Lab.2 General urine Examination (GUE)

Urine (from Latin Urina,) is a typically sterile liquid by-product of the body secreted by the kidneys through a process called urination and excreted through the urethra.

GUE is the important screening procedure gives diagnostically important information about the presence of disease inside and outside the urinary tract by urine analysis screen for renal or urinary tract disease and help detect metabolic and systemic disease. Urine composition is affected mainly by three factors, they are:

1. Nutritional status.
2. State of metabolic processes.
3. Ability of kidney to selectively handle the material presented to it.

Collection of Urine

The urine sample should be collected in a clean, dry container and should be examined fresh. With time, **RBC, and leucocytes tend to be destroyed** due to hypotonicity of the urine. **Casts too tend to get decomposed**. **Bacterial contamination of stale urine is frequent and causes alkalinization of the urine due to conversion of urea to ammonia and loss of glucose**. This rise in pH accelerates **loss of leucocytes and epithelial cells**.

1. ***Random collection*** taken at any time of day with no precautions regarding contamination. For ordinary qualitative, tests a random sample is enough
2. ***Early morning collection*** of the sample before ingestion of any fluid. This is usually hypertonic and reflects the ability of the kidney to concentrate urine during dehydration which occurs overnight.

3. ***Clean-catch, midstream urine specimen***: this is preferred type of specimen for culture and sensitivity testing to reduce microbial contamination.

4. ***Timed collection specimen*** (24h). usually used to measuring creatinine clearance and urine volume.

Macroscopic Examination of Urine

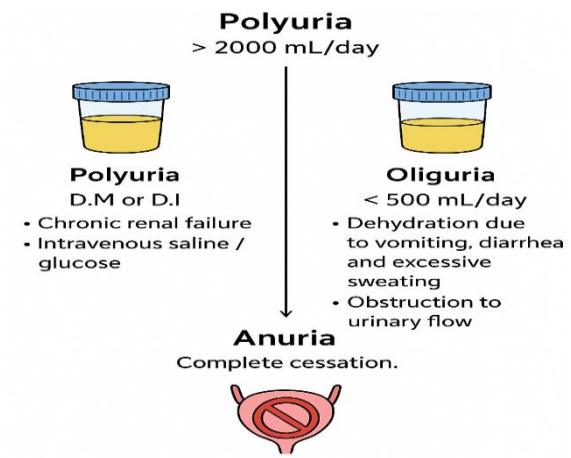
Volume

The average 24 hours urinary output in an adult is around 1200 –1500 ml.

In ***Polyuria*** More than 2000 ml such in cases D.M or chronic renal failure or Intravenous saline / glucose

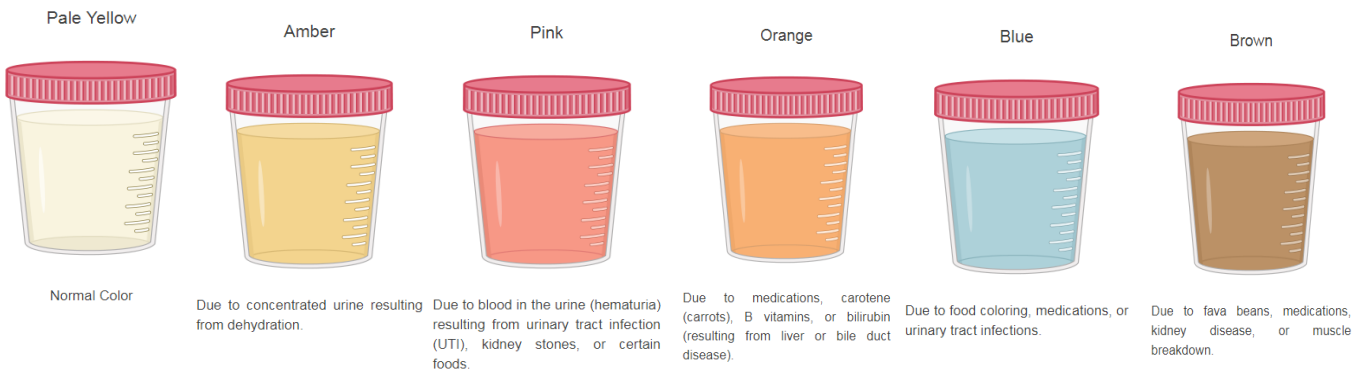
In *Oligouria* Less than 500 ml in Dehydration due to vomiting, diarrhea and excessive sweating or Obstruction to urinary flow.

