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\(^{[1, 2]}\)

**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**: a child has had two episodes of upper UTI, three or more episodes of lower UTI, or one episode of upper UTI and one or two episodes of lower UTI.

**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/septicaemia.
- Poor urine flow.
- Presence of an abdominal or bladder mass.
- Lack of response within 48 hours to treatment with suitable antibiotics.
- An unusual causative organism (ie not *Escherichia coli*).
- An increased serum creatinine level.

This is relevant to guidelines on the need for further investigation (see later).

Classification\(^{[3]}\)

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.

**Epidemiology**[2]

- Febrile UTI is the most common serious bacterial infection in childhood.[3]
- 1 in 10 girls and 1 in 30 boys will have a UTI by the age of 16.
- Boys have a higher incidence of UTI up to the age of 6 months, after which it is more common in girls. Girls also have a higher incidence of recurrent UTI.
- 3% of girls and 1% of boys will have an upper UTI by the age of 7.

**Risk factors**

- Any condition that leads to urinary stasis (renal calculi, obstructive uropathy, vesico-ureteric reflux (VUR) - or family history of, voiding disorders) or poor urine flow - eg, phimosis.
- Dysfunctional elimination syndrome.
- Sexual abuse.
- History suggestive of, or confirmed previous, UTI.
- Constipation.
- Spinal abnormalities.

There is no associated risk factor in the majority of cases.

**Presentation**[1, 2]

- **Infants younger than 3 months**: 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.

**Differential diagnosis**

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

**Examination**

The temperature of the child should always be taken and recorded. The following should also be examined:

- Throat and cervical lymph nodes.
- Abdomen - to look for constipation, tender or palpable kidney.
- Back - to look for stigmata of spina bifida or sacral agenesis.
- Genitalia - to look for phimosis, labial adhesions, vulvitis or epididymo-orchitis.
NICE advises that:

- A diagnosis of acute pyelonephritis/upper UTI should be assumed in:
  - Infants and children who have bacteriuria and a fever of 38°C or more.
  - Infants and children presenting with fever less than 38°C associated with loin pain/tenderness and bacteriuria.

- A diagnosis of cystitis/lower UTI should be assumed in all other infants and children who have bacteriuria but no systemic symptoms or signs.

**Investigations**

### Collecting the urine sample

Ideally, a urine sample should always be taken prior to starting any antibiotics. This can be obtained in various ways, depending on the age of the child and also the clinical presentation of the child.

A clean catch urine sample is the method for urine collection recommended by NICE. The child is placed in the lap of a parent or member of the nursing staff, who holds a sterile foil bowl underneath the infant's genitalia. The infant is offered oral fluids and urine collection is awaited. Although this is time-consuming, there seems to be a good correlation between the results of urine culture obtained by this method and suprapubic aspiration (SPA), with a false positive rate of only 5% and false negative rate of 12%. This technique is obviously much easier in toilet-trained children.

If a clean catch urine sample is not possible:

- A collection bag attached to cleaned genitalia can be used. However, if the genitalia are not cleaned and culture is delayed, there can be a high incidence of false positive results (85-99%).
- Use other non-invasive methods such as urine collection pads but do not use cotton wool balls, gauze or sanitary towels.
- Alternatively, a catheter sample or SPA of urine may be collected where sufficient experience and resources exist. The decreased contamination rate offered by either of these methods can offset the disadvantage of being an invasive procedure. They may be most appropriate in:
  - Pre-toilet-trained children with fever and no focus, or where UTI is considered likely.
  - Children with a history of UTI/VUR/on UTI prophylaxis/having renal tract anomalies.
  - Very sick children.

If the sample needs to be cultured but cannot be cultured within four hours of collection, either refrigerate or preserve it with boric acid immediately.

### Dipstick testing

Nitrites are not a very sensitive dipstick test in infants. This is because not all urinary pathogens reduce nitrate to nitrite. However, false negatives are rare. Dipstick testing is appropriate in children over the age of 3.

If there is a positive dipstick test then the sample should be sent for urine culture.

### Urine testing

- Aged <3 months: if UTI is suspected clinically, refer to a paediatrician. A urine sample is sent for urgent microscopy and culture.
- Aged >3 months but <3 years: send a sample for urgent microscopy and culture. Await the result before starting treatment, unless there are specific urinary symptoms or the child is systemically unwell.
- Aged >3 years: use dipstick test to diagnose UTI:
  - If leukocyte esterase and nitrite are positive: start antibiotic treatment for UTI and, if the child has a high or intermediate risk of serious illness or a history of infection, send urine sample for culture.
  - If leukocyte esterase is negative and nitrite is positive: start antibiotic treatment if a fresh sample was tested and send urine sample for culture.
- If leukocyte esterase is positive and nitrite is negative: send urine sample for microscopy and culture. Only start antibiotic treatment for UTI if there is good clinical evidence of such infection.
- If leukocyte esterase and nitrite are negative: do not start treatment for UTI; explore other causes of illness.

