **Complicating factors:** uncomplicated or complicated UTI.

# How common are urinary tract infections in children? (Epidemiology)<sup>[2]</sup> <sup>[4]</sup>

- Febrile UTI is the most common serious bacterial infection in childhood.<sup>[3]</sup>
- Around 1 in 10 girls and 1 in 30 boys will have had a UTI by the age of 16 years.  
2.1% of girls and 2.2% of boys will have had a UTI before the age of 2 years.
- Uncircumcised boys in the first year of life have a greater than eight-fold higher incidence of UTI compared to girls or circumcised boys.
- Prevalence of UTI is higher among white than among black infants.
- The overall prevalence of UTI in children aged less than 2 years with an undifferentiated febrile illness is approximately 5%.
- White girls with fever over 39.0°C without another potential source of infection have a 30% prevalence of UTI.
- Around 2.7% of girls and 1% of boys will have had an upper UTI (acute pyelonephritis) by the time they turn 7 years of age.

## Risk factors

- Age below one year.
- Female sex (but in the first three months of life, UTI is more common in boys than girls).
- White children.
- Previous UTI; recurrence has been reported in approximately 78% of girls and 71% of boys with UTI within the first year of life, and 45% of girls and 39% of boys with UTI after the age of one year.
- Voiding dysfunction due to factors such as structural abnormalities, neurogenic bladder, voluntary withholding of urine (dysfunctional elimination syndrome), chronic constipation, or indwelling foreign bodies.
- Vesicoureteral reflux (VUR), family history of VUR or renal disease. The prevalence of VUR in the general population is 1-3%.

- Sexual activity. In adolescent girls, there is an increased relative risk in response to
- increased frequency of sexual intercourse. Sexual abuse can cause urinary symptoms, but infection is uncommon.
- No history of breastfeeding. Breastfeeding has a protective effect, which is more pronounced in girls.
- Immunosuppression.

## Symptoms of urinary tract infection in children<sup>[1]</sup> <sup>[2]</sup>

- **Infants younger than 3 months:** urine tract infection symptoms in neonates differ to those in older children. Fever, vomiting, lethargy and irritability are common. Poor feeding and failure to thrive may occur. Abdominal pain, jaundice, haematuria and offensive urine are less common. Neonates are more likely to develop urosepsis and infections in neonates are less likely to be due to *E. coli*.
- **Infants and preverbal children aged 3 months or older:** fever is common. There may also be abdominal pain, loin tenderness, vomiting and poor feeding. Lethargy, irritability, haematuria, offensive urine and failure to thrive are less common. In verbal children, frequency and dysuria are the most common presenting symptoms. In preverbal children, presentation is most often a fever with no apparent cause.
- **Children aged over 3 years:** usual presentation is with specific symptoms such as frequency, dysuria and suprapubic, abdominal or lumbar pain. Dysfunctional voiding and changes to continence may occur. Other less common symptoms include fever, malaise, vomiting, haematuria, offensive urine and cloudy urine.

Symptoms and signs that increase the likelihood that a urinary tract infection (UTI) is present:

- Painful urination (dysuria).
- More frequent urination.
- New bedwetting.

- Foul smelling (malodorous) urine.
- Darker urine.
- Cloudy urine.
- Frank haematuria (visible blood in urine).
- Reduced fluid intake.
- Fever.
- Shivering.
- Abdominal pain.
- Loin tenderness or suprapubic tenderness.
- Capillary refill longer than three seconds.
- Previous history of confirmed urinary tract infection.

Symptoms and signs that decrease the likelihood that a UTI is present:

- Absence of painful urination (dysuria).
- Nappy rash.
- Breathing difficulties.
- Abnormal chest sounds.
- Abnormal ear examination.
- Fever with known alternative cause.

These symptoms and signs should be used to inform a decision about whether urine collection and testing are necessary. It is not an exhaustive list. The presence or absence of a single symptom or sign in isolation should not necessarily be used to decide whether or not to test for UTI. Multiple symptoms and signs increase the likelihood that there is a UTI.

### **Clinical differentiation between acute upper UTI and lower UTI**

Assume a diagnosis of acute upper UTI in babies or children who have either:

- Bacteriuria and fever of 38°C or higher; or

- Bacteriuria, fever lower than 38°C and loin pain or tenderness.

