Symbols & abbreviations

↓	decreased
↑	increased
↔	normal
Ab	antibody
ABGs	arterial blood gases
ACE	angiotensin converting enzyme
ADH	antidiuretic hormone
ADP	adenosine 5-diphosphate
Ag	antigen
AKA	alcoholic ketoacidosis
ALP	alkaline phosphatase
ALT	alanine aminotransferase
ATP	adenosine triphosphate
BBB	blood–brain barrier
BM	bone marrow
BP	blood pressure
Bx	biopsy
CBC	complete blood count
CK	creatine kinase
CL^-	chloride
CRF	chronic renal failure
CRP	C-reactive protein
CSF	cerebrospinal fluid
DCCT	Diabetes Control and Complications Trial
DCT	direct Coombs' test
DM	diabetes mellitus
DNA	deoxyribonucleic acid
EDTA	ethylenediamine tetraacetic acid
ELISA	enzyme-linked immunosorbent assay
Epo	erythropoietin
ESR	erythrocyte sedimentation rate
FPG	fasting plasma glucose
GAD	glutamic acid decarboxylase
γ-GT	γ-glutamyl transpeptidase
GBM	glomerular basement membrane
G6PD	glucose-6-phosphate dehydrogenase
h	hour
HAV	hepatitis A virus
Hb	haemoglobin
HbA	haemoglobin A ($\alpha 2_\beta 2$)
HbA1c	haemoglobin A1c
HbA2	haemoglobin A2 ($\alpha 2^\delta 2$)
HbF	haemoglobin F (fetal Hb, $\alpha 2_\gamma 2$)
HbH	haemoglobin H ($_\beta 4$)
HBsAg	hepatitis B surface antigen
HBV	hepatitis B virus
hCG	human chorionic gonadotropin

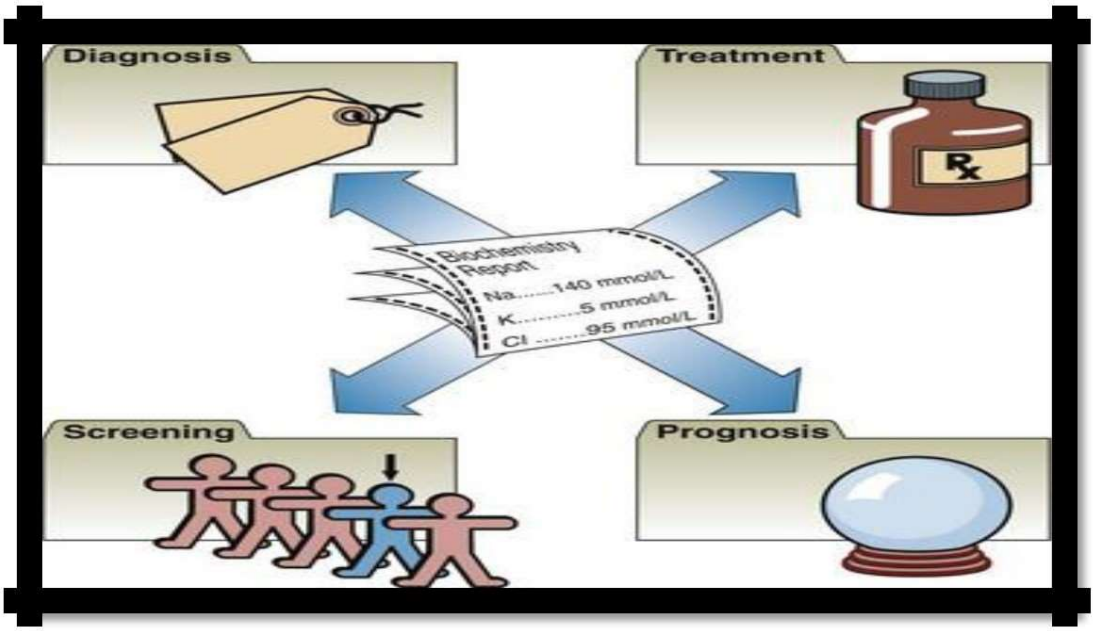
$HCO3^-$	bicarbonate
HCT	haematocrit
HCV	hepatitis C virus
HPLC	high-performance liquid chromatography
IGT	impaired glucose tolerance
Ig	immunoglobulin
IgA	immunoglobulin A
IgD	immunoglobulin D
IgE	immunoglobulin E
IgG	immunoglobulin G
IgM	immunoglobulin M
IM	intramuscular
iu/IU	international units
IV	intravenous
K^+	potassium
kDa	kilo Daltons
kg	kilogram
LDH	lactate dehydrogenase
LFTs	liver function tests
MCH	mean cell haemoglobin
MCHC	mean corpuscular haemoglobin concentration
MCV	mean cell volume
mg	milligram (10^{-3} gram)
µg	microgram (10^{-6} gram)
Na+	sodium
NaCl	sodium chloride
NADP	nicotinamide adenine diphosphate
NADPH	nicotinamide adenine diphosphate (reduced)
NAP	neutrophil alkaline phosphatase
OGTT	oral glucose tolerance test
PSA	prostate-specific antigen
PT	prothrombin time
PV	plasma volume
RBCs	red blood cells
RCC	red blood cell count
RDW	red cell distribution width
Rh	Rhesus
RhF	rheumatoid factor
RIA	radioimmunoassay
T°	temperature
t1/2	half-life
T4	thyroxine
TIBC	total iron binding capacity
TSH	thyroid-stimulating hormone
TT	thrombin time
UTI	urinary tract infection
WBC	white blood count *or* white blood cells
WHO	World Health Organization