In Anuria Complete cessation.

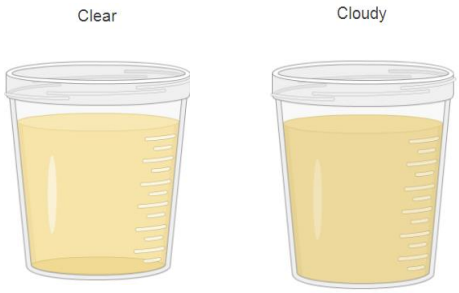


Color and Appearance

Fresh urine is **pale to yellow** or amber in color (urobilinogen). A red or red-brown (abnormal) color could be from a food dye, a drug, or the presence of hemoglobin. Colorless urine (diabetes mellitus, large fluid intake). Orange (sweating, fever, bilirubin). Green (pseudomonal infection). Milky (amorphous).

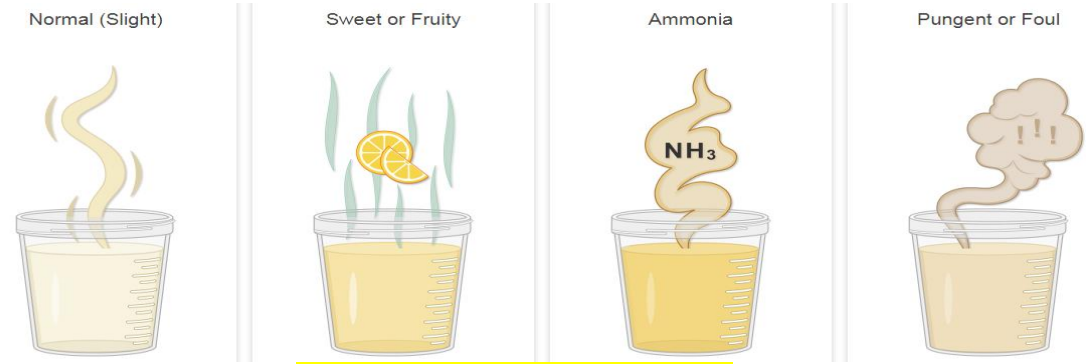


Urine appearance normally **clear to slightly hazy**, Turbidity or cloudiness may be caused by excessive cellular material, amorphous or infection.



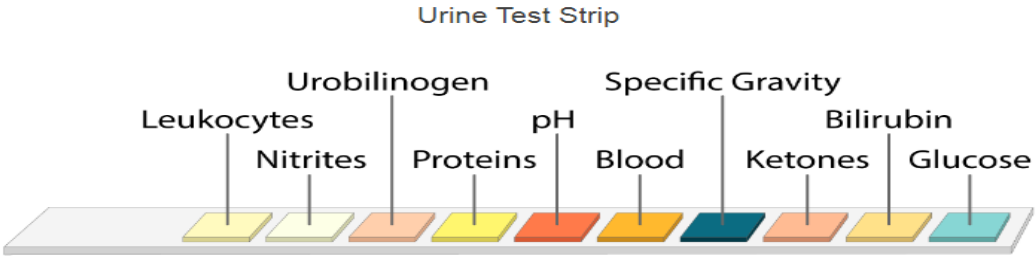
Odour

Important in fresh specimens only and is aromatic because of volatile fatty acids. A **sweet or fruity aroma** can result from elevated glucose or ketones in the urine due to diabetes. **An ammonia (NH_3) smell** can result from dehydration, which increases urine concentration. **A pungent or foul** odor can result from urinary tract infections, medications, or certain foods

