Samples Collection in Clinical Chemistry laboratory

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Introduction

- Clinical chemistry laboratories perform **qualitative** and **quantitative** analyses of body fluids to support **diagnosis**, **monitoring**, **prognosis** and **screening** of a wide range of health conditions and diseases."
- **Proper sample collection** (handling, labeling, processing, storage, and transport) is crucial to ensure accurate results.

Principle functions of biochemical tests

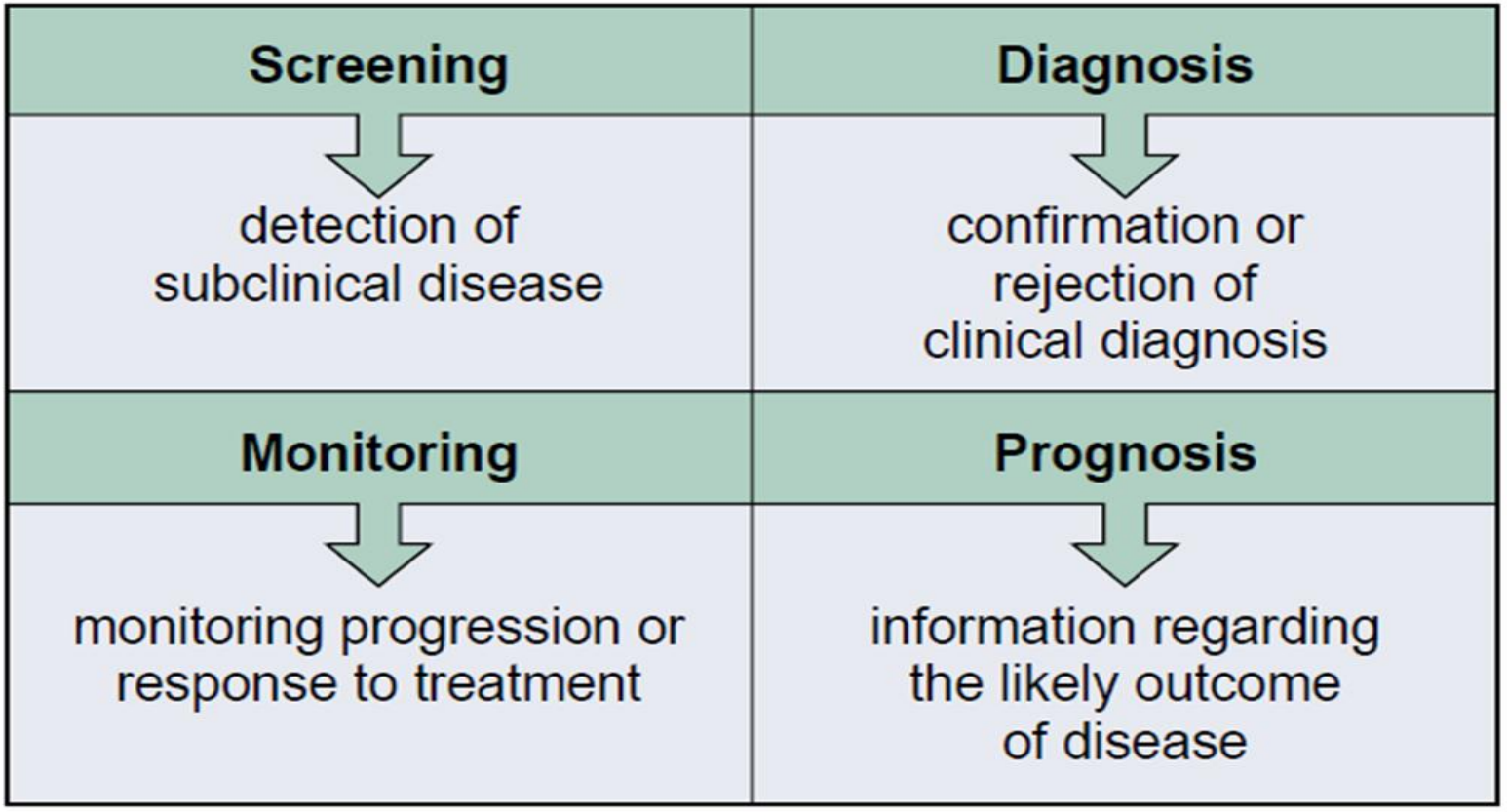


Fig. 2.1 Principal functions of biochemical tests.

