



Introduction to Research and Biostatistics

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Course: RESEARCH METHODOLOGY/BIOSTATISTICS (MA 322)

Summer-Class

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Outline



- Definition of Research
- Features of Research
- Scientific Method
- Steps of the Scientific Method
- Introduction to Biostatistics
- Types of Biomedical Research

■ Objectives

❖ By the end of this lecture, students should be able to:

1. Define research and explain its purpose.
2. Understand the characteristics of research.
3. Distinguish between different types of research.
4. Identify the steps in the research process.
5. Recognize the importance of ethics in research

❑ Definition of Research?



- Is a **systematic, organized, and objective process** of finding **answers to questions, solving problems**, and discovering new knowledge.
- Is a **structural investigation** carried out to discover new **knowledge, verifying existing knowledge** and **develop practical applications**.
- Example: A biologist studying the effect of temperature on fish growth rates.

❑ Research



- It involves:

- i. **Careful planning:** (Research problem, objective, design, data collection, & analysis)
- ii. **Accurate data collection:** (Using standard & reliable methods)
- iii. **Logical interpretation:** (Using appropriate statistical tools)
- iv. **Ethical conduct:** (Respect participant right)

❑ Important features of Research:

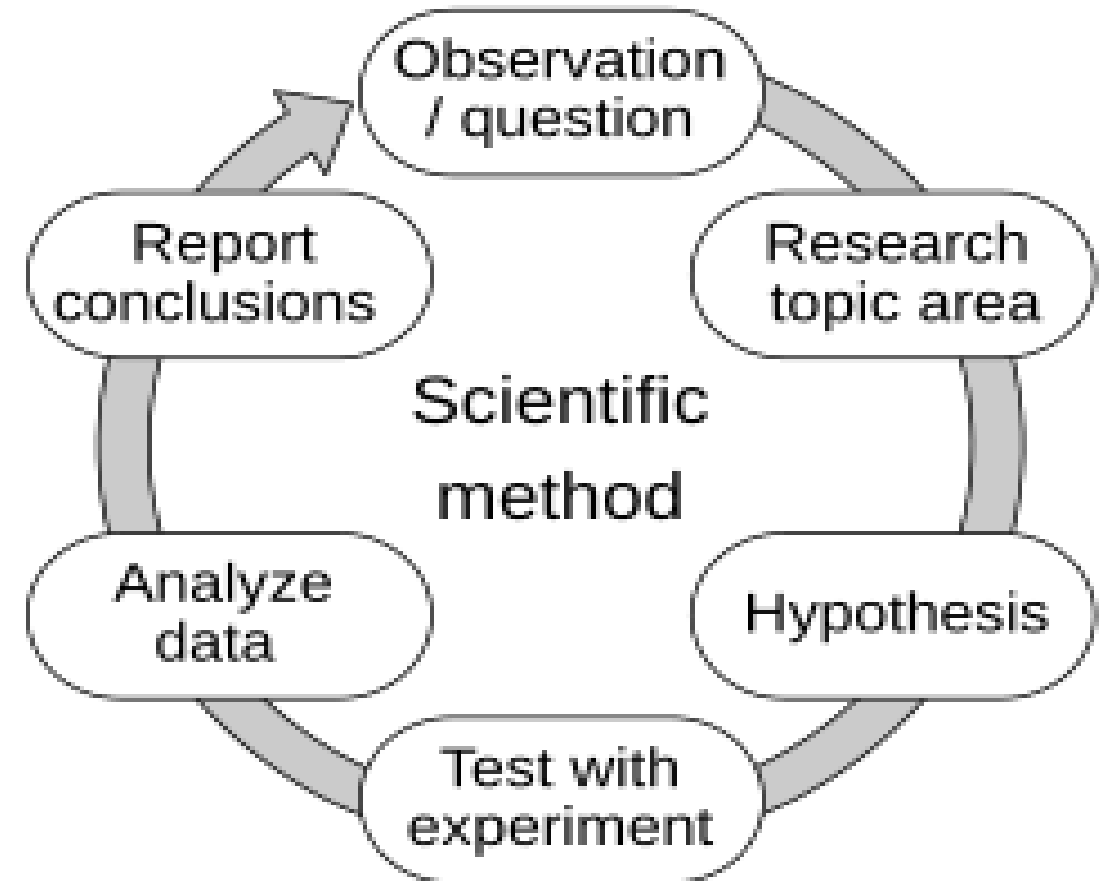


1. Systematic (Step by step process)
2. Empirical (based on observation/experiment)
3. Objective and Unbiased.
4. Replicable and Verifiable.
5. Evidence-based (Not personal belief)
6. Scientific and Logical

❏ Scientific Method



- The scientific method is a structured approach to research that ensures reliability and validity.