### Imaging

These are based on NICE guidelines but there is still some debate. These are usually arranged by secondary care.

#### Imaging guidelines for children less than 6 months old

<table>
<thead>
<tr>
<th>Test</th>
<th>Responds well to treatment within 48 hours</th>
<th>Atypical UTI</th>
<th>Recurrent UTI</th>
</tr>
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<tbody>
<tr>
<td>Ultrasound during the acute infection.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Ultrasound within six weeks.</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Dimercaptosuccinic acid (DMSA) 4-6 months following the acute infection.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Micturating cystourethrogram (MCUG).</td>
<td>No - consider if ultrasound is abnormal.</td>
<td>Yes</td>
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#### Imaging guidelines for children between 6 months and 3 years old

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<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>DMSA 4-6 months after infection.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MCUG.</td>
<td>No</td>
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Imaging guidelines for children older than 3 years

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- **Ultrasound**: Can accurately assess renal size and outline and identify most congenital abnormalities, renal calculi and hydronephrosis or hydroureter, indicating the presence of obstruction or severe reflux. It is less effective in detecting mild or moderate VUR in children with UTIs.

- **Micturating cystography**: Is the gold standard investigation for reflux and is the only imaging technique that provides information about the urethra. Should be performed by a skilled radiologist with experience in acquiring and interpreting the images. The disadvantage of micturating cystography is its invasiveness, as it requires catheterisation.

- **DMSA scintigraphy**: Is the gold standard for detecting renal parenchymal defects. Study renal function using a radio-pharmaceutical such as technetium\(^{99m}\). The isotope is concentrated in the proximal renal tubules; its distribution correlates with functioning renal tissue.

Management\(^{[1]}\)

**General principles**

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

- Children with a high risk of serious illness and/or aged younger than 3 months should be referred immediately to secondary care. This should be assessed in accordance with NICE guidance on feverish illness in children.\(^{[7]}\)
- Do not delay treatment if the sample cannot be obtained and the infant or child is at high risk of serious illness.

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

**Pharmacological**

- Consider referral to secondary care for children aged 3 months and older with acute pyelonephritis or upper UTI but, if appropriate, treat with 7-10 days of oral antibiotics. If the child is unable to tolerate oral antibiotics, start treatment with intravenous (IV) antibiotics until oral intake is possible.
- Children aged 3 months and over with cystitis or infection of the lower urinary tract should be treated with three days of oral antibiotics according to local guidance.
- However, there is some evidence that outcomes of short courses (1-3 days) are inferior to those of 7- to 14-day courses.\(^{[3]}\) In addition, a Cochrane review has found that 10-day antibiotic treatment is more likely to eliminate bacteria from the urine than single-dose treatments.\(^{[8]}\)
The Cochrane review also concluded there were insufficient data to advise about the best choice of antibiotic, which should be therefore be determined by local guidelines. The antibiotic may need to be adjusted according to the MSU results. Currently, Public Health England (PHE) guidelines advise that in a lower UTI, trimethoprim or nitrofurantoin should be first-line choices. Cefalexin should be used second-line. Amoxicillin may be used where there is proven susceptibility. The guidance goes on to advise that in upper UTI, co-amoxiclav is first-line and cefixime second-line.

**Prognosis**[2]

Most children recover quickly and completely with antibiotic treatment. Recurrence of UTI is more likely in:

- Younger children, ie aged less than 6 months.
- Girls compared with boys.
- VUR grade 3-5, compared with reflux grade 1-2, or no reflux.
- Dysfunctional voiding syndrome; this is an abnormality of emptying, due either to a small-capacity, unstable bladder or a large-capacity, poorly emptying bladder.

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.

VUR resolves spontaneously in most children.

Potential complications include:

- Renal scarring (more likely in children with VUR).
- Hypertension (associated with severe renal scarring).
- Possible link with increased risk of bacteriuria, pre-eclampsia and hypertension in pregnancy in later life.

**Prevention**[1]

Advice which may help prevent recurrence 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.
- Asymptomatic bacteriuria in infants and children should not be treated with prophylactic antibiotics.

**Further reading & references**

- Urinary tract infection in children and young people; NICE Quality Standard, July 2013
- Diagnosis of UTI; British Infection Association and Health Protection Agency

1. Urinary tract infection in children: diagnosis, treatment and long-term management; NICE Clinical Guideline (August 2007)
2. Urinary Tract Infection - Children; NICE CKS, July 2015 (UK access only)
5. Urinary tract infection in under 16s: diagnosis and management; NICE Clinical guideline (Aug 2007, updated September 2017)
7. Feverish illness in children - Assessment and initial management in children younger than 5 years ; NICE Guideline (Updated August 2017)

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