

Introduction

The definition of health includes a state of complete and perfect physical, mental, social and spiritual well-being and not just the absence of disease or infirmity and good health is a fundamental right of every living human being on earth.

A Clinical laboratory is a laboratory where tests are done on clinical specimens in order to get information about the health of a patient as pertaining to the diagnosis, treatment, and prevention of disease.

The clinician gives a patient hearing (if the patient is conscious) to his problems and symptoms and also takes note of various signs which he sees or elicits. Sometimes, he may immediately arrive at a diagnosis and may under emergency circumstances institute treatment at first instances. In most cases, However, he will have a differential diagnosis in mind and to arrive at a specific diagnosis he usually orders for a battery of tests.

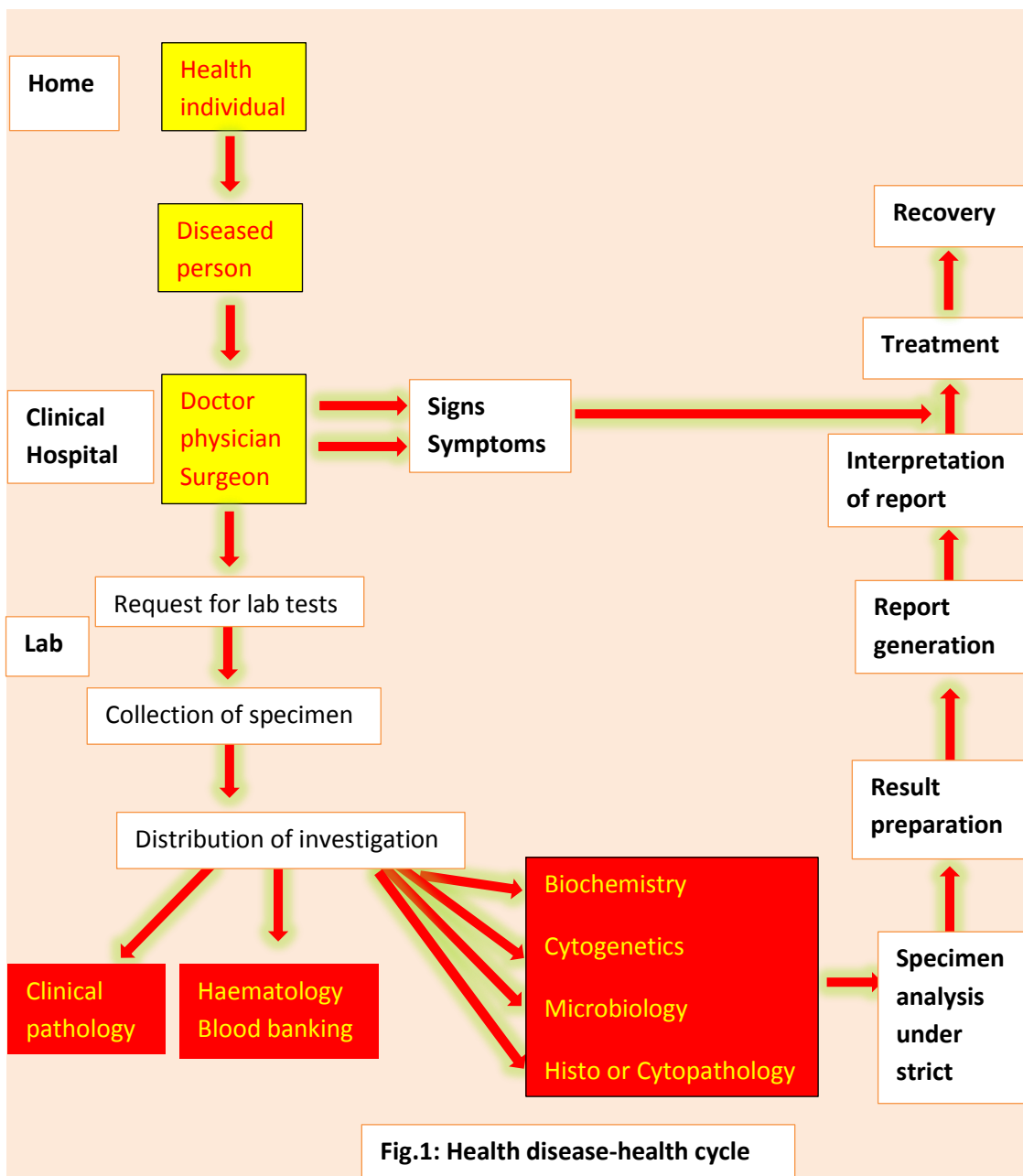
Various means of diagnosis are available:

- 1- **Most important:** Clinical laboratory tests which include any tissue or fluid obtained from the body.
- 2- **Imaging sciences:** X-rays, ultrasound, color Doppler, CAT scan, MRI scan and the latest PET scan.
- 3- **Direct visualization techniques:** with the availability of fibereopic-based technologies, the clinician is now capable of passing small tubes (called **scopes**) through natural passage ways of the human body (without actually surgically opening up the par), e.g. gastroscopy, cystoscopy, etc. These techniques, eventually culminate in taking small tissue samples (**biopsies**) which are sent to histopathology laboratories.

A clinical laboratory can be manned by a qualified **doctor specializing** in clinical pathology, biochemistry, immunology, blood banking, histopathology, cytopathology, hematology, microbiology or cytogenetic. The pathologist is usually assisted by **laboratory technicians** or

technologists (they are also qualified for the job) and lastly the **cleaning and documentation staff**. Only by collective efforts of the individuals mentioned above, a proper report can be generated. Be grateful to the clinician for having faith in you and give back nothing except an accurate and correct timely report. A delayed report may at times be too late. The patient may have lost his life by then. A timely correct report is the essence of running a good laboratory.

