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4th stage
Second Lecture

Medical Laboratory Roles, Types and Results Interpretations

by
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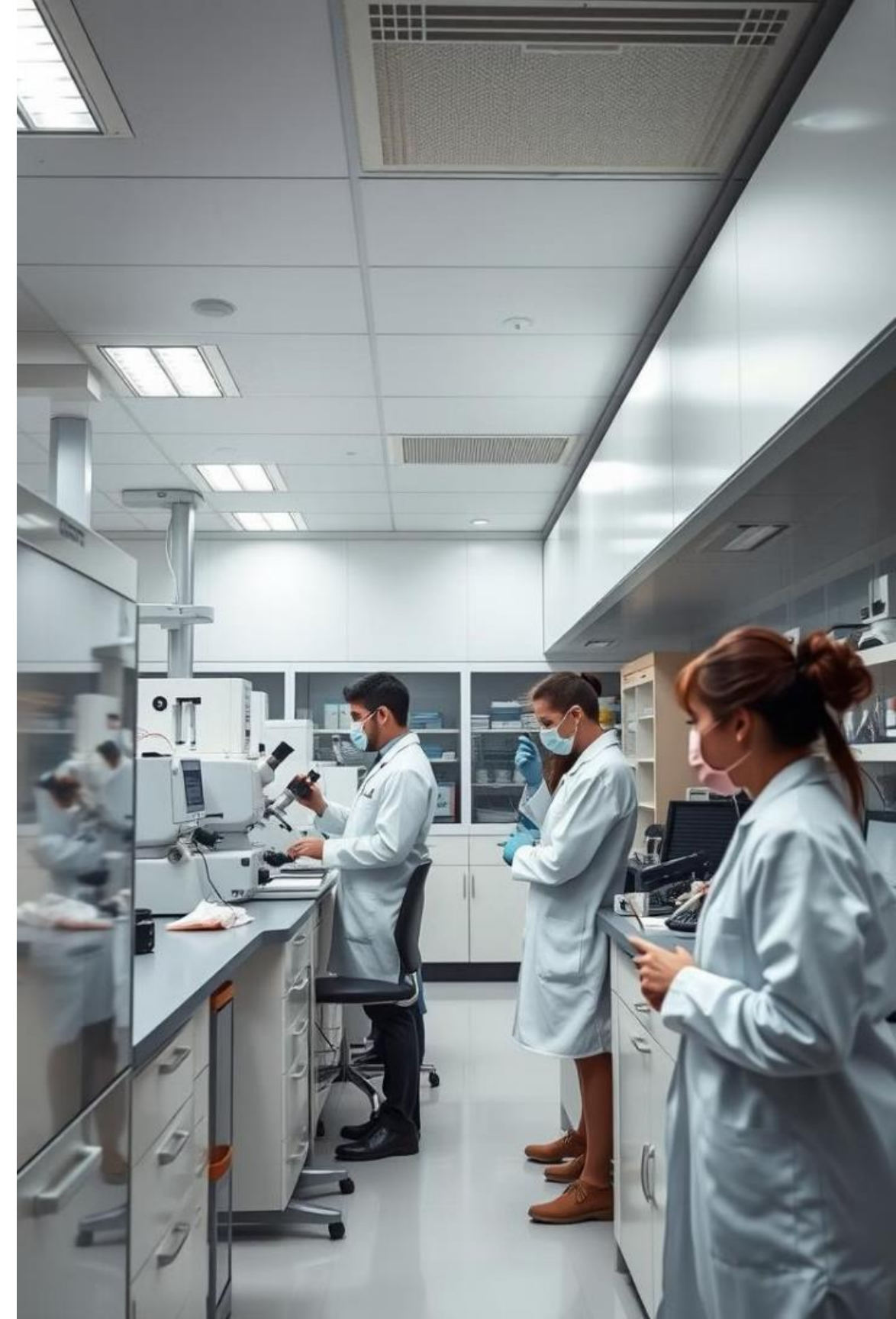


LABORATORY

RESEARCH

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

A medical laboratory or 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.





Role Of Medical Laboratory Services

1 Treating Patients

The medical laboratory services play a essential role in treating patients and monitoring their response to treatment.

3 Disease Control

The medical laboratory services play a essential role in deciding effective control measures against major prevalent disease.

2 Monitoring Pathogens

The medical laboratory services play a essential role in monitoring the development and spread of infectious and dangerous pathogens (disease causing organisms).