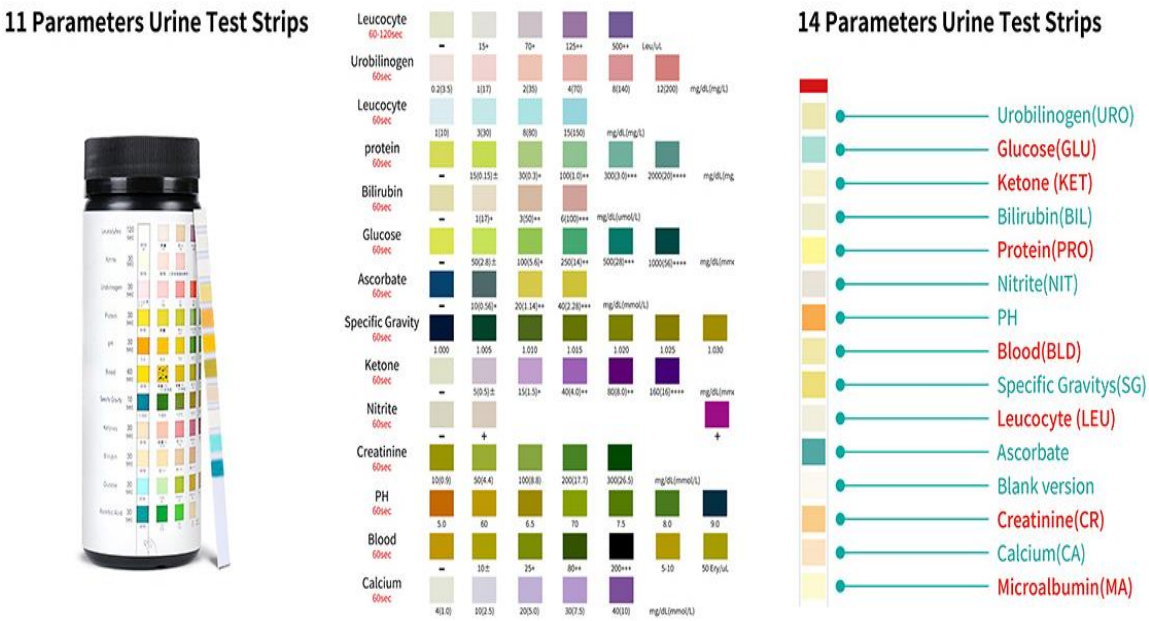


Chemical Analysis of Urine

all can be detecting by specific strip called urine test strip or dipstick is a basic diagnostic tool used to determine pathological changes in a patient's urine in standard urinalysis.



A standard urine test strip may comprise up to 10 different chemical pads or reagents which react (change color) when immersed in, and then removed from, a urine sample. The test can often be read in as little as 60 to 120 seconds after dipping, although certain tests require longer. The analysis includes testing for the **presence** of proteins, glucose, ketones, haemoglobin, bilirubin, urobilinogen, acetone, nitrite and leucocytes as well as testing of pH and specific gravity.



1- **PH**

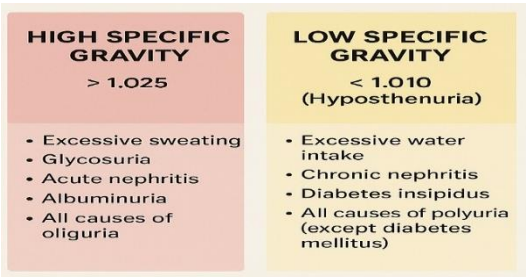
Urinary pH may range from as low as **4.5 to as high as 8.0**, Average pH = 6.0.

Among the urinary tract infection (UTI), *E.coli* caused acidic urine, while *Proteus* caused alkaline urine. Meat protein diet causes urinary acidification, while consumption of citrus fruits makes the urine alkaline

Note: Only a freshly voided sample is suitable for measuring pH.

2- **Specific Gravity (SG)**

Specific gravity (which is directly proportional to urine osmolality which measures solute concentration) measures urine density, or the ability of the kidney to concentrate or dilute



the urine over that of plasma. Specific gravity between **1.002 and 1.035** on a random sample should be considered normal if kidney function is normal.

Temperature of urine specimens affects specific gravity when specific gravity is measured in urine removed from the refrigerator. Specific gravity will be falsely higher.

3- **Protein**

Dipstick screening for protein is done on whole urine. A small amount of filtered plasma proteins and protein secreted by the nephron (mucoprotein) (Tamm-Horsfall protein) can be found in normal urine. Normal total protein excretion does not usually exceed **150 mg/24 hours** (or 10 mg/100 ml in any single specimen). More than 150 mg/day is defined as proteinuria. Proteinuria > 3.5 gm/24 hours is severe and known as **nephrotic syndrome**. The test primarily measures urine albumins that have entered the urinary tract from the bloodstream. Elevated urine proteins (proteinuria) indicate kidney disease or immune disorders.

