The following is a detailed breakdown of the responsibilities of each unit:

- **Microbiology** receives almost any clinical specimen, including swabs, feces, urine, blood, sputum, cerebrospinal fluid, synovial fluid, as well as possible infected tissue. The work here is mainly concerned with cultures, to look for suspected pathogens which, if found, are further identified based on biochemical tests. Also, sensitivity testing is carried out to determine whether the pathogen is sensitive or resistant to a suggested medicine. Results are reported with the identified organism(s) and the type and amount of drug(s) that should be prescribed for the patient.

- **Parasitology** is a microbiology unit that investigates parasites. The most frequently encountered specimen here is faeces. However, blood, urine, sputum, and other samples may also contain parasites.

- **Virology** is concerned with identification of viruses in specimens such as blood, urine, and cerebrospinal fluid.

- **Hematology** works with whole blood to do full blood counts, and blood films as well as many other specialised tests.

- **Coagulation** requires citrated blood samples to analyze blood clotting times and coagulation factors.

- **Clinical Biochemistry** usually receives serum or plasma. They test the serum for chemicals present in blood. These include a wide array of substances, such as lipids, blood sugar, enzymes, and hormones.
- **Toxicology** mainly tests for pharmaceutical and recreational drugs. Urine and blood samples are submitted to this lab.

- **Immunology/Serology** uses the concept of antigen-antibody interaction as a diagnostic tool. Compatibility of transplanted organs is also determined.

- **Immunohaematology**, or Blood bank determines blood groups, and performs compatibility testing on donor blood and recipients. It also prepares blood components, derivatives, and products for transfusion. Regulated by the FDA since giving blood is considered a drug, this unit determines a patient's blood type and Rh status, checks for antibodies to common antigens found on red blood cells, and cross matches units that are negative for the antigen.

- **Urinalysis tests urine** for many analyses. Some health care providers have a urinalysis laboratory, while others don't. Instead, each component of the urinalysis is performed at the corresponding unit. If measuring urine chemicals is required, the specimen is processed in the clinical biochemistry lab, but if cell studies are indicated, the specimen should be submitted to the cytopathology lab, and so on.

- **Histopathology processes** solid tissue removed from the body (biopsies) for evaluation at the microscopic level.

- **Cytopathology** examines smears of cells from all over the body (such as from the cervix) for evidence of inflammation, cancer, and other conditions.

- **Electron microscopy** prepares specimens and takes micrographs of very fine details.
- **Genetics** mainly performs DNA analysis.

- **Cytogenetics** involves using blood and other cells to get a karyotype. This can be helpful in prenatal diagnosis (e.g. Down's syndrome) as well as in cancer (some cancers have abnormal chromosomes).

- **Surgical pathology** examines organs, limbs, tumors, fetuses, and other tissues biopsied in surgery such as breast mastectomys.

Urine analysis

- **Macroscopic examination**
- **The appearance**

The normal appearance of urine is clear, however will become cloudy when allowed to stand the cause of cloudiness:

1- Many result from the presens of mucin or mucous in urine.
2- Bacteria are common cause cloudiness in the urine. specimens that has been allowed to stand. In this case bacteria are not clinically significant.
3- Inflammatory state of the lower urinary genital tract.
4- Amorphous phosphate and occasionally carbonates.
5- Amorphous urate in acidic urine.
6- Spermatozoa or prostatic fluid may also cause cloudiness.
7- Pus cells presence will be seen as white cloudiness.
8- R.B.C and vaginal contaminations.

- **The Specific gravity**

The kidney is regulator of the volume acidity, composition and osmotic pressure of the extracellular fluid. The measurment of specific gravity of urine is one of the means of assessing the ability of the kidney to regulate the composition and osmotic pressure of the extracellular fluid.

Specific gravity is a measurement of the amount of dissolved substances present. More technically specific gravity descrite the weight of a solution compared to the weight of an equal volume of water.

The urine is a water solution various normal substances like urea and Nacl and may be with abnormal dissolved substance which increased the specific gravity. To determine the S.g of the urine specimen assume that (1) liter of urine weight (1008.5mg). In addition, assume (1) liter of water (at the same temperature) weight (996.5mg). The specific gravity of urine specimen should then be 1008.5 divided by 996.5 = 1012.