Assume that babies and children who have bacteriuria but no systemic symptoms or signs have lower UTI (cystitis).

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## Differential diagnosis

Any child presenting with an acute illness, with or without fever. The differential diagnosis for more specific symptoms includes:

- Vulvovaginitis.
- Urethritis.
- Irritation (use of soaps and bubble baths; poor hygiene).
- [Threadworm infestation](#).
- [Balanitis](#).
- Sexual abuse.

## Investigations<sup>[1]</sup>

### Urine testing

Clinical diagnosis of UTI is unreliable, so many children with fever or symptoms of UTI need a urine sample to exclude or make the diagnosis. Take urine samples from children and young people before they are given antibiotics.

Test the urine of babies, children and young people who have symptoms and signs that increase the likelihood that a urinary tract infection (UTI) is present, or if they are unwell and there is a suspicion of a UTI but none of the signs or symptoms listed above.

Refer babies under 3 months with a suspected UTI to paediatric specialist care, and send a urine sample for urgent microscopy and culture.

Do not routinely test the urine of babies, children and young people 3 months and over who have symptoms and signs that suggest an infection other than a UTI. If they remain unwell and there is diagnostic uncertainty, consider urine testing.

Avoid delay when collecting and testing the urine sample. If the sample cannot be collected at the consultation, advise the parents or carers (as appropriate) to collect and return the urine sample as soon as possible, ideally within 24 hours.

Use a clean catch method for urine collection wherever possible. If a clean catch urine sample is not possible, use other non-invasive methods such as urine collection pads. Do not use cotton wool balls, gauze or sanitary towels to collect urine from babies and children. Use catheter samples or suprapubic aspiration (SPA) when it is not possible or practical to collect urine by non-invasive methods. Use ultrasound guidance to confirm that there is urine in the bladder before SPA.

Immediately refrigerate or use boric acid to preserve urine samples that are to be cultured but cannot be cultured within four hours of collection.

### **Dipstick urine testing**

Use [dipstick urine testing](#) for babies and children between 3 months and 3 years with suspected UTI, and:

- If both leukocyte esterase and nitrite are negative: do not give antibiotics; do not send a urine sample for microscopy and culture unless at least one of the following criteria applies. The child:
  - Is thought to have acute upper UTI.
  - Has a high to intermediate risk of serious illness.
  - Is under 3 months old.
  - Has a positive result for leukocyte esterase or nitrite.
  - Has recurrent UTI.
  - Has an infection that does not respond to treatment within 24-48 hours, if no sample has already been sent.
  - Has clinical symptoms and signs but dipstick tests do not correlate.
- If leukocyte esterase or nitrite, or both are positive: send the urine sample for culture; give antibiotics.

Urine dipstick testing strategies for children 3 years or older:

- Dipstick testing for leukocyte esterase and nitrite is diagnostically as useful as microscopy and culture, and can safely be used.
- **Leukocyte esterase and nitrite are both positive:** assume the child has a urinary tract infection (UTI) and give them antibiotics. If the child has a high or intermediate risk of serious illness or a history of previous UTI, send a urine sample for culture.
- **Leukocyte esterase is negative and nitrite is positive:** give the child antibiotics if the urine test was carried out on a fresh urine sample. Send a urine sample for culture. Subsequent management will depend on the result of urine culture.
- **Leukocyte esterase is positive and nitrite is negative:** send a urine sample for microscopy and culture. Do not give the child antibiotics unless there is good clinical evidence of a UTI (eg, obvious urinary symptoms). A positive leukocyte esterase result may indicate an infection outside the urinary tract that may need to be managed differently.



- **Leukocyte esterase and nitrite are both negative:** assume the child does not have a UTI. Do not give the child antibiotics for a UTI or send a urine sample for culture. Explore other possible causes of the child's illness.