Also, by using: - Sulphosalicylic acid test: In the case of clear and acidic urine specimen add 3 drops of (20%) Sulphosalicylic acid to 1 ml of specimen then heating the specimen. If the cloudiness continue means positive result (presence of protein).

4- **Glucose**

Nearly all glucose filtered by the glomeruli is reabsorbed in the proximal tubules and only undetectable amounts appear in urine in healthy patients. Above renal threshold **(10 mmol/L)** glucose will appear in urine. **Glycosuria (excess sugar in urine) generally means diabetes mellitus (DM).** Also detect by Glucose test (Benedicts test), In this method the (Cu) ions redact to the (Cu2O) by the glucose if present. If the glucose concentration 0.1% or less there are no precipitate was seen after cooling specimen**.**

The results as below:

Color		Glucose concentration	Result
Blue		Negative	-
Green		< 0.5% glucose	+
Greenish yellow		0.5 – 1% glucose	++
Yellow		1 – 2% glucose	+++
Orange to red		> 2% glucose	++++

5- **Ketones**

Resulting from either **diabetic ketoacidosis** or some other form of **caloric deprivation (starvation)**.

Normally, measurable amounts of ketones do not appear in the urine, because all the metabolized fat is completely broken down into carbon dioxide and water. However, when the use of available carbohydrate as the major source of energy becomes compromised, body stores of fat must be metabolized to supply energy. Ketones are then detected in urine. Clinical reasons for increased fat metabolism include the **inability to metabolize carbohydrate, as occurs in diabetes mellitus**; **increased loss of carbohydrate from vomiting**; and **inadequate intake of carbohydrate associated with starvation and malabsorption**.

6- **Nitrite**

This test relies on the **breakdown of urinary nitrates to nitrites**, which are not found in normal urine. Many Gram-negative and some Gram-positive bacteria are capable of producing this reaction and a positive test suggests their presence in significant numbers (ie more than 10,000 per ml). A negative result does not rule out a UTI.

7- **Bilirubin**

The test measures bilirubin in the urine that has entered the urinary tract from the bloodstream. Bilirubin is produced by the liver during the

breakdown of heme from RBCs and then released in the bile. The appearance of bilirubin in the urine can provide an early indication of **liver disease**. It is often detected long before the patient exhibits jaundice. The normal value of bile pigment in urine specimen **less than or equal to 0.02 mg% (negative)**.

Results: Green color indicate **+ve test.**

Causes of hyperbilirubinuria: either Moderate to severe hepatocellular damage or Obstruction of bile ducts

8- **Urobilinogen:** The normal value of urobilinogen in urine specimen less than or equal to **1 mg% (normal).** The test measures urobilinogen in the urine that has entered the urinary tract from the bloodstream. Bacteria in the intestines make urobilinogen from bilirubin, which is in the bile produced by the liver. Elevated levels of urine urobilinogen indicate liver disease and dysfunction.

*Causes of urobilinogenuria: Hemolytic anemia or Early, moderate and severe hepatocellular damage.

9-Red cell (**hemoglobin**) this strip contains a chromogenic substrate (tetramethylbenzidine) by the peroxidase activity of hemoglobin give positive result. **Blood** may be present in the urine either in the form of intact red blood cells (**hematuria**) or as the product of red blood cell destruction, hemoglobin (**hemoglobinuria**). Microscopic examination of the urinary sediment shows intact red blood cells, **but free hemoglobin** produced either by hemolytic disorders or lysis of red blood cells is not detected. Therefore, **chemical tests** for hemoglobin provide the **most accurate means for determining the presence of blood**. Once blood has been detected, the microscopic examination can be used to differentiate between hematuria and hemoglobinuria

10- **White blood cell** by detection **leukocyte esterase (LE)**. Chemical test for leukocytes offers a more standardized means for the detection of

leukocytes. The test is **not** designed to measure the concentration of leukocytes, and the manufacturers recommend that quantitation be done by microscopic examination. An additional advantage to the chemical LE test is that it detects the presence of leukocytes that have been lysed, particularly in dilute alkaline urine, and would not appear in the microscopic examination