4 Health Priorities

The medical laboratory services play a essential role in deciding health priorities and allocating resources.



Without Reliable Laboratory Services

Disease Source

The source of a disease may not be identified correctly.

Patient Care

Patients are less likely to receive the best possible care.

Drug Resistance

Resistance to essential drugs may develop and continue to spread.

Epidemic Identification

Epidemic diseases may not be identified on time and with confidence.

What Is Medical Laboratory Science?

1 Clinical Laboratory Tests

Medical laboratory science is the use of clinical laboratory tests to detect, diagnose, monitor and treat disease.

2 Sample Analysis

Blood, tissue and body fluids can be chemically analyzed and examined for foreign organisms and abnormalities.

3 Medical Decisions

This information is then used by the medical team to make decisions regarding a patient's medical care.

4 Clinical Laboratory Testing

85% of all medical decisions are based on the results of clinical laboratory testing.



Laboratory Tests

What are lab tests?

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

Why does your doctor use lab tests?

Your doctor uses laboratory tests to help:

- Identify changes in your health condition before any symptoms occur.
- Diagnose a disease or condition even before you have symptoms
- Plan your treatment for a disease or condition
- Evaluate your response to a treatment, or
- Monitor the course of a disease over time

Laboratory Tests

Many factors affect test results. These include:

- Gender
- Age
- What eat and drink
- Medicines that taken
- How well followed pre-test instructions



What do lab tests show?

1 Normal Ranges

Lab tests show whether or not your results fall within normal ranges.

2 Normal Values

Normal test values are usually given as a range, rather than as a specific number, because normal values vary from person to person.

Types of Laboratories

In many countries, there are two main types of labs

1 - Hospital laboratory are attached to a hospital, and perform tests on patients.

2 - Private (or community) laboratory receive samples from general physician, insurance companies, clinical research sites and other health clinics for analysis.

A lot of samples are sent between different labs for uncommon tests. It is more cost effective if a particular laboratory specializes in a rare test, receiving specimens (and money) from other labs, while sending away tests it cannot do.



Lab Department

1 Clinical Pathology

Hematology, Histopathology,
Cytology, Routine Pathology

2 Clinical Microbiology

Bacteriology, Virology,
Mycology, Parasitology,
Immunology, Serology.

3 Clinical Biochemistry

Biochemical analysis, Hormonal
assays etc.

4 Blood Banks

Blood bank is a separate body. Its laboratory need
Microbiological analysis for infectious diseases that
may be found in blood. Pathology to observe Blood
grouping, Hematology & cross matching reactions..

5 Molecular diagnostic lab or cytogenetic and molecular biology lab

is the latest addition to the three types of medical
laboratories listed above in many countries.

Community based primary health care laboratory

Duties

- ❖ To support primary health care in investigating, controlling and preventing major diseases in the country.
- ❖ Promoting health care by integrated health education.
- ❖ Collect and refer specimens for testing to the district laboratory.

Main Activities

- ❖ Investigate by referral or testing on site, important diseases and health problems affecting the local community. Such investigations usually include bacterial diseases, parasitic diseases and other causes of illness.
- ❖ Assist health care worker in deciding the severity of a patient's conditions.
- ❖ Notify the district hospital at an early stage of any laboratory results of public health importance and send specimens for confirmatory tests.
- ❖ Screen pregnant women for anemia, proteinuria, malaria, and refer serum for antibody testing.
- ❖ Promote health cares and assists in community health education.
- ❖ Keep records, which can be used by health authorities in health planning and for epidemiological purposes.
- ❖ Send an informative monthly report to the district hospital laboratory.

District hospital laboratory

Duties

In addition to the works stated above, these laboratories have an important role in supervising the work of the peripheral community based laboratories, testing referred specimens, and performing a range of tests compatible with the work of district hospital

Main Activities

- A. Perform a range of tests relevant to the medical, surgical, and public health activities of the district hospital.
- B. Support the work of the community-based laboratories by testing referred specimens, providing reagents, controls, standards, specimen containers, and other essential laboratory supplies.
- C. And also visit each primary health care laboratory in their area to inspect and discuss the investigations being performed and, comment on their quality assurance system, safety procedures, as well as the status of equipment maintenance.

Regional hospital laboratory

Duties

In addition to the duties done at the two above lower levels, the regional laboratory assists and supervises the district laboratories. It analyses referred specimens and performs a range of specialized and other tests as required by the work of the regional hospital.