Send urine samples for culture if a baby or child:

- Is thought to have acute upper UTI (pyelonephritis; see the section on clinical differentiation between acute upper UTI and lower UTI).
- Has a high to intermediate risk of serious illness (see the section on assessment of risk of serious illness).
- Is under 3 months old.
- Has a positive result for leukocyte esterase or nitrite.
- Has recurrent UTI.
- Has an infection that does not respond to treatment within 24-48 hours, if no sample has already been sent.
- Has clinical symptoms and signs but dipstick tests do not correlate.

Use clinical criteria for decision making if a urine test does not support findings, because in a small number of cases, this may be the result of a false negative.

### Interpreting microscopy results

- **Pyuria and bacteriuria are both positive:** assume the baby or child has a urinary tract infection (UTI).
- **Pyuria is positive and bacteriuria is negative:** start antibiotic treatment if the baby or child has symptoms or signs of a UTI.
- **Pyuria is negative and bacteriuria is positive:** assume the baby or child has a UTI.
- **Pyuria and bacteriuria are both negative:** assume the baby or child does not have a UTI.

### Laboratory tests for localising UTI

Do not use C-reactive protein alone to differentiate acute upper UTI from lower UTI in babies and children.

## Imaging tests

Imaging is usually arranged by secondary care.

Do not routinely use imaging to localise UTI. In rare instances when it is clinically important to confirm or exclude acute upper UTI, use either power Doppler ultrasound, or a dimercaptosuccinic acid (DMSA) scintigraphy scan if power Doppler ultrasound is not available or the diagnosis has not been confirmed.

- Send babies and children with atypical UTI for a urinary tract ultrasound during the acute infection, to identify structural abnormalities such as obstruction and to ensure prompt management.
- Send babies younger than 6 months with first-time UTI that responds to treatment for ultrasound within six weeks of the UTI.
- Do not routinely send babies and children over 6 months with first-time UTI who respond to treatment for an ultrasound, unless they have atypical UTI.
- Babies and children who have had a lower UTI should be sent for ultrasound (within six weeks) only if they are younger than 6 months, or have had recurrent infections.
- Use a DMSA scan 4-6 months after the acute infection, to detect renal parenchymal defects in babies and children. If the baby or child has a subsequent UTI while waiting for a DMSA scan, review the timing of the scan and consider doing it sooner.

### **Recommended imaging schedule for babies younger than 6 months**

- Ultrasound during the acute infection: if atypical or recurrent UTI.
- Ultrasound within six weeks: if responds well to treatment within 48 hours. If abnormal consider micturating cystourethrogram (MCUG).
- Dimercaptosuccinic acid scintigraphy scan 4-6 months after the acute infection if atypical or recurrent UTI.
- Micturating cystourethrogram: if atypical or recurrent UTI.

- In a baby with a non-*E. coli* urinary tract infection who is responding well to antibiotics and has no other features of atypical infection, a non-urgent ultrasound can be requested, to happen within six weeks.

### **Recommended imaging schedule for babies and children between 6 months to under 3 years**

- Ultrasound during the acute infection: if atypical UTI.
- Ultrasound within six weeks: if recurrent UTI.
- Dimercaptosuccinic acid scintigraphy scan 4-6 months after the acute infection: if atypical or recurrent UTI.
- Micturating cystourethrogram: NO
- While MCUG should not be performed routinely it should be considered if the following features are present:
  - Dilatation on ultrasound.
  - Poor urine flow.
  - Non-*E. coli*-infection.
  - Family history of VUR.
- In babies and children with a non-*E. coli* urinary tract infection that is responding well to antibiotics and has no other features of atypical infection, a non-urgent ultrasound can be requested, to happen within six weeks.

### **Recommended imaging schedule for children 3 years or older**

- Ultrasound during the acute infection: if atypical UTI.
- Ultrasound within six weeks: if recurrent UTI.
- Dimercaptosuccinic acid scintigraphy scan 4-6 months after the acute infection: if recurrent UTI.
- Micturating cystourethrogram: NO.
- Ultrasound in toilet-trained children should be performed with a full bladder with an estimate of bladder volume before and after urination.

- In a child with a non-*E. coli* urinary tract infection that is responding well to antibiotics and has no other features of atypical infection, a non-urgent ultrasound can be requested, to happen within six weeks.

