DRUG STORE MANAGEMENET AND INVENTORY CONTROL

Points to be covered in this topic

- INTRODUCTION
- ORGANISATION OF DRUG STORE
- TYPES OF MATERIALS STOCKED
- STORAGE CONDITION
- PURCHASE
- PURCHASE PROCEDURE
- INVENTORY CONTROL
- METHODS USED FOR THE ANALYSIS OF THE DRUG EXPENDITURE

INTRODUCTION

❑ DRUG STORE

- A drug Store/Pharmacy/Community Pharmacy/chemist's is a retail shop which provides prescription drugs, among other products.
- At the drug store, a pharmacist oversees the fulfillment of medical prescriptions and is available to give advice on their offerings of over the-counter drugs.
- A typical pharmacy would be in the commercial area of a community.
- Every hospital should have a medical store for the purpose of procuring, stocking and distributing the drugs and medicines to various departments

ORGANISATION OF DRUG STORE

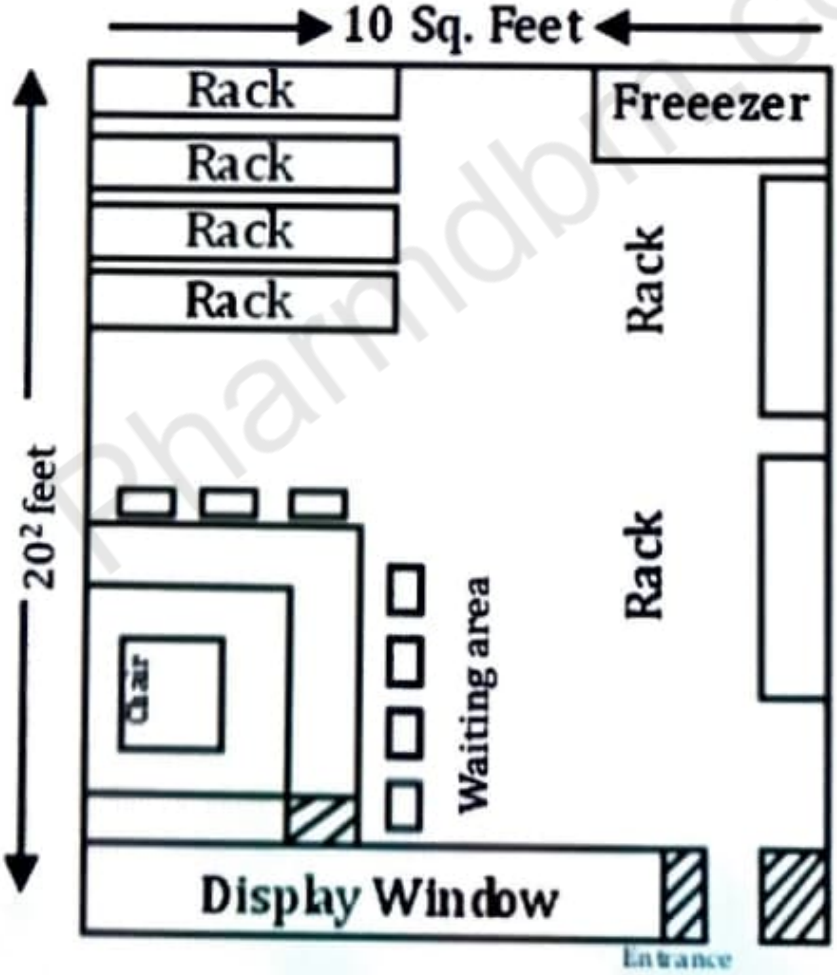
- Stores are defined as a sub - organisation in any hospitals where materials obtained are held in abeyance till inspected, approved and stocked.
- A store should have a standard specification of materials and since the store procured the drugs on behalf of the department for regular flow of material, the condition of storage should be proper.

❑ OBJECTIVE OF DRUG STORE

- To stock all drugs and accessories required in the hospital.
- To procure drugs from different sources.
- To supply drugs to the consuming departments.
- To store drugs required in research work.
- To preserve records of receipt and issue of drugs.
- To maintain records of receipt and issue of drugs.
- To carry out all operations regarding drugs economically to save

❑ GOOD LAYOUT DESIGN

- **Proper ventilation**
- It must be located on the **ground floor**, **close to pharmacy** It must have 2 entries, one for receiving and other for **issuing of materials.**
- **Proper illumination**
- **Walls & roof** should be **painted with washable paint**
- Sufficient no. of **wooden or steel** racks should be provided
- **Movement of men** & material should be minimized thus **saving time, cost**
- **Fast moving items** should kept near the counter while **slow moving items** are kept at **back of shelves.**
- **Bulky items** should store at the bottom of shelve **Surgical instruments** should store in **separate racks**
- **Cash counter ,wrapping counter** should be located near entrance