Types of Samples in Clinical Chemistry lab

Clinical chemistry investigations can be performed on different types of **body fluids**, including:

1. **Blood** – the most commonly used sample.
2. **Urine** – essential for kidney and metabolic studies.
3. **Cerebrospinal Fluid (CSF)** – used for neurological and infectious disease evaluation.
4. **Synovial Fluid** – important in joint disease assessment.
5. **Amniotic Fluid** – used in prenatal and genetic testing.
6. **Other Fluids** – such as saliva, pleural fluid, and seminal fluid, depending on the test.

There are other type of samples such as **stool** or **solid tissue biopsy** which can be used in different aspects of clinical laboratory testing

Methods of Blood Collection

- Blood can be obtained through different techniques depending on the clinical purpose:
- **Venous Blood (Venipuncture):**
  - The **most common** method in clinical practice.
- **Arterial Blood:**
  - Mainly used for **arterial blood gas (ABG) analysis**
- **Capillary Blood (Skin Puncture):**

Venous Blood sampling

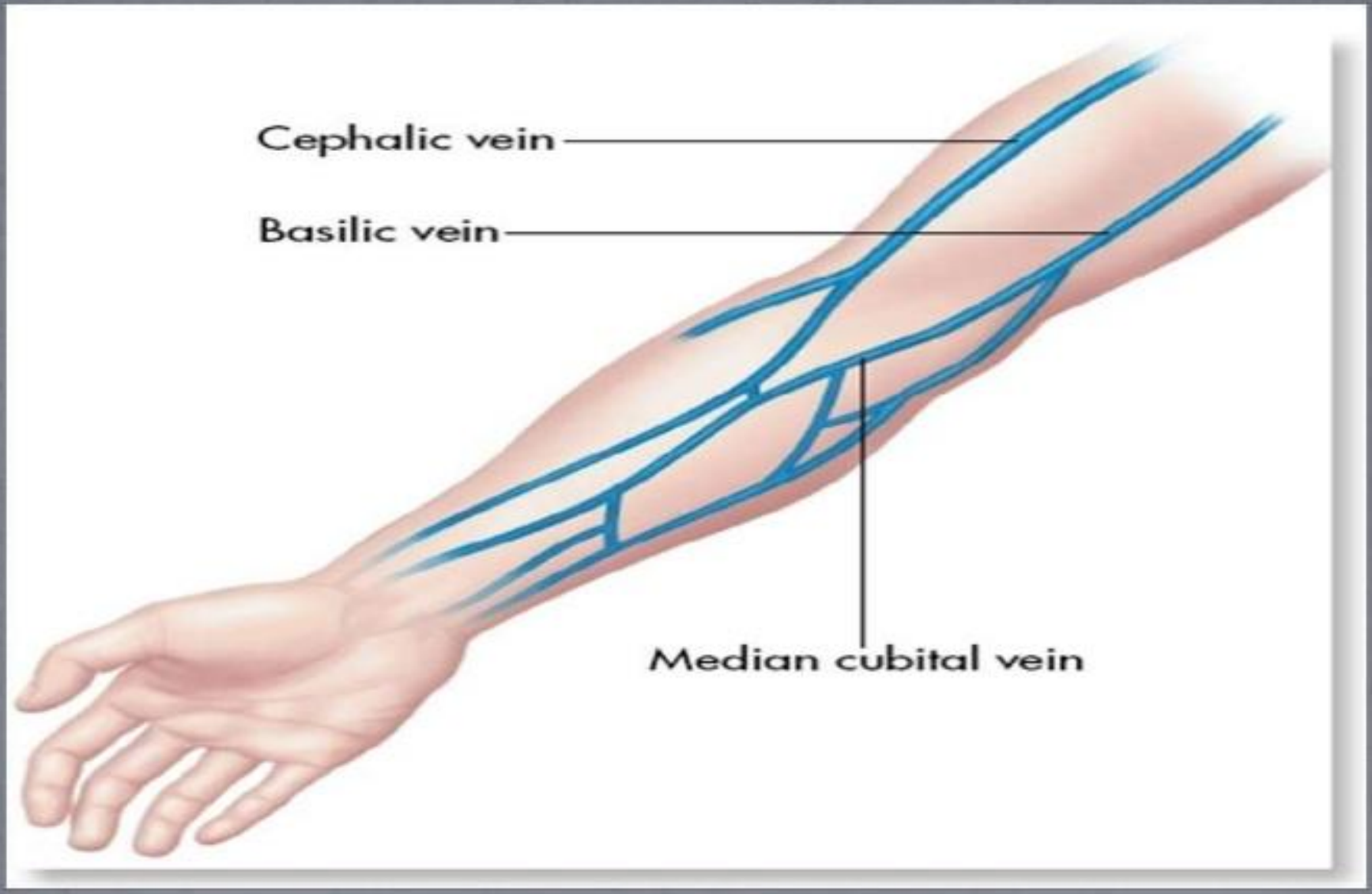
Most common routinely used method in clinical laboratory.
Venous blood (most common): drawn from a vein, usually the antecubital vein in the arm.

