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Research Article

Dynamism in Biomedical Sciences and Health

***Mustapha A.¹, Odunola O.A.² and Anetor J.³**

¹Centre for Infectious Disease Research, Nigeria Institute of Medical Research, Lagos, Nigeria

²Cancer Research and Molecular Biology Laboratories, Department of Biochemistry, University of Ibadan, Ibadan, Nigeria.

³Chemical Pathology Department, College of Medicine, University of Ibadan, Ibadan, Nigeria.

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Abstract

Translational science is a science involving multi-researchers from different fields of study approaching a research problem in a way that the output becomes holistic, and could be used in the development of the society at large. However, in developing nations, the knowledge of translational research is emerging. Hence, the aim of this commentary, is to highlight the dynamism of biomedical and health sciences towards translational solutions. The commentary focused on dynamism in biomedical sciences and health, concept of integrative research, transdisciplinary research in practice and integration of experimental knowledge in research methodologies. It also addresses the challenges of transdisciplinary research and introduces the steps to achieving dynamism in both sciences. Review had shown that biochemistry serves as an integrating point for the biomedical sciences and that various fields in the health sciences have their building blocks as fields in the biomedical sciences. Therefore, various fields in both biomedical and health sciences are linked together. As a result, the understanding and adoption of dynamics in biomedical and health sciences should encourage transdisciplinary research leading to holistic solution in health care practice. However, translational science is not a bed of roses, hence scientists must put in-view the various challenges such as difficulty in conceptualization of research ideas, communication of ideas and results, and even dissemination of research findings. Conclusively, it is worth noting that societal problems affecting health can only be solved when biomedical and health scientists work hand in hand.

Key Words: Translational research, Collaboration, Dynamism, Biomedical Science, Health Science

INTRODUCTION

Murray (2009) has drawn our attention to how biochemistry, a core science (integrating the biomedical sciences) may elegantly illustrate the dynamism in biomedical science and the transdisciplinary and translational trends in medical science and health care. Today, the biochemistry of nucleic acids is the foundation of genetics. Genetics itself is currently increasingly employed in the elucidation of many areas of science and medicine. The science of physiology, concerned with understanding bodily function, interfaces with biochemistry considerably. Immunology, described as a unifying biomedical and biological science concerned with host resistance to disease, employs a variety of biochemical techniques and biochemists are in turn increasingly employing immunological approaches in deciphering molecular mechanisms. Similarly, pharmacology, the study of the beneficial effects of drugs, and at least in part the foundation of pharmacy is built on a sound scientific foundation of biochemistry and physiology. Additionally, the young science of toxicology, previously an appendage of pharmacology, shows that poisons or toxicants disrupt biochemical reactions.

In the study of science of disease, pathology, disorders, such as inflammation, cell damage and carcinogenesis are substantially dependent on good grasp of biochemistry. Further, synthesis of the current wind blowing in science (dynamism) clearly shows how microbiology, recall microbiome, zoology and botany (micronutrients, antioxidants are largely derived from these areas), clearly showing the interdigitation of disciplines and the web that connects science and scientists that promote and sustain health. But sadly, this is poorly recognized among basic scientists and healthcare professionals. This is a huge gap, impairing the effective and efficient delivery of healthcare optimally and requiring major policy thrust. In the words of Murray (2009), 'these connections are not a surprise, given that biochemical processes and reactions are essential to life. In actuality, the traditional relationship between the biological sciences are dissolved, and biochemistry is becoming more and more their common language'. This is a big summon we are yet to accept from this Professor Emeritus from the University of Toronto, a message far beyond the field of biochemistry. This medical scientist further asserts that, 'the practice of medicine will have a reasonable basis that may be modified to suit new

knowledge as long as medical treatment is firmly based in the understanding of biochemistry and other basic sciences. This at least in part, encapsulates the expected dynamic change or developments in biomedical sciences and health and the need for an integrated approach.

Understanding and adoption of such dynamics will encourage transdisciplinary research leading to translational health care practice. An important example that may illustrate this is the arsenic poisoning, which is considered a global poison. The arsenic content in water obtained from wells has poisoned millions of people around the world for decades, particularly in Bangladesh, India and South America, with Bangladesh being the most affected and the target population of different interventions. A team of scientists from the faculties of Science, Health and Life sciences drawn from the UK and Libya came together to examine the possible mitigating role of selenium, an antioxidant micronutrient implicated in toxicity amelioration and immune response modulating activities. They investigated the intake of arsenic and selenium. Interestingly, they found contrary to widely held view, food sources, aside from water contributed significantly to arsenic intake (Al-Ramalli *et al.*, 2016). Eating selenium enriched lentils was found to increase the urinary metabolite of arsenic, a form of detoxification, with attendant improvement in health indicators in the face of continued inevitable arsenic exposure (Smits *et al.*, 2019).

