URINARY TRACT INFECTION IN CHILDREN

1. Epidemiology & Risk Factors

- **Why care?** UTI is an important risk factor for renal scarring, renal insufficiency, and End-Stage Renal Disease (ESRD). The major cause of CKD/ESRD in children is reflux nephropathy + congenital renal anomalies (CAKUT).
- **Gender Ratio:**
  - **< 1 Year Old:** More common in Males (especially uncircumcised; 4-20x higher risk).
  - **> 1 Year Old:** More common in Females (peaks around 4-5 years during toilet training).
- **Recurrence:** 50-60% will develop a 2nd UTI within 1 year.
- **Risk Factors:** Female sex, uncircumcised male, Vesicoureteral Reflux (VUR), voiding dysfunction/ constipation, tight clothing, pinworm, labial adhesions.

2. Pathogenesis & Microbiology

Most UTIs are ascending infections from fecal flora colonizing the perineum. Hematogenous spread is rare (mostly seen in neonates).

Bacterial Pathogens

- **Escherichia coli:** Most common (>80% of 1st UTIs).
- **Klebsiella spp.:** 2nd most common, especially in young infants.
- **Proteus spp.:** As common as E. coli in **males > 1 year**.
- **Pseudomonas:** Non-enteric. Suggests **Renal Tract Abnormality**.
- **Group B Strep (GBS):** Rare, mostly neonatal sepsis.

Other Pathogens & Pathogenicity

- **Staph saprophyticus:** Pathogen in both sexes.
- **Viral (Adenovirus):** May cause viral hemorrhagic cystitis.
- **Fimbriae (Crucial MCQ):** Pathogenicity determined by pili.
  - **Type II (P fimbriae)**: Highly potent uroepithelial attachment. Found in 76-94% of pyelonephritis strains (compared to 19-23% of cystitis strains).

MEMORY AIDS: UTI MICROBIOLOGY

The 3 "P"s of Pathogenesis:

- **P**roteus: **P**enis (Common in males > 1 yr).
- **P**seudomonas: **P**roblematic tract (Anatomical anomalies).
- **P**-fimbriae: **P**yelonephritis (Type II fimbriae).

3. Clinical Manifestations

Feature	Pyelonephritis (Upper Tract)	Cystitis (Lower Tract)
Definition	Involvement of the renal parenchyma.	Bladder involvement ONLY.
Symptoms	**Fever**, flank/abdominal pain, malaise, N/V. Infants may have jaundice, FTT, poor feeding.	Dysuria, urgency, frequency, suprapubic pain, malodorous urine.
Renal Injury Risk	**High risk of renal scarring.**	**Does NOT result in renal injury.**

**Note: A fever >38.0°C in children <2 yr with no defined focus carries a 5% prevalence of UTI.*

4. Diagnosis: Urinalysis & Culture

- **Method of Collection:** Mid-stream void (satisfactory in toilet-trained). Suprapubic aspiration (SPA) or catheterization (gold standard in infants). Bag is unreliable.
- **Urinalysis (Dipstick):**
  - **Nitrite & Leukocyte Esterase:** Usually positive in infected urine.
  - **False +ve Blood:** Myoglobinuria, povidone/iodine, heavy bacterial contamination.
  - **False -ve Blood:** Ascorbic acid (Vitamin C).
- **Microscopy:** RBC (0-3/HPF), WBC (0-5/HPF). **RBC Casts are ALWAYS pathological.**

MCQ TRAP: POSITIVE URINE CULTURE DEFINITIONS

- **Mid-stream / Clean Catch:** > 100,000 colonies of a single pathogen (OR > 10,000 colonies if highly symptomatic).
- **Suprapubic Aspiration (SPA): ANY gram-negative growth** is considered a positive culture!
- **Asymptomatic Bacteriuria:** Positive culture WITHOUT symptoms. Occurs almost exclusively in girls. Benign; **DO NOT TREAT** except in pregnancy.

5. Treatment Protocols

Therapy duration is typically **7-14 days**.

- **Indications for IV Hospitalization:** Child is "toxic", unable to retain oral intake, **infants < 3 months**, or failed oral antibiotics.
- **Pyelonephritis Therapy:** Oral and IV are equally effective if child is stable.
  - **IV Choices:** 3rd Gen Cephalosporin (Ceftriaxone, Cefotaxime) OR Ampicillin + Aminoglycoside (Gentamicin).
  - **Oral Choices:** 3rd Gen Ceph (Cefixime / Suprax).
- **Cystitis Therapy (3-5 days):** TMP-SMX, Amoxicillin, or Nitrofurantoin.

MEMORY AID: THE NITROFURANTOIN RULE

Nitrofurantoin = **N**o **N**ephron penetration.

It does NOT achieve significant renal tissue levels. Therefore, it is **ONLY good for Cystitis** and should NEVER be used for febrile UTI / Pyelonephritis.

6. Imaging Guidelines (Highly Testable)

The goal is to identify anatomic abnormalities and prevent renal scarring.

Modality	Indication & MCQ Board Clues
Ultrasound (US)	**For EVERY child with a 1st febrile UTI.** Do within first 2 days of treatment. Only detects 30% of scars and 40% of VUR, but rules out gross obstruction/ hydronephrosis.
VCUG (Voiding Cystourethrogram)	The best test to diagnose & grade Vesicoureteral Reflux (VUR). **NOT routine after 1st UTI.** ONLY indicated if: Abnormal US (hydronephrosis), atypical UTI, significant family history of VUR, or scars on DMSA.
DMSA Scan (Technetium-99)	**Gold standard** for diagnosing acute pyelonephritis AND detecting late renal scarring.

MEMORY AID: IMAGING

U.V.D.

- **U**ltrasound = **U**niversal (Everyone gets it).
- **V**CUG = **V**UR (To see the reflux grades).
- **D**MSA = **D**amage (To see acute inflammation & scars).

7. Vesicoureteral Reflux (VUR) & Prophylaxis

- **Primary VUR:** Developmental anomaly of the Vesicoureteral (VU) junction.
- **Secondary VUR:** Due to obstruction (e.g., Posterior Urethral Valves) or neurogenic bladder.
- **VUR Grading:**
  - Grade I: Into non-dilated ureter.
  - Grade II: Into renal pelvis/calyces WITHOUT dilation.
  - Grade III: Mild-moderate dilation.
  - Grade IV: Moderate tortuosity and dilation.
  - Grade V: Gross dilation, loss of papillary impressions, severe tortuosity.
- **Antibiotic Prophylaxis:** Indicated for recurrent febrile UTIs with renal tract abnormality / worsening imaging. Options: **TMP-SMX, Nitrofurantoin, Cephalexin, Nalidixic acid.**

8. Enuresis (Bedwetting)

- **Definition:** Involuntary voiding >2 times/week for 3 months in a child > 5 years old.
- **Primary vs Secondary:** Primary = never been dry. Secondary = dry period of at least 6 months before relapse.
- **Monosymptomatic (Nocturnal):** Normal voiding at night, no daytime symptoms. 80-85% of cases. **More common in BOYS.** Only 5% due to organic cause.
- **Polysymptomatic (Diurnal/Daytime):** Bedwetting + urgency/frequency/constipation. 5-10% of cases. **More common in GIRLS.** Higher rate of UTIs and neurogenic bladder.