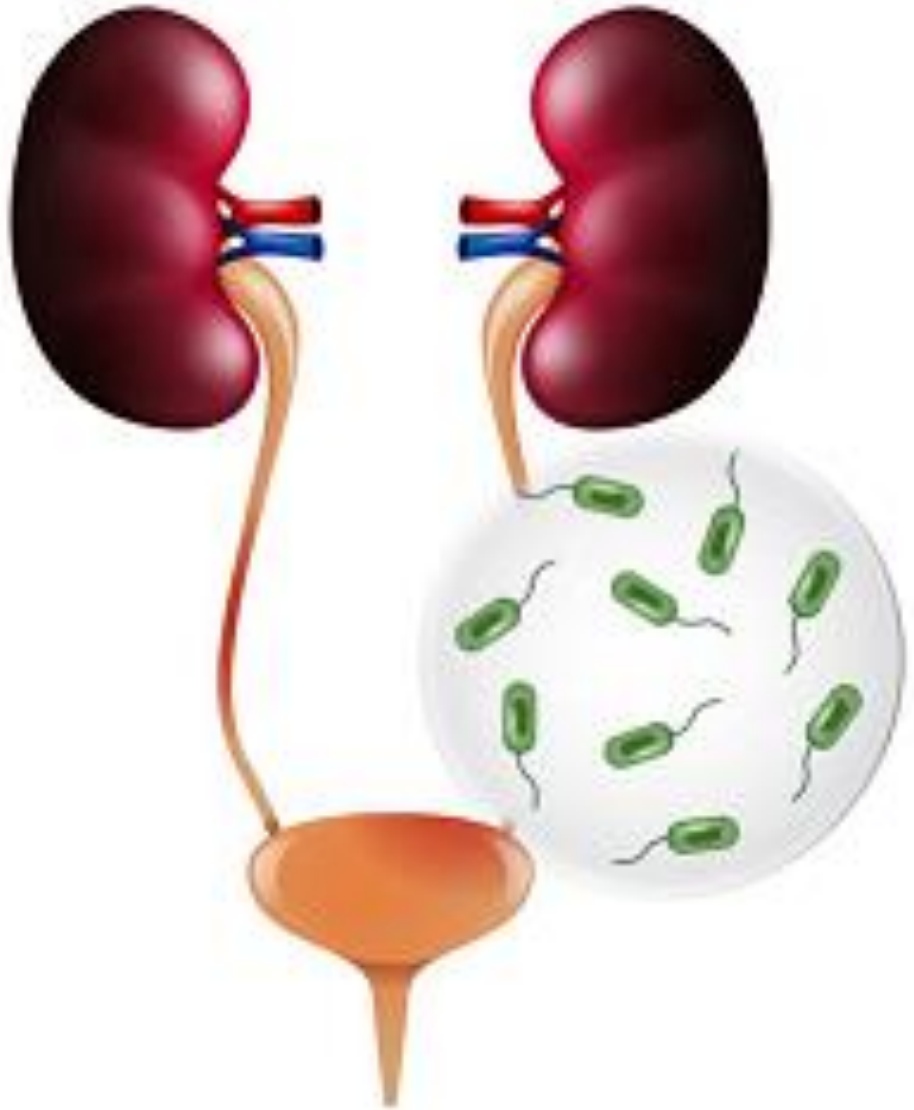
URINARY TRACT INFECTIONS (UTI)



