



Urinalysis

Urine:

- **Urine is a fluid excreted by most of mammals including humans.**
- **It is formed in the kidneys (renal glomeruli).**
- **The fluid undergoes chemical changes before it is excreted as urine.**
- **Normal urine excretion by a healthy person is about 1.5 L per day.**

Physical Properties of urine

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Volume	0.4-2.0 L/day	Polyuria	Diabetes, chronic renal failure
		Oligouria	Dehydration, Acute renal failure
Appearance	Clear	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells
Colour	Pale Yellow	Colorless	Excessive fluid intake, uncontrolled DM, DI, chronic renal failure
		Orange	Dehydration, carotenoid ingestion
		Yellow-Green	Jaundice
		Red	Blood, drugs etc
		Dark brown-black	Methemoglobin, alkaptonuria, melanoma, black water fever
Odor	Urineferous	smoky	glomerulonephritis
		Fruity	Diabetic ketoacidosis
		Ammoniacal	Contaminated and long standing exposed urine
		Mousy	Phenylketonuria
Deposits	None	Burnt sugar	Maple syrup urine disease
		Crystals, salts or cells	Blood clots, necrotic tissues and urinary stones
Reaction (pH)	4.6 - 7.0	Acidic	ketosis (diabetes mellitus & starvation), severe diarrhea, metabolic and respiratory acidosis, excessive ingestion of meat and certain fruits
		Alkaline	Respiratory and metabolic alkalosis, Urinary tract infection, Vegetarians

Chemical Properties of urine

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Protein	< 200mg/day	Proteinuria	Nephrotic syndrome, glomerulonephritis,, multiple myeloma, lower UTI, tumors or stones
Glucose	None	Glucosuria	Uncontrolled DM, gestational diabetes, Fanconi's syndrome
Ketones	None	Ketonuria	Diabetic ketoacidosis, Glycogen storage disease, starvation, Prolonged vomiting, Unbalanced diet: high fat & Low CHO diet
Nitrite	None	Detected	UTI
Bilirubin	None	Detected	Hepatic and post-hepatic jaundice
Urobilinogen	<i>Normal Trace (1mg/dl)</i>	> 2 mg/dl	Jaundice
Blood	None	Hematuria	Acute & chronic glomerulonephritis, <i>Trauma , cystitis , renal calculi and tumors</i> , Bleeding disorders (<i>Hemophilia</i>).
		Hemoglobinuria	Hemoglobinopathies, Malaria, Transfusion reaction (<i>Blood Incompatibility</i>)

Proteins



Normally less than 200 mg protein is excreted in the urine daily; more than this level leads to a condition called “**Proteinuria**”.

➤ **Glomerular proteinuria:**

It is due to ↑ glomerular permeability → filtration of high molecular weight proteins (e.g. glomerulonephritis).

➤ **Tubular proteinuria:**

It occurs as a result of ↓ tubular reabsorption with normal glomerular permeability → excretion of low molecular weight proteins (e.g. chronic nephritis)

Nephrotic syndrome:



- Large amounts of protein are lost in the urine and hypoproteinaemia develops.
- Increase protein excretion in urine can be one of the following two types:

A: High molecular weight protein excretion:

Glomerular proteinuria due to increase glomerular permeability leading to filtration of high molecular weight proteins

B: Low molecular weight protein excretion:

Tubular proteinuria due to decrease reabsorption with normal glomerular permeability

Urinalysis (using dipstick):

Principle:

- ❖ **Dipsticks** are plastic strips impregnated with chemical reagents which react with specific substances in the urine to produce color-coded visual results.
- ❖ They provide quick determination of pH, protein, glucose, ketones, urobilinogen, bilirubin, blood, hemoglobin, nitrite, and specific gravity.
The depth of color produced relates to the concentration of the substance in urine.
- ❖ Color controls are provided against which the actual color produced by the urine sample can be compared. The reaction times of the impregnated chemicals are standardized.

Procedure:

- ❖ Dip the strip in the urine sample provided then remove it immediately.
- ❖ Remove the excess urine and keep the strip in a horizontal position.
- ❖ Read the color produced within 30-60 seconds (*Color changes after more than 2 minutes are of no significance*).
- ❖ Match the color changes to the color scale provided.
- ❖ Give a full report about:
 - Physical examination
 - Chemical examination

Case I (Urine Sample I)

A 12-year-old girl, a known patient with T1DM, presented to Emergency drowsy with short history of vomiting and abdominal pain. On examination:

- Tachycardia
- Tachypnea with a fruity smell of breath.
- BP: 85/50 mmHg (Ref range: 100/66-135/85 mmHg)
- Blood sugar: 26.7 mmol/L (Ref range: 3.9-5.6 mmol/L)
- HbA1C: 9.9% (Ref range: 5.7-6.4%)
- Blood pH: 7.1 (Ref range: 7.35–7.45)
- Circulating Ketone bodies: positive

A mid stream Urine sample was collected for complete urinalysis.

