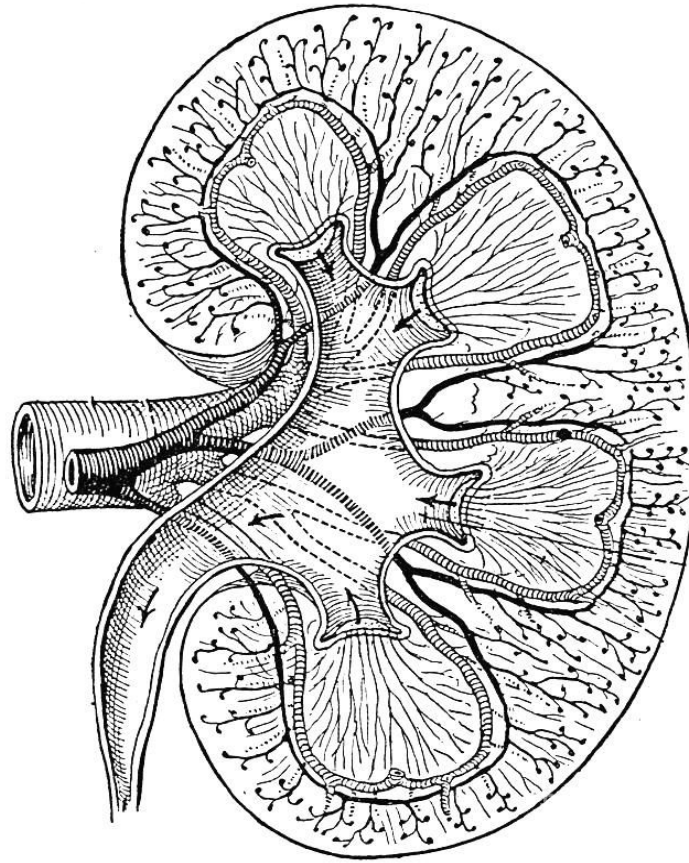


# Microbiology

435's Teamwork  
Renal Block

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- 
- Please contact the team leaders for any suggestion, question or correction.
  - Pay attention to the statements highlighted in **bold** and/or **red**.
  - Extra explanations are added for your understanding in grey.
  - **Footnotes color code:** General | **Females** | **Males**.

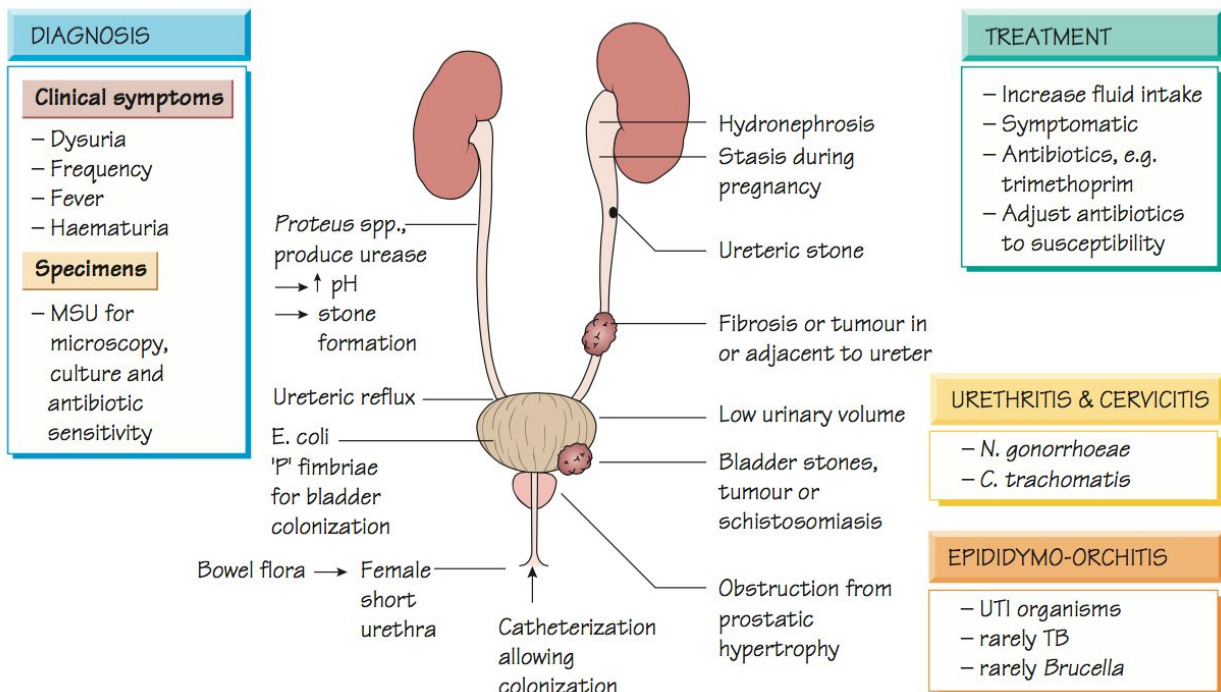
[Microbiology.435@gmail.com](mailto:Microbiology.435@gmail.com)

