

Scope of Ayurveda Biology in Integrative Medicine

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Abstract

At the frontiers of biology and medicine, experts increasingly recognize that health and disease are complex, multifactorial phenomena that require understanding from multiple perspectives. Developing an integrative medicine framework that bridges the holistic principles of traditional medical systems with the reductionist approaches of modern biomedicine offers a more effective strategy to address the growing complexity of human health and emerging diseases. In this context, the traditional Indian system of medicine, Ayurveda, plays a pivotal role. This article examines the potential of an Ayurveda-Biology framework within the landscape of integrative medicine to enhance understanding of human health and to provide more comprehensive management strategies for complex diseases. Additionally, it explores the challenges inherent in constructing a transdisciplinary knowledge framework between epistemologically distinct medical systems.

Introduction

When we examine the standard definition of medicine in Oxford learners' dictionary, it is described as "the study and treatment of diseases and injuries" (Medicine, n.d.). Other sources define it more elaborately as "the practices and procedures used for the prevention, treatment, or relief of symptoms of diseases or abnormal conditions." Interestingly, these definitions tend to focus primarily on disease, its causes, symptoms, and management; rather than on health itself. The emphasis on disease rather than wellness reveals an inherent limitation of modern medicine as it is conventionally understood. It is precisely in this context that the significance of Integrative Medicine and the emerging discipline of Ayurveda Biology can be better appreciated.

Health has always been a priority for human life, shared

universally across all cultures and civilizations; perhaps for all living organisms in this world as well! (Hernandez & Gibb, 2020). Consequently, societies developed various systems and practices, from early times, aiming at maintaining health, preventing diseases and ensuring the homeostasis of body functions. Before the advent of modern principles of biology, globally human civilizations were dependent on naturally available resources for their health and disease management needs. These knowledge and practices were highly indigenous and extremely rooted in their cultural beliefs (Elendu, 2024). Such practices are now referred as traditional medicine, WHO defines traditional medicine as a medicine with long history, codified or non-codified systems for healthcare and well-being, comprising practices, skills, knowledge and philosophies originating in different historical and cultural contexts, which are distinct from and pre-date biomedicine, evolving with science for current use from an experience-based origin. Traditional medicine emphasizes nature-based remedies and holistic, personalized approaches to restore balance of mind, body and environment (World Health Organization, 2025). Historically, we can see that in human societies, diseases were interpreted as the result of functional disturbances in the body, arising from various external and internal

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factors. Sometime, these disturbances or diseases are even deemed to be the result of supernatural powers entering in the body. As a result, healing approaches often combine physical remedies with ritualistic and spiritual methods like shamanism to ward off the etiological agents. In all these approaches, health is viewed as a dynamic equilibrium involving body, mind and spirit, rather than mere absence of disease. In contrast, by the emergence of modern biological sciences a more structural and mechanistic understanding of health and disease was introduced that is rooted in anatomy, physiology and molecular biology (Elendu, 2024).

The discovery of microscope in the 17th century marked the beginning of a new era in the modern biology that revolutionized many fundamental thinking. It was for the first time; scientists could start thinking about the microbial world and its influence in human health and diseases. Pioneering works by Louis Pasteur and Robert Koch and the introduction of the most celebrated germ theory of diseases provided a concrete explanation for disease causation. In the backdrop of germ theory of disease, Robert Koch postulated that microorganisms must be found in diseased individuals and not in healthy individuals. While this was modified later, these postulates had introduced a new paradigm of disease as infection (Gradmann, 2014). This perspective of disease as a consequence of specific pathogenic agents steered scientists towards the development of targeted therapeutic interventions, including antibiotics and vaccines. This perspective led to the most celebrated lock and key hypothesis of drug action, which later become the cornerstone of modern pharmacology and drug discovery. Advances stemming from germ theory, coupled with breakthroughs in immunization and antimicrobial therapy, dramatically reduced mortality from infectious diseases and significantly extended human life expectancy.

