

Definitions

- **Asymptomatic Bacteriuria** = presence of bacteria in well child
 - 1-2% prevalence
 - Treatment confers no benefit, may increase risk of UTI
 - No increased risk of complications
- **Symptomatic Bacteriuria** = presence of bacteria in symptomatic child
- **UTI** = symptomatic significant ($>10^7$ - 10^8 CFU/L) bacteriuria from kidneys to bladder.
- **Lower UTI** = cystitis
- **Upper UTI** = pyelitis or pyelonephritis.
- **Uncomplicated UTI** = usual pathogen in patient with normal urinary tract/kidney fn.
- **Complicated UTI** = where anatomical, functional, or pharmacological factors predispose the person to persistent infection, recurrent infection, or treatment failure.
- **Recurrent UTI** may be due to relapse/re-infection. Significance depends on age and sex.

Epidemiology

- The most common serious bacterial infection of childhood - ~5% of febrile children
- **Boys**
 - Disease of infancy (<1 year)
 - Peak incidence during neonatal age, then linear reduction to 1 year of age
 - More common in boys than girls during the first year of life
 - Overall cumulative incidence during childhood about 3%
- **Girls**
 - Peak incidence at 6-12 months
 - Long tail of risk
 - More common in boys > 1 year
 - Overall cumulative incidence during childhood is about 8% (about double males)

Pathogenesis

- *Escherichia coli* (85%)
- *Proteus mirabilis* (6%)
- *Klebsiella sp.* (5%)
- *Strep. Faecalis* (4%)
- Neonates: also *Staph. aureus*
- Immunosuppressed/Catheterised/Complicated UTI: *Klebsiella sp.*, *Proteus vulgaris*, *Candida albicans*, *Pseudomonas sp.*

Risk factors

- Obstructive uropathy - posterior urethral valves, urethral stenosis
- Calculus
- Catheterisation
- Diabetes
- Spinal lesions - neuropathic bladder
- Vesico-ureteric reflux
- Phimosi
- Constipation
- Uncircumcised penis

Presentation

< 2yr

- Non-specific febrile illness
- Fever/irritability/lethargy/vomiting and/or diarrhoea

> 2yr

- Most have localising symptoms
- Frequency/dysuria/abdominal pain, incontinence

Diagnosis

UTI symptoms AND significant bacteria counts in appropriate urine specimen

Urine:

- Best sample: <6mo: SPA/catheter, 6mo-toilet trained: catheter, >toilet trained: MSU.
- U/A:

	White-cell count (urine microscopy, unpaired data)	Gram stain (urine microscopy, unpaired data)	Unstained bacteria (urine microscopy, unpaired data)	Leucocyte esterase (dipstick, unpaired data)	Nitrite (dipstick, unpaired data)	Either leucocyte esterase or nitrite positive (dipstick combinations, paired data)	Both leucocyte esterase and nitrite positive (dipstick combinations, paired data)
Number of studies	49	17	22	30	46	15	13
Number of children	66 937	12 530	54 088	12 954	62 671	6492	5751
DOR (95% CI)	18 (12.1-26.8)	253.9 (115.1-560.4)	82.6 (26.5-242.1)	vary*	vary*	Relative DOR 1.6 (1.1-2.3); relative to leucocyte esterase alone	Relative DOR 1.1 (0.4-3.1); relative to leucocyte esterase alone
Sensitivity (95% CI)	0.74 (0.67-0.80)	0.91 (0.80-0.96)	0.88 (0.75-0.94)	0.79 (0.73-0.84)	0.49 (0.41-0.57)	0.88 (0.82-0.91)	0.45 (0.30-0.61)
Specificity (95% CI)	0.86 (0.82-0.90)	0.96 (0.92-0.98)	0.92 (0.83-0.96)	0.87 (0.80-0.92)	0.98 (0.96-0.99)	0.79 (0.69-0.87)	0.98 (0.96-0.99)
Area under the curve	0.88	0.98	0.96	0.88	0.87	0.91	0.90

DOR=diagnostic odds ratio.

