

# LEC 1: Urinalysis



Dr. Shaimaa Munther

# What is a Urinalysis?

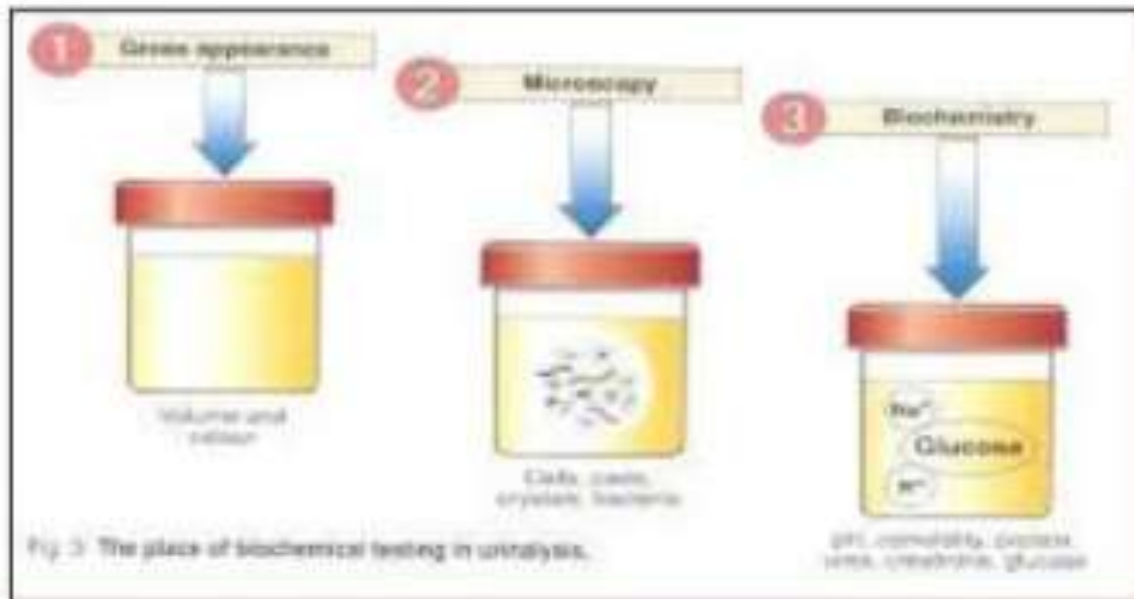
- Urinalysis: A test that determines the content of the urine.
  - Because urine removes toxins and excess liquids from the body, its contents can provide vital health information.
  - Urinalysis can be used to detect some types of disease, particularly in the case of metabolic disorders and kidney disease.
  - Urinalysis can also be used to uncover evidence of drug abuse.

# Urinalysis Basics

- Urinalysis consists of the following components:
  - Macroscopic Examination ( physical examination)
  - Chemical Analysis
  - Microscopic Examination

# Urine Examination

- 1- Physical Examination
- 2- Chemical Examination
- 3- Microscopic Examination



# Macroscopic Examination



- Looking at the physical properties of the urine:

- Color:

- Normal urine should be a shade of yellow ranging from a straw to amber color.
- Abnormal urine can be: colorless, dark yellow, orange, pink, red, green, brown, or black.

- Clarity (transparency):

- Normal urine should be clear
- Abnormal urine can be: hazy, cloudy, or turbid





Colorless or  
Pale yellow

Dark yellow

Green

Yellow-green  
Yellow-brown

Red

Brown-black



Normal

Concentrated

Pseudomonas  
infection  
Methylin blue

Bilirubin  
oxidized to  
Biliverdin

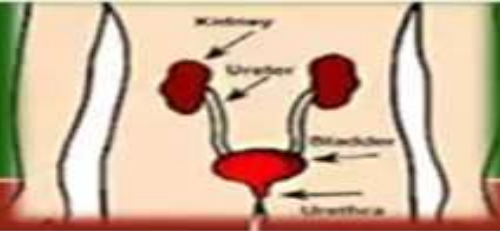
RBCs  
Hemoglobin  
Myoglobin

Methemoglobin  
Alkaptonuria



HealthyAndNaturalWorld.com

Image: James Heilman, MD - Wikimedia Commons



**Appearance**

**Observed in**

**Cloudy**

(due to pus cells, leukocytes and epithelial cells)