The cycle of health-disease with all intermediaries is given below. Just as there are primary, secondary and tertiary health centers, there are also the primary, secondary and tertiary laboratories too.



Primary Laboratory

A primary laboratory may provide only the basic investigations. These investigations are simple to perform and do not involve expensive machinery usage. Such laboratories are also attached to physician chambers now-a-days, so that clinicians may obtain basic inputs right in their own premises. These primary laboratories may provide the following simple investigations:

- **Haemograms** (hemoglobin estimation, total and differential counts, erythrocyte sedimentation rate and packed cell volume with basic peripheral smear study including the reporting of haemoparasites).

- **Routine and microscopic studies of urine and stool.** Routine examination also entails chemical examination either by laborious and time-consuming old chemical methods or by new generation dipstick tests. These may include tests for glucose, bilirubin, ketones, hemoglobin, leukocytes, pH, nitrites, protein, urobilinogen and specific gravity in case of urine. For stool samples, reducing substances, pH and occult blood may be performed. Basic spot/ latex/device tests (e.g. pregnancy test) may be conducted.

Secondary Laboratory

These are laboratories that assist a clinician to confirm a clinical suspicion or establish a diagnosis. Therapy and prognosis monitoring can also be provided from these laboratories. Such laboratories are staffed by qualified personal who are trained and experienced to perform the tests. They also have a perfect knowledge of the equipment and machines they use. They should be aware of quality control essentials and be well versed with interpretational aspects of the reports generated by their laboratories.

In addition to what has been mentioned under primary laboratories, secondary laboratories also perform:

- Routine immunohaematological tests.
- Routine bacteriologic studies including stains, cultures and antibiograms. Routine mycological investigations would include- primary cultures, isolation and identification techniques along with microscopic evaluation.

- Routine immunoserological tests. These can include tests like Widal, STS, ELISA or strip or device tests HIV I and II, Hepatitis B and Hepatitis C, etc.
- Routine biochemistry investigation and organ profile tests, e.g. lipid, cardiac, liver and renal profiles.
- Under hematology, these laboratories may also provide RBC indices, platelet, retic and absolute eosinophil counts. They can also classify anemias and generally speaking should be able to indicate hematologic malignancies. When headed by a pathologist, they should be in a position to report bone marrow smears / preparation too.

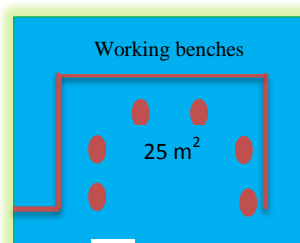
Tertiary Laboratory

These kinds of laboratories should be able to and do perform all kinds of sophisticated and delicate / precise investigations. The tertiary laboratories can branch out in very special fields and not cater to all aspects of specialized tests. Besides doing all investigations that are conducted in secondary laboratories, they also carry out the following:

- Specialized hematological (e.g. leukemia typing), coagulation profiles and immunohaematological investigations. They are equipped with 18 parameter cell counters with differentials and flow cytometry.
- Complete biochemical assays, commonly referred to as SMA-12, SMA-27, etc. Also included are elemental assays, e.g. zinc, magnesium, iron, TIBC, lithium, etc. special enzymes like HBDH, lipase and isoenzymes, etc.
- Complete immunology based assays for hormones, cancer markers, hepatitis markers, rheumatic / autoimmunity etiology-based profiles, TORCH profiles, rare infectious diseases (e.g. brucellosis leptospirosis, cysticercosis, echinococosis, etc.).
- All microbiological processes, e.g. cultures aerobic, anaerobic, fungal, tubercular, etc. with antibiograms.

Laboratory Building and Space

Ample working space is absolutely essential. For **smaller laboratories** up to 25 square meters, the working platforms can be arranged along the walls while the central area is kept free for movement.



A typical small laboratory

For **larger areas**, partitions can be made which would create separate spaces for different sections. The chief pathologist must have free and easy access to all sub-units of the laboratory. If possible, he should be able to directly see into the cabins either through glass windows or through closed circuit cameras. In the cabins again, the central region should be kept free and benches be placed against the walls and away from the doors.

- Hygiene is of utmost importance. The whole facility should be absolutely clean, un crowded and devoid of any hindrances to movement of men and materials. Never, should a chance arise where two people would clash or contaminated material would be split all over.

- Scratch proof matt finish vitrified floor (slip resistant) should be provided. The walls should preferably have white ceramic tiles. Such provisions are resistant to chemicals and disinfectants.

- All benches should be preferably 2 and 1/2 feet high and those to be used while standing should be at least 3 feet high. The bench surfaces should be solvent and acid proof.

- Every laboratory and/ or its section must have at least one sink and one hand wash basin. The hand wash basin should not be used for any other purpose, the sink can be utilized for laboratory purpose like washing off stains from slides or washing glassware or discharging non-contaminated laboratory refuse.

Sero-immunology ELISA"s PCRs, drugs, Cancer markers	Biochemistry	Microbiology
Pathologists chamber	Collection of specimens and report delivery	Hematology + Clinical pathology
Histopathology Cytopathology		Toilet

A typical large/complete laboratory plan

Hazards in the Clinical Laboratory

Clinical laboratory workers may encounter three types of hazards:

- 1- Physical
- 2- Chemical
- 3- Biological

Explain each type of these types in detail?