❑ Main Steps of the Scientific Method:

1. **Observation:** Identify a problem.
2. **Research Question:** Form a clear, focused question.
3. **Hypothesis:** A testable prediction.
4. **Experiment/Data collection:** Perform laboratory experiments, surveys, or clinical studies.
5. **Data Analysis:** Use statistics and logical interpretation.
6. **Conclusion:** Accept or reject the hypothesis.
7. **Communication:** Publish or present findings.

❑ Role of Research in Medical Laboratory Sciences



- Research is fundamental to medical laboratory practice. It:
 - i. Improves diagnostics
 - ii. Enhances disease understanding
 - iii. Supports treatment decisions
 - iv. Promotes public health
- Examples: Comparing old vs new diagnostic methods

❑ Introduction to Biostatistics:



- Is the branch of statistics that deals with the **collection**, **analysis**, **interpretation**, and presentation of **biological** and **medical data**.

➤ **Biostatistics helps to:**

- Summarize large data sets
- Test hypotheses
- Identify relationships
- Support medical decisions
- Reduce bias and error

❑ **Types of Biomedical Research:**



- Is scientific investigation aimed at understanding health, disease, and improving diagnosis, prevention, and treatment.
- It is broadly classified into the following types:
 1. Basic Research.
 2. Applied Research.
 3. Clinical Research
 4. Laboratory-Based Research
 5. Translational Research

❑ Basic (Fundamental) Research:



- **Definition:** Research conducted to expand fundamental knowledge about **biological processes** without immediate clinical application.
- **Focus:** Cell biology, Genetics.
- **Examples:** Studying how enzymes function in cells, Investigating gene expression in cancer cells.

❑ **Applied Research:**



- **Definition:** Research aimed at solving specific practical or medical problems using scientific knowledge.
- **Focus:** Drug discovery, Vaccine development.
- **Examples:** Developing a rapid test for malaria, Identifying biomarkers for diabetes.

❑ Clinical Research:



- **Definition:** Research involving human subjects to study disease, treatment, prevention, or diagnosis.
- **Focus:** Clinical trials, Epidemiological studies.
- **Examples:** Testing a new antibiotic in patients, Studying risk factors for heart disease.

❑ **Laboratory-Based Research:**



- **Definition:** Experimental research conducted in laboratories using cells, tissues, microorganisms, or animals.
- **Focus:** Pathogen identification, Drug screening.
- **Examples:** Culturing bacteria from patient samples, PCR-based detection of viruses.

❑ **Translational Research:**



- **Definition:** Converts laboratory discoveries into clinical applications.
- **Examples:**
 - Moving a biomarker from bench to diagnostic kit
 - Converting immune studies into vaccine design.

❑ Purpose of Research:



❖ The main purposes are:

1. **To Explore:**– Investigating new areas where little is known.
2. **To Describe:**– Providing detailed information about a phenomenon.
3. **To Explain:**– Understanding relationships and causes.
4. **To Predict:**– Using data to forecast future outcomes.

❖ Importance of Research:



1. Improves knowledge and understanding.
2. Helps solve societal, environmental, and economic problems.
3. Supports evidence-based decision-making.
4. Drives innovation and technology.

❖ **Examples of Research in Different Fields:**



- **Biology:**– Studying the genetic basis of disease.
- **Engineering:**– Developing eco-friendly building materials.
- **Education:**– Testing new teaching strategies.
- **Health Sciences:**– Evaluating new vaccines.
- **Public health studies** to reduce malaria in rural areas.

❖ Quiz:

1. What is research? A. A random collection of information B. A systematic process of collecting and analyzing information to answer a question C. A personal opinion about a topic D. A method of memorizing information
2. Which of the following is an important feature of good research? A. Bias B. Guesswork C. Systematic approach D. Personal preference.
3. The _____ method is a systematic approach used to investigate scientific questions.
4. The first step in the scientific method is generally to identify a _____ or question.
5. After formulating a hypothesis, researchers may conduct an _____ to test it.
6. Good research can be based entirely on personal opinions .
7. A hypothesis should be testable.
8. Reproducibility is an important feature of scientific research.
9. List the main steps of the scientific method.
10. Differentiate between basic and applied research.

References



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3. Council for International Organizations of Medical Sciences (CIOMS). (2016). International Ethical Guidelines for Health-related Research Involving Humans.



Thanks