



## INTERDISCIPLINARY RESEARCH IN MEDICAL SCIENCE: SCOPE AND CHALLENGES

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### ABSTRACT

Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice. Interdisciplinary focus on particular problem or questions that are too complex to be answered satisfactorily by any one discipline. Medicine in the 21st century requires expanded multidisciplinary problem-solving in order to deliver cost-effective, quality health care, yet many medical schools still educate their students in relative isolation with little interaction or understanding of other health care professionals. Inclusion of IDR in Medical students' curriculum gives lots of beneficial results. The students will be highly motivated as they have a vested interest in pursuing topics that are interesting to them. Students cover topics in more depth, they will use and develop their critical thinking skills and they also begin to compare and contrast concepts across subject areas. Interdisciplinary knowledge and application of different disciplines can lead to greater creativity. Challenge to Interdisciplinary Research is that the current system of academic advancement favors the independent investigator. Most institutions house scientists in discrete departments. IDR will not work if one discipline is perceived as superior to the other. IDR makes learning more meaningful, purposeful and deeper resulting in learning experiences that stay with the student for a lifetime.

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### INTRODUCTION

Interdisciplinary research (IDR) is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice<sup>1</sup>.

Interdisciplinary focus on particular problem or questions that are too complex to be answered satisfactorily by any one discipline. Interdisciplinarity is a type of academic collaboration in which specialists drawn from two or more academic disciplines work together in pursuit of common goals. True interdisciplinarity occurs when researchers from two or more disciplines pool their approaches and modify them so that they are better suited to the problem at hand whereas Transdisciplinarity connotes a research strategy that crosses many disciplinary boundaries to create a holistic approach. In multidisciplinary, researchers from two or more disciplines work together on a common problem, but without altering their disciplinary approaches or developing a common conceptual framework. 8<sup>th</sup> Annual Global Summit on Graduate Education in 2014 in Newfoundland, Canada addressed the theme of Interdisciplinary Learning in Graduate Education and Research and developed some principles for supporting

Interdisciplinarity in Graduate Education and Research. Interdisciplinary thinking is rapidly becoming an integral feature of research as a result of four powerful drivers 1) the inherent complexity of nature and society 2) the desire to explore problems and questions that are not confined to a single discipline 3) the need to solve societal problems 4) the power of new technologies. Interdisciplinary programs arise from a conviction that the traditional disciplines are unable or unwilling to address an important problem. For example, social science disciplines such as anthropology and sociology paid little attention to the social analysis of technology throughout most of the twentieth century. As a result, many social scientists with interests in technology have joined science and technology studies programs, which are typically staffed by scholars drawn from numerous disciplines (including anthropology, history, philosophy, sociology, and women's studies). Interdisciplinary programs draw from two or more academic disciplines that work together to create a powerful learning experience and emphasize integrative learning, critical thinking, and creative problem solving. Interdisciplinary programs arise from new research developments, such as nanotechnology, which cannot be addressed without combining the approaches of two or more disciplines like quantum information processing, which amalgamates elements of quantum physics and computer science, Bioinformatics, which combines molecular biology with computer science, Imaging science, amalgamates elements of engineering, physics, mathematics, visual perception, color science, and chemistry. Materials Science, amalgamating physics, chemistry and engineering. So IDR

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enhances interprofessional team-based education and practice and also enhances interdisciplinary team-based science.<sup>1,2</sup>

## **METHODOLOGY**

An extensive systemic review of various literatures was done. This systematic review was conducted using electronic databases to report the scope and challenges of IDR in medical science. To find relevant studies various databases was used including PubMed, and the Cochrane Library. All types of relevant studies were included like journal articles, reports and book chapters, because of limited information regarding the topic of interest. Moreover, the research question could be answered by any type of study. All titles and abstracts were screened first, followed by a full-text review of relevant review articles, including meta-analyses, and published studies based on original data and then all the suitable references were added to the list of articles.

