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An Overview of Interdisciplinary Research and Clinical Medicine

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Abstract

Medicine has historically been built upon the discoveries of interdisciplinary research, yet modern clinical medicine has stagnated in its production of such research. This is despite multiple calls for interdisciplinary clinical medicine research from both inside and outside the discipline. Complex issues, such as those that physicians are recently facing, require complex solutions that cannot be achieved through the use of a single discipline. In order to promote interdisciplinary research, certain approaches need to change. Such changes include the reorganization of university department structures to prioritize interdisciplinary scholarship and create 'translator' positions to help bridge the knowledge gap between disciplines. This paper reviews how clinical medicine and interdisciplinary research are intertwined, assesses why there is a lack of interdisciplinary work within clinical medicine, and explores methods to encourage more collaboration between clinical medicine and other disciplines.

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1. Introduction

Interdisciplinarity refers to the combination of knowledge from many different specialties or disciplines.[1] Despite interdisciplinarity having a commonly agreed upon meaning, interdisciplinary research is a term that is still being acutely defined. For this paper, the meaning of interdisciplinary research is taken from the Institute of Medicine, who defines it as 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 concepts".[2] In short, it is a form of research that involves an integration of distinct disciplines. This differs from other forms of collaborative research, such as multidisciplinary work, because researchers in those projects "remain conceptually and methodologically anchored in their respective fields".[3] There is a distinct lack of integration between the fields in multidisciplinary research. Research, particularly science research, is becoming more and more interdisciplinary as time goes on[4]; yet clinical medicine is an outlier and strikingly uni-disciplinary.[5]

2. Clinical Medicine and Interdisciplinary Research

2.1 Interdisciplinary Research

As stated above, research in the fields of science is becoming more and more interdisciplinary, to the point where papers with a single author are becoming increasingly rare.[4] That is not to say that science is only recently becoming interdisciplinary. Modern clinical medicine itself is built upon the discoveries from interdisciplinary problems. For example, radiotherapy is founded on the pioneering work of physicist and chemist, Marie Curie, and engineer and physicist, William Roentgen. The ground-breaking work of Franklin (chemist), Crick (physicist), Watson (biologist), and Wilkins (physicist) centered upon determining the structure of DNA is now secure in the public record.[6] The trend of interdisciplinary discoveries fueling medicine stands the test of time. Recently, mathematical frameworks have been recognized as being a valuable asset to medicine, and has led to a 'migration of mathematical physicists into medicine where their skills are being used to advance epidemiological modeling, develop novel clinical trials, and understand tumor dynamics'.[6] Interdisciplinarity is so integral to medicine that within the last 35 years, 11 of the Nobel prize winners for medicine have had a background in fields such as chemistry, physics, or engineering.[7]

While interdisciplinary research is important for medicine on a large scale, it is also integral to a patient to patient basis because clinical medicine is constantly facing and researching complex issues. Not all the issues that clinicians face are purely medical. When treating a patient, a clinician may have to factor in societal or environmental issues that are impacting the patients' health. Complex problems, such as the ones clinicians face, are not amenable to single-discipline investigations. Discoveries are more likely to be found on the boundaries between fields.[8]

2.2 Syndemics Theory

Societal and environmental factors playing into patient health is not a new concept. A theory called syndemics, which has been steadily gaining traction since its original proposal in 1996, is a testament to the intersection between medical conditions and sociological, environmental, and political issues. Syndemics, in short, are synergistically interacting epidemics that occur in a particular context with shared drivers.[9] The most researched and well-known example of syndemics is the SAVA model. It refers to the clustering of health and social crises such as substance abuse, violence, and AIDS into an interrelated complex.[10] The SAVA syndemic takes what seem like three parallel epidemics occurring in a population and connects them into interdependent threats that cannot be wholly separated.[10] Since these epidemics are interdependent, one cannot be solved without addressing and treating the others. Recently, the covid-19 pandemic has been the focus of syndemics, which is increasing attention of the theory in clinical medicine and global health.[9] At its core, the syndemics theory is a call for interdisciplinarity for the sake of patient care. It states that you cannot treat a health epidemic without addressing the noxious social conditions that contribute to the severity of it. Medical field professionals cannot treat the complex issues involved in syndemics alone; the task involves the work of policymakers, sociologists, public health officials, and a myriad of professionals from other disciplines.

