

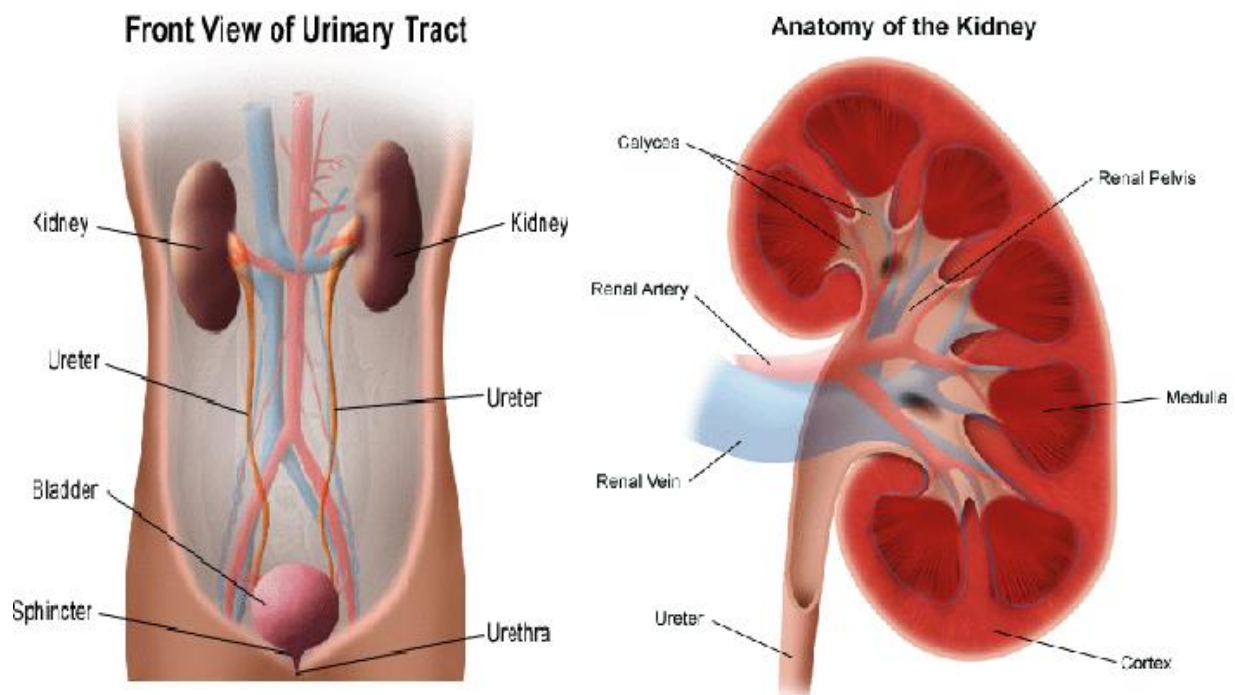
# INTRODUCTION TO URINE ANALYSIS

Urine analysis: is a test of urine, used to detect and manage a wide range of disorders, such as urinary tract infections, kidney disease and diabetes. A urinalysis involves checking the appearance, concentration and content of urine. Abnormal urinalysis results may point to a disease or illness.

## GENERAL VIEW

### Urinary system

Urinary system consists of pair of kidneys and urinary tracts which includes (two ureters, urinary bladder and urethra). Each kidney contains 1.3 million urinary units called nephrons. Each nephron consists of glomerulus and urinary ducts (Bowman's capsule, proximal convoluted tubule, Henley loop, distal convoluted tubule and collecting duct).



The kidneys extract the soluble wastes from the blood stream, as well as excess water, sugars, and a variety of other compounds. The resulting urine contains high concentrations of urea and other substances, including toxins.

**Urination:** is a voluntary process depends on person's choice to the suitable time and place to empty the urinary bladder from storage urine, without pain.

**Disturbances in urination include:**

- 1- Painful urination, frequency, Urgency. Because of microbial UTI.
- 2- Impairment of urine flow, hesitancy, dribbling urine, incomplete emptying .Because of urinary bladder obstruction.
- 3- Urinary retention, a sign of benign prostate enlargement (hypertrophy), urinary incontinence (enuresis) due to dysfunction of bladder muscles or sphincter muscles.

**Urinary tract infection (UTI):**

**Urinary tract infection** occurs where bacteria and white blood cells are present in the urine of a patient with symptoms of infection of the urethra, urinary bladder, or the kidney.