Whole sale drug store design

TYPES OF MATERIALS STOCKED

❑ TYPES OF MATERIAL STOCKED

- Sufficient number of racks should he provide
- Fire extinguishers should be provide at strategic points along with fire buckets Material stocked are
- Capsules, tablets. liquid dosage form and injections
- Biological and antibiotics should store in refrigerator
- Schedule X drugs, Narcotic and psychotropic substances should store under lock and key
- Poisons are store in separate rack, labeled as POISON
- Stock of Alcohol and alcohol containing preparation should maintain in register
- Large bulk items should be on bottom

STORAGE CONDITION

❑ COLD STORAGE (2°-8 °C)

❖ List A

- Sera, vaccine, Whole human blood, plasma, concentrated RBC, thrombin, inj. preparation, oxytocin inj., vasopressin inj., snake antidotes etc.

❑ COOL TEMP (8°-25°C)

❖ List B

- Antibiotics, blood preparations (dried plasma, fibrinogens, thrombin),
- Hormone preparation (corticotropins, oxytocin tablets),
- Vitamin preparations (Vit A , B1, B2 , B6 , C , D , B complex , k) , dextran inj, dextrose inj, halothane ergot liquid extract

❑ ROOM TEMP (25 °-30°C)

- Tablet , capsule , antibiotics ,

❑ WARM TEMP (30°-40°C) multi- vitamine injection

❑ EXCESSIVE HEAT (ABOVE 40°C)

PURCHASE

❑ PRINCIPLE

- The basic purpose of purchases is to ensure continuous flow of raw materials of right quality, right quantity, right price and from right sources.
- Another objective of purchasing is the avoidance of duplication and wastage with respect to various items purchased.
- Some important terms explained below.

1. RIGHT QUALITY

- Right quality means the quality which is available according to the particulars mentioned in terms of grades, brands or trade name, physico-chemical characteristics, etc.

2. RIGHT QUANTITY

- Right quantity is an important parameter of purchasing for continuous supply of raw materials. "Economic order Quantity" or any other technique may be followed in order to avoid shortage.

3. RIGHT PRICE

- The term right price means consistant matching with the quality of drug.
- Generally tender system is followed in hospitals and the lowest bidder is chosen for supplying the order.

4. RIGHT SOURCE

- The supplier should be dependable and capable of supplying as per requirements from time to time.
- The selection of supplier requires consideration of various factors.

5. RIGHT TIME

- Purchased department should have lead time information for all products. Lead time is the total time period between the placing of order and receipt of material while doing purchases.

PURCHASE PROCEDURE

- **Purchase procedure** involves **different steps** for procurement of goods.
- They are as under:

1. DETERMINATION OF REQUIREMENT

- The **materials** to be purchased for **particular period** are well planned for the **purpose** of their **regular and continuous** use.
- **Purchase requisition** is generally prepared by **departmental heads** and **provides information** mentioned below.
  - i. **Type of material to be purchased,**
  - ii. **Time of requirement,**
  - iii. **Quantity to be purchased,**

2. SOURCE OF SUPPLY

- The **pharmacy and therapeutic committee** sets adequate standards for the **purchase of quality drugs.**
- **Procurement of stores** is generally done by following sources
  - i. **Medical store depot**
  - ii. **Directorate general supplies** and disposals
  - iii. Direct from **whole sellers and manufacturers**
  - iv. By **inviting tenders**
  - v. **Emergency purchases** from **local market**

(i) MEDICAL STORE DEPOT (MSD)

- This **organisation** has **six medical store** deport at **Mumbai, Chennai, Calcutta, karnal, Hyderabad, Guwahati.**
- The **items purchased** by these **organisations** are subjected to various in **house tests** at the **testing units** in Chennai and Mumbai.
- It runs on **no-profit and no-loss basis.**

(II) DIRECTORATE GENERAL SUPPLIES AND DISPOSALS (DGS &D)

- **DGS&D calls** for **tender and places** the order.
- The payment is made only after the **verification of inspection** report by the **indentor** on the **prescribed performa.**

(III) DIRECT PURCHASE FROM WHOLESELLERS OR MANUFACTURER

- Direct purchases from wholesellers , manufacturers are done following a proper purchase procedure.
- Materials are then received and stocked at their relevant places under proper storage conditions.

(IV) BY INVITING TENDERS

- Tenders are invited from various supplier and generally the lowest bidder is choosen for supplying the order.
- However price and quality both are considered as well.

(V) EMERGENCY DRUGS FROM LOCAL MARKET

- Items not available at MSD, DGS &D and any emergency drug which is out of stock can be immediately purchased from local market.
- For this purchase from is prepared in duplicate, one copy is sent to the department and other copy is retained in the pharmacy.
- This avoids the department concerned to re order the same item.