In this context, an important point to highlight is the paradoxical relationship between lifespan and healthspan. While these advancements in biology, medicine, and public health have significantly extended human lifespan, they did not proportionately enhanced healthspan - the period of life spent in good health (Crimmins, 2015). This widening discrepancy underscores a major limitation of the dominant biomedical paradigm. Historically, the lock-and-key hypothesis and targeted intervention approaches were remarkably successful in combating infectious diseases and reducing the mortality rates. However, these strategies – focusing on single targets and single causes – were less effective in addressing the rising burden of such as diabetes, cardiovascular diseases, neurodegenerative conditions, and cancer. These diseases are multifactorial, deeply influenced by behaviour, environment, socio-cultural factors, and complex biological interactions, making them less responsive to narrowly targeted biomedical interventions. A very recent article published in *Nature Communications* by Garmany and Terzic (2025) categorically mentions that the “healthspan-lifespan gap” is universal, but differs in its magnitude and the disease contribution to this gap (Garmany & Terzic, 2025). Their analysis highlights a critical need to rethink current health strategies and to explore more integrative, preventive, and holistic

approaches capable of improving not just longevity, but the quality of life across the entire lifespan.

The pressing question then is why this paradox between lifespan and healthspan arises. A central reason lies in the philosophical and conceptual gap in how modern biomedicine understands health and disease. The lock-and-key paradigm, which shaped most of the current biomedical thinking, is fundamentally reductionist. This framework views biological processes as a linear cause-and-effect mechanism, with an assumption that disease can be traced back to a single identifiable target or mechanism (Beresford, 2010; Berlin, Gruen, & Best, 2017). This perspective works exceptionally well in addressing diseases caused by identifiable pathogens as well as effective in providing symptomatic relief of diseases expressions. However, this linear model struggles to address multifactorial and systemic disease conditions that evolve over time due to complex interactions between genetics, environment, behaviour, and lifestyle. Chronic diseases such as diabetes, cardiovascular disorders, cancer, mental-health conditions, and autoimmune diseases do not fit neatly into a single-cause–single-intervention framework. Instead, they emerge from highly interconnected biological networks whose behaviour cannot be predicted or fully understood through reductionist approaches alone.

At the frontiers of biology, experts unanimously agree to the fact that health and disease should be viewed as emergent phenomena of complex biological networks, which are better explained through the lens of complexity science, systems biology, network theory, and even chaos theory (Somvanshi & Venkatesh, 2013; Oliven, Nelson, & Goldberger, 2020). These frameworks emphasize interdependence, feedback loops, tipping points, and non-linear dynamics that govern physiological regulation and dysregulation both in health and diseases rather than simple linear models. It is within this broader systems perspective that integrative medicine becomes especially relevant. Integrative medicine recognizes the multi-dimensional nature of health and seeks to bridge biological, psychological, behavioural, ecological, and cultural determinants of well-being. By

combining evidence-based biomedical interventions with holistic, preventive, and lifestyle-oriented approaches, it offers a conceptual shift capable of addressing the limitations of strictly reductionist models and aligning medical practice more closely with the complex realities of human health.

Understanding the importance of integrative medicine in health and disease management.

WHO defines integrative medicine as an interdisciplinary and evidence-based approach to health and well-being by combining biomedical and traditional and/or complementary medical knowledge, skills and practices. By integrating these diverse systems of healing, it will benefit from the positive effects of both holistic and reductionist perspectives of health and disease management. This allows for a more comprehensive model of care that addresses not only biological mechanisms but also behavioural, environmental, and cultural dimensions of health (World Health Organization, 2025).