Microbiology lecture 3

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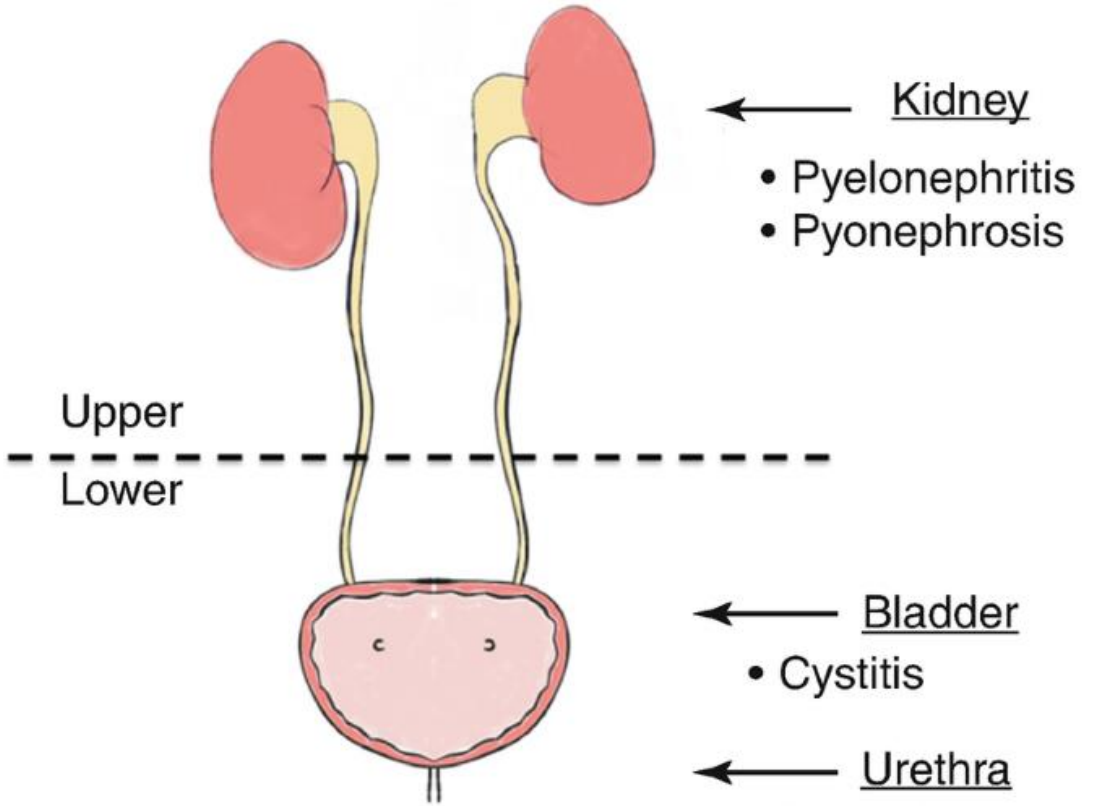
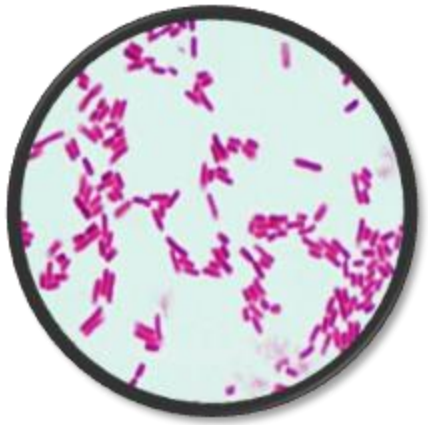
Introduction to Urinary Tract Infections

- UTIs are infections in any part of urinary system - the bladder, urethra, ureters, or kidneys.
- UTIs are the most common outpatient infections.
- Between 50% and 60% of adult women will have at least one UTI in their life, and close to 10% of postmenopausal women indicate that they had a UTI in the previous year.