3. PURCHASE ORDER

- After selecting the supplier, the chief pharmacist or any other suitable authority prepares a purchase order giving detailed description, specification, packaging, price and quantity needed etc. of the items.
- This purchase order is in written form and it is the evidence of contract between the buyer and the supplier.
- Number of purchase order copies varies from hospitals to hospital
  - (a) The original copy is sent to the supplier.
  - (b) One copy for accounts section.
  - (c) One copy for purchase department.
  - (d) One copy for the department.
  - (e) Fifth and Sixth copy for concerned receiving department.
  - (f) Seventh copy as history copy

4. RECEIPT OF ACKNOWLEDGMENT

- After placing the order to supplier by sending a copy of purchase order, the supplier in turn sends acknowledgement of the order saying that he will be able to supply the goods with the terms and conditions which are mentioned in the purchase order.

5. RECEIPT OF DRUGS

- On receipt of drugs , there should be a system in the stores whereby the supply of drugs received in the medical stores from the manufacturer are properly checked by person specially assigned for this purpose.
- Preferably the same person is responsible for reviewing the stocks, date of expiry, description, quantity, batch number, as mentioned in the order form.
- Random sampling can be done to make sure that products confirm to the tendered specifications like date of expiry and visible sign of deterioration , such as change of colour , caking etc.
- If any such deterioration is observed the matter should be reported to medical superintendent and local drug inspector.

6. DISTRIBUTION OF DRUGS TO WARDS

- Drugs should be supplied in the original packing of manufacturers.
- However if it is not possible to do so, then that should be supplied in clean containers so that the integrity and original properties can be preserved.
- Name and quantity of the drug should be properly labelled.

PURCHASE REQUEST FORM

All India Institute of Medical Sciences(AIIMS), Bhubaneswar

Ref.---------- **Date.----------**

Code no.-------- **Charge no.-------**

Purchase order no.-------

Date of supply----------

Suggested Venders:

1.

2.

3.

No	Description of items required, Specification/ Prepacking	Price per unit	Units Required	Total Price	Quantity in Hand Required

Requested by ---------- **Approved By----------**

All India Institute of Medical Sciences (AIIMS), Bhubaneswar

To M/s----------Purchase Order No.----------(Quote this No. on all package)

Date---------- **Our Ref. No.----------**

Account Code no.----------

Name of Account---------- Date ----------

Item no.	Specifications/Packing	Price per Unit	Quantity	Net amount(paid)

INVENTORY CONTROL

- **Drug store management** is based on principles of **inventory control.**
- **Mismanagement of stores** and **non-applicability** of **Scientific and Modern techniques** has been identified as the root cause of **material storage** in **majority of hospitals.**

❑ OBJECTIVE OF INVENTORY CONTROL

1. To **supply drug in time.**
2. To **reduce investment** in inventories and **made effective** use of **capital investment.**
3. **Efforts** are made to procure goods at **minimum price** without **bargaining the quality.**
4. To **avoid stock** out and **shortage.**
5. **Wastage are avoided**

METHODS USED FOR THE ANALYSIS OF THE DRUG EXPENDITURE

(i) ABC analysis
(ii) VED analysis
(iii) EOQ
(iv) Lead time
(v) Buffer stock

(i) ABC ANALYSIS

- This **technique divides** inventory into **three categories A , B and C** based on **cost of material** and **annual consumption** value.
  - ✓ **A item 10%** of total items which have the **highest rupee** percentages, require proper **storage and handling , over stocking** should be avoided
  - ✓ **B item – 20%** of all items with the next **highest rupee percentages.**
  - ✓ **C item – 70%** of all item with the **lowest rupee percentages.**a

✓ **Advantages**

- **Gives rewarding** results quickly
- Helps to point out **obsolete stocks easily**
- In case of **A items careful attention** can be paid at every step such as **estimate of requirements** , **purchase** , **safety stock** , **receipts** , **inspections** , issues , etc and close control is maintained
- Helps **better planning** of **inventory control**
- **Provides sound basis** for allocation of **funds and human resources.**

✓ **Disadvantages**

- **Proper standardization** and codification of **inventory control** items needed
- Considers only **money value** of items and **neglects the importance** of items for the **production process** or assembly or functioning.