- Clinically the specific gravity of urine may be used to obtain information about two general function:
- State of renal epithelium.
- State of hydration of the patient.

The normal range of urine S.G. is 1.008-1.030. However, if the renal epithelium is not function adequately, it will gradually lose the ability to concentration the urine which caused diluting of urine.

Two frequently observed cases where S.G. dose not vary inversely with urinary volume are: *Diabetes mellitus* and, certain type of renal diseases with *Diabetes mellitus* abnormally large urine volume associated with an abnormally high S.G. This is caused by the presence of large amounts of dissolved sugrar which raises the specific gravity of the urine.

In certain types of renal disease such as glomerulonephritis and pyelonephritis, there is a combination of low S.G. with low urine volume. The probably results from the inability of renal epithelium either to excrete normal amount of water or to concentration the waste product.

- **Microscopic examination**

Consist cellular constituents:

1-Red blood cells (R.B.Cs)

R.B.Cs are abnormal urinary constituents and the presence of more than (2/H.P.F). Is always of pathogenical significance. The cases in which RBCs present in the urine termed haemoglobin urea. The haematuria urine colour varies from a clear bloody specimen on gross examination to a specimen that shows no change in colour.

Haematuria may be result of urogenital tract bleeding or associated with any urogenital tract disease. The determination of haematuria cause depends on the site of the bleeding. The bleeding though glomerulus will often have combined by RBCs casts. As seen in acut glomerulonephritis. The occurance of haematuria without accopained protein and casts usually, indicate that the bleeding site in the lower urogenital tract.

2- PUS cells

Pus cells means degeneration of leucocytes. The presence of a few pus cells (1-5/H.P.F) in urine is abnormal. The presence of large number of pus cells in urine sample rank pyouria which indicate for inflammation at any site along the urogenital tract. The inflammation may result by the infection or other causes. If the infection in the upper part of urogenital tract likes kidneys the pus cells accompained with celluler or granular casts.

3- Epithelial cells

The structures that make up the urinary system consist of several layers of epithelial, except for the single layered tubules of the nephron.

The epithelial cells lining organs such as the urethra and bladder (besides contaminating cells of male and female genital tracts) are continually sloughed off in to urine and replaced by cells originating from deeper layers. Therefore, urine always contains some epithelial cells.

The sequamous epithelial cells are seen especially in urine specimens of female as a result of contamination from the vagina or vula.

Renal nephron tubules lining with simple epithelial tissue. The occurrence of these cells in urine is most important, for it implies serious pathology and destruction of renal tubule, as dose the presence of epithelial casts. Renal cells are often found in association with casts.

4- Casts

Casts are long cylindrical structures that result from the solidification of material within the lumen of the kidney tubules. They are important because anything that is contained within the tubules is flashed out in the casts. Casts may be formed at any site of the nephron, either by parcipitation of protein or by grouping together of material within the tubular lumen.

• **The types of the casts:**

1- Hyaline casts: colourless, homogenous and transperance.

The cause of this type:

A-Heart failure, **B**-Renal defect in Diabetic patients,

C-Chronic renal failure, **D-**Glumerulonephritis and pyelonephritis**.**

2- Granular casts: This kind divided in to: fine granular cast (consist of fine granules in all part of the cast), and coarse granular cast (consist of fats, analysied cells or protein clumping which are seen as dark granules). The causes of these casts are:

A-nephron syndrom **B-** poisoning with iron

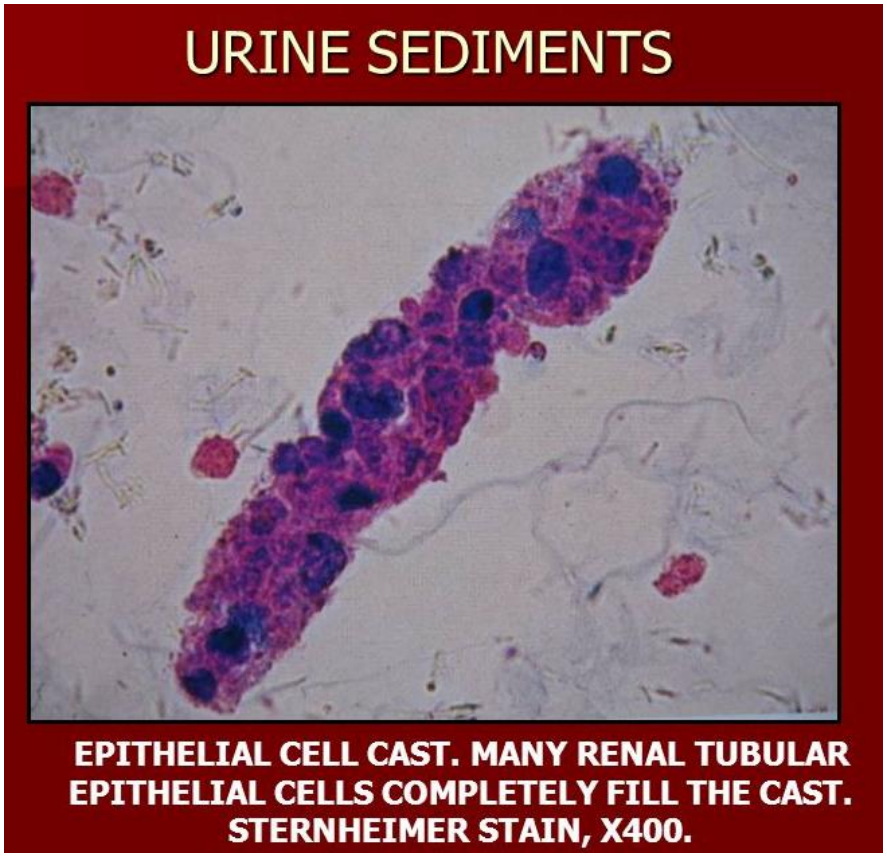
C- Glumerulonephritis and pyelonephritis.

3- RBCs casts: It is consisting of haemoglobin produced by haemolysis of RBCs. The colour of this casts yellow to orang. The causes: **A-** acute glumerulonephritis **B-** semi acute bacteria infection.

4-leukocytes casts: It was consist of pus cells aggregation the cause are:
A- pyelonephritis **B-** Interstitial nephritis

5- Tubular epithelial casts: this is a similar of leukocytes casts but seen as two rows of the cells. The cause is: **A-** Tubular necrosis **B-** viral infection C- poisoning with heavy metales.

6- Waxy casts: It is yellow and homogenous.
The cause is: **A-** Renal failure **B-** Marked tubular atrophy.



5- Crystals and Amorphous material

A-Normal crystals of acidic urine

1-Amorphous ureates

This is amorphous material found in acidic urine. Chemically, amorphous ureates are the sodium salts of uric acid. When present in sufficient number, they from a pink precipitate.

2- Uric acid

These crystals have a variety of shapes and colour. Typically, they are yellow or reddish brown, much like the chemically related amorphous urates. The most typical shape is the whetstone. Other shape includes rhomic plates or prisms, oval shape with pointed ends. Uric acid crystals are commonly seen in urine specimens; especially after the specimens has been standing. Amorphous urates and uric acid may be associated with gout or stone formation besides chronic renal disease.

3- Calcium oxalate (Ca. oxalate)

Ca. oxalate crystats have a characteristic envelope appearance. Ca. oxalate crystal common in acidic urine but may also be seen in neutral or alkaline urine. Ca. oxalate may be associated with stone formation.

B-Normal crystals of alkaline urine

1- Amorphous phosphates

The amorphous material found in alkaline urine is amorphous phosphates. Phosphates are the most common cause of turbidity in alkaline urine and seen as a fine white precipitate microscopically.

2- Triple phosphates

They are colourless crystals and commonly show great variation in size.

3- Ammonium biurate

This ammonium salt is the alkaline counterpart of uric acid and amorphous urates in urine. The crystals are spherical with radial or concentric striations and long prismatic spicules, resembling thorn apples. Ammonium biurate are often present in old urine specimens.

4-Calcium phosphate

They are colourless and appear as flat plates (which are often mistaken for epithelial cells) or as slender wedges that occur singly or in rosettes.

5- Calcium carbonate

They are colourless granules that typically occur in pair, but may occur also singly.