**UTI**

Lesions of Kidney, Urethra, Prostate Gland and Renal Pelvis

**Cloudy**

Due to excessive Phosphates

**Rickets**

**Cloudy**

Due to excessive Urates

**Gouty Arthritis, Leukemia**

**Milky**

**Fat Globules**

# Turbidity

## Physiological causes:

1. Mucus
2. Squamous epithelial cells
3. Presence of spermatozoa
4. Crystaluria
5. Contrast media
6. Fecal contamination



## Pathological causes:

1. White blood cells
2. Red blood cells
3. Presence of bacteria
4. Presence of yeast
5. Abnormal crystals
6. Lymph fluids and lipids



# Chemical Analysis

- The chemical properties of urine, including pH, specific gravity, protein content, glucose content, ketone content, are tested.
- Urine test strips are often used to detect the chemical properties of urine.







Download

### TESTS AND READING TIME

**LEU**

<b>LEUKOCYTES</b>	<b>NEGATIVE</b>	<b>TRACE</b>	<b>SMALL</b> +	<b>MODERATE</b> ++	<b>LARGE</b> +++
<b>2 minutes</b>					

**NIT**

<b>NITRITE</b>	<b>NEGATIVE</b>	<b>POSITIVE</b> (any degree of uniform pink color)			
<b>60 seconds</b>					

**URO**

<b>UROBILINOGEN</b>	<b>0.2</b>	<b>NORMAL</b>	<b>1</b>	<b>mg/dL URINE (1 mg = approx. 1 EU)</b>		
<b>60 seconds</b>						

**PRO**

<b>PROTEIN</b>	<b>NEGATIVE</b>	<b>TRACE</b>	<b>mg/dL</b>			
<b>60 seconds</b>			<b>30</b> +	<b>100</b> ++	<b>300</b> +++	<b>2000 or more</b> ++++

**pH**

<b>pH</b>	<b>5.0</b>	<b>6.0</b>	<b>6.5</b>	<b>7.0</b>	<b>7.5</b>	<b>8.0</b>	<b>8.5</b>
<b>60 seconds</b>							

**BLO**

<b>BLOOD</b>	<b>NEGATIVE</b>	<b>NON-HEMOLYZED</b>		<b>HEMOLYZED</b>	<b>SMALL</b> +	<b>MODERATE</b> ++	<b>LARGE</b> +++
<b>60 seconds</b>		<b>TRACE</b>	<b>MODERATE</b>	<b>TRACE</b>			

**SG**

<b>SPECIFIC GRAVITY</b>	<b>1.000</b>	<b>1.005</b>	<b>1.010</b>	<b>1.015</b>	<b>1.020</b>	<b>1.025</b>	<b>1.030</b>
<b>45 seconds</b>							

**KET**

<b>KETONE</b>	<b>NEGATIVE</b>	<b>mg/dL</b>			<b>SMALL</b> 15	<b>MODERATE</b> 40	<b>LARGE</b> 80	<b>160</b>
<b>40 seconds</b>		<b>TRACE</b> 5						

**BIL**

<b>BILIRUBIN</b>	<b>NEGATIVE</b>	<b>SMALL</b> +			<b>MODERATE</b> ++	<b>LARGE</b> +++
<b>30 seconds</b>						

**GLU**

<b>GLUCOSE</b>	<b>NEGATIVE</b>	<b>g/dL (%)</b>		<b>1/10 (tr.)</b>	<b>1/4</b>	<b>1/2</b>	<b>1</b>	<b>2 or more</b>
<b>30 seconds</b>		<b>mg/dL</b>	<b>100</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000 or more</b>	