2. VED (VITAL , ESSENTIAL AND DESIRABLE) ANALYSIS

- It is based on **utility of material**, **importance of item** and its effect on the **functioning and efficiency** of a hospital

✓ **Vital items**

- Its shortage may cause **havoc & stop** the work in **hospital/ward/patient care.**
- They are **stocked adequately** to ensure **smooth operation.**

✓ **Essential items**

- Here, **reasonable risk** can be taken. If not available, the work does not stop; but the **efficiency of functions** in **hospital/ward/patient care** is **adversely affected** due to **expediting expenses.**
- They should be **sufficiently stocked** to ensure **regular flow of work**

✓ **Desirable items**

- Its **non availability** does not stop the work because they can be **easily purchased** from the **market as & when needed.**
- They may be **stocked very low** or not stocked.

3. ECONOMIC ORDER QUANTITY

- Economic order quantity or fixed order quantity system is the technique of ordering materials whenever stock reaches the reorder point.
- It includes ordering cost and carrying cost.
- Ordering cost – It is the cost of ordering the item and securing its supply
- It includes expenses from raising the indent , purchase requisition by user department till the execution of order , receipt and inspection of material.
- Inventory carrying costs
- Costs incurred for holding the volume of inventory , insurance cost , storage and handling cost
- Can be calculate by tabular method.

4. LEAD TIME

- The lead time is the sum of the supply delay and the reordering delay.
- The lead time is the applicable duration to calculate the lead demand, the safety stock or the reorder point through a direct quantile forecast.
- The longer the lead time, the higher the total inventory level or the larger is the safety stock, resulting in excess of investment in inventories.
- As far as possible efforts should be made to decrease the lead time for effective inventory control.

5. BUFFER STOCK

- Buffer stock is used in emergency to meet the unforeseen demands, in other words it refers to minimum quantity of a particular item which must be kept in the stores of all time.
- Buffer stocks can be calculated using the following formula
- Buffer stocks= (Maximum consumption rate / day average-consumption rate / day)X lead time
- Buffer stocks needs following factors to be taken into consideration like;
    - (i) Lead time
    - (ii) Nature of item and rate of consumption
    - (iii) Availability of substitutes
    - (iv) Re-order level
    - (v) Stock out cost

REORDER QUANTITY LEVEL

- It is based on the average time taken by the supplier for replenishment, maximum usage of the item during the replenishment time, and safety stock requirement.
- It is also known as reorder point.
- Reorder level is the stock level of a particular item of inventory, at which a firm needs to place an order for the fresh supply or replenishment of the item.
- It gives a signal regarding when to place a new order for the fresh supply of an inventory item.
- Whereas the external factor involved in reorder level is lead time taken by the supplier.
- The main risk factor in reorder level is being out of stock and some other risk factors are disruption in production and foregone sales.
- The following formula is used for estimation of reorder level
- Reorder level = (Average daily usage rate x Average lead time in days) + Safety level.

INVESTIGATIONAL USE OF DRUGS

Points to be covered in this topic

- INTRODUCTION
- PRINCIPLE
- CLASSIFICATION
- CONTROL
- ROLE OF HOSPITAL PHARMACIST
- ADVISORY COMMITTEE

INTRODUCTION

- Any **drug or placebo** which is being **tested or used** as a reference in a **clinical trial**, including a **registered drug** used in a **different formulation**, or used for an **unapproved indication**, or used in doses outside the **approved range** is called as **investigational drugs.**
- **Hospitals** and other **healthcare agencies** are the **major centers** for **clinical studies** with **investigational drugs** and **pharmacists** in these institutions should be involved with **policies and procedures** for the safe and **ethical use of these drugs**

PRINCIPLE

- By **definition** these are drugs which have not yet been released by the Federal Food and Drug Administration for **general use.**
- Since **investigational drugs** have not been **certified as being** for **general use** and have not been cleared for **sale in interstate** commerce by the Federal **Food and Drug Administration**, **hospitals** and their **medical staffs** have an **obligation** to their patients to see that proper procedures for their **use are established.**
- **Procedures** for the **control of investigational drugs** should be based upon the following principles.

1. **Investigational drugs** should be used only under the **direct supervision** of the **principal investigator** who should be a member of the **medical staff** and who should assume the **burden of securing** the **necessary consent.**
2. The **hospital should** do all in its **power to foster** research consistent with **adequate safeguard** for the **patient.**

3. When nurses are called upon to administer investigational drugs, they should have available to them basic information concerning such drugs- including dosage forms strengths available, actions and uses, side effects and symptoms of toxicity etc.
4. The hospital should establish, preferably through the pharmacy and therapeutics committee, a central unit where essential information on investigational drugs is maintained and whence it may be made available to authorized personnel.
5. The pharmacy department is the appropriate area for the storage of investigational drugs as it is for all other drugs.

CLASSIFICATION

I. ON THE BASIS OF HOSPITAL RESEARCH PROGRAMME THE INVESTIGATIONAL DRUGS

(a) **CLASS A** - should contain all investigational use drugs that are in a preliminary experimental stage. The use of drug in this category is usually restricted to the principal investigator.

