

GENERAL URINE EXAMINATION

Urine (from Latin Urina), is normally sterile liquid by-product of the body secreted by the kidneys and excreted through the urethra through a process called urination. The specifications of urine and its contents are an important indicators reflects the normal or pathological of physiological state of the body.

Normal urine is sterile and contains no bacteria, viruses, or fungi. Urine is a mixture of water and chemicals, proteins, or electrolytes such as:

- sodium
- potassium
- urea, which is formed when protein breaks down
- creatinine, which is formed when muscles break down
- other chemical compounds

Urine analysis include many laboratory test, and the most common are:

- 1- General Urine Examination (GUE).
- 2- Urine for Culture and Sensitivity test (urine for c/s).
- 3- Urine biochemical tests.
- 4- Urine cytology and other special tests.

Types of urine collection

- 1. Random sample- routine:** The specimen must be collected in a clean dry, disposable container about 40 ml. if the examination is (GUE).
- 2. Mid-stream of urine:** This collection requires instruction to the patient that leaves the beginning of urine as well as the last and collects from the mid-stream urine in a dry and sterile container with cover. This collection is indicated for culture and sensitivity test.
- 3. Cumulative collection:** Here required from patient to collect urine for 24 hours in the same container, it starts from eight o'clock until eight o'clock the next day and to prevent bacterial contamination of the urine due to the long time period, it is preferred to add a preservative such as boric acid by (1 gm. Per 454 gm. of urine). This type of collection is indicated for 2 cases:
 - A. Investigation for Mycobacterium tuberculosis (TB) bacteria that may infect the kidneys which is low in number due to long generation time of 18 hours, this required cumulative collection.
 - B. To measure the amount of total protein in urine.

First: General Urine Examination (G.U.E):

It includes two basic tests:

A-Macroscopic examination

B-Microscopic examination

A-Macroscopic examination of the urine:

1. Volume
2. Specific gravity
3. Color,
4. Appearance.
5. Reaction (pH)
6. Odor
7. Sugar
8. Ketone bodies
9. Protein (Albumin)
10. Bilirubin
11. Urobilinogen.
12. Bile Salt

1. Volume:

The normal range of urine output is 800 to 2,000 milliliters per day if you have a normal fluid intake of about 2 liters per day.

Abnormal volumes which are:

a) **Polyuria** >2000 mls./day, an abnormally high urine volume may indicate:

- Diabetes mellitus.
- Renal diabetes insipidus.
- Some forms of kidney failure.
- Unusually large fluid intake.
- Use of diuretic medications.

b) **Oliguria** <400 mls. /day, An abnormally low urine volume may indicate:

- Inadequate fluid intake.
- Diarrhea.
- Dehydration.
- Renal insufficiency.
- Renal failure.

c) **Dysuria:** is any discomfort or painful associated with urination which often signifies an infection of the lower urinary tract.

d) **Anuria:** complete cessation انقطاع تام of urine caused by presence of tumor or large renal stone (Calculus).

2. Specific gravity:

It is a test that shows the concentration of all chemical particles in the urine that compares the density of urine to the density of water, depends on the concentration of various solutes in urine like salt, Albumins, Sugar.

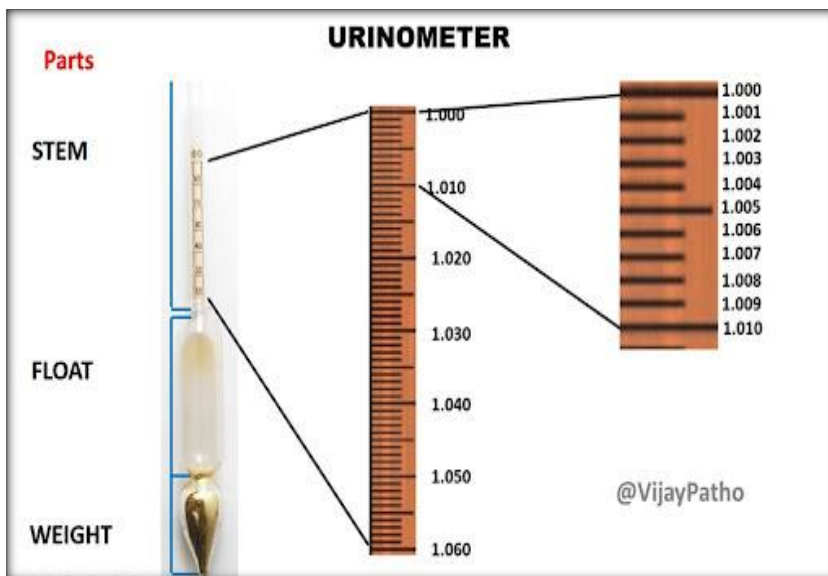
Test is done by using **Hydrometer** (Urinometer), **Refractometer** & **Dipsticks**.