# Parts of Chemical Analysis

- pH

- Test measures if urine is acidic, basic or neutral
- Normal urine ranges from 4.6 to 8.0

- Specific Gravity:

- Test measures the concentration of particles in the urine and evaluates the body's water balance.
- The more concentrated the urine, the higher the urine specific gravity.
- The most common increase in urine specific gravity is the result of dehydration.
- Normal urine ranges between 1.002 to 1.028

# Parts of Chemical Analysis

- Ketones:

- Test measures the presence or absence of ketones, the endpoint of rapid or excessive fat breakdown, in the urine.
- Normal urine does not contain ketones

- Protein:

- Normally, you have very little protein in your urine. A large amount of protein in urine (proteinuria) may mean that you have a problem with your kidneys.
- Normal urine levels of proteins (called albumin) are very small
- For a random urine sample, normal values are 0 to 14 mg/dL.
- For a 24-hour urine collection, the normal value is less than 80 mg per 24 hours.

# Parts of Chemical Analysis

- Glucose:

- The glucose urine test measures the amount of sugar (glucose) in a urine sample.
- The presence of glucose in the urine is called glycosuria or glucosuria.

- Normal Results

Glucose is not usually found in urine.

Normal glucose range in urine: 0 to 0.8 mmol/l (0 to 15 mg/dL)

- Abnormal Results Mean

Higher than normal levels of glucose may occur with:

- ❖ Diabetes
- ❖ Pregnancy
- ❖ Renal glycosuria (A rare condition in which glucose is released from the kidneys into the urine, even when blood glucose levels are normal)

pH

Specific Gravity

Protein

Glucose

partial assessment of acid base status; alkaline pH indicates old sample or urinary tract infection

state of kidney and hydration status of patient

primarily detects protein called albumin; important indicator in the detection of renal disease

primarily detects glucose (sugar); important indicator of diabetes mellitus

Blood

Ketone

Bilirubin

Urobilinogen

red blood cells,  
hemoglobin, or  
myoglobin  
(muscle  
hemoglobin);  
sensitive early  
indicator of  
renal disease

normal product of  
fat metabolism;  
increased  
amounts seen in  
**diabetes** or  
starvation  
(extreme dieting)

detects bilirubin  
(a product of  
red cell  
breakdown);  
**indicator of  
liver function**

another by-product  
of red cell  
breakdown;  
increased amounts  
seen in fever,  
dehydration,  
**hemolytic  
anemia and liver  
disease**



Nitrite

Leukocyte  
Esterase

Ascorbic  
Acid

certain bacteria  
convert normal  
urine nitrate to  
nitrite; **indicator  
of urinary tract  
infection**

detects esterase  
enzyme present in  
certain white blood  
cells (e.g, neutrophils,  
monocytes); **indicator  
of urinary tract  
infection**