(b) **CLASS B** - should consist of investigational use drugs which have passed through the preliminary research stage. Usually, drugs in this category are supplied to the department of pharmacy by the principal investigator and are dispensed only upon his written prescription.

(c) **CLASS C** - is limited to drugs approved by the USP, NF or passed by the Federal FDA for commercial distribution. Drugs in this category may be used within the hospital or its clinics if the physician complies with some specific procedures

(d) **CLASS D** - drugs are preparations which have been accepted for use in the hospital and are listed in the hospital formulary.

II. ON THE BASIS OF HOSPITAL PHARMACY OPERATION

(a) GENERAL - An FDA-approved drug which as recommended as essential for good patient care with a well established usage, once accepted, may be prescribed by all members of the attending and house staff.

(b) CONDITIONAL – Certain drugs may be approved for a conditional period of trial. A drug approved by the FDA for general use, but which the Committee wishes to evaluate for given period before final consideration, may be prescribed by all members of the attending and house staff.

(c) INVESTIGATIONAL – Drugs which are not approved by the FDA for use other than under controlled clinical settings must be approved by the Research Advisory Committee. A protocol of any study involving drugs must be submitted to the pharmacy.

CONTROL

- All investigational drugs should be registered with the Pharmacy and Therapeutics Committee.
- This may be accomplished by a letter from the principal investigator, which provides the following information
  1. New drug number
  2. Generic name
  3. Manufacturer
  4. Chemical Name
  5. Proprietary name
  6. General Chemistry
  7. Pharmacology
  8. Toxicology
  9. Dose Range
  10. Method of Administration
  11. Antidote
  12. Therapeutic use.

❑ THESE FORMS ARE USUALLY TITLED

1. **Physician's Data Sheet on Investigational Drugs**
2. **Nurse's Data Sheet on Investigational Drugs**
3. **Pharmacist's Data Sheet on Investigational Drug**

1. PHYSICIAN'S DATA SHEET

- The **Physician's data** sheet must contain **following information:**
  - ✓ Name of the **Investigational Drugs**
  - ✓ **Manufacturer** or other source
  - ✓ **Strength** and Form of Investigational Drug
  - ✓ **Amount Received**
  - ✓ **Date Received**
  - ✓ Control or Batch
  - ✓ **Pharmacologic and Therapeutic Properties,** Dosage, Precautions
  - ✓ **Arrangements** which have made for its administration
  - ✓ Signature of Investigator

2. NURSE'S DATA SHEET

- The **Nurse's data sheet** must contain following information:
  - ✓ Name of the **Investigational Drugs**
  - ✓ **Manufacturer** or other source
  - ✓ **Strength and Form** of Investigational Drug
  - ✓ **Pharmacologic** and **Therapeutic Properties, Dosage, Precautions** to be observed
  - ✓ Arrangements which have **made for its administration**
  - ✓ Signature of **Nursing In-charge**

3. PHARMACIST'S DATA SHEET

- The Pharmacist's data sheet must contain following information:
  - ✓ Investigational Drug
  - ✓ Manufacture
  - ✓ Chief Investigator
  - ✓ Date
  - ✓ Physician
  - ✓ Patient
  - ✓ Rx.
  - ✓ Amount
  - ✓ Ward
  - ✓ Signature of Chief Pharmacist

❑ IDENTIFICATION OF INVESTIGATIONAL USE OF DRUGS

- Whenever Class A or class B drugs are dispensed from the pharmacy, they should be labeled in such a manner as to differentiate them from routine prescription drugs.
- In some hospitals, investigational use drug labels are printed in red ink on white paper stock.
- In addition to commonly required information are
  - (i) Patient's name
  - (ii) Data
  - (iii) Prescription number
  - (iv) Doctor's name and
  - (v) Directions for use
  - (vi) A space for the research drug number is provided.

ROLE OF HOSPITAL PHARMACIST

- Assisting in the development of the study design
- Acting as an impartial collaborator
- Collecting , storing and distributing essential information concerning the drugs being studied
- Packing and labelling investigational drugs in multiple or unit dose containers
- Preparing dosage forms
- Dispensing of investigational drugs to both inpatients and outpatients.

ADVISORY COMMITTEE

- The Pharmacy and Therapeutic Committee (PTC)
- FDA advisory committee system

1. THE PHARMACY AND THERAPEUTIC COMMITTEE (PTC)

- The PTC is a group of persons which formulate policies regarding evaluation and therapeutic use of investigational drugs.
- This committee is composed of Physicians, Pharmacist, and other health professionals with the inclusion of the medical staff.
- It looks after the safety in handling and administering the investigational drug.
- It also plays a vital role in monitoring adverse drug reaction

2. FDA ADVISORY COMMITTEE SYSTEM

- FDA advisory committee provides technical assistance related to the development and evaluation of investigational drugs, biologics, and medical devices.
- It also lends credibility to its decisions and decision-making processes, and provides a forum for public discussion of certain controversial issues.