Urinary Tract Infections Types



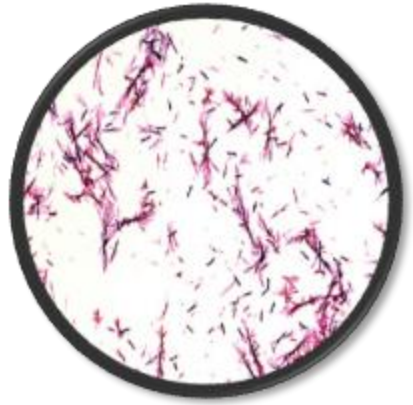
Causes of UTI



E. coli

S. saprophyticus

K. pneumoniae



P. mirabilis

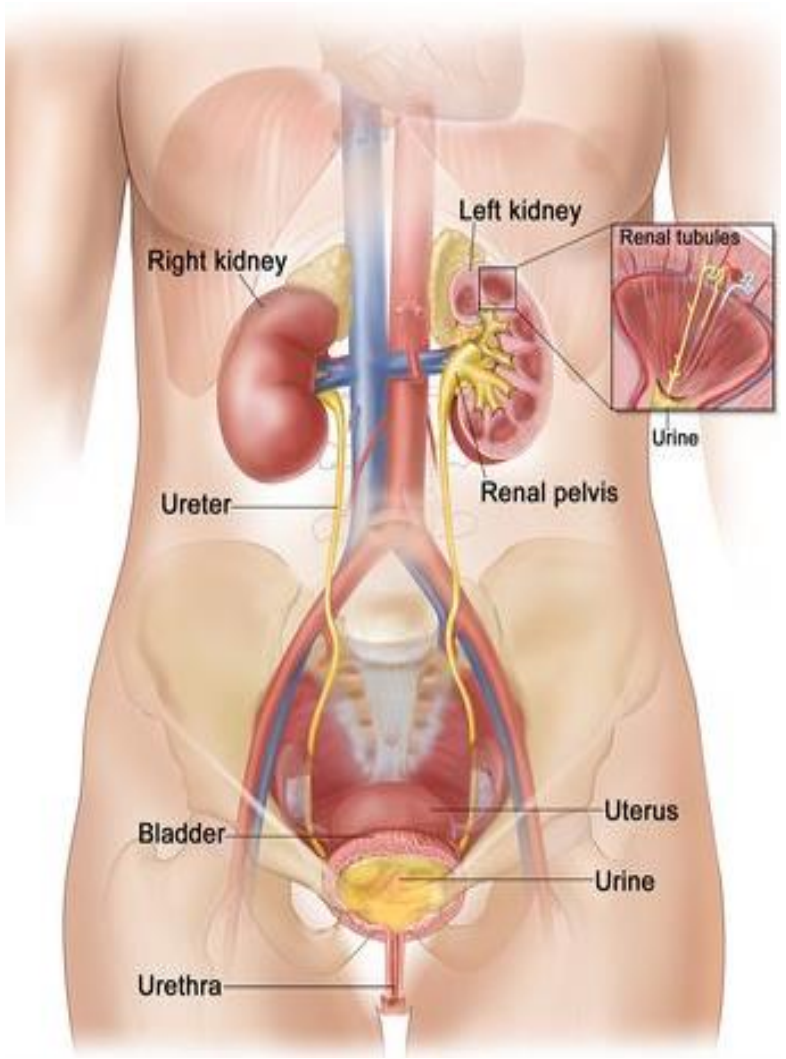
Viruses

Fungi

Predisposing Factors of UTIs

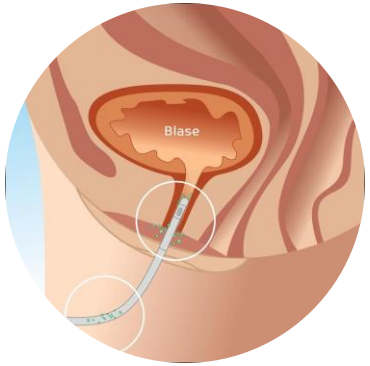
Host-dependent factors

- Structural or functional abnormalities of the urinary tract
- Gender
- Pregnancy
- Post menopause
- Chronic constipation
- Prior conditions