# Cystitis

- Lecture One -  
[Introductive Video](#)

## Learning Objectives:

1. Define the term **cystitis**.
2. Describe the **pathogenesis** and **risk factors** of cystitis.
3. Know the most common **causative organisms** of cystitis
4. Recognize different **types** of cystitis: infectious/non-infectious.
5. Recognize that **venereal<sup>1</sup> diseases** can be present with cystitis.
6. Understand the laboratory **diagnosis** of cystitis.
7. Know the antimicrobial agents suitable for the **treatment** and **prevention** of cystitis.



<sup>1</sup> Sexually transmitted.

## Introduction:

Urinary tract infections are divided into **upper** and **lower**. The upper urinary tract infection usually involves the **kidney** and its **pelvis**, known as acute or chronic **pyelonephritis**. The lower urinary tract infection may involve the bladder with superficial mucosal infections (**cystitis**), urethra with **sexually transmitted pathogens**<sup>2</sup> (**urethritis**), prostate (**prostatitis**) or epididymis (**epididymitis**).

They are classified according to the factors that trigger the infection into:

1. **Complicated UTI:** Nosocomial<sup>3</sup>, relapses, structural<sup>4</sup> or functional abnormalities (stasis), males, and upper UTI.
2. **Uncomplicated UTI:** Non-pregnant, young, healthy, sexually active females<sup>5</sup> without any structural or neurological abnormality and empirical therapy is possible.

## Bacteriuria:

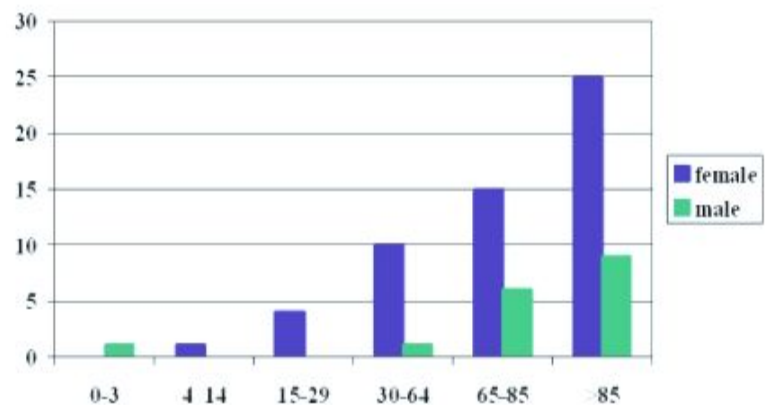
Presence and colonization of bacteria in the urine within the urinary tract (**bacteriuria**) is common and can sometimes invade the surrounding tissue that is responsible of the manufacture, transport and storage of urine. It is usually of two types:

1. **Symptomatic bacteriuria:**  
Patient presents with significant bacteriuria **with** urinary symptoms.
2. **Asymptomatic bacteriuria:**  
20% of Patient presents with significant bacteriuria but **without** urinary symptoms (common in diabetics).

**(Significant bacteriuria =  $10^5$  bacteria/ml)**<sup>6 7</sup>

The data shown concludes that bacteriuria is:

- 1-More common in **women** than in men.
- 2-More common in **elderly** than in youth.



