

LABORATORY INSTRUMENTS

Introduction of laboratory instruments
and technique.

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Outlines

- Overview of laboratories
- Classification of laboratories
- Lab departments
- Lab tests
- Laboratory organization
- Structure of medical laboratory services
- Requirements of clinical & medical laboratories

Medical laboratory scientists: known as clinical laboratory scientist or medical technologists, play a crucial role in the diagnosis, treatment and management of patients. They are the third largest medical profession (after doctors & nurses). Medical laboratory scientists perform complex testing using sophisticated instruments to detect diseases and monitor treatment.

- ❖ Blood, tissue and body fluids can be chemically analyzed and examined for foreign organisms and abnormalities.
- ❖ The obtained information is then used by the medical team to make decisions regarding a patient's medical care.

Laboratory: is a facility that provides controlled conditions in which scientific or technological research, experiments, and measurement may be performed.

Medical laboratory (clinical laboratory): is a laboratory where clinical specimens (Whole blood, serum, plasma, urine, stool, sputum etc) are tested in order to get information about the health of a patient towards the diagnosis, treatment and prevention of disease.



Classification of medical laboratories

Basic laboratory level I

Basic laboratory level I is the simplest kind and adequate for work with organisms which have low risk to the individual laboratory personnel as well as to the members of the community.

Such organisms are categorized under **Risk Group I** by WHO. These organisms are unlikely to cause human diseases. Example, food spoilage bacteria, common molds and yeasts.

Basic laboratory level II

Basic laboratory **level II** is suitable for work with organisms that predispose to moderate risk to the laboratory worker and a limited risk to the members of the community. Such organisms are categorized under **Risk Group II** by WHO. They can cause serious human diseases but not serious hazards due to the availability of effective preventive measures and treatment.

Examples: *staphylococci*, *streptococci*, Enterobacteria except *Salmonella typhi* and others. Such laboratory should be clean, provide enough space, have adequate sanitary facilities and equipped with **autoclave**.

Containment laboratory (Level III)

Containment laboratory is more advanced and it is used for work with infectious organisms that present a high risk to the laboratory personnel but a lower risk to the community. Such organisms are categorized under **Risk Group III** by WHO.

Example: *Tubercle bacilli*, *Salmonella typhi*, HIV, *Yersinia* and others. The principle is to remove from the basic laboratory those organisms and activities which are particularly hazardous. They are easily transmitted through **airborne, ingestion of contaminated food or water and parenterally.**

Such laboratory should be a separate room with controlled access by authorized staff. It should also be fitted with microbial safety cabinet.

Maximum containment laboratory

Maximum containment laboratory is intended for work with **viruses**, which predispose to a high risk for both laboratory personnel and the community. Such organisms are categorized under **Risk Group IV** by WHO.

Example: **Small pox, Ebola, Lassa fever** and others. Most of these organisms cause serious disease and readily transmitted from one person to another. These laboratories are usually a separate building with strictly controlled access.

Lab Departments

There are mainly four types of Medical Laboratories based on the types of investigations.

1. **Clinical Pathology:** Haematology, Histopathology, Cytology, Routine Pathology
2. **Clinical Microbiology:** Bacteriology, Virology, Mycology, Parasitology, Immunology, Serology.
3. **Clinical Biochemistry:** Biochemical analysis, Hormonal assays etc.
4. **Molecular diagnostic** (or Cytogenetics and Molecular biology) lab is the latest addition to the medical laboratories.

Listed below is a partial list of types of individual clinical laboratories

- Blood Bank/Apheresis
- Chemistry/Immunoassay
- Hematology and Coagulation
- Urinalysis, Fluid Analysis and Medical Microscopy
- Cytogenetic
- Endocrinology
- Immunoserology
- Microbiology (including Bacteriology, Virology, Parasitology, etc.)
- Molecular Pathology
- Tissue Typing/HLA
- Toxicology

Laboratory Tests

What are lab tests?

Laboratory tests are medical procedures that involve testing different samples such as blood, urine, or other tissues or substances in the body.

The importance of laboratory tests:

1. Diagnosing of diseases

- Errors occur when diagnosis of diseases depend on clinical symptoms alone

2. Treating of diseases

- Antibiotic sensitivity testing
- Monitoring of patients response to treatment

3. Screening of diseases

- Detection of in apparent infections

4. Control of epidemics

- Early detection of pathogens

5. Surveillance & provision of health information

- Source identification
 - Water supply testing
 - Carrier identification
 - Risk factor assessment

6. Controlling field trials

- New drug/vaccine testing
- Vaccine potency test

Role of medical Laboratory technologist

Some of the major roles of medical laboratory technologist are to:

- 1. Perform routine and advanced laboratory tests using standard laboratory methods**
- 2. Apply problem-solving strategies to administrative, technical and research problems**
- 3. Provide professional consultancy on matters related to the establishment, renovation, upgrading and reorganization of medical laboratories of intermediate levels**

Structure of medical laboratory service

A laboratory service network consists of:

- **Primary health care laboratory (community based)**
- **District hospital laboratory**
- **Regional hospital laboratory**
- **Central and public health laboratory**

Keeping of laboratory records

The laboratory must keep a record of all results and it should contain:

- Patient's identification (name, age, sex, full address),
- Type of the specimen (s),
- Type of test(s) done,
- Date and result(s) of the test (s).

Laboratory organization

Organization: - is a system, an orderly structure, putting things together into a working order, and making arrangements for undertakings that involve cooperation. The emphasis is on arrangements that enable peoples working together and accomplishing common objectives in an efficient, planned and economic manner. In a single medical laboratory at least there are two interlocking components of organizations. These are laboratory head and other staff having their own duties and responsibilities.

Requirements of clinical & medical laboratories

- The accuracy and precision of these results are of great importance.
- Excellent equipment design and effective quality control programs are essential.

Laboratory instrumentation:

is the use or application of instruments for observation, measurement, or control.

Laboratory instrumentation is a collection of laboratory test equipment. Such a collection of equipment might be used to automate testing procedure.

It could also include: "The design, construction, and provision of instruments for measurement, control, etc.

Laboratory Instruments

Laboratory instrument: is a general term for all kinds of instruments, vessels, and other tools needed for operations in various laboratories, synthesis and analysis. Laboratory Instruments are exposed to some extreme chemical and physical influences and must simultaneously provide accurate measurement results, must have a long life and provide safety for the user. Therefore, laboratory instruments must have a high quality and be durable in order to meet the high standards in laboratory technology.

There are two general types of laboratory instruments :

1- Bench based instruments

2- Portable or hand-held instruments.

Laboratory equipment

Laboratory equipment refers to the various tools and equipment used by scientists working in a laboratory.

What is the difference between laboratory equipment and laboratory instruments?

Instruments are used to measure the units, like flow, pressure, weight etc. An instrument is a part of the equipment. Equipment consists of one or more instruments to perform different kinds of activities. For example: a weight balance is an instrument.

Laboratory techniques refer to the sum of procedures used in natural sciences such as chemistry, biology, and physics in order to conduct an experiment.

Thank you

Questions and Discussion