**Bacteriuria** occurs when **bacteria** are present in the urine.

**pyuria** occurs when **white blood cells** are present in the urine.

The lower urinary tract includes the urethra (urethritis) and urinary bladder (cystitis).

The upper urinary tract includes the ureters and kidneys, infection in the upper urinary tract called (**pyelonephritis**). The bacteria that cause urinary tract infections are usually of fecal origin (e.g., *Escherichia coli*).

**Etiology:**

The most common cause of urinary tract infections (urethritis, cystitis, and pyelonephritis) is *E coli*.

*Staphylococcus saprophyticus* is the second most common cause of these infections in females between the ages of 13 and 40. In complicated cases of urinary tract infections such as those resulting from anatomic obstructions or from catheterization, the most common causes are *E coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterococcus*, and *Pseudomonas aeruginosa*.

**Manifestations:**

- **Urethritis:** is an infection of the urethra that causes pain and discomfort during voiding (**dysuria**).
- **Cystitis:** is an infection of the urinary bladder. Signs and symptoms of cystitis include urgency and frequency of urination, voiding small volumes of urine, and supra pubic tenderness just before or immediately after voiding.

- **Pyelonephritis:** is an infection of the upper urinary tract ascends the ureters to enter the kidneys, the signs and symptoms include fever, flank pain and tenderness, cost vertebral angle tenderness, and nausea and vomiting.
- **Kidney stones** can serve as a location in which bacteria can escape antibiotics and cause recurrent urinary tract infections. **Proteus can cause stones** to form when it produces an enzyme called urease, which can catalyze the breakdown of urea to ammonia and carbon dioxide. The ammonia that results from this reaction will increase the pH of urine and cause formation of kidney stones.




**Host factors that are important in protection from UTI:**

These include: the normal daily flow of urine, the constant sloughing of the uroepithelial cells lining the urinary tract, and the presence of large numbers of *Lactobacillus* in the vaginal mucosa.

**Kidney Function Test (URINE ANALYSIS):**

The most common sites of urinary tract infection (UTI) are the urinary\_bladder (cystitis) and the urethra. From these sites the infection may\_ascend into the ureters (ureteritis) and subsequently involve the kidney (pyelonephritis).

### 3 Types of Urinalysis

1. Complete Urinalysis	2. Rapid Urinalysis	3. 24-hour Urine Collection
		
<p>Performed in lab Looks at urine composition</p>	<p>Performed at doctor's office using test strips Checks for common renal abnormalities</p>	<p>Performed at home over 24 hours Gives clearer picture of renal function</p>

**verywell**

## Collection of urine samples:

### How should we collect and store the urine sample

We should:

- Collect the urine sample in a completely clean (sterile) container
- Store it in a fridge in a sealed plastic bag if you can't hand it in straight away.



The types of urine samples we might be asked for test include:

## Types of urine sample

Sample type	Sampling	Purpose
Random specimen	No specific time most common, taken anytime of day	Routine screening, chemical & FEME
Morning sample	First urine in the morning, most concentrated	Pregnancy test, microscopic test
Clean catch midstream	Discard first few ml, collect the rest	Culture
24 hours	All the urine passed during the day and night and next day 1 <sup>st</sup> sample is collected.	used for quantitative and qualitative analysis of substances
Postprandial	2 hours after meal	Determine glucose in diabetic monitoring
Supra-pubic aspired	Needle aspiration	Obtaining sterile urine

## Gross examination of urine:

### Physical examination



#### 1-**Urine volume:**

This is dependent normally up on fluid intake, environmental condition, diet and activity of the human.

Value above or below the **normal value (1.5 L/Day)** can be considered as pathological disorder but it should be combined with clinical and laboratory examination.

- **Above normal (polyuria) urine volume (> 2.5-3L/Day)** due to large quantities intake of liquids, diuretics, alcohol, in sufficient of urinary ducts in reabsorption of water and urine concentrated as in diabetes mellitus or diabetes insipidus.
- **Under normal (Oligourea) urine volume (< 400 ml/Day)**
- **Anuria, urine volume (< 50 ml/Day)**, due to: hot weather, sweating, low water intake, or due to disease in kidney or urinary ducts.

#### 2-**Color:**

Can be observed in a test tube or in a urinometer tube, strip. The following designations are used to observe the sample and correlated to the following terms.