<sup>2</sup> Such as *Neisseria gonorrhoeae* and *Chlamydia*.

<sup>3</sup> Hospital acquired infection.

<sup>4</sup> Congenital or acquired obstruction.

<sup>5</sup> Usually from 18-45 year old.

<sup>6</sup> Seen in most cases.

<sup>7</sup> Normally urine is sterile, once it reaches the urethra it catches some bacteria, if we count the bacteriuria and found out that it has  **$10^5$  bacteria/ml** that indicates UTI.

## **Cystitis is an inflammation in the urinary bladder.**

It can be common due to a number of reasons:

<b>In women</b> <sup>8</sup>	<b>Short wide urethra</b> <sup>9</sup>
	Pregnancy
	Decreased estrogen production during menopause
<b>In men</b>	Persistent bacterial infection of the prostate
<b>In both sexes</b>	Presence of bladder stone
	Urethral stricture <sup>10</sup>
	Catheterization of the urinary tract
	Diabetes mellitus <sup>11</sup>
	Genetic predisposing factors (multifactorial) Seen in neonates especially male

### Pathogenesis:

1. The infection results when the bacteria<sup>12</sup> **ascends** from the **urethra** to the urinary **bladder**, causing frequent irritations of their mucosal surfaces.
2. These bacteria are either **residents**<sup>13</sup> or **transient**<sup>14</sup> members of the perineal flora<sup>15</sup> that are derived from the large intestine flora nearby.
3. Toxins then get produced.

### What are the possible conditions that can create access to the bladder?

- Sexual intercourse.
- Short urethral distance in females.

### Risk factors:<sup>16</sup>

- Catheterization of the urinary bladder and instrumentation<sup>17</sup>.
- Sexually transmitted diseases (STD).
- Structural abnormalities.
- Obstruction.
- Hematogenous spread of the pathogens from other sites of infection.<sup>18</sup>

<sup>8</sup> UTI are more common in women than men due to short urethra, But it's more serious in men.

<sup>9</sup> المسافة التي يقطعها مسبب المرض في طريقه للمثانة البولية قصيرة جدًا مقارنة بالجهاز الذكري.

<sup>10</sup> Narrowing of the urethra caused by injury.

<sup>11</sup> Due to Functional abnormality.

<sup>12</sup> Usually colonic pathogens.

<sup>13</sup> Urogenital normal flora. Native.

<sup>14</sup> Non-urogenital normal flora. From somewhere else.

<sup>15</sup> Bacterial flora of the female genital tract.

<sup>16</sup> It's important to know the risk factor for prevention.

<sup>17</sup> For example cystoscope.

<sup>18</sup> إذا انتشرت البكتيريا من التهاب ما في الجسم إلى الجهاز البولي عن طريق الدورة الدموية .More in Upper UTI

Etiology	
<i>Escherichia coli</i> (90%)	The most common cause of cystitis
Enterobacteria	<i>Klebsiella pneumoniae</i> and <i>Proteus</i> species
Gram negative rods	<i>Pseudomonas aeruginosa</i> <sup>19</sup>
Gram positive bacteria	<i>Enterococcus faecalis</i> , group B <i>Streptococcus</i> , <i>Staphylococcus saprophyticus</i> <sup>20</sup> (honeymoon cystitis) <sup>21</sup>
<i>Candida</i> species <sup>22</sup>	Diabetic, catheterized or on broad spectrum antibiotics
Venereal diseases	<i>Gonorrhoea</i> and <i>Chlamydia</i> may be present with cystitis
<i>Schistosoma haematobium</i> <sup>23</sup>	In endemic areas <sup>24</sup> (cause hematuria)
Special cases	<i>Staphylococcus epidermidis</i> Yeasts (catheter related result) Viruses <sup>25</sup> (Adeno, Varicella)

Uncomplicated UTI	Complicated UTI <sup>26</sup> (Multi-resistant strains)	
<i>E. coli</i> (64%)	1st	<i>E. coli</i>
<i>Enterococcus</i> species (20%)	2nd	<i>Enterobacteriaceae</i>
<i>Enterobacteriaceae</i> (16%)	3rd	<i>Pseudomonas</i> species
<i>Pseudomonas</i> species (<1%)	4th	<i>Acinetobacter</i> species
<i>Staphylococcus aureus</i> (<1%)	5th	

<sup>19</sup> Hospital acquired. Usually accompanied by urinary abnormalities.