Common Sites:

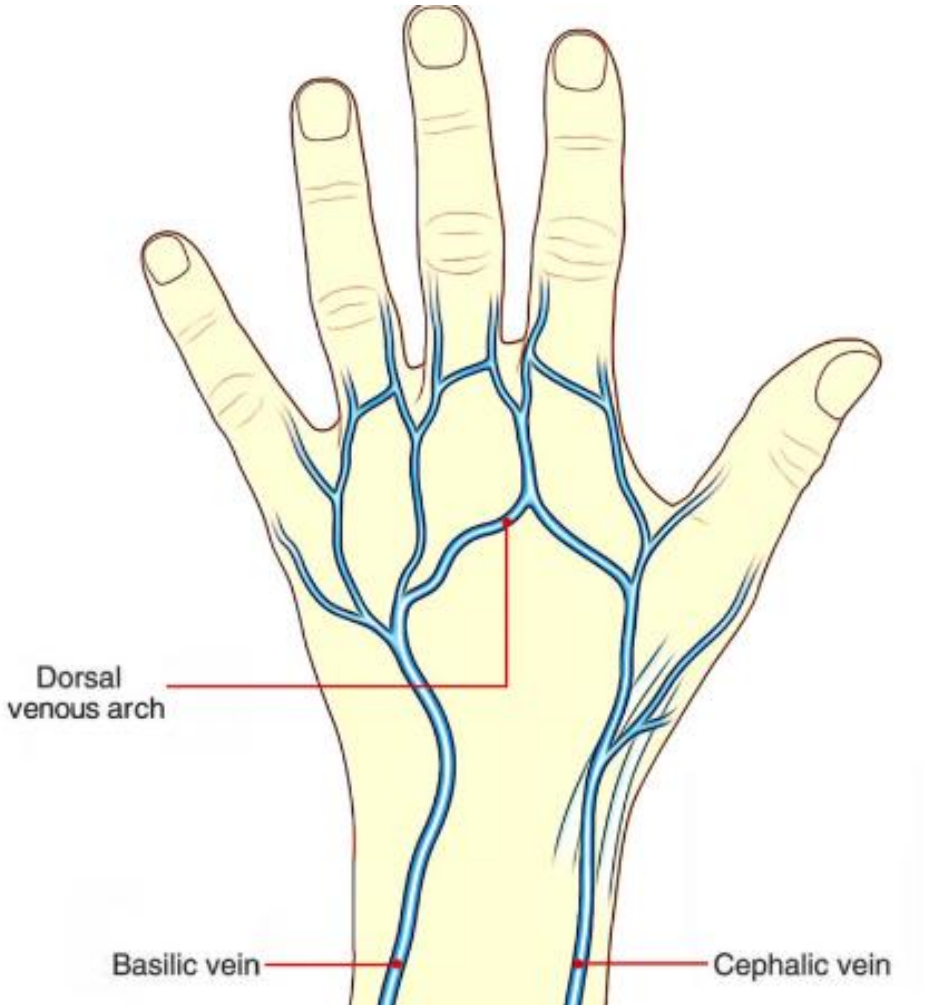
- Median cubital vein (**most common**)
- Cephalic vein
- Basilic vein
- Dorsal hand veins (alternative site)

Indications:

- Routine hematology and biochemistry tests
- Serology and immunology tests
- When larger volumes of blood are required



Common Sites for Venipuncture


Dorsal
venous arch
Basilic vein
Cephalic vein

Arterial Blood sampling

- Collection of blood directly from an artery, usually for assessing oxygenation and acid-base status.

