



## Medical research: a general perspective

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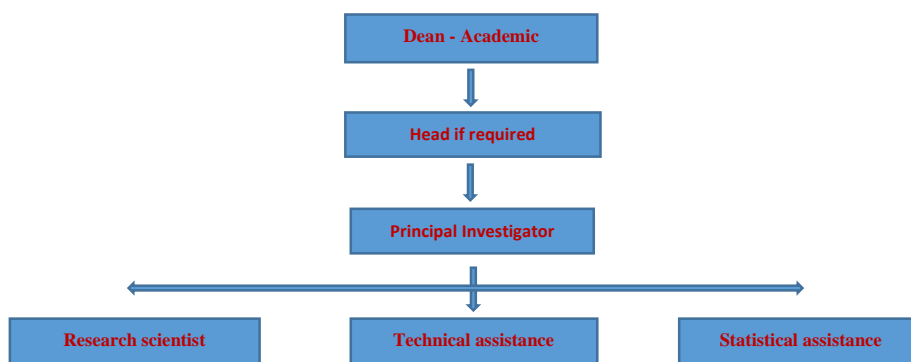
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*Medical research is truly one of the world's most powerful tools to improve the quality of other people's lives.*  
Ross McKinney Jr., Association of American Medical Colleges

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Medical research is defined as "all scholarly activities that deal with any of the areas of studies being conducted in the pre, para, and clinical areas being taught in a medical school". Such a definition is somewhat arbitrary, as medical research covers a much larger field and ultimately affects every individual. The results of research activities are directly translated into social action, such as pollution control, vaccinations, mass fluoridation and nutritional improvements. The eradication of diseases like smallpox, poliomyelitis and plague, the decline in the death rate from infectious and cardiovascular diseases, and the diagnosis of genetic disorders are some examples of how medical research helps to provide improved health care. Thus, the wealth of medical knowledge that grows through the process of discovery and research development becomes part of daily living. The aim of scientific research is always to extend the frontiers of knowledge and to discover rational correlations and principles [1, 2]. Medical research can be divided into biomedical (basic medical), clinical, and health science research. The areas overlap each other and health science research has a component of social research. Experimental research covers areas such as physiology, biochemistry, microbiology, pharmacology and pathology and is relatively easy to conduct. If adequate financial support is obtained, the necessary infrastructure for laboratory research could be built and experimental animals maintained in an animal house. For clinical research, the patients with a particular disease are the direct object of study. This type of research involves dealing with the clinical picture, diagnosis, therapy and prognosis of the disease. Dealing with human beings requires stringent regulations and precautions to be observed. It requires setting up a research team in the hospital to monitor and chart out guidelines involving the ethical dimension of the problem to be studied and maintain a systematic medical recording system. Moreover, it is through a prolonged study of a large number of cases of the same disease that clinical research learns to predict the likely prognosis and judge the efficacy of the treatment. This type of research activity has limitations in the form of having a restricted number of cases of the disease under investigation, a need to update one's knowledge concerning laboratory techniques from which he obtains his 'cues', and the longer time interval required to complete the work. Health science research is a recent development of medical research due to the demands placed on many health services. More often basic medical and clinical research go hand in hand and are inseparable. Furthermore, clinical research workers often conduct studies on experimental animals, due to either the limited number of human cases or for ethical considerations.

**Medical research worker:** An experienced research worker can recognize a problem, analyze its various hypotheses, and choose the appropriate methods that are at his disposal during the study. The organization of research requires good experience in various laboratory techniques and a trained mind that can dissect a problem into its essential components in a logical sequence and analyze the findings of the investigations. Scrupulous honesty, persistence, hard work and intellectual integrity are some of the basic requirements of a good research worker. Therefore, a research worker attains his proficiency only after a period of disciplined training [3]. It is extremely beneficial to encourage and conduct research in a medical school, which could be applied to improving health conditions and promoting the teaching of undergraduates, postgraduates and junior teaching staff [4]. Progress in medical research is hampered due to a lack of opportunities to recruit good scientists. Another drawback is the inflexible training programs followed for medical graduates coupled with a lack of financial support and research coordination and integration. Medical science research is usually undertaken both by medical and science graduates to develop an academic career and also to work in a hospital department of medicine. Research in a department is supervised and led by the heads of the departments in association with senior members and postdoctoral staff. The research personnel and their interactions are shown in **Figure 1**.