INTERPRETATION OF CLINICAL LABORATORY TESTS

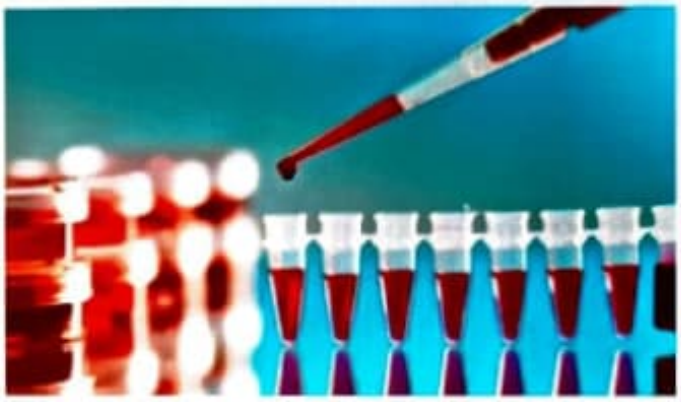
Points to be covered in this topic

- INTRODUCTION
- BLOOD CHEMISTRY
- HEMATOLOGY
- URINALYSIS

INTRODUCTION

- **Clinical laboratory** test results are a very important parameter in **diagnosis monitoring** and **screening.**
- **70 – 80 %** of **decisions** in **diagnosis** are based on **laboratory results** and more **laboratory analyses** are requested.
- Thus a **lot of data** are provided and that is therefore **imperative** for **patient care** that the **clinicians are familiar** with the tests and with **interpretation** of the results.

BLOOD CHEMISTRY



- **Blood chemistry tests** are blood tests that **measure amounts** of certain chemicals in a **sample of blood.**
- They show how well **certain organs** are **working** and can help **find abnormalities.**
- They measure **chemicals** including **enzymes, electrolytes, fats** (also called lipids), **hormones, sugars, proteins, vitamins** and **minerals.** Often several chemicals are grouped together and **measured** at the same time.

❑ REASON FOR CONDUCTING BLOOD CHEMISTRY TESTS

- An **unusual** (higher or lower than normal) amount of a **substance present** in the **blood** can be a **sign of disease** in the **organ or tissue** that makes it.
- They are **often done** as part of a **routine checkup**, but can be done at any time.
- **Learn information** about your **general health.**
- Check how **certain organs** are **working,** such as the **kidneys, liver** and **thyroid.**
- Check the **body's electrolyte balance.**
- Help **diagnose diseases** and **conditions.**
- Provide the **levels of chemicals** (a baseline) to compare with future **blood chemistry tests**
- Check how a treatment is **affecting certain organs.**
- **Monitor cancer** or another condition

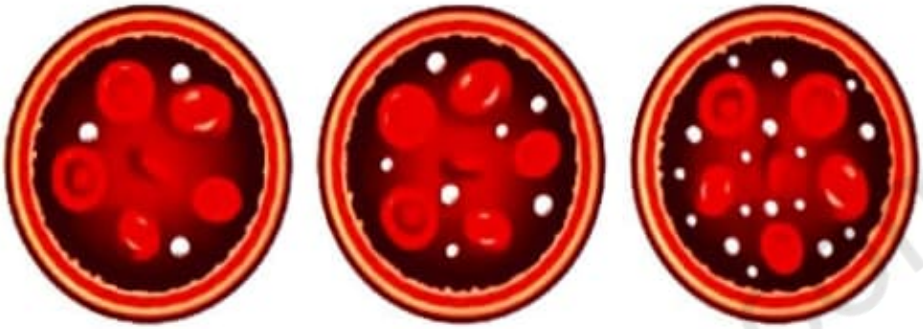
❑ COMMON BLOOD CHEMISTRY TESTS

❖ BASIC METABOLIC PANEL (BMP)

- The **BMP provides** information on **blood sugar** (glucose) level, the **balance of electrolytes** and **fluids**, and the **function of the kidneys**.

❖ BLOOD GLUCOSE LEVEL

- This test is **conducted** to screen for and **diagnose diabetes** and **prediabetes** and to monitor for **high blood glucose** (hyperglycemia) or **low blood glucose** (hypoglycemia).