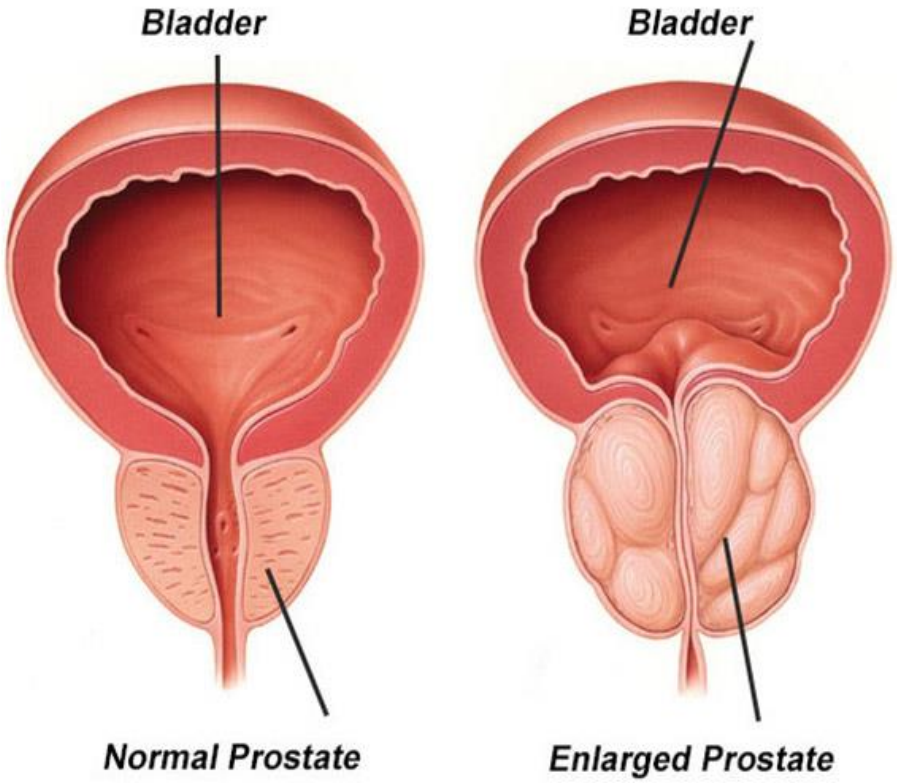
Other factors

- Postcoital cystitis
- Catheter-associated UTI

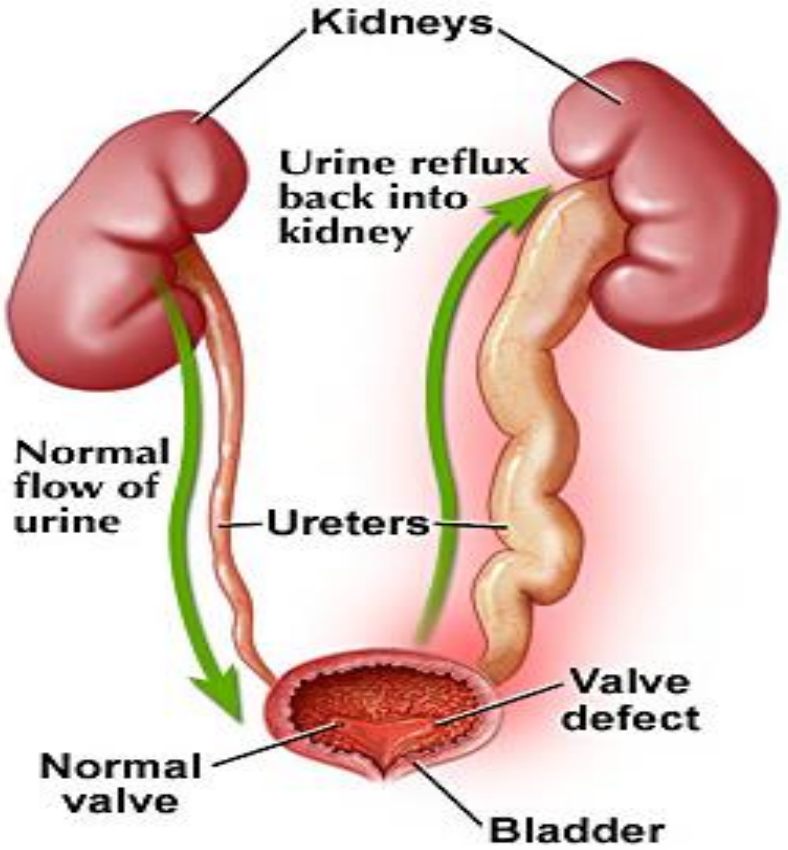


Predisposing Factors of UTIs

Examples of Structural or functional abnormalities of the urinary tract



Benign prostatic hyperplasia



vesicoureteral reflux

Classification of urinary tract infections

By clinical presentation

Asymptomatic bacteriuria (ASB)

defined by the presence of ≥ 100,000 CFU/mL in at least two voided urine samples in patients with no symptoms of UTI

Urinary tract infection (UTI)

Bacteriuria and clinical features of UTI

Classification of urinary tract infections

By location

Lower UTI

- Infection of the bladder (cystitis), the most common location of UTIs
- Often accompanied by urethritis (urethritis in isolation is suggestive of STI)
- Can be associated with prostatitis in men

Upper UTI

- Infection of the kidneys and ureter (pyelonephritis)

Classification of urinary tract infections

By frequency

Recurrent UTI

≥ 3 episodes of symptomatic, culture-proven UTI in one year or ≥ 2 episodes in 6 months

Classification of urinary tract infections

By severity

Uncomplicated UTI	Infection in nonpregnant, premenopausal women without further risk factors for infection, treatment failure, or serious outcomes

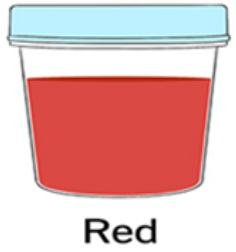
Complicated UTI	• Infection in patients with risk factors for infection, treatment failure, or serious outcomes, including:
	  • Male
	  • Pregnancy, Post menopause
	  • Children with features of atypical paediatric UTI
	  • Significant anatomical or functional abnormalities
	  • Immunosuppression, Renal failure
	  • Metabolic disorders (e.g., diabetes)
	• Infection associated with recent instrumentation or medical devices.
	• Healthcare-associated UTIs