While the syndemics theory is a staple in the medical anthropology and global health lexicon, it is not the only call for more interdisciplinary work coming from the field of clinical medicine. Clinicians are advocating for a change in treatment models for diagnoses such as musculoskeletal and cardiovascular conditions. Patients with cardiovascular disease often experience multimorbidity, meaning that they have two or more chronic medical conditions. These comorbidities cluster into five distinct patterns, each impacting patients' quality of life and clinical outcomes differently.[11] Patients require specialized, individualized care depending on which cluster they fall into, as symptoms can be altered by the presence of multiple underlying medical conditions. For example, noncardiovascular comorbidities are associated with a

higher overall symptom burden and the display of more severe symptoms than what cardiovascular comorbidities would cause alone. In addition, cardiovascular comorbidities were more likely to be associated with pain and anxiety rather than symptoms of shortness of breath or fatigue.[12] The current treatment models are not meeting individual patients' needs due to the complex psychosocial and multi-morbidity facets of the conditions.[13,14] Clinicians and researchers are calling for more interdisciplinary research to help improve patient care for complex diagnoses.

3. The lack of Interdisciplinary Research in Clinical Medicine

3.1 Clinical Medicine

Despite the fact that clinical medicine was founded on the discoveries of interdisciplinary research, and that there is a call from within the house of clinical medicine for more interdisciplinary research, there is shockingly little of it being produced. A citation-based analysis over the years of 2001-2010 found that clinical medicine is strongly uni-discipline, meaning clinical medicine papers rarely cite, and are rarely cited by other disciplines. This is the polar opposite of the health field, which is increasingly interdisciplinary.[5] This implies that while the generalized field of health is pushing the boundaries of its discipline, clinical medicine is not. It also shows that there is more that can be done to promote interdisciplinary research within clinical medicine.[6]

Since there is a historical precedent for interdisciplinary research in medicine, and an established need for it within clinical medicine, the question becomes why is there a lack of it being produced? Van Noorden, the author of the citation analysis from 2001-2010, proposes that clinical medicine is uni-disciplinary because it is a very specialized field of practice. The proposal bears some thought, as clinical medicine is indeed a specialized field with many niche sub-fields. However, it was not always this way. In 1518, when the Royal College of Physicians was founded, individual physicians 'often embodied interdisciplinarity'.[6] The enormous advances in medicine are what led to this stratification of clinical medicine. Said stratification can be attributed to what researcher Zurubavel calls the "rigid mind". This rigidity is part human nature, creating an identity involves "lumping supposedly homogenous clusters" together.[15] The rigidity, however, is further cemented within academia due to the way "academic libraries, journals, curricula, etc. are organized".[15] This mental categorizing means the structure of academic scholarship is usually envisioned 'in terms of well-defined, sharply delineated fields' that are seen as insular entities separated by a large intellectual divide.[16] This divide has even spread to fields that are closely related, such as the fields of the biomedical sciences

and clinical medicine; more than 50% of medical practitioners believe that research is only related to advancement of personal careers rather than patient care.[17] The rigid delineation of fields of study discourages interdisciplinary work and inhibits creativity.

3.2 SSH Study

For example, a study interviewed 29 social scientists' and humanities scholars (SSH), who were working in a medical research environment. The goal of the interviews was to gauge the integration of the scholars into the different research environments. 18 out of 29 SSH scholars reported a partial adaptation in which they altered their research methods to fit into the medical research environment. 3 out of 29 ended up converting wholly to medical research due to the divide between disciplines. Another 3 reported alienation and felt marginalized from their peers within the field.[18] One interviewee remarked that "I'm creating a new niche for myself, which is actually making me increasingly marginal in my department ... I have fewer and fewer colleagues that I can discuss my ideas with. I'm increasingly becoming sort of alienated from my own environment". The reward these scholars get for pursuing interdisciplinary research is alienation and isolation from their own fields. Their peers view the fields of social sciences/humanities and medical research as fields separated by 'walls', interviewee's mentioned the separation of the fields were further pushed when publication of papers came into play. The scholars had the choice of either "watering down" their social theory analysis in order to publish their research in clinical journals or publish the work in social science journals and face a lack the recognition from their medical research environment.[18] All of these facets lead to the aforementioned marginalization.

3.3 Obstacles

Rigid thinking is not the only factor inhibiting interdisciplinary research within the field of clinical medicine. There are more practical obstacles compared to philosophical hinderances. 'The Challenges of Interdisciplinarity' by Brewer[19] discusses such obstacles. Practical obstacles often stem from how different fields operate, as each discipline has differing frames of reference, methods and operations, and even 'languages' or terminology commonly used in them. Institutional workings also pose an impediment due to different funding priorities between disciplinary and interdisciplinary work. There are also professional obstacles concerning hiring, promotions, status and recognition. [19] Interdisciplinary work is often incredibly niche, and doesn't fit into the standard assessments that can aid in decisions such as hiring and promotions.

Another possible reason why interdisciplinary research is scarce within the clinical medicine community is that it has a complicated relationship with scientific impact. A study that analyzed all the articles published in the *Web of Science* in 2000 found that articles with both the highest levels of interdisciplinarity and the lowest of interdisciplinarity had lower scientific impacts compared to articles in between those extremes.[20] Finding the right balance between the two extremes can be an intimidating factor that scholars are hesitant to tackle.