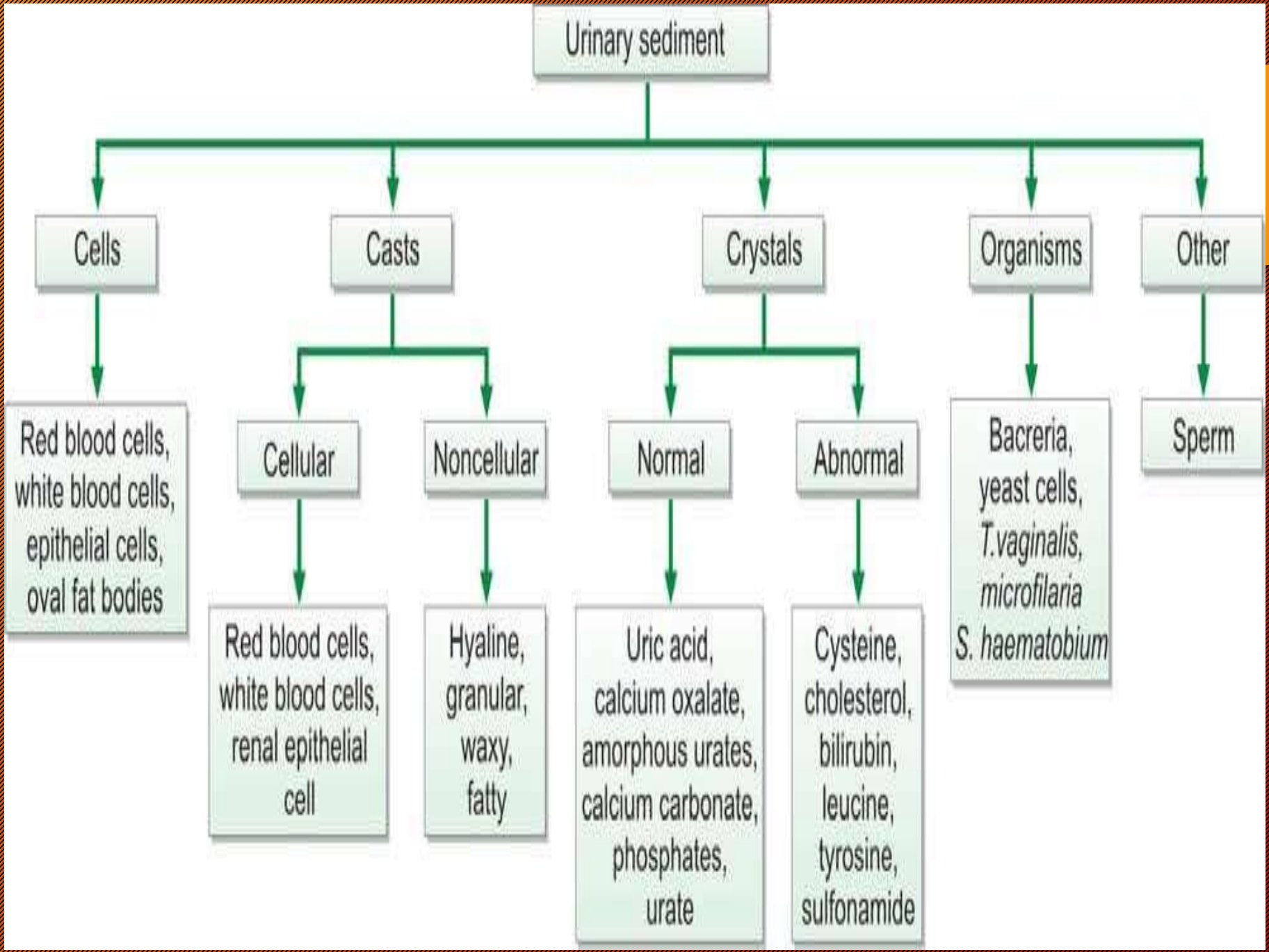
Ascorbic acid (vitamin  
C) is known to  
interfere with the  
oxidation reaction of  
the blood and glucose  
pad on common urine  
test strips.

# Microscopic Examination

- A variety of normal and abnormal cellular elements may be seen in urine when looked at under a microscope, including:
  - Red blood cells
  - White blood cells
  - Epithelial cells
  - Crystals
  - Bacteria

# Microscopic Examination

- Red blood cells are not found in normal urine.
- White blood cells and bacteria, signs of infections, are not found in normal urine.
- Epithelial cells are found in urine as they are the cells that line the urinary tract
- Common crystals seen even in healthy patients include calcium oxalate, triple phosphate crystals and amorphous phosphates.
  - A large number of crystals, or certain types of crystals, may mean kidney stones are present or there is a problem with how the body is using food