Clinical features of UTI

Lower UTI

Painful urination or dysuria

increased urinary frequency



Haematuria

Cloudy or foul-smelling urine

Suprapubic tenderness

Clinical features of UTI

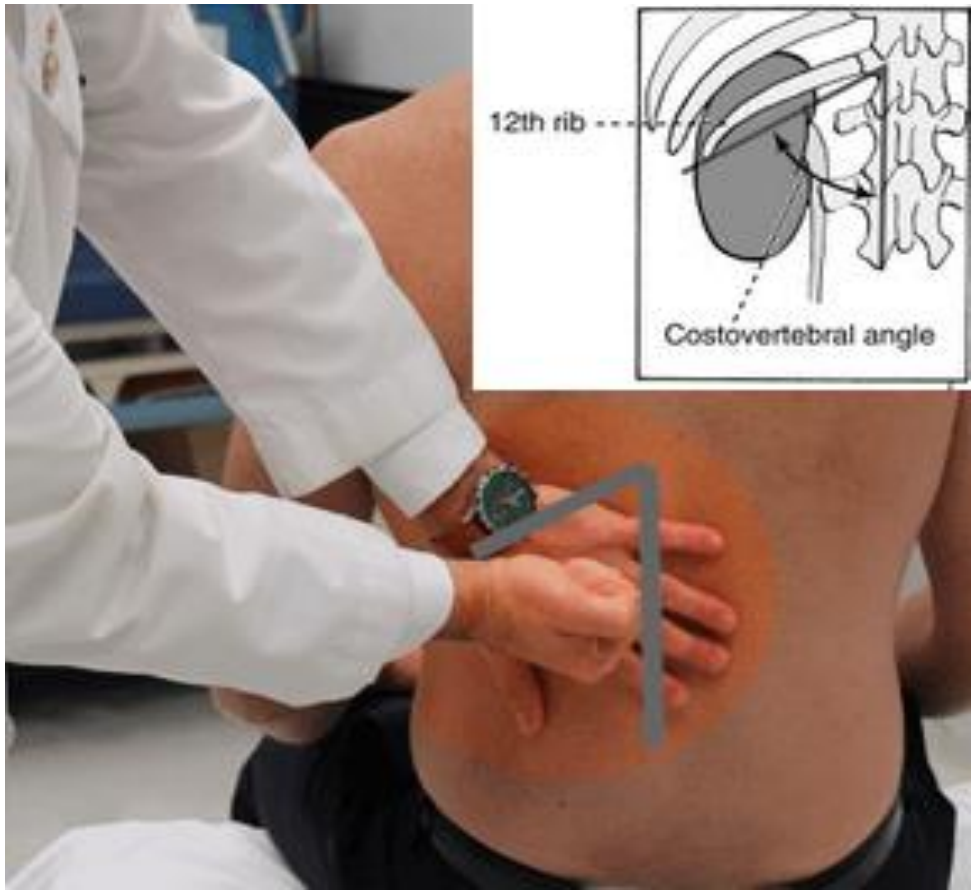
Upper UTI

Fever

Nausea and vomiting

Flank pain

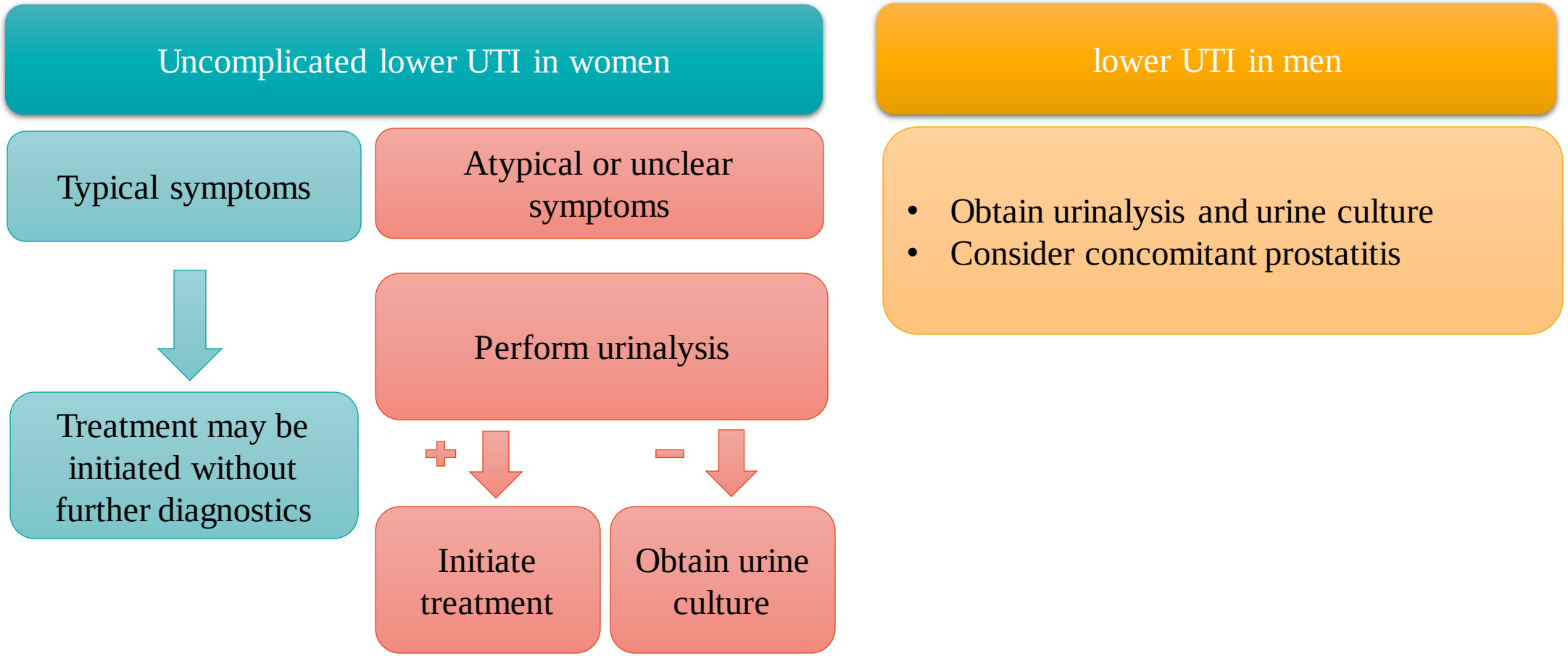
Fatigue



UTI symptoms in special patient groups:

- Male individuals: pain in the prostatic/perineal area
- Children: Caregivers may report the following in young children: new-onset urinary incontinence (if toilet trained), irritability, crying when urinating, poor feeding, malodorous urine.
- Older adults: delirium/acute confusion

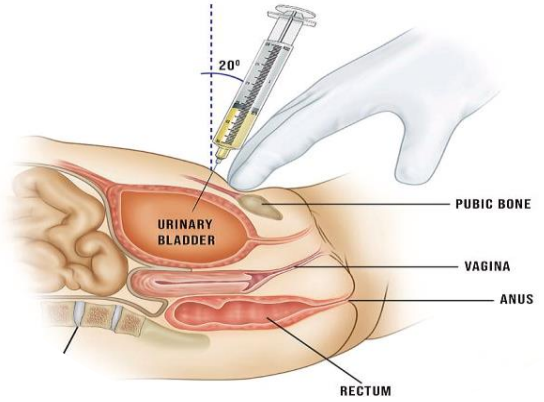
Diagnostics: Approach



Laboratory studies: Urinalysis

- Indications: best initial test for all patients
- Procedure: visual, chemical (dipstick), and microscopic examination of urine
- Specimen collection method:
  - Clean-catch midstream sample → reduce contamination with vaginal or skin flora.
  - Straight catheterization of the bladder → if the risk of contamination is high.
  - Suprapubic aspiration → no contamination if performed correctly

    rarely used due to its invasive nature.