Complex socioeconomic issues that have an impact on health include rapid urbanization, growing inequalities, climate change, the rising burden of chronic disease and the epidemiologic shift from infectious to non-communicable diseases in low- and medium-income countries (LMIC). Therefore, in order to address the complex global challenges affecting health, it is necessary for actors from many sectors to collaborate in the production of knowledge and policy (The Academy of Medical Sciences, 2016). Hence, integrative and transdisciplinary research and solutions are necessary in this situation.

The concept of integrative research

In health research and other domains, there are many terminology like multi-, inter- and transdisciplinary used occasionally and interchangeably when defining integrative research (Stokols *et al.*, 2013). Multidisciplinarity, interdisciplinarity, and transdisciplinarity are the three basic strategies for collaboration. All of them are opposed to a monodisciplinary strategy, in which a health issue is addressed by only one discipline. In order to inform treatment to address disparities in health outcome and access, monodisciplinary methods have not proven successful in capturing the multifaceted and complex nature of disease and therefore have limited ability to inform interventions to resolve disparities in health outcomes and access (Pineo *et al.*, 2021).

Multidisciplinary research involves scientists from several disciplines collaborate during the research process, yet they each approach the problem at hand through the lens of their own specialties. While Scientists may engage on the same overarching project, they may develop and address distinct research topics, leading to distinct findings that are often published in their respective disciplinary publications (Friedman & Friedman, 1985). At the end of the entire project, discipline investigators in multidisciplinary research centers typically try to integrate and make meaning of their separately derived conclusions. Although this method would certainly

yield more information than a monodisciplinary effort, viewing the problem through a few limited disciplinary lenses prevent us from seeing all of the factors that contribute to health disparities and the intricate relationships that exist between them (Rosenfield, 1992).

Interdisciplinary approaches aim to transfer information from one field of study to another (Nicolescu, 1997) and may even lead to the creation of a brand-new field, like biopsychology or health economics. Interdisciplinary approaches do enable discipline scientists to inform one another's work and discuss and compare their separate research findings, even though they do not provide the broadest and most comprehensive perspective of the drivers of disease. In this approach, researchers who are deeply rooted in their respective fields inform their own work by interacting and working with others. However, as McGregor (2004) noted, "even though the boundaries come down so information can flow between the disciplines, when an answer has been found that fits the needs of the root discipline, the walls come up". The intricate interconnections among biological, behavioral, social, and environmental elements that cause these disparities are challenging to describe using this approach, despite the fact that interdisciplinary work has shed light on certain aspects of health disparities (McGregor, 2004).

Transdisciplinarity is positioned as crucial to understanding and solving global issues by offering a holistic perspective, integrating various information and transcending disciplinary perspectives (Nicolescu, 2002). By way of definition, transdisciplinary research is an integrative process involving scholars, practitioners from academic and non-academic fields working together to develop and use novel conceptual and methodological approaches that synthesize and extend discipline-specific perspectives, theories, methods, and translational strategies to produce innovative solutions to specific scientific and societal problems (Stokols *et al.*, 2013). Transdisciplinary research is used in environment and health research, such as EcoHealth approaches (Buse *et al.*, 2018). The report on pollution and health (Fuller *et al.*, 2022) involving about 30 investigators from very diverse background showing that 9 million people die every year globally from pollution elegantly illustrates the great advantage of collaborative and transdisciplinary research.

Transdisciplinary research in practice and integration of experiential knowledge in research process

A new form of research collaboration is necessary due to the inherent complexity of disease inequalities, including those in cancer and cardiovascular disease, and the enormous number of interconnected causal pathways that underlie them. For instance, premenopausal Black women are more likely to develop breast tumors lacking estrogen, progesterone, and HER2/neu receptors than premenopausal White women; these cancers are linked to rapid growth and poorer outcomes (Carey *et al.*, 2006; Reynolds, 2007). Survival certainly relies on the stage of identification because some Black women's tumors are more aggressive than the tumors typically detected in White women. Yet, compare to locations where population are mostly white, healthcare facilities in communities where Black women live are less likely to provide timely breast cancer screening utilizing cutting-edge methods (Elmore *et al.*, 2005; Hirschman, Whitman & Ansell, 2007). Black/White disparities in breast cancer mortality are almost certainly caused by these interaction between biological and

community-level variables. It would be harder for researchers who focused on different level of influence to find important relationships (Gehlert *et al.*, 2010). The account of the development of the formulation of the dietary treatment of phenylketonuria (PKU), a very serious in born error of metabolism by an outstanding diverse team of investigators involving biochemists, physicians, pediatricians, nurses and dieticians is a great illustration of the benefit of team science that can be translational (Green, 2020).