## Urinary tract infection in children treatment and management<sup>[1]</sup> <sup>[2]</sup> <sup>[5]</sup>

### General principles

- The aims of urinary tract infection treatment are to:
  - Eliminate urinary tract infection symptoms and eradicate bacteriuria.
  - Prevent renal scarring.
  - Prevent recurrent UTIs.
  - Correct any associated urological lesions.

Carefully assess the degree of toxicity, dehydration and ability to maintain oral fluid intake. Encourage fluids, avoid or correct constipation and encourage full voiding.

- If the child has been assessed at high risk of serious illness, refer urgently to secondary care.
- If UTI is suspected in children aged under 3 months, refer urgently to a paediatric specialist for treatment with parenteral antibiotics, and send a urine sample for urgent microscopy and culture.

### Acute management

- Immediately refer babies and children with a high risk of serious illness to a paediatric specialist.
- Immediately refer babies under 3 months with a suspected UTI to a paediatric specialist.
- Paediatric specialists should give babies under 3 months with a suspected UTI parenteral antibiotics.
- Consider referring babies and children over 3 months with upper UTI to a paediatric specialist.

## **For children 3 months or older with acute pyelonephritis/upper UTI<sup>[6]</sup>**

- Consider referral to a paediatric specialist.
- Cefalexin or co-amoxiclav (only if culture results are available and bacteria are susceptible) at usual doses for 7-10 days for acute pyelonephritis, as first-choice oral antibiotics.
- First-line intravenous antibiotics, at usual doses, for children and young people who are unable to take oral antibiotics due to vomiting, or are more severely unwell:
- Co-amoxiclav (only in combination or if culture results are available and bacteria are susceptible), cefuroxime or ceftriaxone (a third-generation cephalosporin), which would be suitable alternatives to co-amoxiclav, gentamicin or amikacin (aminoglycosides); which may be appropriate for some children and young people with acute pyelonephritis, particularly those with severe infection or sepsis.
- The use of intravenous antibiotics should be reviewed by 48 hours (taking into account the person's response to treatment and susceptibility results from urine culture) and switched to oral treatment where possible. Efforts should be made to identify the causal bacteria and use reviewed at 48 hours.

## **For children 3 months or older with cystitis/lower UTI<sup>[7]</sup>**

- Start oral antibiotic treatment. Trimethoprim or nitrofurantoin at usual doses as first-choice antibiotics.
- Nitrofurantoin (if not used as first-choice), amoxicillin or cefalexin at usual doses as second-choice antibiotics for use if lower UTI symptoms get worse on a first-choice antibiotic taken for at least 48 hours or first-choice antibiotics are not suitable.
- Amoxicillin is recommended only if culture results are available and bacteria are susceptible, because resistance rates are high.
- Duration of recommended treatment is three days for all antibiotic choices.

If there are symptoms of upper UTI (acute pyelonephritis) or the person has a complicated UTI (associated with a structural or functional abnormality, or underlying disease, which increases the risk of a more serious outcome or treatment failure), antibiotics recommended for acute pyelonephritis (as above) should be prescribed.

If dysfunctional elimination syndromes and/or constipation are suspected, these should be addressed.

- For children with suspected voiding dysfunction and/or urine withholding, regular bladder-emptying during the day (every 90-120 minutes) should be advised.
- Stool softener may be prescribed if there is constipation.

### **Follow-up**

- Do not routinely follow up babies and children who have not had imaging investigations.
- Refer babies and children who have recurrent UTI or abnormal imaging results for assessment by a paediatric specialist.
- When assessing babies and children with renal parenchymal defects, include height, weight, blood pressure and routine testing for proteinuria.
- Do not offer long-term follow-up to babies and children with minor, unilateral renal parenchymal defects, unless they have recurrent UTI, family history or lifestyle risk factors for hypertension.
- Babies and children who have bilateral renal abnormalities, impaired kidney function, raised blood pressure or proteinuria should have monitoring and appropriate management by a paediatric nephrologist to slow the progression of chronic kidney disease.
- Do not routinely retest babies' and children's urine for infection if they are asymptomatic after an episode of UTI.
- Do not follow up babies and children based only on the presence of asymptomatic bacteriuria.