## **RESULTS**

The opportunities in interdisciplinary research have prompted academic leaders to create additional structures to enhance interdisciplinary and interdepartmental research.<sup>3</sup> Identification of priority areas such as cancer, neurosciences, inflammation, and emerging infectious diseases, through a “top down” strategic planning process are some of these strategies. These efforts have helped to develop successful models for interdisciplinary research and have facilitated work across disciplines.<sup>4</sup>

But IDR is still not so popular among researchers. Factors that discourage ID research are poor career structures for academic interdisciplinary researchers, low esteem of interdisciplinary research by mono-disciplinary colleagues, lack of opportunities to publish research results in high ranking refereed journals, discrimination by referees against interdisciplinary research proposals and publications and last of all Interdisciplinary researchers may experience difficulty getting funding for their research.

Individual researchers should acquire the skill to understand the languages, research methods and cultures of different disciplines and he should have high tolerance and willingness to learn from other disciplines. Research managers having interdisciplinary background, should acquire the skill to respect for other disciplines. They should have good interpersonal and team building skills, they should be proactive in engaging with other partners, they should not be too ambitious in their own field and interested in a wide range of subjects

Despite the apparent benefits of IDR, researchers interested in pursuing it often face daunting obstacles and disincentives. Some of them take the form of personal communication or “culture” barriers like lack of confidence and cooperation others are related to the tradition in academic institutions of organizing research and teaching activities by discipline-based departments, a tradition that is commonly mirrored in funding organizations, professional societies, and journals.

Different disciplines set boundaries of acceptability and standards of measurements because they are guided by two types of dimensions a) Epistemic i.e. Different ways of knowing (Relating to Knowledge) and b) Social i.e. Different ways of working. Epistemic dimensions i.e. way of knowing or expressing themselves are mainly due to the reasons like

different disciplines have distinct analytic tools, concepts and methods, they have distinct languages and representations (terminology and notation – e.g., math vs music), they have distinct mechanisms for demonstrating knowledge (proof, score, demo, product, paper) and they have distinct mechanisms for property (authorship, patents, copy writes, open source, etc). Social dimensions i.e. way of working different for different disciplines are mainly due to the reasons like Disciplines have “bodies of disciples” They share formative experiences and common culture (cooperation, competition, etc.).

A successful IDR learner should have the traits of broad ranging curiosity, open mindedness, risk taking, modesty and willingness to work hard to learn new things. They often receive delayed gratification.

Individual shortcomings and risks as felt by the individual researchers are that IDR often takes a lot of time and effort, researchers may not get credit in home discipline, there is often long lead time to achieve something and lastly it is tough for students from interdisciplinary fields to get jobs in academic field. As a result young researchers are often get demotivated to perform interdisciplinary research. As Popkin rightly said “It takes time to truly build teams. Not one or two years, it takes five years – for people to truly start talking to and understanding each other. And for the methods to start melding together – the measurements concerns, the statistics concerns, and the theoretical concerns.” There are some Generic Barriers to IDR like students are often eager, but untrained. Faculties are untrained, tenure-scared, time limited, peer-inhibited, but naturally curious. Fields tend to be conservative and everyone tries to restrict themselves in their own field. Administration is often discipline-centric and designed to support college and departmental structure. Office space, teaching areas, research labs, all arranged by individual disciplines and lastly granting agencies also designed to support individual disciplines. Due to the above barriers, interdisciplinary research areas are often strongly motivated to become disciplines themselves. If they succeed, they can establish their own research funding programs and make their own tenure and promotion decisions. Some examples of former interdisciplinary research areas that have become disciplines include neuroscience, biochemistry, materials science, and biomedical engineering.

Traditional academic structures and practices have not consistently supported interdisciplinary research.<sup>5-7</sup> For example, fund flows in academic centers generally follow departmental or center structures. Undergraduate students should seek out interdisciplinary experiences, such as courses at the interfaces of traditional disciplines that address basic research problems, interdisciplinary courses that address societal problems and research experiences that span more than one traditional discipline. Graduate students should explore ways to broaden their experience by gaining requisite knowledge in one or more fields in addition to their primary field. Researchers and faculty members desiring to work on interdisciplinary research, education, and training projects should immerse themselves in the languages, cultures and knowledge of their collaborators in IDR. Educators should facilitate IDR by providing educational and training opportunities for undergraduates, graduate students, and post-doctoral scholars, such as relating foundation courses, data gathering and analysis and research activities to other fields of