<sup>20</sup> Why? Because it's a normal vaginal flora. It can easily cause UTI during sexual activity.

<sup>21</sup> If the case is: Female, just married, presented with UTI and suprapubic pain what's the diagnosis? saprophyticus.

<sup>22</sup> Infects diabetics (the immunocompromised).

<sup>23</sup> Could cause cancer.

<sup>24</sup> Where Schistosomiasis is abundant.

<sup>25</sup> More common in children.

<sup>26</sup> Hospital acquired (nosocomial), manifests as multiple episodes of cystitis.

## Clinical presentation:

- Symptoms usually of acute onset.
- Dysuria (painful urination).
- Frequency (frequent voiding<sup>27</sup>).
- Urgency (an imperative call for toilet).
- Hematuria (blood in urine) in 50% of cases.
- Usually no fever (in children fever and in old age hypothermia ).<sup>28</sup>

## How can we differentiate between cystitis and urethritis?

Cystitis is presented with the following unique manifestations:

- Acute onset.
- More sever symptoms.
- Pain and tenderness on the supra-pubic area.
- Presence of bacteria in urine (**bacteriuria**)<sup>29</sup>.
- Urine cloudy, malodorous and may be bloody.

## Differential diagnosis:

Can be thought of as non-infectious.

- **Traumatic cystitis**<sup>30</sup>: in women<sup>31</sup>.
- **Interstitial cystitis**: unknown cause, may be an autoimmune attack of the bladder.
- **Eosinophilic cystitis**<sup>32</sup>: due to *Schistosoma haematobium*.
- **Hemorrhagic cystitis**<sup>33</sup>: due to radiotherapy or chemotherapy.

## Recurrent<sup>34</sup> cystitis:

- Three or more episodes of cystitis per year.
- Requires further investigations such as Intravenous Urogram<sup>35</sup> (IVU) or Ultrasound to detect obstructions or congenital deformities.
- Cystoscopy<sup>36</sup> may be required in some cases.

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<sup>27</sup> Discharge.

<sup>28</sup> If it's a case of **UPPER UTI** (pyelonephritis) fever is one of important clinical presentations.

<sup>29</sup> In urethritis, pus cells are observed in urine.

<sup>30</sup> Bruising of the bladder by sexual intercourse that is too forceful.

<sup>31</sup> After delivery.

<sup>32</sup> May be caused by medications, especially in children.

<sup>33</sup> Can occur as a side effect of cyclophosphamide, ifosfamide, and radiation therapy.

<sup>35</sup> Uses X-ray to investigate the urinary system. [MORE](#)

<sup>36</sup> Used to examine the inside of the bladder using an instrument called a cystoscope.

<sup>34</sup> يذهب ويعود باستمرار.

## Laboratory Investigations

<b>Specimen collection<sup>37</sup></b>	Collect a sample of midstream urine ( <b>MSU</b> ) which is also called “clean catch urine” in order to avoid any contamination by perineal flora
	The sample must be before starting antibiotic
	Supra-pubic aspiration or catheterization may be used for children
	Catheter urine <sup>38</sup> should not be used for diagnosis of UTI
<b>Microscopic examination</b>	About 90% of patients have > 10 WBCs /cu.mm <sup>39</sup>
	Gram stain of uncentrifuged <sup>40</sup> sample is sensitive and specific
	One organism per oil-immersion <sup>41</sup> field is indicative of infection
	Blood cells, parasites or crystals can be seen
<b>Chemical screening tests</b>	<b>Urine dipstick<sup>42</sup>: rapid, detects nitrites<sup>43</sup> released by bacterial metabolism and leukocyte esterase from inflammatory cells.</b>
	Non-specific <sup>44</sup> test.
<b>Urine culture</b>	Important to identify bacterial cause and antimicrobial sensitivity
	Quantitative culture <sup>45</sup> typical of UTI ( >100,000 /cumm)
	Lower count (<100,000 or less 1000/cumm ) is indicative of cystitis if the patient is symptomatic.
	We can detect the pathogen using: <ol style="list-style-type: none"> <li>1. blood agar.</li> <li>2. MacConkey agar.</li> <li>3. CLED (cysteine-, lactose-, and electrolyte-deficient).</li> </ol>