Normal value of S.G. (1008-1030), Increased S.G. concentration of solutes in the urine called (Hypersthenuria) reach at 1060 this case is associated with chronic renal disease when kidney has lost the ability to reabsorb the solid material, low S.G. called (Hyposthenuria) reach to 1001 because the kidney lost the ability to concentrate the urine so it is secretion a dilute urine.

How the test is performed using Urinometer?

1. Fill 2/3 of urinometer's container with urine.
2. Allow the urinometer to float into the urine.
3. Read the graduation at the lowest level of urine.

NOTE: If the amount received is insufficient urine we were wrights Quantity Not Sufficient (Q.N.S).



3. Colour:

Normal urine color has a wide range of variation ranging from pale yellow, yellow, dark yellow, amber due to bile pigments appears in urine.

Colour Abnormalities

- **Colorless or pale yellow:** Diabetes Mellitus, Using of diuretic.
- **Dark yellow:** causes Low water intake, Excessive sweating and fever.
- **Orange:** caused by vitamin (A) intake or Nitrofurantoin (antibiotic used against *E. coli* in urinary tract infection).
- **Brownish yellow:** caused by Hepatitis and obstructive jaundice.
- **Reddish:** Due to the presence of fresh blood, Urinary tract infection, Trauma, Menstrual period, Cancer of kidney or bladder .
- **Dark brown:** Malignant Melanoma and Nephritic syndrome (cola color of urine).

4. Appearance:

Normal appearance of urine is **clear** and abnormal **cloudy or turbid** implying to presence salt, albumin and pus cells.

5. Reaction (pH):

Reaction reflects ability of kidney to maintain normal hydrogen ion concentration in plasma. The average value for urine pH is 6.0, but it can range from 4.5 to 8.0. Urine under 5.0 is acidic, and urine higher than 8.0 is alkaline, or basic.

How the test is performed?

Test is performed by:

1. litmus paper
2. pH paper
3. Dipsticks

6. Odor:

Fresh normal urine has a faint aromatic odor and leaving it for a long time leads to convert urea into ammonia which has foul odor.

In some pathological conditions, certain metabolites may be produced to give a specific odor called **Fruity odor** caused by the presence of **ketone** bodies and acetic acid in Diabetic patient's urine, however:

- Ammonia odor urine standing for a long time.
- Offensive or bad odor caused by Bacterial action of pus cells (UTI).

7. Sugar:

The normal level of Random blood sugar is (80-180 mg/dl), and **insulin** and **kidney threshold** is responsible for blood level control, but when blood sugar is elevated above 180 mg. /dl. (Kidney threshold) the kidney plays an important role by excreting excess sugar in urine this case is associated with **Diabetes Mellitus** patients, urine sugar can be measured by using:

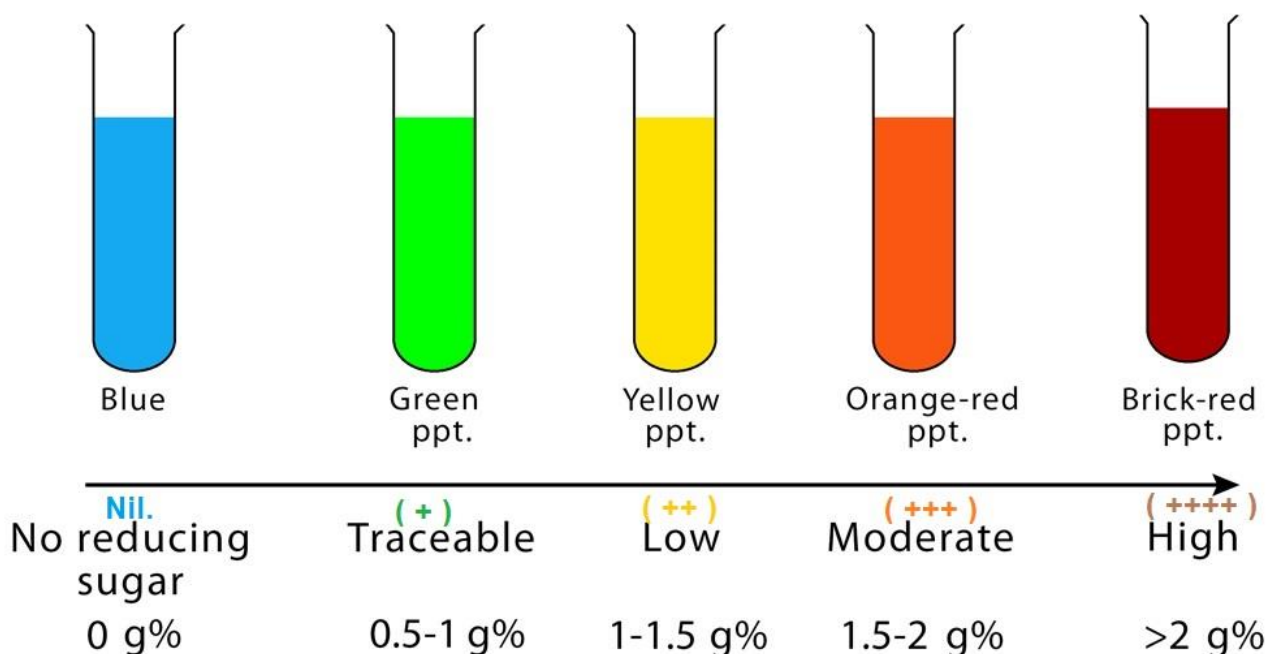
- Benedict's Reagent
- Fehling's Reagent

Principle: Benedict's reagent contains CuSO_4 in the presence of reducing sugars *cupric ions* are converted to *cuprous oxide* which is hastened or hurry by heating, to give the color in urine.

Method: Takes 5ml of Benedict's reagent in a test tube, add 1 ml of urine.

Boil the mixture and the color of urine will change as follows:

- Blue = Negative (-) and written (Nil).
- Blue-green = Trace.
- Green = (+).
- Yellow = (++)
- Orange – Red = (+++).
- Brick red = (++++).



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8. Ketone bodies test:

Normally, your body burns sugar for energy. But if you don't have enough sugar in cases of extreme fasting in your body for energy and people with (type 1 or type 2 diabetes) often have high ketone levels because they don't make enough insulin. Or their body doesn't respond well to insulin, and they can't use the sugar in the blood for energy. The body burns fat instead and produces substances called ketones. The ketones end up in your blood and urine.

Test name: ACETEST TABLET TEST

Principle:

The **Acetest tablet** consists of sodium nitroprusside, glycine, and an alkaline buffer. Discoloration of the tablet color turned into (Purple lavender color) indicates the presence of acetoacetate or acetone (≥ 5 mg/dl). A rough estimate of the amount of ketone bodies can be obtained by comparison with the color chart provided by the manufacturer.

Reagents

- Sodium nitroprusside
- Aminoacetic acid
- Disodium phosphate – provides optimal ph
- Lactose

Method:

Is to place a tablet on a clean white surface such as typing paper. A drop of urine is placed on the tablet, and 30 seconds later the color of the top of the tablet is compared with the color chart provided, which has color blocks with various shades of purple representing trace, moderate, and strongly positive reactions.

The tablet remains white if the urine is negative.

A **False-positive** test can occur in the presence of phenylketonuria.