Clinical chemistry (also known as clinical biochemistry , chemical pathology , medical biochemistry or pure blood chemistry)is the area of pathology .

The analysis of individual constituents proteins , enzymes , nutrients . waste products , metabolites , hormones, etc. in blood or body fluids that provides information regarding the function or integrity of a tissue , organ or organ system.

The clinical chemistry laboratory measures change in biochemical compounds as an indicator of health status or disease processes , because the biochemical changes of compounds are not uniform in tissue and organs in measurement of selected biochemical markers can be used to monitor disease .

The clinical chemistry laboratory provides accurate, precise measurements of selected biochemical markers ,accompanied by reference or comparison ranges of the concentration of these biochemical markers in health individuals.



How Biochemical Tests Are Used ?

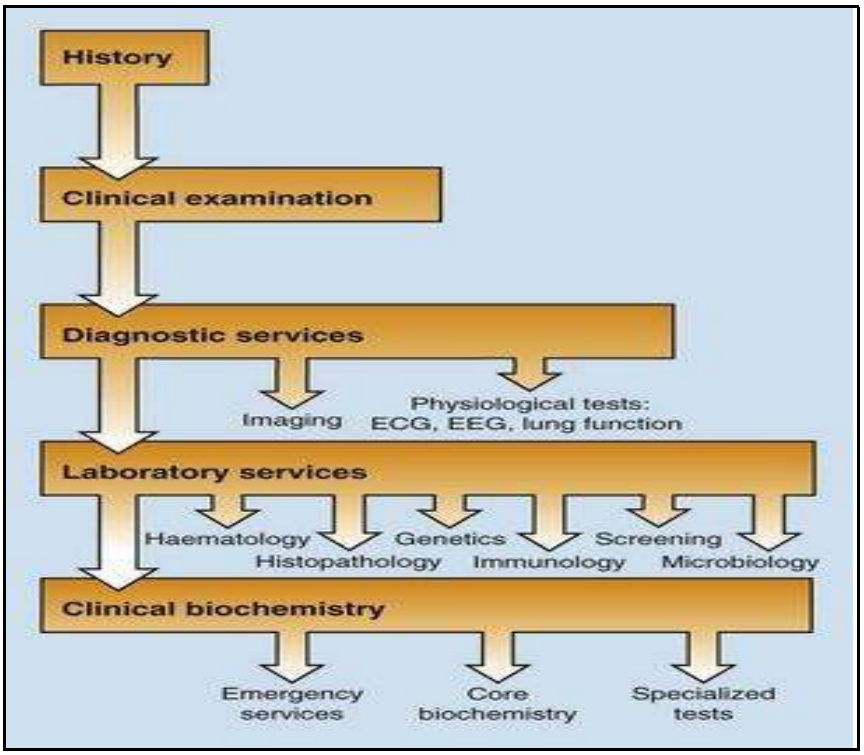
Four categories of organic biochemical markers are used for assessment and diagnosis of disease ; carbohydrates , lipids , proteins and nucleic acids and derivatives of these markers.