Main Activities

- A. Operate a regional blood transfusion center.
- B. Prepare reagents, controls, standard solutions and others as found necessary.
- C. Investigate epidemics and perform tests of public health importance in the region.
- D. Supervise and support the work of district laboratories.
- E. Send specimens that require special investigation to the central and public health laboratory.
- F. Prepare periodical reports and send to the central and public health laboratory.

Central And Public Health Laboratory

Duties

The central and public health laboratory is responsible for planning, advising and overall coordinating of medical laboratory services in the region.

Main Activities

- A. Formulate a professional code of conduct to medical laboratory personnel
- B. Perform a range of special tests not normally undertaken in the regional laboratories such as viral, histopathological, cytological, immunological, forensic and genetic investigations.
- C. Carry out appropriate research of importance in order to ease public health problems.
- D. Evaluate new technologies and standardize techniques.

Specimen Identification and Handling

1 Unique Identification

Upon arrival at the laboratory reception, each form and specimen is assigned a unique identifying number or barcode.

2 High Volume Handling

Laboratories process thousands of requests and samples daily, emphasizing the importance of clear identification to prevent mix-ups.



Lab Request and Report Forms

Lab Request Form

The lab request form, either computerized or paper-based, is filled out by the doctor and sent to the laboratory. It lists the tests to be performed on the patient's specimen.

Lab Report Form

The lab report form contains the results of the patient's tests. Each laboratory has specific request forms, such as chemistry requests, hematology requests, etc.

Laboratory Workflow Cycle

Test Ordering

The workflow cycle begins with a doctor ordering a test.

1

Specimen Collection

The next step involves specimen collection, which may be done by a nurse or other healthcare professional.

2

Transport and Processing

The collected specimen is then transported to the laboratory for processing.

3

Analytical Testing

The laboratory performs the requested tests on the specimen.

4

Result Transmission

Once the tests are complete, the results are transmitted to the doctor.

5

Interpretation and Follow-up

The doctor interprets the results and may recommend further testing or treatment.

6

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Phases of Laboratory Testing

Pre-analytical Phase

This phase encompasses test ordering, specimen collection, transport, and processing.

Analytical Phase

This phase involves the actual testing of the specimen.

Post-analytical Phase

This phase includes result transmission, interpretation, follow-up, and retesting.

The Use of Biochemical Tests

1 Diagnostic Tool

Biochemical investigations play a crucial role in various branches of clinical medicine, aiding in diagnosis.

2 Treatment Monitoring

Biochemical tests are essential for monitoring the effectiveness of treatment and adjusting medication as needed.

3 Disease Screening

Biochemical tests can be used to screen for diseases, allowing for early detection and intervention.

4 Prognosis Assessment

Biochemical tests can help assess the prognosis of a disease once a diagnosis has been made.

