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Review Article

Critical Analysis of the Current Status of Transdisciplinary Research in Neonatology and Sustainable Development Goals

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ABSTRACT

Background: Neonatology, a discipline that deals with a variety of medical conditions such as prematurity, breathing, infections and birth defects, has seen rapid development and significant advancements during the past decades to ensure the survival and healthy life of newborns.

Although the efforts of medical scientists following the multidisciplinary and interdisciplinary approaches have successfully reduced the neonatal mortality rate from about 5 million before 2000s to 2.3 million as of 2022, but stills challenges in understanding and addressing the complex neonatal health issues remain unsolved, which invites the necessity to apply complex and comprehensive transdisciplinary research approaches. Transdisciplinary research approaches are complex types of approaches applied for complex types of issues, engaging all stakeholders of society, so a holistic approach to understand the neonatal health, and the impacts of environmental, social, and biological factors should be studied.

This article has shed light on the significance of transdisciplinarity which has proven its role in the development of a sustainable society and these holistic research approaches, can ensure meaningful results to reduce the mortality rate of newborns from 50% to 5%.

Keywords: Knowledge integration, Neonatology, Unsolved issues, Research approaches, Transdisciplinary research

Introduction

Transdisciplinary research approach is a scientific approach developed by the integrating the knowledge from all disciplines after a process of co-production or co-creation to solve a complex daily life problem (1). Transdisciplinarity connotes a research strategy that crosses disciplinary boundaries to create a holistic approach involving the close working of actors from all sciences, medicine, and stakeholders of the society (business groups, NGOs, policy makers and even the people themselves) (2). In fact, Transdisciplinarity is more than an approach, it is a mother discipline of several disciplines dealing with the solutions of complex or wicked problems. The concept of a wicked problems, first introduced in the early 1970s by Rittel and Webber (3) in the social science but now a days, it is being applied in all disciplines. The Sustainable Development Goals (SDGs) have described the wicked problems as vital issues critical to the sustainability of a society and it has been described to focus on the neonatal mortality rates (NMRs) as one of the SDGs (4). Transdisciplinary research approach focuses on the real-world connections understanding the real problems of a society and force you to think outside the box and in case of Neonatology, the box is the medicinal approach. In following sections, transdisciplinary research in neonatology, its significance in the global health challenges and SDGs, and applications of data sciences toward a new paradigm in the health of newborns have been

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discussed.

Conceptual Understanding of Transdisciplinary Approaches in Clinical Practices

Transdisciplinary approaches are unique research approaches where a holistic approach is applied to solve complex social issues (5, 6). There are five general types of research approaches being practiced by scientific communities around the world (7, 8)

- Uni- or intra- disciplinary
- Multidisciplinary
- Interdisciplinary
- Transdisciplinary
- Cross disciplinary

Transdisciplinary research practice is employed by a research leader or a team having strong grip over almost all scientific disciplines so they can have a broader understanding of engaging all stakeholders while doing research for every scientific issue as shown in figure 1 (5, 6, 9). In clinical practices, several innovative therapeutic approaches have been applied in the past decades but engaging transdisciplinary experts have been limited. For example, involvement of clinical anthropologists in the therapeutic process of some critical life-threatening diseases such as cancer to encourage the patients to take a stand and have a hope of full recovery might produce better outcomes (10-12).

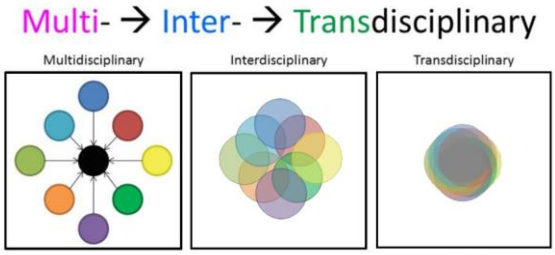

Figure 1: Visualization of Conceptual Differences among Multidisciplinary, Interdisciplinary and Transdisciplinary research approaches

Transdisciplinarity in clinics is an attempt to encourage the physicians and therapist to focus on the social determinants of a diseases and then apply surgical or pharmaceutical treatment only if necessary as these determinants could be the main cause of the diseases and can be solved easily to make treatment more effective (10).

Challenges for Transdisciplinary Science in Clinical Practice

Clinical practice is one of the highest-regulated professions globally, with a focus on patient safety, treatment efficacy, and ethical considerations. Due to the complex nature of human health, there are strict rules and very specific standard operating procedures (SOPs) for each department and section of the hospitals. These regulations are to ensure medical safety and therapeutic effectiveness as these are formulated based on the principle of "*do no harm*". However, as science is evolving everyday, there is an increasing call to incorporate novel and modern approaches such as transdisciplinary practices in the healthcare (13).

In clinical pharmacology, understanding the complex relationship between race, ethnicity, and health outcomes is a persistent issue of the pharmacodynamics for a careful evaluation of the readiness of therapeutic drugs for a diverse patient populations, especially considering the variability in genetic, ethnic, and racial backgrounds (14). To have a nearly perfect knowledge of these disparities requires a shift from traditional approaches to more inclusive model, such as those offered by transdisciplinary science. By following these models, we might observe a decline in the current high mortality rate of 35.1% for the hospital admitted patients (15).