The assessment of inorganic chemicals , such as ions , minerals , and dissolved gases .

Steps in the investigation of a patient :

Patient history Physical Examination Laboratory test

Imaging techniques Diagnosis Therapy Evaluation



Analytical Procedures \ Methods

- Photometry
- Fluorometry
- Nephelmetry
- Electrophoresis
- Isotopic immunoassay
- Chromatography
- Spectrophotometry

Sampling Proper :

- Proper blood collection tube .
- Adequate volume .
- Labeled with :
    1. Patient name
    2. Age
    3. Department
    4. Date of specimen collection

All biochemical tests come under chemical pathology . these are performed on any kind of body fluid , but mostly on serum or plasma.

Serum : is the yellow watery part of blood that is left after blood has been allowed to clot and all blood cells have been removed.

Plasma : is essentially the same as serum , but is obtained centrifuging the blood **without clotting** . plasma therefore contains all of the clotting factors, including fibrinogen. Biological Specimens :

Blood , Urine , Cerebrospinal Fluid (comprise the majority of all specimens analyzed)

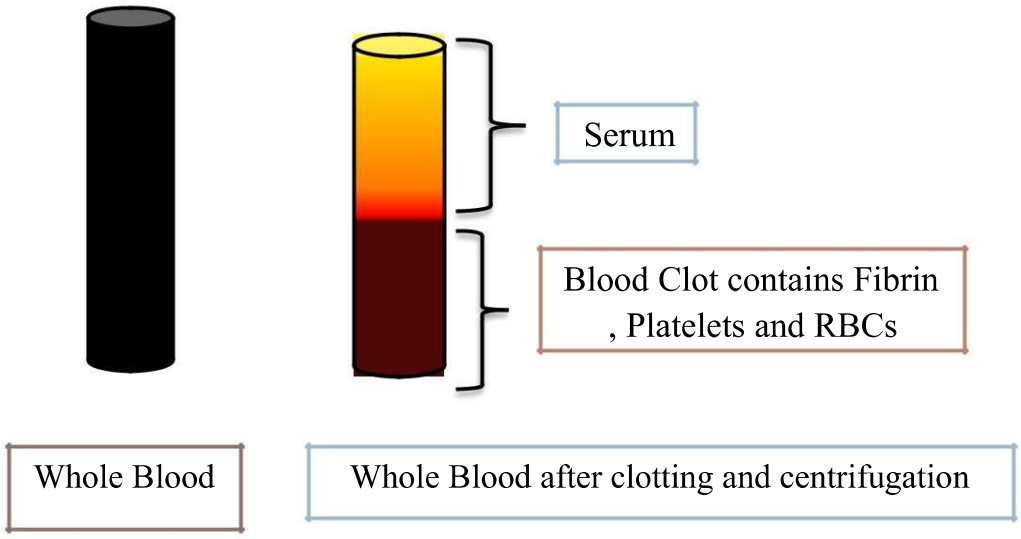
Gastric Juice , Gall stone , Kidney stone , Stools , Saliva , Synovial fluid , Tissue specimen .