Table 3: Summary estimates of tests of individual rapid tests and dipstick combination tests for the diagnosis of urinary tract infection in children

- In young children sterile pyuria not uncommon in fever so U/A nitrites & bacteria on microscopy helpful, but always need to culture
- M,C&S: Single organism usually (5% two orgs), count is sample dependent:
 - Bladder tap: any growth
 - Catheter: $\geq 10^7$ /L definite, 10^{6-7} /L possible
 - Voided: $\geq 10^8$ /L, definite, 10^{7-8} /L possible, 10% false positives
 - Bag: don't use, >30-80% false positives
 - CFUs (colony forming units) 10-100 equates to 10^{7-8} /L
 - Two samples advised if contamination is possible

Bloods (if severe or DDx): FBC, UEC, culture

Imaging: NICE guidelines for confirmed UTI:

- Age <6mo:
 - If typical - USS <6wk.
 - If atypical or recurrent - USS during infection, DMSA at 4-6mo, MCUG
- Age \geq 6mo- <3y
 - If typical - no f/u imaging
 - If atypical - USS during infection, DMSA at 4-6mo. MCUG: if abnormal USS, poor flow, non-E.Coli infection or FamHx VUR
 - If recurrent - USS <6wks. DMSA at 4-6mo. MCUG: if abnormal USS, poor flow, non-E.Coli infection or FamHx VUR
- Age \geq 3yr: USS <6wk if recurrent. MCUG: if abnormal USS.
 - If typical - no f/u imaging
 - If atypical - USS during infection.
 - If recurrent - USS <6wks. DMSA at 4-6mo.
- NB: Atypical=non-E.Coli, septicaemia, abdo/bladder mass, poor flow, raised Cr, poor response to 48hrs ABx. Recurrent=2+ UTI (≥ 1 is upper UTI) or 3+ lower UTI.

Management

Non-drug: Good hydration, regular voiding with good posture, wiping method, Mx constipation.

Drug treatment

- Supportive: Ural, analgesics, antipyretics
- Child:
 - If cystitis >6mo: PO **cephalexin** 12.5mg/kg bd, **cotrimoxazole** 4+20mg/kg bd, or **co-amoxiclav** 12.5+3.1mg/kg bd x 3-7d until symptoms resolved.
 - If <3mo or pyelonephritis: IV (**ampicillin** 50mg/kg q6h plus **gentamicin** 7.5mg/kg [6mg/kg if >10y] od) or **cefotaxime** 50mg/kg q8h for 3d or until fever resolves.
- Child prophylaxis: **cotrimoxazole** 2+10mg/kg, **cephalexin** 12.5mg/kg, or **nitrofurantoin** 1-2.5mg/kg od

Complications

- Pyelonephritis or recurrent UTI
- Perinephric and intrarenal abscess
- Hydronephrosis or pyonephrosis
- Renal failure
- Septicaemia

Vesicoureteric Reflux

- Prevalence 1-5%
- ~25% of children with recurrent UTI
- Increased risk for siblings
- ESRD from reflux nephropathy vs UTI
 - 1 episode per 170-800 children with VUR
 - 1 episode per 16,000 children with UTI
- Lower risk than prev thought of normal kidneys → reflux → UTI → nephropathy/ESRD
- Genetic/environmental factors leading to early dysplastic kidney & risk of UTI & ESRD

Mx:

- Treat symptomatic UTI
- Screen for asymptomatic UTI
- Long-term low dose antibiotics - NNT 12-13 children. Abs risk reduction only 8% over 1yr or 12.6% over 2yr, but ↑risk for resistant orgs.
- Reimplantation surgery
- Circumcision
- Cranberry juice - proanthocyanidins inhibit uropathogenic E.Coli p-fimbriae adhesion to uro-epithelium - reduces freq UTI recurrence for a patient
- Combination therapy