4. How to promote more Interdisciplinary Clinical Medicine Research

4.1 Solutions

Though there are obstacles that hinder interdisciplinary research within the field of clinical medicine, there are just as many possible solutions. Some that are grounded in research, and some that need to be tested further for viability. With part of the lack of interdisciplinarity in clinical medicine being tied back to Zerubavel's rigid mind, a way to combat it is to promote what he calls a 'flexible mind'.[15] A flexible mind is one in which the mental map of academia still features specialty areas, yet not as discrete islands separated from one another by wide intellectual divides. Academic fields are seen as nebulous entities which lack sharp contours and are constantly changing their forms and melding into other intellectual nebulae.[15] To promote this flexible mindset concerning academia, universities need to enact foundational changes to alter the organizational structure of departments and centers.[21] Some universities are employing this strategy by modifying the traditional department structure in order to promote interdisciplinary research. This has been achieved by creating, promoting, differentiating, evolving, and consolidating departments and research centers.[22,23] To assess the correlation between restructuring academic units and the promotion of interdisciplinary research, Leahey and Balinger conducted an analytical study that examined 9211 research centers and 12,323 departments across 156 universities. They found that universities that enact structural changes to manifest their commitment to interdisciplinary research produce more interdisciplinary scholarships. Not only that, but the universities with a greater structural commitment to interdisciplinary research were observed to have a higher level of scholarship productivity and NIH grant activity relative to institutions with less structural commitment.[18] This model offers universities a way to adapt to the need for interdisciplinary areas without

demolishing traditional department structures, as no previously existing departments are eliminated.[24-26]

4.2 Strategies

As for strategies to specifically target clinical medicine, many potential strategies start in medical school. The general agreement is that "the solution lies in an approach early in a clinical education path that involves training medical students to become junior scientists".[27] The two main strategies involve either introducing research into medical studies at an early stage or introducing clinical rotations for basic researchers in Master or PhD programs. For example, the Berlin Brandenburg School for Regenerative Therapies (BRST) promotes interdisciplinarity by offering a "a three-track graduate system embracing clinical scientists as well as biologists and engineers. An essential feature of these tracks is that there is a deliberate strategy to create an incubator model where trainees in the three disciplines work and study together, allowing the cross-fertilization of ideas and cultures".[27] The Stanford School of Medicine takes the second approach, offering a Master of Science in Medicine; where instead of targeting future clinicians, they aim to get researchers into clinics in order to create a larger group of scientists knowledgeable about human diseases in order to bridge the language and intellect barrier between the field.[27]

Another strategy to increase interdisciplinary research is to implement ways to make interdisciplinary research projects run smoother. This strategy is one that could show very quick results once implemented, as it targets projects that are either in progress or starting out, compared to the earlier models which target professional school structures. Targeting the educational systems tackles the problem at the root but would take a longer time to produce results. One proposal on how to help interdisciplinary research is to create a new form of medical practitioner, a sort of translator who assists in the transfer of research findings into clinical practice.[28] This would solve the problem of different "languages" between fields.

There are a few names for these "translators", the most being a mentored clinical scientist career path (CSCP).[27] The downside to this model is that the "translator" would need to have sufficient knowledge in a variety of highly specialized fields, someone with such skill set would most likely be difficult to find. Of course these are only a few solutions, and the reality is that more research needs to be done on the inner workings of interdisciplinary research teams to learn how to promote it within other fields.

5. Conclusion

Historically, interdisciplinary research has always been a part of scientific discoveries (especially within the field of clinical medicine), and in modern times we are seeing a rise in interdisciplinary research.[4] However, the clinical medicine field is very far behind on that trend, despite calls for more interdisciplinary research due to the increasing complexity of patient diagnoses. Physicians are noticing that multimorbidity and socioeconomic conditions are causing patients to require more personalized care plans, ones that they are struggling to meet.[13,14] The lack of interdisciplinary research in medicine is due to a variety of reasons. They range from the increasing stratification of academia -leading to the idea that the different disciplines are separated by wide gaps that cannot be crossed- to the stark differences in methodology and language between different disciplines. The general agreement on how to promote interdisciplinary work in clinical medicine is to approach it early in a clinical education path that involves training medical students to become junior scientists. There are also strategies that involve Master-level and PhD-level students to be involved in clinical rotations so that more researchers are knowledgeable on clinical medicine. This paper scratches the surface of interdisciplinary research and clinical medicine, and in order to have more concrete answers on how to encourage this combination, more research needs to be done on how to effectively create teams of professionals in a way that overcomes any departmental differences.

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