Despite these challenges, several studies have demonstrated the potential benefits of transdisciplinary approaches in clinical settings such as improved patient outcomes, reduce clinical risks, and enhance patient safety (16). Integration of transdisciplinary research into the management of complex diseases, such as cancer, diabetes, and cardiovascular diseases, has led to the development of more personalized treatment plans considering the psycho-social and environmental factors in addition to the biological and medical factors. These approaches have also proposed several models of improving clinical decision-making, enhancing collaboration between healthcare providers, and promoting patient-centered care (17, 18).

Several leading global institutes have already implemented transdisciplinary approaches in their healthcare settings, with promising results. These initiatives have focused on the integration of clinical practice with community health, social work, and other non-medical disciplines establishing a patient-family-society relationship to provide more comprehensive care for patients. (8, 19). Other challenges, such as which model should be applied or what is the role of patient in clinical decision-making process or who is the expert leading the transdisciplinary team etc are still

under-debate and looking for a comprehensive transdisciplinary solutions (20).

Neonatology and the Sustainable Development Goals (SDGs)

The health of neonates is a fundamental indicator of overall health systems and reflects the strength of a country's healthcare infrastructure which intersect with Sustainable Development Goals (SDGs) such as Goal 3 (Good Health and Well-Being) or Goal 10 (Reduced Inequality) etc adopted by the United Nations in 2015 (21). Neonatal health is an essential milestone in achieving the SDGs as neonatal mortality rates remain high in many low- and middle-income countries (LMICs) and is continue to be a major public health concern around the world. According to the World Health Organization (WHO), globally there are nearly 2.4 million deaths of neonates each year, with the majority of these deaths occurring in LMICs (22).

The challenges of reducing the neonatal mortality including the equitable access to care and better maternal health are awaiting transdisciplinary approaches where highly coordinated efforts across healthcare systems, policy frameworks, and society should be followed (23).

The Role of Transdisciplinary Research in Neonatology and SDGs

Transdisciplinary research is an approach of working together and developing knowledge with an understanding of all scientific disciplines. In contrast to multidisciplinary and interdisciplinary approaches, transdisciplinarity focuses on the co-creation and co-production of knowledge through engaging scientists, clinicians, and experts across various other domains to develop comprehensive SOPs for the complex and multifaceted issues which are not solvable via uni-disciplinary or interdisciplinary approaches (5, 6). The Sustainable Development Goals (SDGs) by UNO has been introduced to reach a target of sustainable world focusing on the complicated global issues. Neonatal mortality is one of the selected SDGs and it has called for a reduction in neonatal mortality rates to 12 or fewer per 1,000 live births by 2030 which is currently standing at 25/1000 (24). In neonatology, as every new born is unique in developmental needs and vulnerabilities, applying transdisciplinary approaches might help to understand and integrate the knowledge of several disciplines such as molecular biology, develop-pmental psychology, pharmacology, epidemiology, genetics and immunology etc. In this way, we can have a better understanding of the mechanisms behind neonatal immune development, family dynamics, socioeconomic status, and maternal health etc.

While working on the current conditions, such as prematurity, congenital anomalies and neonatal infections, data analysis and bioinformatics tools can help us to process large sets of data to develop a prediction map of potential associated health risks (25, 26). Digital health, machine learning, and artificial intelligence are revolutionizing the knowledge and opening the windows of new possibilities for transdisciplinary research as these algorithms can analyse a huge data sets, genetic profiles of newborns and records of neonatal intensive care unit (NICU) to identify the patterns and develop neonatal care strategies accordingly (27, 28). Biomedical engineers can develop wearable devices for continuous monitoring if they are engaged in neonatology transdisciplinary research team which can help the neonatologists to make proactive decisions to enhance the infant's health status and reduce the mortality rate.

Discussion and Conclusion

Transdisciplinary research in neonatology has emerged and resulted in a major shift toward a more integrative and patient-centred approach where several working and educational models have been developed and are being implemented to reduce the neonatal mortality rate. National Associations of Neonatal Therapists of United States, has developed several Transdisciplinary Research based working Models and educational or training approaches such as NOLE (Neonatal On-Line Education) to achieve the SDGs by 2030. These research based models focus on the enhanced engagement of stakeholders such as Parents, NGOs, NICU team etc. (29). The same kind of approaches are also being applied in other developed countries such as Australia (28), Canada (30), New Zealand (27) etc.

It has been proven that by connecting diverse scientific and clinical fields, we can have a thorough understanding of challenges faced by newborns and then can design solutions to address the physical, social, and environmental complexities in the neonatology. As technology continues to advance especially with the emergence of data science, it is possible to study the efficacy of a model or approaches to enhance the culture of collaboration and unearth a real potential of transdisciplinary research to improve

the quality of life for newborns as well as their families. It is the need of time to work closely and not just to think out of the boxes but also to come out of boxes to ensure the sustainable development of the society and a better future for human beings.

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Conflicts of interest

Author of this review article declares no conflict of interest with any person or organization.

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