Chapter 1:

Introduction to Medical Research

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By the end of this chapter we should be able to:
➢ define research.
➢ recognize the importance of medical research in disease prevention and management
➢ identify the aims of medical research
➢ realize why we are doing research.
➢ understand the basic steps in research work
➢ define epidemiology and biostatistics and recognize their role in medical research
1.1: Definition of research

The research process is a complementary step. But, before involving in this process, researchers need to know how to define research and what are the importances of doing research. The Advanced Learner’s Dictionary of Current English lays down the meaning of research as “a careful investigation or inquiry especially through search for new facts in any branch of knowledge.” (The Advanced Learner’s Dictionary of Current English, Oxford, 1952, p. 1069).

The word research is composed of two syllables, "re" and "search"; re is a prefix meaning again, a new or over again, search is a verb meaning to examine closely and carefully, to test and try, or to probe. Together they form a noun describing a careful, systematic, event study to express or to investigate a new problem or phenomenon.

Alternatively, "re- search" implying that the subject matter is already known but, for one reason or another, needs to be studied again.

For this reason, research is considered as an academic activity, and as such the term should be used in a technical sense. The process must meet certain methodological requirements to be called research starting from defining and redefining problems, formulating hypothesis, collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.

In medicine, medical research refers to a search for new medical knowledge by a scientific and systematic search for pertinent information on a specific topic in different medical specialties. In fact, research is the art of scientific investigation and the soul of new finding in medicines, it is the backbone of medical development, and actually was the movement and voyage in all most all previous and current medical discoveries. Thus, we seek only one type of research that can find new medical knowledge: good research.

1.2: Importance of medical research

With our current level of knowledge in different branches of medical specialties, there are numerous problems that challenge our absolute comprehension and stay out of clear explanation. Research is the activity guides for comprehension and explanation.

Finding from medical research frequently play the role in identification, description, exploration, explanation, prediction and control of phenomena related to medical professionals.

Medical research is an extended and valuable process that involves drug discovery, laboratory development, clinical development, and health system evaluation. This process is necessary not only for understanding the target disease but also for providing substantial evidence regarding prevention and control. It provides assurance that the disease or health
problem under investigation will possess good understanding such as occurrence, distribution, management, prevention, and control.

From other side, applying the results of research to patients care is the major reason practicing clinicians read or do the medical study. They want to know which diagnostic procedures are best, which modes of treatment are optimal, and how the treatment regimen should be design and implemented of course; they also read researches in medical journals to stay aware and up to date in medicine in general as well as their specific area of interest.

Health professionals always look for prestigious journals and good researches for best evidence. Comprehension and explanation of research results in the era of evidence-based health care need to critically appraise the methodological and statistical aspects of published articles in order to judge the implications and reliability of reported results.

1.3: Aims of medical research.

There are several aims to medical research which are a very powerful tool, come to rescue because it allows us to:
1) Monitoring and surveillance of health and disease.
2) Detecting disease.
3) Establishing causes of disease or factors associated with death or disease.
4) Preventing death or disease.
5) Evaluating treatments for disease.
6) Evaluating health services and programs.

1.4: Why we are doing research

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:
1) Appeal to get a research degree along with its consequential benefits.
2) Seek for job promotion.
3) Wish for facing the challenge in solving the unsolved problems.
4) Desire to be of service to society.
5) Aspire to get respectability.

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations.
1.5: Types of research

From the viewpoint of objectives, a research can be classified as:

1) Descriptive research attempts to describe systematically a situation, problem, phenomenon, service or programme, or provides information about, say, living condition of a community, or describes attitudes towards an issue.

2) Correlational research attempts to discover or establish the existence of a relationship/interdependence between two or more aspects of a situation.

3) Explanatory research attempts to clarify why and how there is a relationship between two or more aspects of a situation or phenomenon.

4) Exploratory research is undertaken to explore an area where little is known or to investigate the possibilities of undertaking a particular research study (feasibility study/pilot study).

In practice most studies are a combination of the first three categories.

1.6: Steps in medical research

Step-by-step approach is the best way to understand medical research. The steps of a research may be broken down into the following steps:

1) Select and specify the medical or health problem to be addressed. Put the research question in the form of hypothesis.

2) Recognize data and identify which variables (exposure, outcome) that can address research question and which variables (confounding variables) that can affect the answer.

3) Rule suitable research design that solves research question, find the real relationship between exposure and outcome, and controls or randomizes the confounding variables within available resources.

4) Identify sampling methods and do a power analysis to determine a good sample size for the research.

5) Assign the methods of quantifying the occurrence of events or disease and identify the suitable measurements (incidence, prevalence, proportion, average....etc.) that are relevant to the research question and design.

6) Collect and gather data relevant to the research question by using an appropriate tool (interview or questionnaire.....etc.)