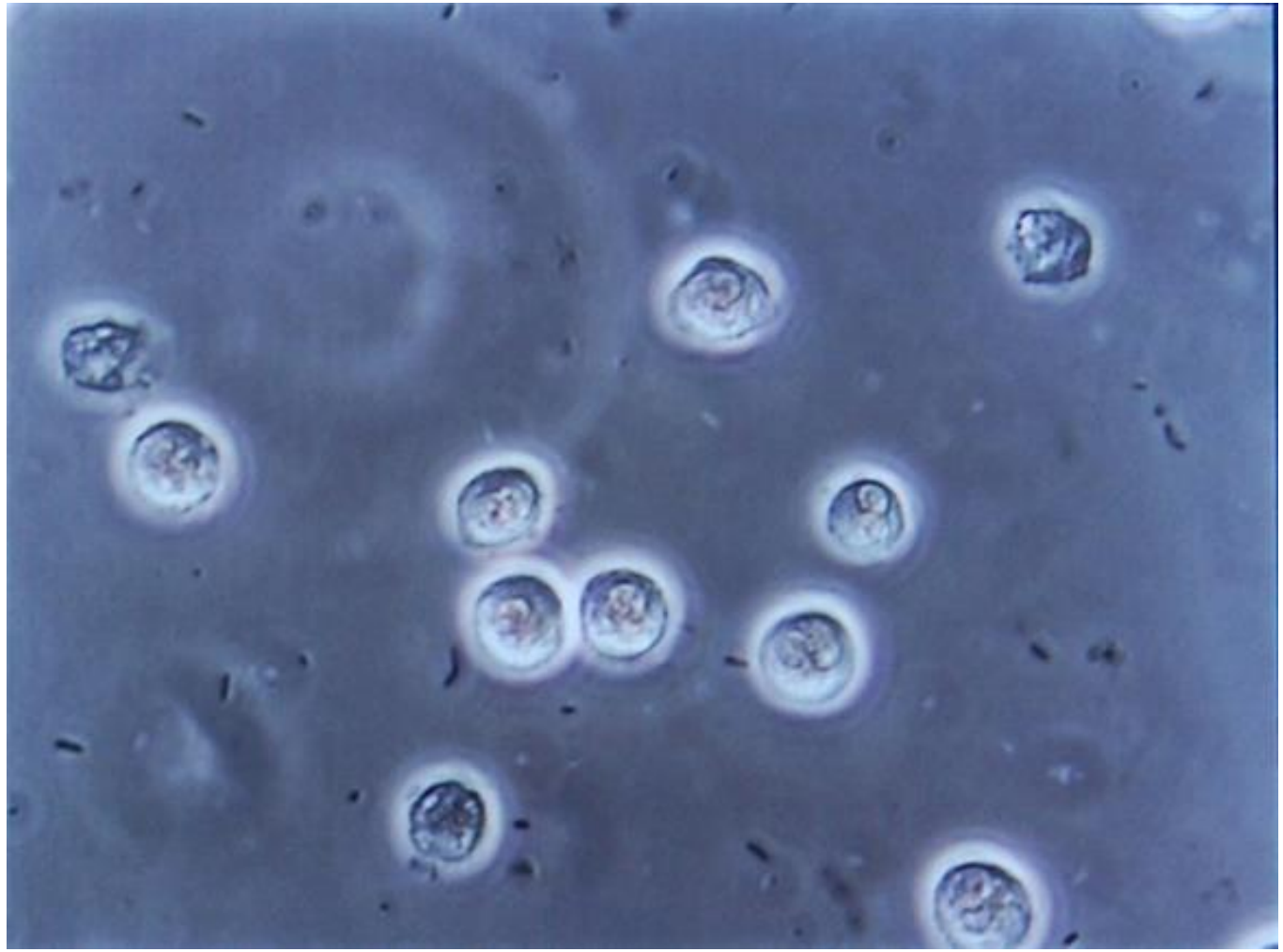


Typical urinalysis findings of UTI

- **Pyuria**: presence of white blood cells (WBCs) in the urine.
- **Positive leukocyte esterase**: an enzyme produced by WBC
- **Bacteriuria**: presence of bacteria in the urine.
- **Positive urinary nitrites**: indicate bacteria that convert nitrates to nitrites (most commonly gram-negative bacteria; e.g., E.coli)
- **Direct visualization** by gram stain (rarely performed)
- Other findings:
  - **Leukocyte casts** rare finding → a strong indicator for pyelonephritis.
  - Micro- or macroscopic **haematuria**.

Typical urinalysis findings of UTI

- Pyuria and bacteriuria on microscopy. Multiple white blood cells (large, light-colored structures) and bacteria (small black structures) are visible.



Laboratory studies: Urine culture

- Indications:
  - Suspicion for complicated UTI or healthcare-associated UTI.
  - Suspicion for pyelonephritis or urosepsis.
  - Suspicion for uncomplicated cystitis with either of the following: history of recurrent UTIs, unclear urinalysis, atypical symptoms, concern for multi-resistant pathogens, age $\geq$ 65 years.
  - Follow-up cultures for test of cure in the following cases: Non-resolving symptoms despite antibiotic treatment, anatomic or functional abnormalities of the urinary tract, continued pathological findings on urinalysis.