9. Protein (Albumin):

Proteinuria is: The presence of protein in the urine and include these five types of protein:

1-Albumine

2-Globuline

3-Mucine

4-Haemoglobin

5-Bence-Jones protein (It appears only in people with bone cancer)

Proteinuria is classified into three types according to origin of protein in urine:

- 1- **Accidental proteinuria:** It is found in contaminated urine with other condition such as hemorrhage in the urinary tract (menses), Vaginal or urethral secretions. This type of proteinuria is not due to kidney disease.
- 2- **Functional proteinuria** any proteinuria that is not due to renal disease, such as orthostatic proteinuria, or the transient proteinuria of pregnancy, or produced by eating of certain foods, or occurring as a result of vigorous and prolonged exercise of the lower limbs also called athletic proteinuria.
- 3- **Organic Proteinuria (Glomerular proteinuria)** the most common kind of proteinuria, being due to Kidney disease and abnormal permeability of the glomerular capillaries to protein.

Test methods: Heat & Acetic acid test.

Principle-proteins are denatured & coagulated by heating to give white cloud precipitate.

Method:

Take 2 mls of urine in test tube after centrifugation to get rid of all the turbidity causing substances in the urine then heat only the upper part keeping lower part as control.

Presence of phosphates, carbonates, proteins gives a white cloud formation. Add acetic acid 1-2 drops, if the cloud persists it indicates it is protein (acetic acid dissolves the carbonates/phosphates)

Albumins estimation have different degrees:

- very few Fog = trace
- Light Fog = Very few
- Turbidity = (+).
- Clearer turbidity = (++).
- The presence of small pieces conglomerate = (+++).
- The existence of a piece chess on the surface = (++++).

10. Bilirubin:

Bilirubinuria: Is the presence of bile pigments (Bilirubin and Urubilinogen) in the urine.

Causes: Liver diseases or injury, viral hepatitis and Obstruction to biliary duct.

Test Methods:

1- Foams test: 2 mls of Urine is placed to one-third of tube then heat the upper part of it to boiling until foam appears on the surface. If a yellow foam appeared on surface of urine the test is **positive**, but if the foam is not yellow (Colorless) then the test is **negative**.

2-Smith test: Smith reagent (consisting of one part iodine and 9 parts of alcohol) placed in a test tube and gradually add urine on the walls. If a green ring appeared at the point of confluence (meeting) between reagent and urine indicate a positive test, and if not appear, the test is negative.

11. Urobilinogen:

Urobilinogen is formed from the reduction of bilirubin. Urinary urobilinogen may be increased in the presence of a hemolytic process such as hemolytic anemia. It may also be increased with infectious hepatitis, or with cirrhosis.

Causes

Hemolytic anemias, and liver disease such as hepatitis or cirrhosis

Ehrlich aldehyde test: Ehrlich's reagent (which consists of **hydrochloric acid** 20 ml, **distilled water** 80 ml, and **paradimethylaminobenzaldehyde** 2 gm).

Method:

Equal volumes (6ml) of urine and (6ml) of (10% barium chloride) are mixed and then filtered through a filter paper, (This step is made to remove bilirubin because presence of bilirubin interferes with the reaction, and therefore it should be removed).

Then take 5 ml of filtrate urine in a test tube. Add 0.5 ml of Ehrlich's aldehyde reagent. Allow to stand at room temperature for 5 minutes. Development of dark pink color indicates amount of urobilinogen. Darkred color means increased amount of Urobilinogen (pdimethylaminobenzaldehyde) reacts with urobilinogen in urine to produce a pink color. Intensity of color developed depends on the amount of urobilinogen present (Positive + test). Light pink color indicate Negative test.

Note: Test should be performed directly after collection, leaving urine for long time convert urobilinogen into urobilin, which cannot be detected by test.

12. Bile salts:

Bile salts are salts of four different types of bile acids; **Cholic**, **Deoxycholic**, **Chenodeoxycholic**, and **Lithocholic**. These bile acids combine with glycine to form complex salts to emulsify fat and reduce the surface tension on fat droplets so that enzymes (lipases) can breakdown the fat.

Cause: Obstruction to bile flow (obstructive jaundice).

The test used for their detection is **Hay's surface tension test**. The property of bile salts to lower the surface tension is utilized in this test. Where we added a small amount of sulfur powder crystals flower on the surface of the urine sample. If **immersed** to the bottom indication of the **positive test**. If remained **floating** on the surface indication of the absence of bile salts (**Negative**) because these salts reduce the surface tension of urine.