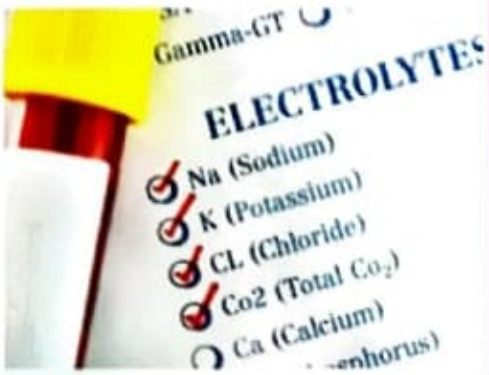


❖ BLOOD CALCIUM LEVEL

- This test **measures the amount** of calcium in the **blood or urine**, which **reflects the amount** of total and **ionized calcium** in the **body.**

❖ AN ELECTROLYTE PANEL

- It is **helpful for detecting a problem** with the **body's fluid** and **electrolyte balance.**
- The **electrolyte panel** measures the levels of the **main electrolytes** in the body such as **sodium, potassium, chloride, magnesium, phosphate and bicarbonate etc.**



❖ KIDNEY FUNCTION TEST/ RENAL PANEL

- **Waste product** (urea) filtered out of the blood by the **kidneys;** as **kidney function decreases, BUN level rises.**

- This test is **conducted to evaluate** the health of the **kidneys**; to help **diagnose kidney** disease; to monitor the **effectiveness of dialysis** and other treatments related to **kidney disease or damage.**

HEMATOLOGY

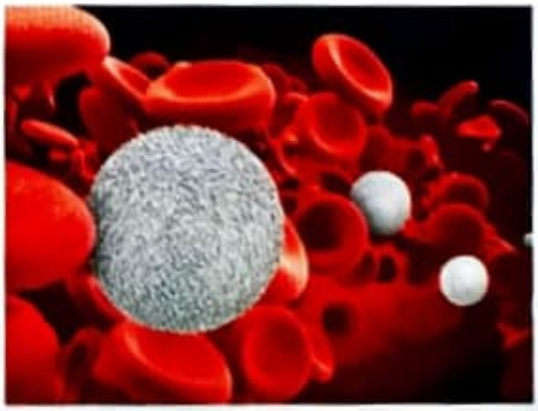
1. ERYTHROCYTES (RED BLOOD CELLS)

- Total **RBC count** of blood is expressed as number of **cells per mm^3.**

❖ **Significance**

- A **relative or absolute** increase in the number of **circulating R.B.C.**
- Leads to **polycythaemia** (erythrocytosis) and is observed in various **pathological conditions** like **chronic heart disease, cholera, burns.**
- A decrease in **number of R.B.C.** is observed in **pregnancy anaemia** etc

2. LEUCOCYTES (WHITE BLOOD CELLS)



- The **total leucocytes** count is expressed as number of **W.B.C.** in a **cubic mm** of **whole blood.**

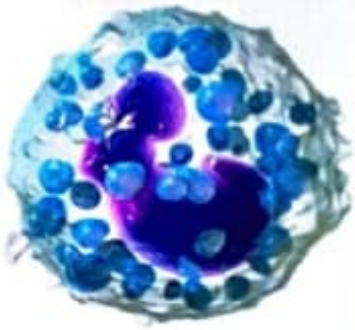
❖ **Significance**

- An **Increase in W.B.C's** indicates an infection like **bacterial infection, fever, tonsillitis, diptheria, smallpox,** cold, etc.

- **Physiological leucocytosis** (increase W.B.C count) is observed in **pregnancy, newborn infants, emotional disturbances, menstruation,** fear etc.
- **Great increase** shows leukaemia.

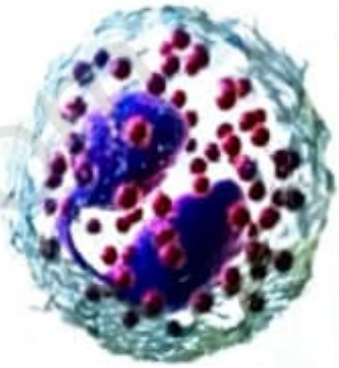
❖ **W.B.C. Differential analysis**

(i) Basophils



- An increase in **basophil number** is indicated in **various pathological conditions** like **mumps, chickenpox, viral hepatitis, tuberculosis, pertusis, granulocytic leukaemia, lymphocytic leukaemia, breast cancer.**

(ii) Eosinophils



- Increase in **eosinophils** (Eosinophilia) is indicative of **allergic disorders** (bronchial asthama, eczema, food allergy), **skin diseases** (pruritis, leprosy, exfoliative dermatitis), **cholera, scarlet fever, tumours** of **ovary and uterus, ulcerative colitis,** etc.