7) Analyze and describe research data, present the result systematically, usually with a text, table and/or graph. Communicate the results effectively and precisely. And, choose the suitable statistical tools.

8) Write the research scientifically, and interpret the result.
All these steps in the research process are dealt with in detail in the different chapters of the book and actually the sequence of chapters in this book is according to these steps.

Figure 1.1: Summery steps in research work.

1.7: Tools in medical research

In all of medical research the ultimate goal is to seek out true differences, associations and causations between variables in group or groups of population. It has only been with the aid of epidemiologic and statistical techniques that such relations introduced to society. Epidemiology and biostatistics are indispensable tools in medical research; they are vital components of the research process; from the earliest planning stages of a study to the final presentation of its results. For this purpose, epidemiology and biostatistics play an important role in medical research not only to provide a valid and fair assessment of the disease or health problem under investigation prior to disease prevention measures but also to ensure that the disease or health problem will be managed with the desired accuracy and efficiency.
1.7.1 What is Epidemiology?

Medical research requires the principles of epidemiology, which is concerned with the study of the distribution and determinants of disease within and between populations. In epidemiology there is an emphasis on empiricism, that is, the study of observable phenomena by scientific methods, detailed observation and accurate measurement. Acquiring these measuring essentially involves quantifying the relationship between two or more variables.

The word epidemiology comes from the Greek words epi, meaning “on or upon,” demos, meaning “people,” and logos, meaning “the study of.” Epidemiology is the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems.

This definition of epidemiology includes several terms which reflect some of the important principles of the discipline in medical research:

- **Study**: Epidemiology is a scientific discipline, sometimes called “the basic science of public health.” It has, at its foundation, sound methods of scientific inquiry.

- **Distribution**: Epidemiology is concerned with the frequency of spreading of health events in a population. Frequency includes not only the number of such events in a population, but also the rate or risk of disease in the population. The rate (number of events divided by size of the population) is critical to epidemiologists because it allows valid comparisons across different populations.

- **Pattern**: Epidemiology is involved in the pattern of the occurrence of health-related events by time, place, and personal characteristics.
  - Time characteristics include annual occurrence, seasonal occurrence, and daily or even hourly occurrence during an epidemic.
  - Place characteristics include geographic variation, urban-rural differences, and location of worksites or schools.
  - Personal characteristics include demographic factors such as age, race, sex, marital status, and socioeconomic status, as well as behaviors and environmental exposures.

  This characterization of the distribution of health-related states or events is one broad aspect of epidemiology called descriptive epidemiology. Descriptive epidemiology provides the What, Who, When, and Where of health-related events.

- **Determinants**: Epidemiology is also used to search for causes and other factors that influence the occurrence of health-related events. This is the other aspect of epidemiology which is called Analytic epidemiology. Analytic epidemiology attempts to provide the Why and How of such events by comparing groups with different rates of disease occurrence and with differences in demographic characteristics, genetic or immunologic make-up, behaviors, environmental exposures, and other so-called
1.7.2 What is Biostatistics?

Biostatistics, which is simply statistics as applied to the biological sciences, quantifies variables and achieves the aims above in assessing a relationship between variables. Biostatistics is a science that deals with the collection, organization, analysis, interpretation, and presentation of information that can be stated numerically.

Biostatistics provides a framework of handling data. As data can come in many different forms and statistical design and analysis are needed to collect and understand data obtained from sample and we usually want to use this information to make inductive inferences about the population. Perhaps the most difficult aspect of statistics is the logic associated with these inductive inferences, yet all scientific evidence is based on this type of statistical inference. All observations of subjects in a study are analyzed to determine the beneficial in drawing conclusion regarding that study. It is important to know how to recognize these forms and to use the correct statistical technique for that form as we will read the next chapters. Concerns of biostatistics: There are 2 areas of statistics:

1) Descriptive statistics: Techniques that allow the researcher to 'describe' data. It includes the collection, summarization, organization, presentation and description of sample data. Descriptive statistics come in the form of charts, tables, graphs and narrative.

2) Inferential statistics: Techniques that allow the researcher to offer conclusions about collected data when only a part of the data is observed. Inferential statistics allow the researcher to infer properties about entire group (population) of individuals from a small number of those individuals (sample). This is usually done by:

- Use sampling techniques, experimental designs, and statistical tests to make inferences about research data.
- Use observations to generalize from the sample to the population, perform hypothesis testing, estimate confidence interval, determine relationships among variables, and make predictions about variables.

It is essential to have the skills to decide whether research results are credible and therefore have implications for current clinical practice or future research directions. Without knowledge of these techniques, it is all too easy to draw the wrong conclusions from research data which can be disastrous in health research, while understanding and using these techniques correctly in analyzing research data help to draw robust conclusions.