<sup>37</sup> The procedure goes as follows: Disinfect the area with alcohol swabs, collect the middle portion of your urine sample. Why? To avoid contamination. [WATCH](#)

<sup>38</sup> Tubes that collect urine from the bladder.

<sup>39</sup> WBCs are not seen in urine (or found in small amounts <5).

<sup>40</sup> لم يتم التأثير على العينة بجهاز الطرد المركزي الذي يستخدم لخص العينات في المختبر.  
<sup>41</sup> قطرة الزيت المكبرة في الميكروسكوب.

<sup>42</sup> [WATCH](#)

<sup>43</sup> Nitrites are produced by bacterial metabolism (in conversion of nitrates), only positive with cases of gram -ve infections.

<sup>44</sup> Nitrites and Leukocyte-esterase are not specific (They might test negative in patients with cystitis).

<sup>45</sup> Quantitative culture is basically a method in which bacteria are enumerated.

## Treatment:

- Empiric treatment<sup>46</sup> is commonly used depending on the knowledge of the most common organism and sensitivity pattern.
- Treatment best be guided by susceptibility pattern of the causative bacteria.

### Common agents:

Ampicillin<sup>47</sup>, Cephadrine, **Ciprofloxacin**, Norfloxacin, **Gentamicin** or **TRM-SMX**<sup>48</sup>  
**Ceftriaxone**.

### Duration of treatment:

**3-7 days** for **uncomplicated cystitis**.

**10-14 days** for **complicated**<sup>49</sup> and **recurrent cystitis**.

### Prophylaxis required for recurrent cases:

**Nitrofurantoin** or **TRM-SMX**.

### Prevention:

**Drinking plenty of water** and using **prophylactic antibiotic** when required.

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### Resources:

Prof. Hanan Habib's 2016 lecture.

Dr. Ali Someli's 2016 lecture.

P. 867-868 Sherris Medical Microbiology.

P. 339 and 374-375 Lippincott's Illustrated Reviews of Microbiology.

P. 108-109 Medical Microbiology and Infection Control at a glance.

### Helpful read:

<http://pennstatehershey.adam.com/content.aspx?productId=10&pid=10&gid=000036>

### Additional Videos:

[Interstitial Cystitis Talked about on The Doctors](#)

[Bladder infection - Causes and treatment](#)

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<sup>46</sup> Based on the doctor's clinical experience. It is given initially until the lab results are ready.

<sup>47</sup> [Not used anymore, in UTIs due to resistance.](#)

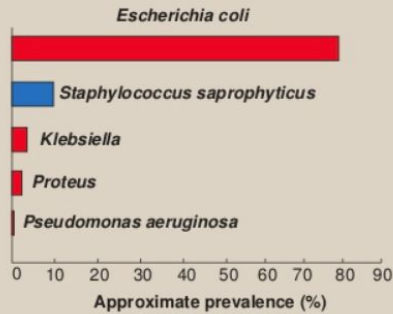
<sup>48</sup> Trimethoprim-sulfamethoxazole.

<sup>49</sup> [Complicated and upper UTI 10-14 days.](#)



# URINARY TRACT INFECTIONS

## A Common causes of urinary tract infection (UTI)<sup>1</sup>



## B Classification of pathogens

### Gram (+) cocci

*Staphylococcus saprophyticus*

### Gram (-) rods

*Escherichia coli*  
*Klebsiella* species  
*Proteus* species  
*Pseudomonas aeruginosa*

### *Escherichia coli*

- E. coli* is the most common cause of UTI, including cystitis and pyelonephritis. Women are particularly at risk for infection. Acquisition is frequently from the patient's flora.
- Uncomplicated cystitis (the most commonly encountered UTI) is caused by uropathogenic strains of *E. coli*, characterized by P fimbriae (an adherence factor). Complicated UTI (pyelonephritis) often occurs in settings of obstructed urinary flow, and may be caused by nonuropathogenic strains of *E. coli*. UTI requires treatment with antibiotics.