### **Preventing recurrence**

- Manage dysfunctional elimination syndromes and constipation in babies and children who have had a UTI.
- Encourage children who have had a UTI to drink enough water to avoid dehydration.
- Ensure that children who have had a UTI have access to clean toilets when needed and do not have to delay voiding unnecessarily.
- Do not routinely give prophylactic antibiotics to babies and children following first-time UTI.

## Complications of urinary tract infection in children<sup>[2]</sup>

Possible complications of childhood UTI include:

- Renal scarring/damage: around 5% of children presenting with first-time UTI will have renal parenchymal defects on imaging. Renal scarring is almost always preceded by an upper UTI (acute pyelonephritis), although not all upper UTIs are followed by renal scarring. Renal scarring is more common in children with vesicoureteric reflux (VUR) and is most common with the most severe grades. VUR is both a cause of acute pyelonephritis and a compounder of its effects.
- Hypertension may be associated with UTI in childhood, but the risk is likely to be small and clinically important only if the child has severe or bilateral renal scarring.
- Bacteriuria and hypertension in pregnancy; pre-eclampsia: limited data suggest that pregnant women who have a history of childhood UTI are at increased risk of bacteriuria, and renal scarring (especially more severe or bilateral renal scarring) may be associated with an increase in hypertension and pre-eclampsia during pregnancy.
- Renal insufficiency and failure: childhood UTI appears to be associated with a small increased risk of established renal failure during childhood or early adulthood. Adult disease, therefore, may also relate to childhood UTI. However, chronic renal failure/insufficiency without established renal failure may be a much more common outcome.

## Prognosis<sup>[2]</sup>

Overall, the prognosis after childhood urinary tract infection is good. However, in people with urinary tract comorbidity, progression of renal dysfunction is likely.

Girls are more likely than boys to have a recurrent UTI. In addition, girls tend to have more recurrences, and their recurrence rate increases with age.

Infants and children with intrarenal vesicoureteric reflux or bilateral VUR are more likely to have recurrent UTIs.

Risk of recurrence is estimated to be 75% for infants under 1 year of age and 40% (for girls)/30% (for boys) aged over 1 year.

## Prevention of urinary tract infection in children<sup>[1]</sup>

Advice which may help prevent recurrence

This includes:

- Management of voiding dysfunction.
- Good hygiene.
- Avoiding constipation.
- Adequate fluid intake.
- Avoidance of delayed voiding; ready access to clean toilets.

### NICE recommends the following regarding prophylaxis

- Antibiotic prophylaxis should not be routinely recommended in infants and children following first-time UTI.
- Antibiotic prophylaxis may be considered in infants and children with recurrent UTI.<sup>[8]</sup>
- Asymptomatic bacteriuria in infants and children should not be treated with prophylactic antibiotics.



A Cochrane review concluded that no significant benefit was demonstrated for probiotics for preventing UTIs in adults and children compared with placebo or no treatment, but a benefit cannot be ruled out as the data were few, and derived from small studies with poor methodological reporting.<sup>[9]</sup>

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## Further reading

- [Urinary tract infection in children and young people](#); NICE Quality Standard, July 2013 – last updated July 2022
- [Pyelonephritis \(acute\): antimicrobial prescribing](#); NICE Guidance (October 2018)
- [Urinary tract infection \(lower\): antimicrobial prescribing](#); NICE Guidance (October 2018)
- [Khan A, Jhaveri R, Seed PC, et al](#); Update on Associated Risk Factors, Diagnosis, and Management of Recurrent Urinary Tract Infections in Children. *J Pediatric Infect Dis Soc.* 2019 May 11;8(2):152–159. doi: 10.1093/jpids/piy065.
- [Leung AKC, Wong AHC, Leung AAM, et al](#); Urinary Tract Infection in Children. *Recent Pat Inflamm Allergy Drug Discov.* 2019;13(1):2–18. doi: 10.2174/1872213X13666181228154940.
- [t Hoen LA, Bogaert G, Radmayr C, et al](#); Update of the EAU/ESPU guidelines on urinary tract infections in children. *J Pediatr Urol.* 2021 Apr;17(2):200–207. doi: 10.1016/j.jpuro.2021.01.037. Epub 2021 Feb 2.

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