Urinary sediment

Cells

Red blood cells, white blood cells, epithelial cells, oval fat bodies

Cast

Cellular

Red blood cells, white blood cells, renal epithelial cell

Noncellular

Hyaline, granular, waxy, fatty

Crystal

Normal

Uric acid, calcium oxalate, amorphous urates, calcium carbonate, phosphates, urate

Abnormal

Cysteine, cholesterol, bilirubin, leucine, tyrosine, sulfonamide

Organism

Bacteria, yeast cells, *T.vaginalis*, *microfilaria*, *S. haematobium*

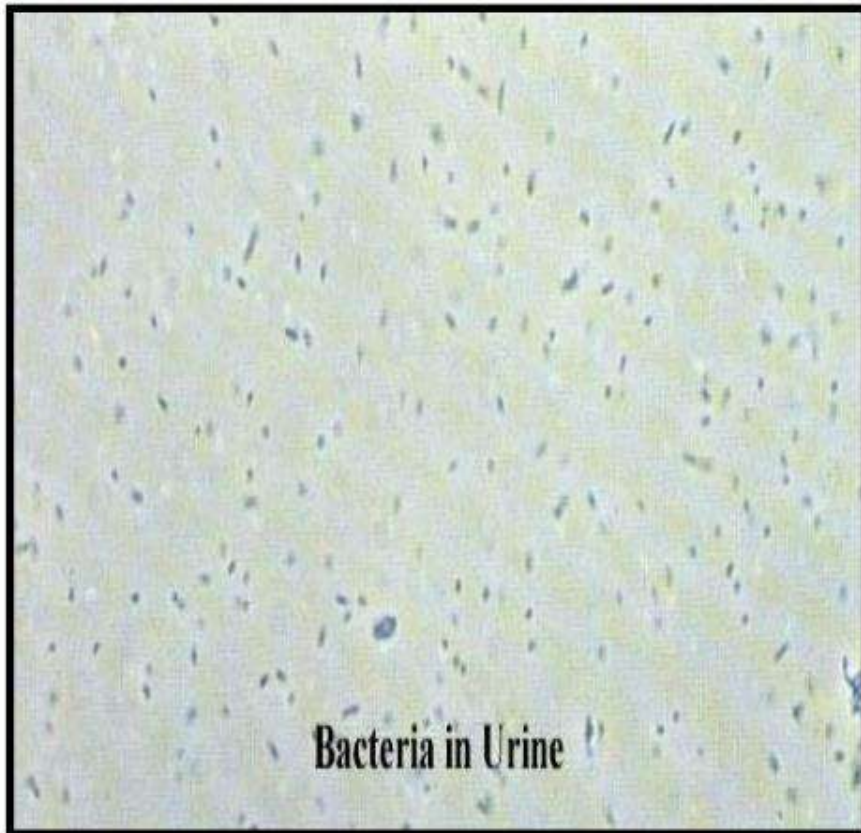
Other

Sperm

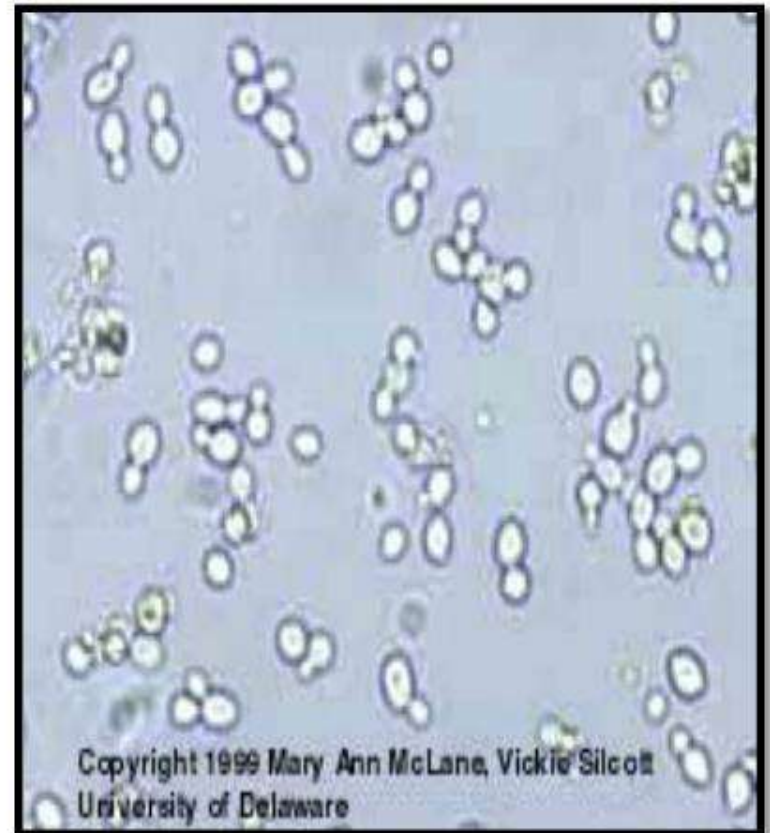
# URINE ANALYSIS

## Microscopic Examination

### Bacteria



### Yeast



RBCs