\*Colorless, Greenish yellow, Blue, Pale yellow, Green, Milky, Yellow, Red, Dark yellow, Reddish brown, Yellow brown, Brown.

#### Interpretation

- **Yellow to amber (Normal);** the **color comes** primarily from the presence of **urobilin**. Urobilin is a final waste product resulting from the breakdown of heme from hemoglobin during the destruction of aging blood cells.
- **Colorless to pale yellow;** dilute urine with low specific gravity and polyuria.

- **Dark yellow or yellow brown;** concentrated urine with a high specific gravity and small quantity.
- **Yellow brown or greenish yellow;** yellow green foam when urine is shaken  
Urobilinoids – chromagon derived from heme , yellow-brown-bilirubin-and urobilin.
- **Cloudy;** hematuria (clearer after centrifugation).
- **Translucent;** hemoglobinuria.
- **Brown to brownish black;** hemoglobin up on standing bile large amounts.
- **Green;** bile biliverdin
- **Red to pink;** phenothiazine (beet root)
- **Blue;** medication contain methylene blue or food with blue dyes.

### 3-Transparency (clarity):

**Clear** – freshly voided urine is clear.

**Cloudy** – not necessarily pathological as many samples may become cloudy.

**Epithelial cells** – present in large numbers.

**Blood** – red to brown color and smoky.

**Leukocytes** – may produce milky, ropy appearance if large number.

**Bacteria** – produce a uniform turbidity if in large number; the turbidity doesn't settle out and cannot be removed by filtration.

### 4-Specific gravity (SG):

It determined by refractometer and indicator paper stripes. Normal value in Man **1.010 – 1.030**(Average normal = 1.025).depending on SG the urine will be diluted (SG< 1.002) or concentrated (SG>1.065) depend on the solvents in urine.SG used to determine the kidney efficiency keeping water balance in urine.

### 5-Odour:

Normal odor – aromatic or acetone

Abnormal odor – aromatic odor of ketone bodies (sweet fruit odor) as in starvation and diabetes.

In UTI the odor of urine is bad smell.

### 6-Foam:

Shake the sample and observe:

- If the amount of foam produced is in excess and slow to disappear – proteinuria
- If the color of the foam great – yellow or brown – bile pigments
- If the color of the foam red to brown – hemoglobinuria