Laboratory studies: Urine culture

- Interpretation
  - Cultures are considered positive if either of the following is present:
  - Significant bacteriuria: defined as $\geq 10^5$ CFU/mL in a clean-catch specimen
  - Any organisms in a specimen obtained by suprapubic aspiration

- Typical colony findings:
  - E. coli: intensely pink on MacConkey agar
  - Klebsiella pneumoniae: viscous colonies
  - Proteus mirabilis: swarming motility pattern
  - Pseudomonas aeruginosa: blue-green pigment

K. pneumonia


P. aeruginosa

Diagnostics: imaging

- Imaging is generally not indicated for the diagnosis of lower UTI, but indications may include:
  - Suspected urinary tract obstruction
  - Severe illness (e.g., septic shock)
  - Early recurrence of UTI (within two weeks of appropriate treatment)
  - Persistent bacteriuria despite treatment
  - Recurrent complicated UTI
  - Men with febrile UTI

Diagnostics: imaging

- **CT scan:**
  - CT abdomen and pelvis with or without IV contrast is considered **most sensitive** for initial imaging.
  - Findings supportive of pyelonephritis → Renal parenchyma may appear normal (early) or edematous
  - Findings supportive of urinary tract obstruction → Hydroureter, hydronephrosis
    Nephrolithiasis, urolithiasis

Diagnostics: imaging

- **Ultrasound of the kidneys and bladder**
  - Perform if there are contraindications to contrast or radiation.
  - Useful for detecting hydronephrosis and measuring postvoid residual volume if an obstruction is suspected

- Additional modalities include MRI abdomen and pelvis, voiding cystourethrography, and retrograde cystography.

Treatment: General principles

- Antibiotic treatment is recommended for all patients with symptomatic UTI.
- The optimal therapy depends on disease severity, local resistance patterns, and patient characteristics (e.g., allergies).
- Initial treatment is with an empiric regimen, which is maintained for uncomplicated cystitis. In unclear or complicated cases, the regimen may subsequently have to be adjusted based on urine culture data.
- Consider the need for supportive analgesic treatment.

Treatment

- **Uncomplicated lower UTI:**
  - Management can typically be done in the outpatient setting with oral therapy.
  - First-line treatment: Nitrofurantoin for 5 days Or Trimethoprim/sulfamethoxazole (TMP/SMX) for 3 days.
- **Complicated lower UTI:**
  - Empiric antibiotic therapy should have broad-spectrum activity against the expected uropathogens. Antibiotic therapy must be adapted to culture results and is commonly given for 7–14 days.
  - Options for the initial empiric treatment of complicated lower UTIs include Fluoroquinolones PO or IV: e.g., ciprofloxacin or levofloxacin.
  - complicating factors (e.g., obstruction) should be treated, if possible.

Treatment

- **Uncomplicated pyelonephritis:**
  - Outpatient treatment is generally appropriate.
  - Empiric antibiotic therapy for uncomplicated pyelonephritis
  - Most patients can be treated with an oral fluoroquinolone (e.g., ciprofloxacin, levofloxacin) for 5–7 days. Trimethoprim-sulfamethoxazole, for 10–14 days (only recommended if susceptibility is known).

Treatment

- **Complicated pyelonephritis:**
  - Patients with complicated acute pyelonephritis should be admitted to the hospital and started on parenteral empiric antibiotic therapy.
  - **Not severely ill** and no risk factors for multidrug-resistant bacterial infection: One of the following: a fluoroquinolone: Ciprofloxacin, Levofloxacin, an extended-spectrum cephalosporin: Ceftriaxone, Cefotaxime
  - **Severely ill (i.e., septic)** and/or with risk factor(s) for multidrug-resistant gram-negative bacterial infection: One of the following: A carbapenem: Meropenem, Aztreonam, or an extended-spectrum cephalosporin (e.g, ceftriaxone).

Complications

In general

- Perinephric abscess
- Urosepsis
- Emphysematous pyelonephritis
- Atrophic kidneys
- End-stage renal disease (ESRD)

In male individuals

- Urethral stricture
- Epididymitis
- Prostatitis
- Orchitis

In pregnant women

- Increased risk of preterm labour and birth