WBC

WBC cast

Epi cast

gran cast



# URINE ANALYSIS

## Microscopic Examination

### NORMAL CRYSTALS



Uric Acid



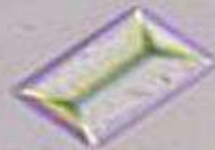
Ca Oxalate



Hippuric



Ca Phosphate



Triple Phosphate



Ca Carbonate



Ammon. Biurate

### ABNORMAL CRYSTALS



Bilirubin



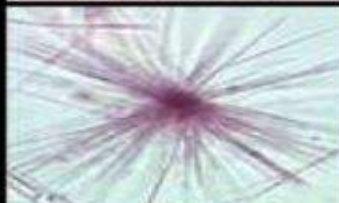
Cholesterol



Cystine



Leucine



Tyrosine



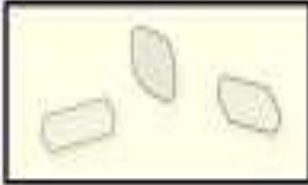
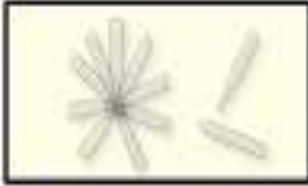
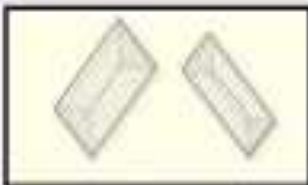
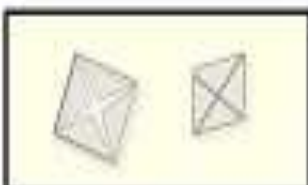
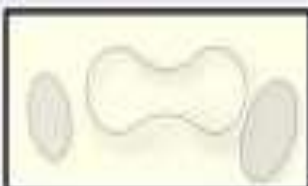
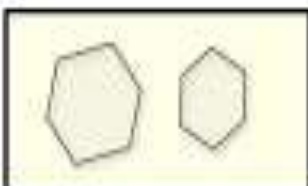
Sulfa