## Microscopic Examination of Urine Samples

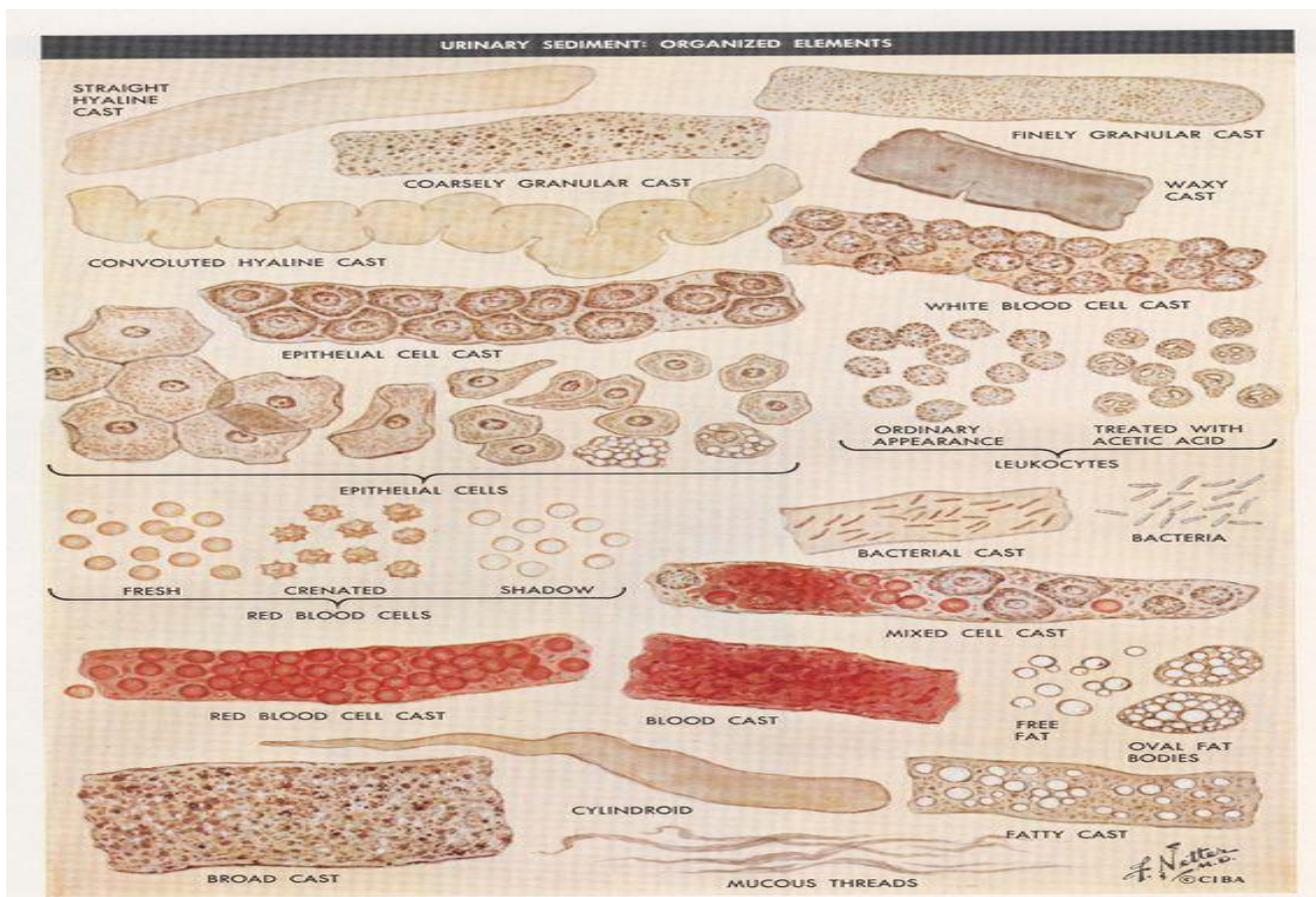
It is of great clinical importance and should never be omitted. Important structures to be included are casts, erythrocytes, leukocytes, epithelial cells, budding yeasts, protozoa and bacteria.

- **Casts:**

Cylindrical bodies formed in distal collecting tubules from RBCs or WBCs or fatty compounds or waxes. Diagnosis of cast type aids in diagnosis of the disease.

### Types of casts:

Hyaline casts, densely granulated casts, finely granulated casts, red cell casts (hematuria), and white cell casts (inflammation), wax casts, fat casts, and epithelial casts.



- **Mucus:**






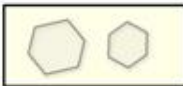
Mucus is a thick, slimy substance that coats and moistens certain parts of the body, including the nose, mouth, throat, and urinary tract. A small amount of mucus in your urine is normal. An excess amount may indicate a urinary tract infection (UTI) or other medical condition.


- **Crystals:**

Crystals is a salt compounds organized in geometrical shapes and looks like crystals, important in stones formation (cysteine crystals and oxalate crystals).

**Amorphous urate** – white or pink cloud **in acid urine**

**Amorphous phosphate** – white cloud **in alkaline urine**

Crystals	Characteristics of Formation	Appearance	Diagnostic Utility
Uric Acid	Formation promoted by acidic urine		Seen in tumor lysis syndrome
Calcium phosphate	Formation promoted by alkaline urine		Not suggestive of any specific systemic disease
Magnesium ammonium phosphate (a.k.a. struvite or "triple phosphate")	Formation promoted by alkaline urine		Seen in UTIs by urease-producing organisms (e.g. <i>Proteus</i> , <i>Klebsiella</i> )
Calcium oxalate dihydrate	Formation is largely independent of urine pH		Not suggestive of any specific systemic disease
Calcium oxalate monohydrate	Formation is largely independent of urine pH		Seen in ethylene glycol ingestion
Cystine	Formation promoted by acidic urine		Diagnostic of cystinuria



- **Erythrocytes and leukocytes:** present in urine in case of UTI, diseases, inflammation.
- **Epithelial cells:** presence normally due to sloughing the lining layer of urinary tubules, bladder and urethra or because of some renal diseases.
- **Budding yeasts:** *Candida albicans*, found in diabetes patient's urine because of the low PH and the presence of sugar necessary for the growth.
- **Protozoa:** like *Trichomona svaginalis* that infect the vagina in women and urethra in men and cause trichomoniasis.