study and to society at large. Academic institutions should develop new policies and strengthen existing policies and practices that lower or remove barriers to interdisciplinary research and scholarship. Institutions should experiment with more innovative policies and structures to facilitate IDR and making use of lessons learned from IDR in industrial and national laboratories. Institutions should support interdisciplinary education and training for students, postdoctoral scholars, researchers, and faculty by providing such mechanisms as undergraduate research opportunities, faculty team-teaching credit, and IDR management training. Institutions should develop equitable and flexible budgetary and cost-sharing policies that support IDR. Recruitment practices should be revised to include recruitment across department and college lines. The traditional practices and norms in hiring of faculty members and in making tenure decisions should be revised to take into account more fully the values inherent in IDR activities. Continuing social science, humanities, community medicine and information-science-based studies of the complex social and intellectual processes that make for successful IDR are needed. Institutions should explore alternative administrative structures and business models that facilitate IDR across traditional organizational structures. Allocations of resources from high-level administration to inter-disciplinary units, to further their formation and continued operation, should be considered in addition to resource allocations of discipline-driven departments and colleges. Such allocations should be driven by the inherent intellectual values of the research and by the promise of IDR in addressing urgent societal and socio-clinical problems. Institutions should explore alternative administrative structures and business models that facilitate IDR across traditional organizational structures.

## **DISCUSSION**

Challenge to Interdisciplinary Research is that the current system of academic advancement favors the independent investigator. Most institutions house scientists in discrete departments. Interdisciplinary science requires interdisciplinary peer-review. Project management and oversight is currently performed by discrete disciplines and interdisciplinary research teams take time to assemble and require unique resources.

Single discipline research had encountered a bottle-neck and more than one discipline needed to make a breakthrough. Inter-disciplinary research by definition requires the researchers to learn the other discipline's vocabulary, methodology and techniques. This requires effort and investment of time. The researchers involved must trust each other and have a mutual respect for each other. It will not work if one discipline is perceived as superior to the other. There must be a reward system in place which will acknowledge the overhead in time and effort that interdisciplinary research takes. All these will facilitate Inter-disciplinary Research.

Newer applications of Inter-disciplinary research in new medical, scientific and technological problems like Biotechnology, BioInformatics, Nano science and Nano technology, Space science, Networking, developing sensor webs, computer webs and social webs, Complex systems and their interaction over time, environment, machines, people, society and cultures will motivate young scientist to take Inter-disciplinary research.

Policy should be interdisciplinary (e.g. transport, environment, health, environment), there should be knowledge transfer i.e. from laboratory findings to application in real world and there should be user driven research, not necessarily commercial and heavily applied.

Inclusion of IDR in Medical students 'curriculum gives lots of beneficial results. The students will be highly motivated as they have a vested interest in pursuing topics that are interesting to them. Students cover topics in more depth because they are considering the many and varied perspectives from which a topic can be explored. They will use and develop their critical thinking skills as they look across disciplinary boundaries to consider other viewpoints and also begin to compare and contrast concepts across subject areas. Interdisciplinary knowledge and application of different disciplines can lead to greater creativity. Consequently, the learning becomes meaningful, purposeful and deeper resulting in learning experiences that stay with the student for a lifetime<sup>2</sup>.

## **CONCLUSION**

Inter-disciplinary research will help under graduate and post graduate medical students and people to build their experience and skills as interdisciplinary workers, help to be seeds, spreading new methods, new approaches and new ideas and also to provide a context, in which those working in the field can present, discuss, and explore their work with the next generation. IDR can be one of the most productive and inspiring of human pursuits that provides a format for conversations and connections leading to new knowledge. As a mode of discovery and education, it has delivered much already and promises more like a sustainable environment, healthier and more prosperous lives, new discoveries and technologies to inspire young minds, and a deeper understanding of our place in space and time. The challenges that lie ahead for the Section of Computational Biomedicine are no less difficult. As sequencing technologies continue to rapidly evolve, the infrastructure needed to support storage, analysis, and dissemination of these growing datasets will be more difficult to sustain. Integrating these emerging molecular datasets with clinical data from electronic medical records is yet another frontier that will need to be crossed. The biggest challenge, however, may rest with our ability to identify and influence physicians at all levels of training within particular disciplines like internal medicine and other specialties of medicine who are willing and able to pursue additional training in this discipline. This represents a critical need if we are to produce the next generation of physician-scientists who will be leaders in applying and stimulating the development of post-genomic technologies to clinical research and the practice of medicine<sup>2</sup>.

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