Common Sites:

- Radial artery (most common)
- Brachial artery
- Femoral artery

Indications:

- Arterial blood gas (**ABG**) to measure O_2, CO_2, and pH levels, oxygenation status and assessment of acid-base balance (commonly used in respiratory care unit **RCU**)

Requires special care due to complications risk.

Capillary Blood (Skin Puncture):

Obtained from fingertip, heelstick (infants), or earlobe puncture..

• For children <1 year: heel prick is used instead of finger prick.

Indications:

- Point-of-care testing (glucose, hemoglobin, hematocrit)
- Neonatal screening tests
- When venipuncture is difficult or unnecessary (only a small amount of blood is needed)

Tools required for sample collection

Tools:

- Needle (different sizes)
- Blood tubes (color-coded)
- Syringe (if needed)
- Tourniquet (to see veins)
- Alcohol swab (to clean skin)
- Gloves
- Gauze / Bandage
- Sharps container (to throw away needles safely)

Patient preparation and identification

Preparation:

- Explain the procedure to reduce anxiety.
- Ensure the patient is comfortable and seated or lying down.
- Fasting if required for specific tests (e.g., glucose, lipid profile).Hydration: encourage water intake unless restricted.

Patient identification

Required Patient Information:

1. Full name
2. Medical record number
3. Date of birth or age
4. Room/bed (if inpatient)
5. Type of test requested
6. Date of test
7. Test status (timed, fasting, urgent, etc.)

Blood Sample Collection Process (Phlebotomy)

The process of collecting blood samples (**Phlebotomy**) includes the following steps:

- Ensure patient is at rest. Position arm straight
- Position arm straight, tourniquet is applied about 4 inches (10 cm) above the intended puncture site, A tourniquet should be applied for **no longer than one minute.**
- Disinfect collection site with 70% isopropanol in circular motion from the site outward
- Insert the needle bevel up at ~15-30° angle into site of collection.
- Avoid forcing blood into tube (prevents hemolysis).
- Label tubes at the bedside with patient ID, date, and time.
- Ensure proper transport to the lab.
- Dispose of needle and sharps into a sharps container.

Clinical notes during phlebotomy

❖ Prolonged torniquet application can alter blood test results:

- Increases potassium, protein, and hematocrit.
- Can cause hemoconcentration.

❖ An arm with an inserted intravenous (IV) line should be avoided, as should an arm with extensive scarring or a hematoma at the intended collection site

❖ If fluid is being infused intravenously into a limb, the fluid should be shut off for 3 minutes (with clinician consent). Specimens obtained from the opposite arm are preferred or specimens below the infusion site in the same arm

❖**Hemolysis**: Rupture of red blood cells in the sample.

- Causes: Rough handling, prolonged tourniquet, small needle, shaking tubes.

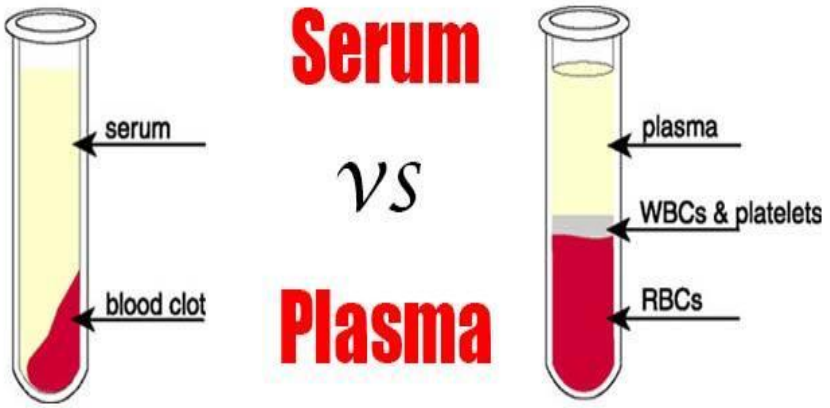
- Effect: Falsely increases potassium, LDH, AST, and other intracellular analytes.

