

Review Article

The one health paradigm: a review

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ABSTRACT

The One Health paradigm aims to achieve optimal health outcomes by recognizing the interconnection between people, animals, plants, and their shared environment. The increasing emergence of zoonotic diseases, environmental disruptions, and antimicrobial resistance (AMR) calls for an integrated and transdisciplinary approach. This review explores the origin and evolution of the One Health concept, its core principles, its alignment with primary health care strategies, and its role in combating zoonotic diseases and AMR. Special attention is given to the Indian context, highlighting significant national initiatives that illustrate the implementation of One Health. By analyzing current frameworks, we also emphasize the necessity of intersectoral collaboration, policy integration, and sustainable practices. The review concludes with recommendations for future directions, including global surveillance, community participation, and capacity building. Overall, the One Health approach presents a comprehensive strategy to confront global health challenges through unified efforts in human, animal, and environmental health sectors.

Keywords: One Health, Zoonotic diseases, Antimicrobial resistance, Primary health care, Environmental health, Public health policy

INTRODUCTION

An interdisciplinary approach known as "One Health" recognizes the complex relationships that exist between environmental, animal, and human health. An integrated strategy to disease prevention and management is required due to the growing frequency of zoonotic spillover events, deforestation, climate change, and antibiotic resistance. In order to avoid and mitigate public health concerns, the Centres for Disease Mitigation and Prevention (CDC) defines One Health as a cooperative endeavor encompassing several sectors, such as agriculture, environmental science, public health, and human and veterinary medicine.¹

In order to address global health issues like the COVID-19 pandemic, food security, and biodiversity conservation, the

World Health Organization (WHO) has underlined the significance of One Health.²

HISTORICAL BACKGROUND

The phrase "One Medicine," coined by Calvin W. Schwabe in 1964, served as the inspiration for the One Health concept. As time went on, this idea was extended to human and environmental health in addition to veterinary care.

The "One World, One Health" conference, which was hosted by the Wildlife Conservation Society in 2004, brought attention to the necessity of a multidisciplinary approach to health. As a result, in 2010, the World Organization for Animal Health (WOAH), Food and Agriculture Organization (FAO), and WHO established the Tripartite collaboration. The United Nations Environment Programme (UNEP) joined the partnership in

2021, creating the Quadripartite Alliance to improve the implementation of One Health around the world.³

CORE PRINCIPLES OF ONE HEALTH

The One Health framework is guided by key principles that promote a holistic and collaborative approach to health. Interdisciplinary collaboration lies at its foundation, requiring coordinated efforts from public health experts, veterinarians, environmental scientists, and policymakers. Equity among sectors is equally important, ensuring balanced distribution of attention and resources across human, animal, and environmental health domains. A socioecological balance is emphasized, recognizing the role of biodiversity and ecosystem integrity in preventing disease emergence and transmission. Sustainable practices, such as antimicrobial stewardship and responsible land use, support long-term health goals. Lastly, the integration of these principles into national and international policies is critical to achieving global health resilience.⁴ These interconnected principles are visually represented in Figure 1, which illustrates the overlap and shared responsibilities among human, animal, and environmental health systems.

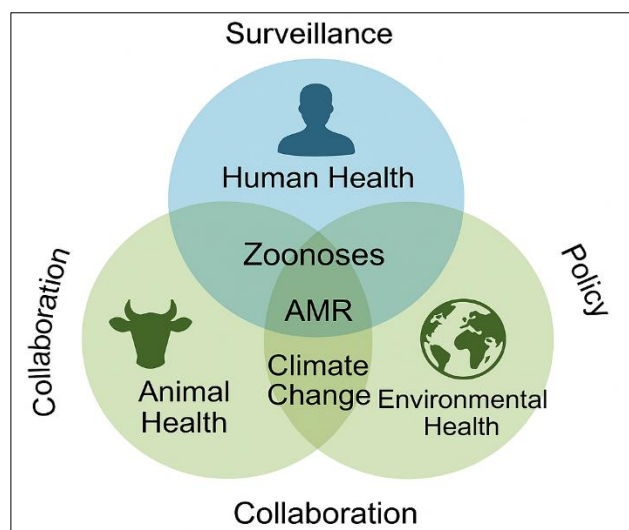


Figure 1: Venn diagram illustrating the One Health triad—human, animal, and environmental health—highlighting interconnected challenges such as zoonoses, AMR, and climate change. Effective collaboration, surveillance, and policy are essential for integrated health management.