Acyclovir



Indinavir

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



# Urine Sediment

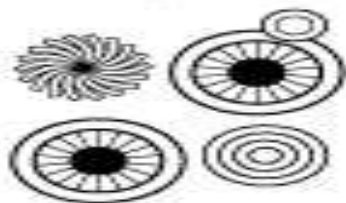
## Acid Urine



Calcium oxalate crystals



Uric acid crystals



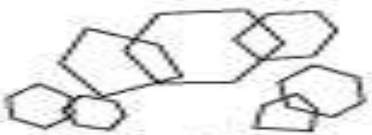
Leucine spheres



Sodium urate crystals



Tyrosine needles



Cystine crystals

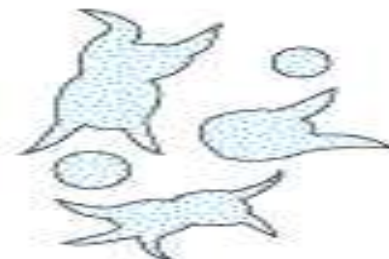
## Alkaline Urine



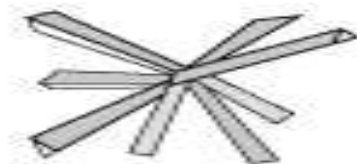
Amorphous phosphates



Calcium carbonate crystals

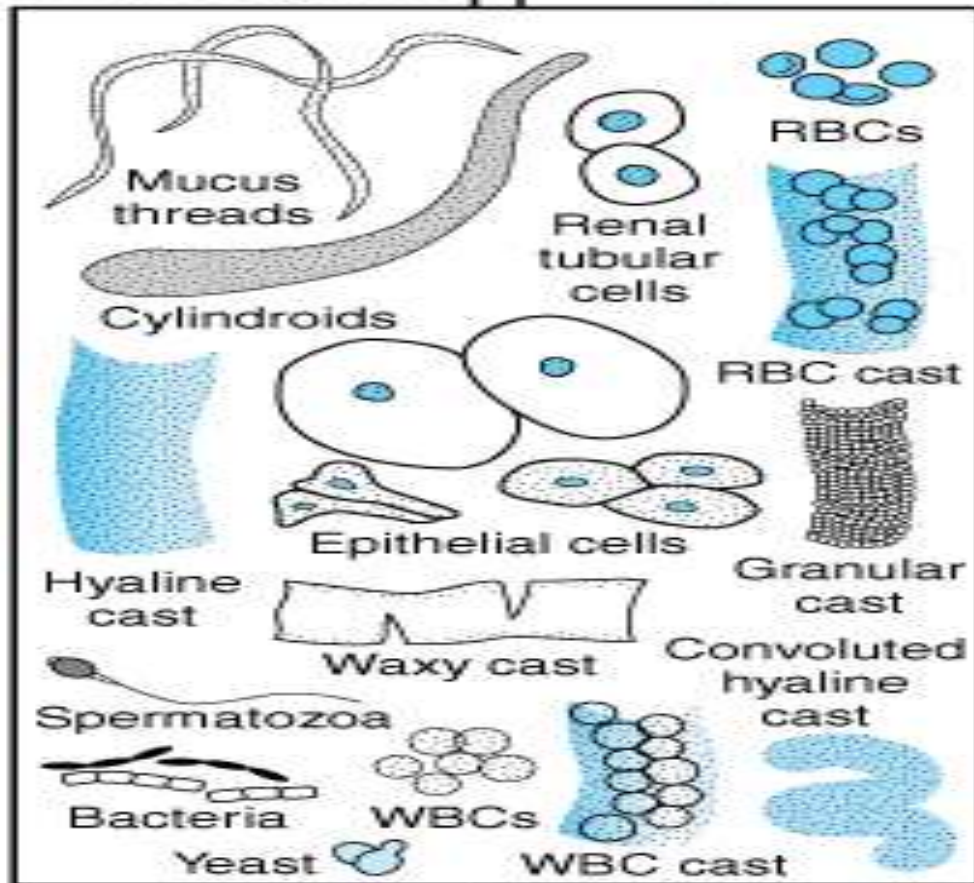


Ammonium urate crystals

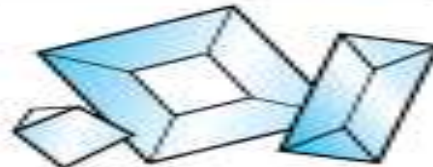


Calcium phosphate crystals

Triple phosphate crystals



Amorphous urates



# 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

Thank You