Locally in Nigeria, a study that involved scientists from near multidisciplinary approach was the investigation of methanol poisoning outbreak in Ode-Irele in Ondo state (Michael *et al.*, 2018). The investigation involved scientists from, pharmacology, toxicology, environmental health scientists, chemists, and ophthalmologists. Sadly, no epidemiologists, social scientists and public health experts were involved. But it represents the commencement of movement in the right direction on which further studies with a transdisciplinary approach can be adopted. A year later, a team of investigators consisting biomedical scientist, public health specialists, environmental scientists were put in place to investigate or at least, make proposal to examine the Nigerian environment and health insecurity prevailing issues and projections for at least 3 decades ahead (Anetor *et al.*, 2019).

The integration of experiential knowledge in the biomedical innovation process usually takes place implicitly and on adhoc basis. Patients' involvement in biomedical research is uncommon nevertheless. Aside from advocacy studies, there are few studies, if any, where patients are used as co-investigators; they are mainly used as participants in research at the moment. Inclusion of patients as co-investigators may enhance the research process and the reach of findings obtained. The pattern of medical care is changing as a result of advancements across many disciplines, relevance, depth and quality, and it appears that this is creating growing demands for a wider variety of skills and for more people to work in specialized fields of techniques and treatment regimen, even patients. Patients provide experiential information to the study process, which is based on their own encounter with their bodies and illnesses. Therefore, patient's involvement in the creation of biomedical knowledge may improve the relevance and quality of discoveries and lead to the development of more suitable technology (Flinterman *et al.*, 2001). Perhaps, a new addition is the need to bridge indigenous methods of treatment with that of modern scientific medicine as is being currently pushed for to take advantage of the many methods and medicines of indigenous or traditional medical practitioners (Redvers, 2019).

Addressing challenges of transdisciplinary research

According to Tinniswood (2019) in his examination of the emergence of modern science and the pioneering role played by the Royal Society of the United Kingdom and the involvement of investigators from virtually any imaginable field, the search for truth takes time, it is hoped that transdisciplinary and translational research will gradually pick up. Despite this recognition, transdisciplinary research is saddled with various challenges. There may be difficulties when conceptualizing ideas since research partners whether academic or not may be motivated by differing preconceptions resulting in a project with longer time. As a result, it could be difficult to secure enough funds for lengthy and larger projects. Furthermore, communication issues both within and

outside the team may develop. Also, it could be challenging to believe that other academic researchers method of knowing or conducting themselves reflect excellent science, especially when they diverge from the norm in one's field of study (Lynch, 2006; Lang *et al.*, 2012; Black *et al.*, 2019). There may also be the difficulty of publishing in high impact journals, with specialized or narrow focus.

To address these challenges, sponsored sessions at professional meetings to educate on transdisciplinary research as well as joint meetings and alliances among professional societies can help people get more familiar with one another's viewpoints and research. It will also be beneficial in this regard to locate research centers in Universities in open areas that are centrally managed rather than through specific schools and departments. Institutions will need to modify their reward systems to account for transdisciplinary teaching and research, for as by changing their promotion rules (not just independent or first-authored work). Further, biomedical journals publishing multilevel approaches and can develop new review guidelines that foster these efforts. Successfully adopting a transdisciplinary approach represents a career turning point for scientists, fostering their professional development and inventiveness (Abrams, 2006).

Collaborative and transdisciplinary research has the potential to improve healthcare service delivery in Nigeria, where there is currently so much unnecessary rivalry, that one is tempted to ask whether the practitioners are collaborators that they are supposed to be or gladiators?

Steps to achieving dynamism in Biomedical Science and Health

To address the complex and diffuse nature of contemporary problems, Biomedical Sciences need to evolve through the following:

- a) Biomedical researchers adapting to change by unlearning and relearning to move from disciplinary to transdisciplinary approach
- b) Sustained network between biomedical, clinical and social scientists, epidemiologists, research administrators and communicators, patients and their families, communities, non-governmental organizations and policy-makers
- c) Improved models of prediction, means of response and modes of translation
- d) Integration of experiential knowledge (including patient participation) in the biomedical innovation process and teaching curriculum
- e) Capacity building, international exposure, partnership with industry and participation in transdisciplinary networks to influence policy change and change in practice

Complex societal problems that affect health will not be solved by health researchers or biomedical scientists working alone. As the distinctive Consortium, University of Leeds puts it, 'Ideas and critical thinking are developed from multiple perspectives, allowing greater creativity and the synthesis of novel synergistic and effective solutions that are beyond the capability of a single discipline' (Fairweather *et al.*, 2018).

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