ONE HEALTH AND PRIMARY HEALTH CARE

The principles of One Health closely align with those of primary health care (PHC), both emphasizing a preventive, equitable, and community-focused approach. Preventive care is central to both frameworks, with One Health focusing on early detection and response to emerging zoonoses, environmental hazards, and antimicrobial resistance. Equity is another shared goal, aiming to provide accessible health services across human and animal

populations, especially in underserved communities. Both models stress the importance of community engagement and awareness, recognizing that sustainable health solutions must involve local populations in decision-making and implementation. Additionally, interdisciplinary collaboration is vital to both approaches, as achieving comprehensive health outcomes necessitates joint efforts from healthcare professionals, veterinarians, environmental scientists, and policymakers. The convergence of One Health with PHC thus provides an integrated pathway to strengthen public health systems at both national and global levels.⁵

ZOONOTIC DISEASES AND PUBLIC HEALTH

Zoonotic diseases, which are transmitted from animals to humans, account for more than 75% of emerging infectious diseases globally.⁶ Their increasing incidence is largely driven by factors such as deforestation, habitat fragmentation, the illegal wildlife trade, and heightened human-animal interactions. Among the most significant zoonotic diseases is rabies, a fatal viral illness typically transmitted through the bites of infected animals, particularly dogs. COVID-19, caused by the SARS-CoV-2 virus, is another critical example, with bats believed to be the original hosts and pangolins as potential intermediate carriers.⁷ Brucellosis, a bacterial disease often spread through unpasteurized dairy products, affects both humans and animals. Salmonellosis, primarily associated with contaminated animal-derived food products, is another notable zoonosis caused by *Salmonella* bacteria. Furthermore, the Ebola virus disease has been linked to contact with infected wild animals, especially bats and non-human primates. These examples underscore the urgent need for a unified public health strategy that integrates environmental, veterinary, and human health perspectives to prevent and manage zoonotic threats effectively.⁸

ANTIMICROBIAL RESISTANCE

Antimicrobial resistance (AMR) makes infections more difficult to cure by causing bacteria, viruses, fungi, and parasites to become resistant to antimicrobial treatments. AMR has increased as a result of the overuse and abuse of antibiotics in both human and veterinary medicine. AMR's effects include longer hospital stays, higher death rates, and financial strain on healthcare systems. The WHO and CDC advise putting surveillance systems like the World Animal Health Information System (WAHIS) and the Global Early Warning System (GLEWS) into place to fight AMR. The National Animal Disease Reporting System (NADRS) in India tracks changes in antibiotic resistance and animal health.⁹

ONE HEALTH IN INDIA

India, with its dense population, diverse ecosystems, and high livestock-human interaction, is particularly vulnerable to zoonotic diseases and antimicrobial

resistance. Recognizing the need for a unified health strategy, the country has taken significant strides in implementing the One Health approach. In 2009, the One Health Alliance South Asia (OHASA) was established to address the threat of zoonotic diseases. This was followed by the launch of the National Centre for Disease Control (NCDC) in 2010 by the Ministry of Health and Family Welfare, serving as a central hub for health surveillance and disease management. In 2014, the Centre for One Health Education, Advocacy, Research, and Training (COHEART) was inaugurated at Kerala Veterinary and Animal Sciences University to foster academic and practical One Health initiatives. A collaborative One Health research partnership was initiated in 2019 involving the Ministry of Health, the Department of Biotechnology, and the Ministry of Agriculture. Most notably, in 2021, the National One Health Mission was launched to integrate human, animal, and environmental health systems under a cohesive national framework. These milestones underscore India's growing commitment to operationalizing the One Health paradigm through institutional support, research, and intersectoral coordination.¹⁰