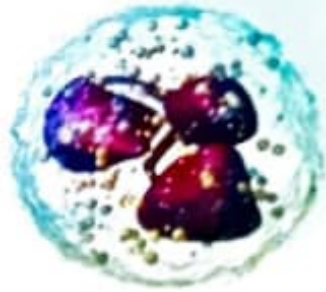
(iii) Monocytes

- These are **phagocytic cells.**
- A marked increase in **monocytes** (Monocytosis) is found in **tuberculosis, monocytic leukemia, ulcerative colitis, malaria** and various **bacterial infections.**

(iv) Lymphocytes

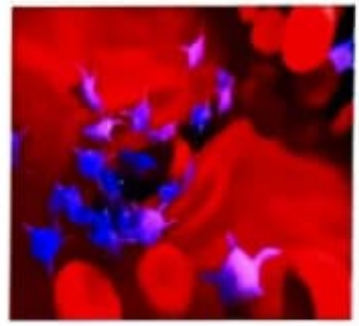
- **Lymphocytosis** (increase in lymphocytes) is observed in children with **viral infection** (measles and mumps), **whooping cough.**
- Other **pathological conditions** are **syphilis, tuberculosis, breast cancer,** etc

(v) **Neutrophils**



- **Neutrophils leukocytosis** (an incrase in neutrophil) is seen in **rheumatic fever, rheumatoid arthiritis, gout, myocardial infraction, gangrene,** etc

3. THROMBOCYTES (PLATELETS)



- **Platelets** are **very small bodies** (3μ diameter).
- They play a **vital role** in **blood coagulation.**

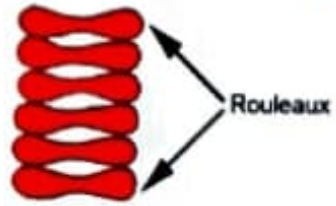
❖ **Significance**

- **Thrombocytosis** (increase in number of thrombocytes) is observed in various conditions like **tuberculosis, cirrhosis** of **liver, acute haemorrhage , iron deficiency anaemia, Hodgkin's disease**

4. HAEMOGLOBIN

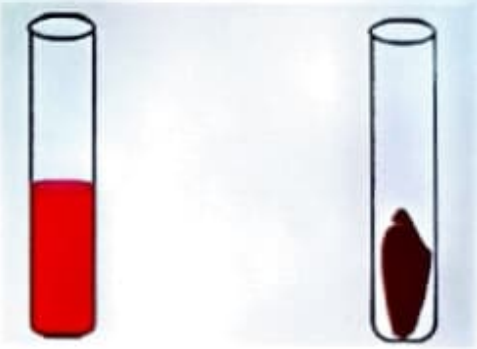
- Haemoglobin gives the idea of **oxygen carrying** capacity of **red blood cells.**
- **Anaemia** is the condition where the **haemoglobin percentage** is low.
- They are above **normal in dehydration** and **polycythaemia.**

5. E.S.R. OR ERYTHROCYTE SEDIMENTATION RATE



- In this **erythrocytes** (RBC's) are allowed to **settle in whole blood** under the **force of gravity** over a **period of time** (usually 1 hr).

6. CLOTTING TIME OF BLOOD



- It is the **time required** for **coagulation of blood**, where **fibrinogen is converted** into **fibrin** to form **matrix for fixation** of **cellular portion.**
- **Normal range** of **whole body clotting** time is **4-9 minutes** at 370C.

❖ **Significance**

- It is used to **diagnose haemophilia**, **Vitamin K deficiency anaemia**, **leukaemia**, **obstructive jaundice** etc.

URINALYSIS

Abnormal constituents appear in the **urine sample** whenever there is **pathological condition** of the body.

❖ Abnormal constituents of urine and the disorders.

SN	ABNORMAL CONSTITUENTS	DISORDER
1	Sugar (glucose)	Diabetes mellitus, endocrine disorder
2	Proteins (Albuin) Normal (50-80 mg/mL)	If albumin present in urine, It can be due to kidney damage
3	Bile pigments like bilirubin	Jundice
4	Ketone bodies	Diabetes mellitus, starvation, ketosis
5	Blood cells	Haematoria, T.B, cancer, Acute inflammation of urinary organ, haemolysis

❖ List of various physical examinations of urine, their normal values and associated disorders

TEST	NORMAL VALUE	RELATED DISORDER
Volume	700-2500 ml	Increase in polyurea, diabetes mellitus, diabetes insipidus, Decrease in diarrhoea
Appearance	Clear form, Colour ranges pale yellow to deep gold	Red color indicates the presence of blood, yellow with tetracycline, It becomes cloudy due to presence of pus or phosphate
Specific gravity	Normal range is 1.003 to 1.025	Increase in Diabetes mellitus, Nephrosis Decrease in Diabetes insupidus
pH	4.5-9.0 is the normal value (Acidic)	Alkaline pH shows alkalosis or use of certain drug