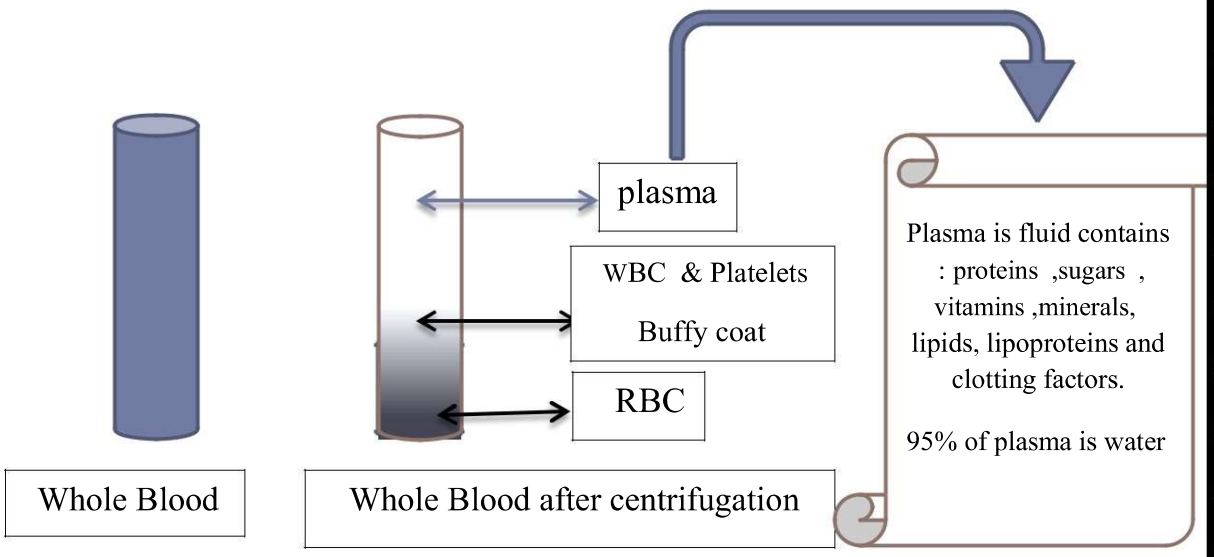
Choice of specimen type depends on :

- Analyze to be measured.
- Ease of collection.

MANY ARE CALLED , BUT FEW ARE CHOSEN !!!!

Blood Composition :





Collection Tubes :

The most widely used tubes for blood collection are evacuated tubes (Vacationers)

- Negative pressure facilitates collection .
- Easy to use .
- Sterile

Universally used colour-coded rubber stoppers to denote tube type , tubes can contain various anticoagulants for the collection of whole blood or plasma.

Types of Collection Tubes :

a) Red-top tubes contain no anticoagulants or preservatives.

b) Red-top tubes are used for collection serum (10-15 min is required to allow blood to clot before centrifuging)

c) Gold- top tubes contain a gel that forms a physical barrier between serum and clot .

d) Gray- top tubes used for glucose measurement and contain either :
   - Sodium fluoride and potassium oxalate , or
   - Sodium iodoacetate.

e) green-top tubes contain either the Na , K or Li salts of heparin . most widely used anticoagulant for chemistry tests.

f) Lavender -top tubes contain the K salt of EDTA , which chelates calcium and inhibits coagulation.

g) Blue-top tubes contain sodium citrate , which chelates calcium and inhibits coagulation

h) Brown-top tubes are specially cleaned for trace metal studies.

Special chemistry instrumentation and analytical methods :

Just about any analytical technique can be found in a special Chem Lab.

1) Electrophoresis
   - used to separate serum protein and lipoproteins .
   - used to separate isoforms of enzymes.
2) HPLC : used to measure vitamins and hemoglobin variants.
3) Infrared spectroscopy : used to analyze components of kidney stones.
4) Radioimmunoassay (RIA) : used less and less but still employed for those analysts present in minute amounts in the blood (i.e. : testosterone)
5) GC –MS (Gas chromatography – mass spectroscopy) and /or LC-MS (Liquid chromatography – mass spectroscopy) used for quantitative drug measurement.

Point of care testing (POCT):

Tests are of urgent importance and results will affect the immediate of the patient .