METHODS

This review was conducted by analyzing peer-reviewed journals, reports from international health agencies including WHO, CDC, FAO, and UNEP, and publications from government and academic sources related to One Health. Databases such as PubMed, Google Scholar, and WHO IRIS were used to identify relevant literature published between 2000 and 2024. Key search terms included “One Health,” “zoonotic diseases,” “antimicrobial resistance,” “climate change,” and “India One Health policy.” Selected studies were synthesized to present a comprehensive overview of the One Health framework and its application.

DISCUSSION

The One Health concept has transitioned from a theoretical framework to a pragmatic solution for global health threats. Literature underscores the role of biodiversity conservation and AMR surveillance in reducing disease transmission. For instance, Taylor et al. emphasized the ecological factors underlying disease emergence, while Jones et al. highlighted global trends in emerging zoonoses.^{6,12} In another comprehensive review, Zinsstag et al. discussed the application of One Health in global health security and the value of intersectoral partnerships in developing countries.³

Moreover, studies such as those by Lebov et al. have evaluated the integrated health outcomes associated with One Health approaches, confirming their utility in addressing multifaceted health challenges including foodborne illnesses and vector-borne diseases.¹⁰ The integration of environmental surveillance with health information systems has proven successful in early

detection of outbreaks, such as avian influenza and Rift Valley fever, as documented by Queenan et al. in the development of a roadmap for One Health implementation.¹¹ Similarly, the Global Early Warning System (GLEWS) and the World Animal Health Information System (WAHIS) represent international efforts to coordinate data sharing between sectors to combat AMR.⁹ Despite these advancements, challenges persist. Limited funding, fragmented governance, inadequate workforce training, and data silos hinder the full operationalization of the One Health framework. A review by Okello et al. on operationalizing One Health in sub-Saharan Africa revealed that institutional capacity and political commitment are vital for sustained implementation. Additionally, the COVID-19 pandemic further illustrated the cost of inaction, where a lack of integrated surveillance delayed early response. India's One Health roadmap, including COHEART and the National One Health Mission, represents progressive steps, but continued interministerial coordination and local community engagement are necessary to achieve long-term success.¹⁰

Embedding One Health in the curricula of medical, veterinary, and environmental sciences is crucial for cultivating a new generation of professionals capable of cross-sectoral collaboration. Public awareness campaigns, cross-border data harmonization, and consistent funding mechanisms will also be essential. By consolidating efforts across human, animal, and environmental sectors, and anchoring them in research and policy, the One Health approach can truly serve as a sustainable solution for the prevention and control of global health threats.

FUTURE DIRECTIONS

The successful implementation of One Health requires strategic integration into public health policies and healthcare systems. Strengthening collaboration among sectors is essential, not only at national and state levels but also across international borders. Research and data collection must be enhanced to identify health threats early and to evaluate the effectiveness of One Health interventions.¹¹ Increasing public awareness through education and communication campaigns can help communities understand the importance of a holistic health perspective. Capacity building is another key aspect—training professionals across disciplines in One Health principles will improve coordinated responses. Finally, ensuring sustained financial investment and support from global organizations and governments will be crucial to institutionalizing the One Health paradigm and ensuring long-term impact.¹²

CONCLUSION

The One Health paradigm is an essential framework for addressing the complex and interdependent challenges of human, animal, and environmental health. As global threats such as zoonotic diseases, antimicrobial resistance,

and ecological disruption continue to rise, the need for an integrated and collaborative approach becomes increasingly urgent. This review highlights the significance of One Health in enhancing disease prevention, promoting sustainable health practices, and improving health systems through interdisciplinary partnerships. In the Indian context, the establishment of national programs and cross-sectoral alliances reflects a promising direction, although implementation gaps remain. Moving forward, embedding One Health into national policies, enhancing public and professional awareness, and fostering global cooperation are vital steps toward ensuring a healthier and more resilient future for all living beings and ecosystems.

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