Before understanding integrative medicine, it is important to discuss what is meant by an interdisciplinary approach in science. Science is basically the systematic study of the changes and phenomena in nature through observations, experimentations and critical evaluation. It aims at creating new knowledge about the structural and functional aspects of nature. In this sense, science is a methodology that creates new knowledge through systemic processes with objectivity and verifiability (Lederman, 2007). The methodology used for knowledge creation is grounded in philosophical foundations referred to as ontology (what exists), epistemology (how we know), logic (rules of reasoning), and axiology (values guiding inquiry) (Scotland, 2012). Within this philosophical framework, the word discipline can be understood as a branch of knowledge characterized by its unique ontology, epistemology, logic and axiology. Each discipline develops a unique perspective through which it interprets nature and its functions; and formulates various research questions. A discipline creates a specific boundary of epistemological assumptions, methodologies and even ontology, that define the scope of inquiry and nature of research questions which will influence the validation of knowledge (perhaps, it even limits how broadly a phenomenon can be understood and validated!). However, historically, a disciplinary approach for understanding the complexity of nature was imperative because the advancements in science and technology had expanded the amount and depth of knowledge generated. Therefore, managing and organizing information required a smaller and narrower field that made knowledge handling easy. The benefit of such a disciplinary approach is its ability to promote focused, in-depth investigation of an area enabling the researcher to deepen knowledge about the scientific questions. Consequently, a disciplinary approach provides a more reductionist view of a complex problem, but with a very detailed nuance of its components. While this is very essential to understand certain aspects of the problem, it results in narrow focus and fails to address the broader connections of the that

underlie a complex problem. This is extremely important for understanding specific aspects of a complex problem in detail.

However, this approach creates limitations. It may overlook the broader interactions, relationships, and emergent properties of the complex system and its real-world challenges. This is very relevant in cases like health and disease, as well as biology as a whole, as they are too complex and cannot be studied only through the lenses of any one discipline. As discussed earlier, the early developments of biology (including health and disease) were grounded in a more holistic and functional perspective where the entire functional aspects of nature are considered, acknowledging interconnectedness of all living systems. Over time, however, human civilization adopted an increasingly anthropocentric worldview for health and diseases placing human interests at centre and neglecting the values of ecosystem involvement in health, wellness and disease. This shift contributed to a fragmented scientific landscape that made integration of knowledge across disciplines more difficult. At the level of human health, this approach manifested as a dominant paradigm focusing more on understanding biological changes only at the molecular level, ignoring its systems-level consequences. As a result, biomedical science excelled at understanding parts of the system but struggled to explain how these parts interact to produce health or disease as emergent outcomes. As philosophy of science recognises two prevailing schools of thought, holism (studying complex systems as a whole) and reductionism (interpreting a complex system as its parts), at ontological, methodological and theoretical levels, both these perspectives are equally important for the knowledge domains of health and disease. Therefore, an interdisciplinary approach is important to bring together these different perspectives as each illuminates different dimensions of the complexity of health and disease.

The role of Ayurveda integrative medicine.

This is the context where the Indian System of Medicine (ISM) becomes relevant and novel. Ayurveda, the most widely used ISM, has its unique principles, epistemology and ontology of understanding the biological

changes. Ayurveda as a health management system evolved from various local health traditions and was systematized progressively. It is one of the codified medical sciences that had established its efficacy over a period of time. As discussed in the previous paragraph, Ayurveda being a science established much before the development of modern biology, its epistemology and ontology of understanding human health and disease are different and unique. The perspective of health in Ayurveda is holistic and personalized and it is derived from the doctrines of Indian knowledge systems such as Vedas, Sankhya, Nyaya-Vaisheshika and Vedantha systems of philosophy. Pratyaksha pramana (perceived by the sense organs) and Anumana Pramana (inferred from the perception) are used in Ayurveda as means of authenticating valid knowledge, along with Yukti (logic), for hypothesizing the cause (Nidana) of the disease from its manifestations as well as deciphering the possible manifestations from various causes. The fascinating scope of Ayurveda Biology is to bridge these two epistemologically different knowledge systems can create a new trans-disciplinary framework work for understanding the wellness and disease biology. Creating such a knowledge interface can in turn translate to novel integrative strategies for wellness and disease management. Additionally, it is also important to note that the concept of health and wellness in Ayurveda encompasses all living forms in the universe and acknowledge the interdependence of living and non-living entities in the universe. Moreover, Ayurveda considers human beings as an inseparable part of the whole nature, and the health and well-being of the human being is dependent on the health and wellbeing of the universe. Consequently, the human health and wellness in Ayurveda is expanded to the concepts of One Health and Planetary Health as well. Integrating this holistic perspective of human health Ayurveda - covering the physiology, biochemistry, psychology and even the ecological determinants of health – with the modern biomedical concepts would help in expanding the frontiers of biology.