- ✓ Blood glucose.
- ✓ Urinalysis.
- ✓ Blood gases.
- ✓ Electrolytes.
- ✓ Cardiac markers (Troponin I & T).
- ✓ Drug screens.

EXAMPLES OF PHYSIOLOGICAL FACTORS AFFECTING THE RESULTS OF BIOCHEMICAL TESTS.

Factor	Test (all in serum or plasma)
Age	**Cholesterol, urate, ALP.**
Sex	**Gonadal steroids, gonadotropins, HDL_C.**
Body mass	**Triglycerides TG.**
Stress	**Cortisol, prolactin, growth hormone (G.H), catecholamine, glucose.**
posture	**Renin, aldosterone, plasma proteins.**
Food take	**Glucose, TG, phosphate.**

Sample integrity :

1. In patient receiving IV fluids or medication, use alternative arm to draw specimen .
2. Most blood constituents do not change significantly after eating (fasting for glucose, TG and cholesterol).
3. Collection timing is important for cardiac enzyme, some hormones, iron, and steroids.
4. Refrigerate samples if not tested within one hour .
5. Some enzymes required freezing after drawing to preserve activity.
6. Bilirubin is degraded by light.

Pre-analytical errors :

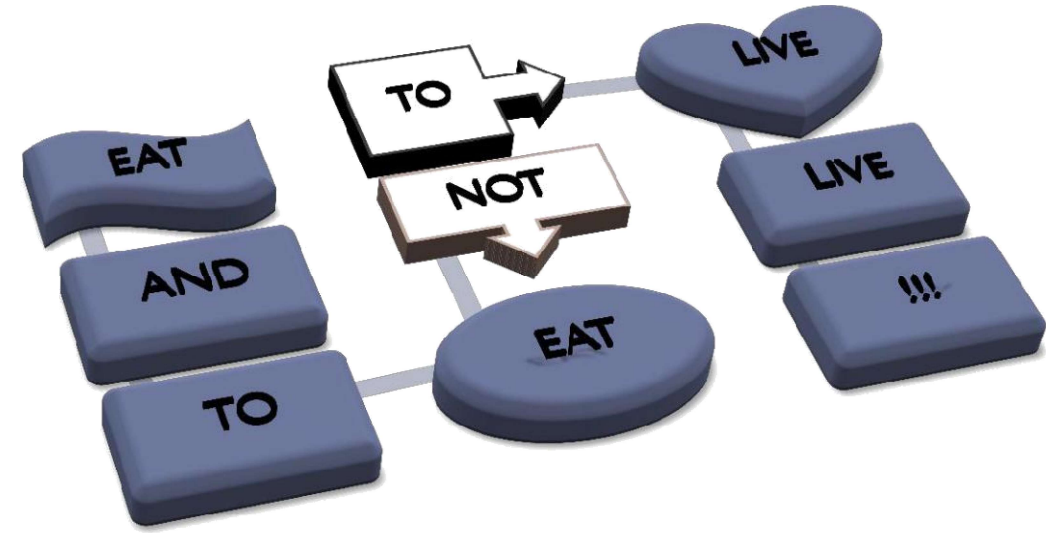
1. Collection
   - Was the right tube used?
   - Was venipuncture performed correctly
   - ? Was the specimen properly stored ?
2. Identification
   - Was the blood collected from the correct patient ?
   - Was the blood correctly labeled?

Is the patient supine , sitting or standing ?

- Going from lying (supine) to upright reduces total blood volume by about 700 ml.
- The following may decrease by 5-15 % in the supine patient :

- Total protein
- Albumin
- Lipids
- Iron
- Calcium
- Enzymes

- Blocking the flow of blood with the tourniquet with eventually lead to a sieving effect
  Small molecules, water and ions are forced out blood vessels and larger molecules are concentrated .
  - ✓ Increases total protein, iron, cholesterol and bilirubin.
  - ✓ Decreases potassium K^+.

Chemistry reagent Kits:

- Wide range of tests available .
- Most reagent are liquid stable and ready for use.
- Simple procedures and fast turn-around.