The Use of Biochemical Tests

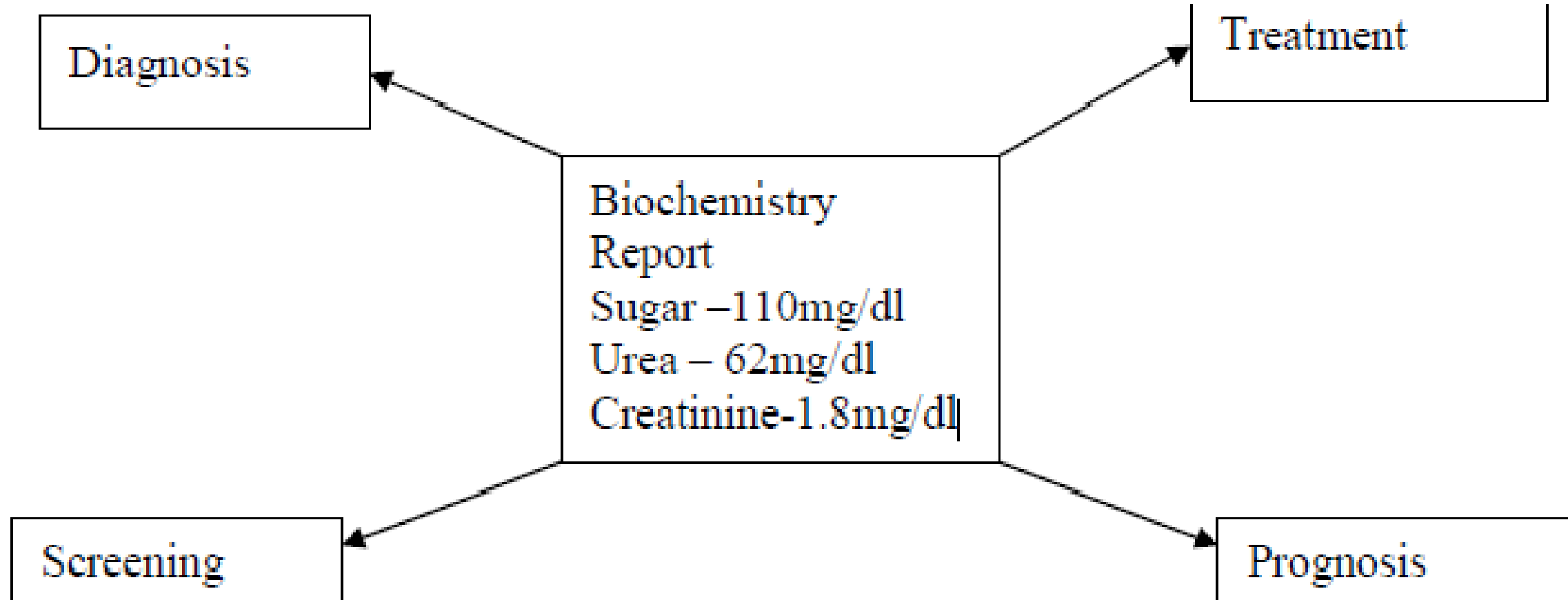


Fig. 1 How Biochemical Tests are used



Interpretation of Results

1

Lab Report Significance

Laboratory reports, despite appearing as simple numbers, require careful interpretation to ensure accurate diagnosis and treatment.

2

Units of Concentration

Results in clinical chemistry are often reported in units of concentration or activity.

3

Quantity and Volume

Units of concentration include both units of quantity (grams, equivalents, moles) and units of volume (liters, milliliters, deciliters).

4

Unit Conversion

Units can be converted without numerical change, for example, from mg% to mg/100 ml to mg/dl.



Units of Quantity and Volume

1 Quantity Units

The amount of substance present can be expressed in grams, equivalents, or moles or divisions of these ie. milligrams, milliequivalents millimoles etc.

2 Volume Units

Similarly the volume can be expressed in liters milliliters or deciliters (100 ml). Just as a milliliter is one thousandth of a liter so a 100 ml. is one tenth of a liter (a deciliter) so units have changed from mg % to mg/100 ml to mg (dl) without any numerical change

Standard International Units

Quantity Units

Where the molecular weight of the substance being measured is known, the units of quantity should be the mole submultiple of a mole. e.g., millimoles and Micromoles.

Volume Units

The units of volume should be the liter. Units of concentration. Will therefore be millimoles per liter etc. e.g., sodium of .140 m eg/l in S.I. units is 140 m mol/l. glucose of 180 mg/100 ml in S.I. units is 10 m mol/l

Unknown Molecular Weight

When the molecular weight is not known, the for example for serum protein or albumin determinations the concentration should be expressed in grams per liter i.e. 7.0 g/100 ml becomes 70 g/l.



Units of Activity

- ❑ Activity is a measure of the rate at which a process takes place.
- ❑ Enzymatic activity is usually estimated by measuring the rate at which a substrate is converted to a product. This activity is affected by many things e.g. temperature, time over which the activity is measured, incubation conditions



Reporting Results

Error in Results

There is a certain error in all results. Usually laboratory will claim 95 % confidence in its result i.e. plus or minus two standard deviation.

Standard Deviation

Thus a blood sugar report of 100 mg/100 ml with a standard deviation of 1 mg per 100 ml would really be 100 ± 2 mg/100 ml.

Simplicity

For simplicity the variation is not usually reported with the individual result.

Method Standard Deviation

The standard deviation for the method should be indicated and the result given with the understanding that the variation is understood

Laboratory Informatics

- Laboratories today are held together by a system of software programs and computers that exchange data about patients, test requests, and test results known as a Laboratory Information System or LIS.
- This system enables hospitals and labs to order the correct test requests for each patient, keep track of individual patient or specimen histories, and help guarantee a better quality of results as well as printing hard copies of the results for patient charts and doctors to check.