Challenges associated with and Ayurveda Biology approach.

While Ayurveda Biology holds significant promise within the broader landscape of integrative medicine, constructing a logical and coherent transdisciplinary narrative between the two knowledge systems remains a complex task. These challenges can be broadly classified under four headings viz. Philosophical, Linguistic and Cultural, Historical, Societal and Experimental. Philosophically the primary challenge lies in the integration between a holistic and reductionist perspectives of biology. As discussed earlier, health and disease are the result of complex non-linear interactions of various components involved in it. Their manifestations are always more than the sum of their individual interactions. At a conceptual level, both Ayurveda and modern biology acknowledge a holistic understanding of health as the harmonious functioning of physiological, biochemical, and psychological processes. However, in practice, biomedicine largely employs a reductionist, molecular-cellular framework to decipher biological change, whereas Ayurveda adopts a holistic and functional systems view. Because these epistemological foundations differ, drawing direct

comparisons between the two is inherently challenging. The need of the hour is to have more detailed scholarly discussions to understand the different epistemologies and clarify their convergence and divergence and draw parallels between these perspectives. The second challenge is at the level of language and culture. As a system evolved in Southern Asia, particularly in the Indian subcontinent, Ayurvedic knowledge is documented in Sanskrit as well as in other vernacular languages of India. The meaning of the words used in Ayurveda need to be interpreted and explained in connection with its epistemology and ontology; and a simple, direct translation often fail to capture their depth. For example, translating Agni merely as “fire” overlooks its nuanced biochemical, metabolic, and regulatory connotations in contexts such as Swasthya (health), Pandu (anemia), or Prameha (diabetes and glucose-metabolism disorders). The task for scholars, then, is to interpret such concepts faithfully—preserving their epistemic essence while enabling meaningful dialogue with modern biology. Another major issue of creating a transdisciplinary knowledge framework is the religious and ritualistic aspects inter-knitted with the Ayurveda knowledge system. Careful academic discussion and distinction is required to prevent ambiguity and unscientific claims. At societal level, the dominance of a particular knowledge system (here biomedicine) will force the other knowledge system (here Ayurveda) to juxtapose its philosophical views to the framework of dominant system. This results in inappropriate integration of the concepts. Last and the major challenge is experimental. Current experimental model to prove the efficacy and mode of action are developed based on the molecular understanding of biology and such model systems may not answer the complex cellular and tissue level crosstalk that define the functional aspects of health and disease. Therefore, it is imperative to develop new experimental models at both in-vitro and in-vivo levels that are suitable for Ayurveda-Biology research.

Conclusion

Ayurveda Biology offers immense potential to enrich integrative medicine by bridging holistic Ayurvedic principles with



contemporary biological sciences. However, for effective integration a complex set of philosophical, linguistic, cultural, historical, societal and experimental challenges that currently hinder meaningful dialogue between the two knowledge systems needs to be addressed. Building a logical transdisciplinary framework necessitates careful interpretation of Ayurvedic concepts within their original contexts, and the development of innovative experimental models capable of capturing systemic and emergent biological phenomena. It is also important to have deeper discussions on the epistemologies of both Ayurveda and modern biology to evolve Ayurveda Biology as a meaningful scientific approach contributing new insights to the understanding of health and disease.

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