1- Do urinalysis using dipsticks and give a full report regarding:

A- Physical examination.

B- Chemical examination.

2- What is the most likely diagnosis?

Case II (Urine Sample II)

- ⌘ A 49-old woman with a history of DM came to hospital with fever, weakness and dysuria (pain during urination) for the last three days.
- ⌘ The results of her laboratory tests were as follows:

Test	Result	Reference range
Fasting blood glucose	7.5	3.9-5.8 mmol/L
Creatinine	75	55-120 mmol/L
Urea	3.7	2.5-6.4 mmol/L
Sodium	140	135-145 mmol/L
Potassium	3.9	3.5-5.1 mmol/L

A mid stream Urine sample was collected for complete urinalysis.

- ⌘ Microscopic examination of urine showed:-

⊠ WBCs: > 100/HPF (Ref range: 2-3/HPF)

⊠ RBCs: 50/ HPF (Ref range: 0-2/HPF)

1- Do urinalysis using dipsticks and give a full report regarding:

A- Physical examination.

B- Chemical examination.

2- What is the most likely diagnosis?

Case III (Urine Sample III)

A 6-year-old boy, developed marked edema over a period of few days. His mother had noticed puffiness around the eyes, characteristically in the morning. She also noticed that his urine had become frothy. His general practitioner ordered the following investigations:

Test	Result	Reference range
Creatinine	58	55-120 mmol/L
Urea	3.4	2.5-6.4 mmol/L
Sodium	136	135-145 mmol/L
Potassium	4.0	3.5-5.1 mmol/L
Total protein	34	60-80 g/L
Albumin	14	35-50 g/L
Cholesterol	11	3.2-5.2 mmol/L
Triglycerides	1.5	0.5-2.27 mmol/L

A mid stream Urine sample was collected for complete urinalysis.

1- Do urinalysis using dipsticks and give a full report regarding:

A- Physical examination.

B- Chemical examination.

2- What is the most likely diagnosis?

Task I. Physical Examination :

Appearance

Color

Odor

Deposits

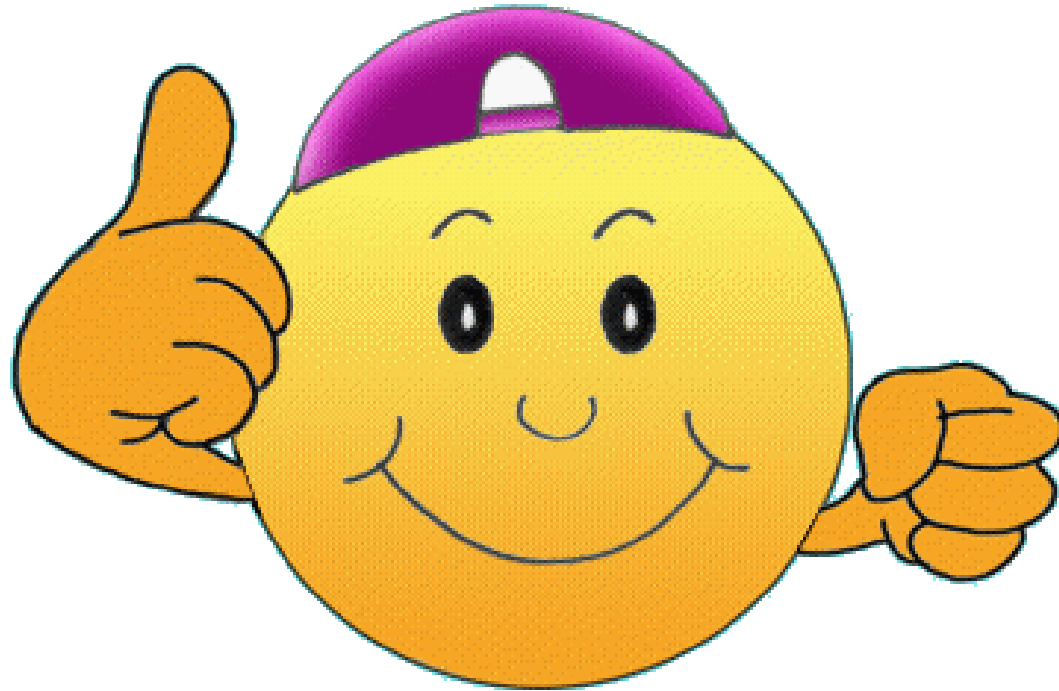
Specific gravity

Reaction (pH)

Task II. Chemical Examination:

<u>Item</u>	<u>Observation</u>	<u>Comment</u>
<u>Protein</u>		
<u>Glucose</u>		
<u>Ketones</u>		
<u>Nitrite</u>		
<u>Bilirubin</u>		
<u>Urobilinogen</u>		
<u>Blood</u>		

GO FOR IT !



GOOD LUCK !