Types of Blood Samples

- **Whole Blood**: Blood collected directly from a vein or capillary with anticoagulant. Contains all components: red cells, white cells, platelets, and plasma. Used for CBC, hematology tests, and some special assays.
- **Plasma:** Blood collected in a tube with anticoagulant and centrifuged. Liquid portion of blood that still contains clotting factors and fibrinogen. Used for **coagulation tests** and some biochemistry assays and when rapid results needed in emergency situations.
- **Serum:** Blood allowed to clot and then centrifuged. Liquid portion of blood without clotting factors and fibrinogen. Used for biochemistry, serology, and immunology tests.

Plasma vs. Serum

- **Serum**: obtained after blood clots and centrifugation.
- **Plasma**: obtained by centrifugation of anticoagulated blood.
- **Plasma contains fibrinogen and clotting factors; serum does not.**
- Test requirements vary (serum, plasma, c whole blood).

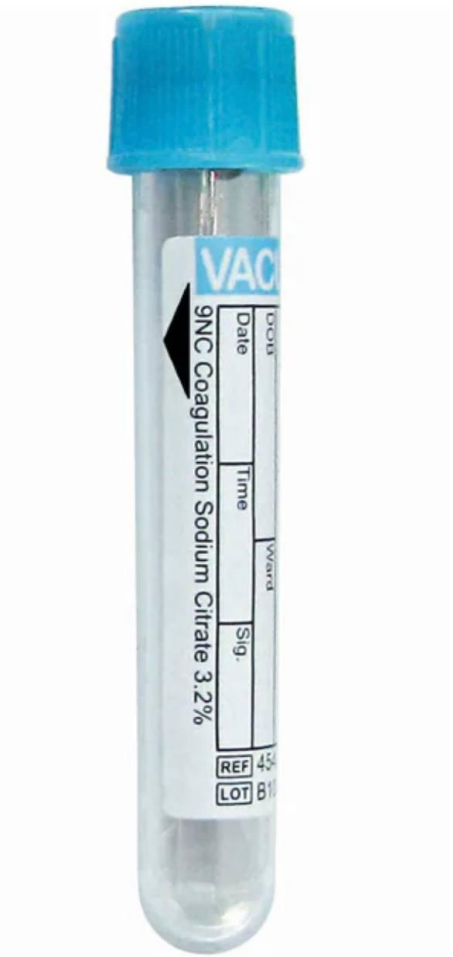


Serum = Plasma – Clotting Factors

Type of sample collecting tubes

- **EDTA Tube (Lavender/Purple top)Anticoagulant:** *Ethylenediaminetetraacetic acid (EDTA).*
- **Anticoagulant**: contains K3-EDTA as an anticoagulant
- **Mechanism**: chelates calcium (prevents clotting).
- **Uses**: Hematology tests → CBC, blood film, HbA1c.
- Not used for calcium or potassium (K) measurement (interferes with results by lowering calcium and increasing potassium).

- **Citrate Tube (Light Blue top)Anticoagulant:**
- **Anticoagulant:** *Sodium citrate.*
- **Mechanism:** Binds calcium in a reversible way.
- **Uses:** Coagulation studies → PT, aPTT, INR, D-dimer.



Heparin Tube (Green top)

- **Anticoagulant:** Sodium, lithium, or ammonium heparin.
- **Mechanism:** Inhibits thrombin and other clotting factors.
- **Uses:** Plasma chemistry tests, blood gases, electrolytes.

Oxalate/Fluoride Tube (Gray top)

- **Anticoagulant:** Potassium oxalate (anticoagulant) + Sodium fluoride (glycolysis inhibitor).
- **Uses:** Glucose measurement, lactate levels.

- **Yellow-top gel tube (serum separator):**
- **No anticoagulant** is present in the tube; it contains a serum separator gel.
- During centrifugation, this gel moves up to the interface between serum and clot, forming a separator layer
- This tube is used for collecting serum and this is **the most common tube used in clinical chemistry**

Good luck