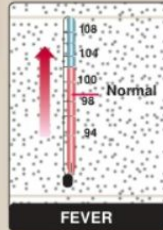
### *Staphylococcus saprophyticus*

- S. saprophyticus* is a frequent cause of cystitis in women, probably related to its occurrence as part of normal vaginal flora. It is also an important agent of hospital-acquired infections associated with the use of catheters.
- S. saprophyticus* is a coagulase-negative staphylococcal species. It tends to be sensitive to most antibiotics, even penicillin G. It can be distinguished from most other coagulase-negative staphylococci by its natural resistance to novobiocin.

## C Common complaints



DYSURIA  
LUMBAR PAIN



FEVER



CHILLS

### Other enterobacteria

- Other genera of *Enterobacteriaceae*, such as *Klebsiella*, *Enterobacter*, *Proteus*, and *Serratia*, which can be found as normal inhabitants of the large intestine, include organisms that are primarily opportunistic and often nosocomial pathogens. They all frequently colonize hospitalized patients, especially in association with antibiotic treatment, indwelling catheters, or invasive procedures, causing extra-intestinal infections such as those of the urinary tract.
- Wide-spread antibiotic resistance among these organisms necessitates sensitivity testing to determine the appropriate antibiotic treatment.

### *Pseudomonas aeruginosa*

- P. aeruginosa* is a significant opportunistic pathogen and a major cause of hospital-acquired (nosocomial) infections such as UTI, particularly in patients who have been subjected to catheterization, instrumentation, surgery, or renal transplantation, or prior antibiotic therapy.
- P. aeruginosa* disease begins with attachment and colonization of host tissue. Pili on the bacteria mediate adherence, and an alginate capsule reduces the effectiveness of normal clearance mechanisms. Host tissue damage facilitates adherence and colonization. Because *Pseudomonas* infections typically occur in patients with impaired defenses, aggressive antimicrobial therapy is generally required.

## D Empiric therapy

### Cystitis (uncomplicated)

- Three days of therapy often sufficient

1 Ciprofloxacin

2 Trimethoprim/sulfamethoxazole<sup>1</sup>

<sup>1</sup> *Escherichia coli* is increasingly resistant.

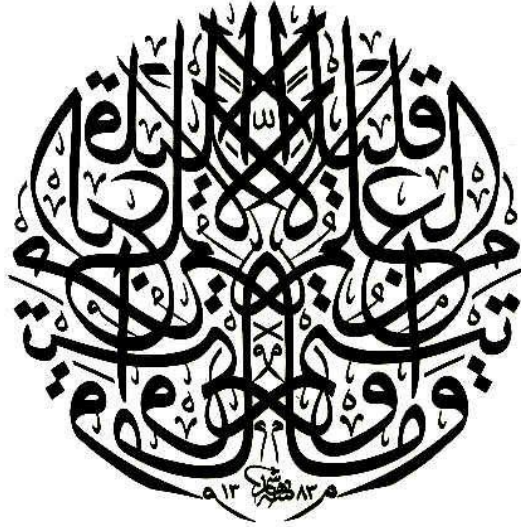
### Pyelonephritis

- Ten to fourteen days of therapy often required

1 Amoxicillin/clavulnate

1 Ciprofloxacin

2 Trimethoprim/sulfamethoxazole



« وَيَسْأَلُونَكَ عَنِ الرُّوحِ قُلِ الرُّوحُ مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ مِنَ الْعِلْمِ إِلَّا قَلِيلًا »

سورة الإسراء الآية ٨٥

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### Team Leaders

Sara Alenezy & Ali Alzahrani

### Heartful thanks to our phenomenal team members

Fawzan Alotaibi  
Shamma Alsaad  
Kowthar Almousa  
Khawla Alammari  
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Shahad Alenezy  
Maryam Saidan  
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