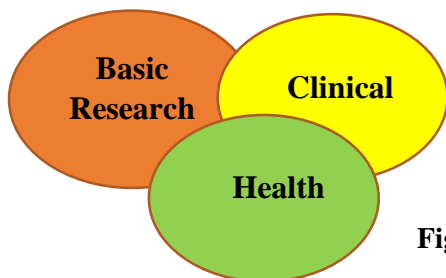


**Figure 1:** Hierarchy of research spiral

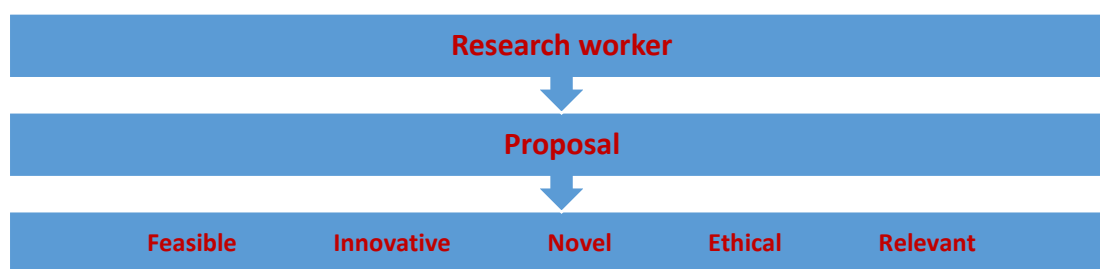
**Plan of research: the central dogma:** Biomedical research could broadly be classified as fundamental (basic) research and applied research. However, there is considerable overlap between the two. Basic research, though it may not have specific applications, is directed toward advancing scientific knowledge. On the other hand, applied research is of practical value and beneficial to the community. Most medical research is usually of the latter type where the information gathered by scientists is applied to the diagnosis, treatment and prevention of human diseases [4, 5]. The selection of a research project often involves a critical appraisal of the existing knowledge on a particular subject, thus prompting certain questions to be answered after a carefully planned scientific study. In addition, certain phenomena may be observed that cannot be explained based on current knowledge, thereby necessitating research into potential causative factors and management of complications. A certain form of research is conducted to test or prove the hypotheses of other researchers. The research plan in a medical school needs scrutiny. The interest and background of the researcher play an important part in the choice of the research project. Encouragement must also be given to studies related to community-based genetic or acquired diseases pertinent to the environment and the community at large. Most of the research in medicine is interdisciplinary bringing clinicians closer to scientists. This has led to great advances in medical research and to shed greater light on the diagnosis and/or management of health disorders **Figure 2**.

**The planning of research: how to start it?** After selecting a good research project the following steps need to be taken: *Literature review:* a comprehensive and critical review of the existing knowledge on the work needs to be carried out to extract information relevant to the project. Formulation of a hypothesis, project preparation including experimental design. Application to relevant sector or agency for financial support. Acquisition of research tools, laboratory equipment and materials. Implementation of the work plan, including

initiation of experimental investigation. Tabulation of study data and statistical analyses. Drawing research conclusions and reporting. Periodical checkup and submission of progress report. However, a research worker has to overcome many problems before a successful research project can be initiated **Figure 3**.



**Figure 2:** Interdependence of basic, clinical and health research



**Figure 3:** A research worker's difficulties

**Finance:** Financial funding is given to a research project through some agencies [6]. Such finance requires the support of the institution where the research work is to be carried out. The institute has to provide the following facilities: Basic laboratory facilities (equipment, technical/personnel), an undertaking by the institute to support research throughout the tenure of work, and qualified staff members to start such a project.

**Basic requirements of research:** Getting laboratories equipped with standard instruments and chemicals is a basic obstacle in developing countries. Some of the sophisticated instruments need to be purchased from abroad and this takes time due to various causes including customs restrictions. Instruments such as electron microscopes, immunoassay systems, automated instruments, and high-voltage electrophoresis apparatus need special space and installation conditions. Tissue culture studies, genetic engineering, biotechnology experiments and working on certain organisms and animals need extra financial support. Apart from providing the basic facilities, the installation of instruments, maintenance, training of personnel and updating the equipment are essential and usually not given adequate attention. The information explosion, statistical evaluation and three-dimensional elucidation of structures are some of the areas which require the participation of computer technology. Such computer-aided provisions remain an important area for consideration for furthering research studies. With artificial intelligence, machine learning e-learning and digital education play an important role in medical education and research. Financial constraints, administrative delays, teaching loads, poor study designs lack of statistical support, improper motivation of research in the minds of undergraduate students through the threat of examination system and lack of coordination between different departments are some of the grey areas one needs to watch for improving and initiating research projects in a medical school or university or an organization. In short medical research, particularly basic fundamental research is the foundation stone for the development of medical science and education [6, 7]. Medical research has to give priority to basic and then applied research. Research is part and parcel of higher education. With Department of Community Medicine and Postgraduate students' need to conduct and submit dissertations makes it relevant to introspect the status of medical research and its role in medical education.

**Conflict of interest:** The authors declare the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

**Ethical issues:** Including plagiarism, informed consent, data fabrication or falsification and double publication or submission have completely been observed by the authors.

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