

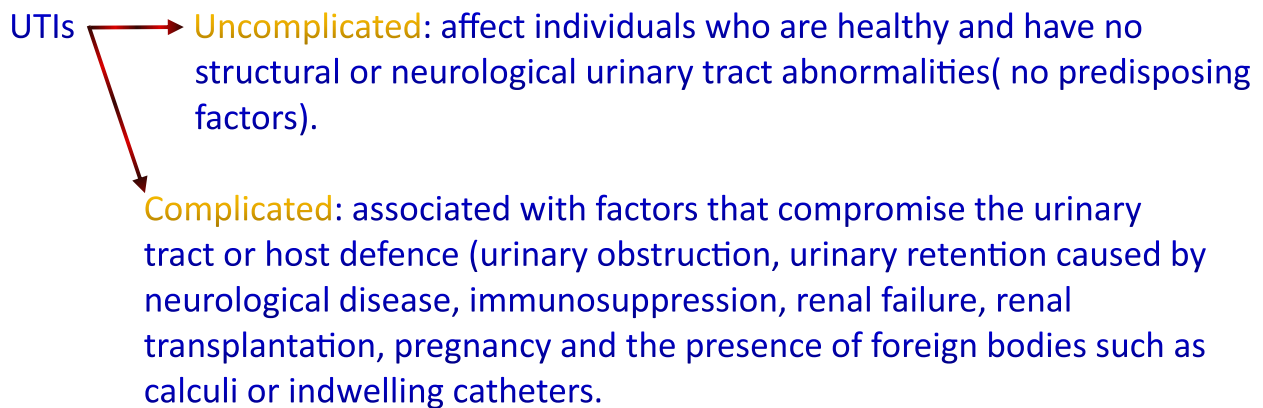
## Urinary tract defenses

- UT is a sterile environment.
  - The bacteria reach the UT more commonly than the CNS.
  - The CNS mount an exaggerated response to the bacterial infection, while the UT can mount a proper response against the infection.
1. The bulk flow of **urine** through the bladder and micturition can work to rinse away non-attached or weakly adherent microbes from the bladder surface.
  2. The **low pH and osmolarity** of urine can be inhibitory to bacterial growth, and the salts, urea, and organic acids present in the urine can reduce bacterial survival
  3. **Lactoferrin** within urine can scavenge essential iron away from incoming microbes.
  4. **Anti-adherence factors** (Tamm-Horsfall protein, low molecular weight sugars, secretory IgA, and uromucoid) → competitively inhibiting bacterial attachment to the bladder surface.

## Urinary tract infection (UTI)

- 1- **Asymptomatic bacteriuria (ASB)**.
  - 2- **Cystitis**: Inflammation of the bladder.
  - 3- **Prostatitis**: Inflammation of the prostate.
  - 4- **Pyelonephritis**: Inflammation of the kidney.
- If the **kidney** is involved >>> **Upper** urinary tract infections (UUTI).
  - If the **urethra/bladder/ prostate** is involved >>> **Lower** urinary tract infections (LUTI).
- As many as 50–80% of women in the general population acquire at least one UTI during their lifetime—uncomplicated cystitis in most cases.
  - About 20–30% of women who have had one episode of UTI will have recurrent episodes.
  - Early recurrence (within 2 weeks) is usually regarded as **relapse** (the symptoms disappear for some time, and then in less than two weeks, the bacteria replicates and the symptoms appear again) rather than **reinfection** (infection has been completely cleared).
  - Asymptomatic bacteriuria occurs in all age groups and does not necessarily result in clinical infection.
  - UTIs are the most common type of healthcare-associated infection.
  - Virtually all healthcare-associated UTIs are caused by instrumentation (Catheter-associated urinary tract infection (CAUTI)).

- The source of microorganisms causing CAUTI can be **endogenous**, typically via meatal, rectal, or vaginal colonization (the microbiota cause an infection), or **exogenous**, such as via contaminated hands of healthcare personnel or equipment.
- For the majority of the human lifetime (**preschool, school age, reproductive age**): the incidence is much higher in **females**: since females have a much shorter urethra: much more accessible for the bacteria to go in and cause infections.
- In the **neonates** periods, the incidence in **males** is higher (the congenital malformations in the UT passage are more common in males, which will lead to urine stasis).
- **Geriatric** period, they have a **similar** ratio due to the fact that they have prostate hyperplasia, which will prevent the flow of the urine out of the urethra: stasis → UTIs.
- **The age group isn't a risk factor.**



## Etiology of UTIs:

### 1) Uropathogenic E.coli (UPEC) :

- A gram-negative rod, facultative anaerobe. The optimum growth temperature is 37°C. On Nutrient agar, colonies are large, thick, greyish white, moist, and smooth.
- A causative agent in the vast majority of UTIs.
- E-coli is part of the GIT microbiota, some of them gain certain virulence factors, that's while it called Uropathogenic E-coli.
- E. coli O157:H7 is the subset that is associated with epidemics and outbreaks of diarrhea.

#### Virulence factors in UPEC

- 
- adhesive **fimbriae**: enable bacteria to adhere avidly to specific receptors on the urothelium.
  - **Flagella**: enable bacteria to swim along the urinary tract including 'upstream' from the bladder to the kidneys.
  - **Toxins (haemolysin and cytotoxic necrotizing factor)**: disrupt the epithelial barrier and enable access to the underlying tissue.
  - **Siderophores**: enable bacteria to chelate iron that is important for growth.
  - Expression of cell surface **capsules**: enable them to resist the bactericidal actions of complement and phagocytic cells.

### 2) Enterococcus faecalis:

- Gram-positive cocci, arranged in pair (diplococci).
- Found in the large intestine in high concentrations and in the genitourinary tract.
- One of the most common causes of infections acquired in the hospital (**nosocomial infection**).
- The urinary tract is the most common site of enterococcal infections, and infections are frequently associated with urinary **catheterization** or instrumentation, so it's quite found in **complicated UTIs**.
- **Antibiotics (Ab) resistant**.

### 3) *Klebsiella pneumoniae*:

- Found in the human nose, mouth, and gastrointestinal tract as normal flora.
- The ability of *K. pneumoniae* to **colonize the hospital environment**, including carpeting, sinks, flowers, and various surfaces, as well as the skin of patients and hospital staff, has been identified as a major factor in the spread of **hospital-acquired infections**.
- **Antibiotics (Ab) resistant**.

### 4) *Proteus mirabilis*:

- Gram-negative, facultatively anaerobic, rod-shaped bacterium. It shows swarming motility and urease activity.
- Urease activity and ammonia generation → increase in local pH.  
- In the urinary tract, alkaline pH leads to precipitation of calcium and magnesium ions and the formation of **urinary stones** composed of magnesium ammonium phosphate (**struvite**) and calcium phosphate (**apatite**).