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One health concepts and its applications in clinical practice: a comprehensive review

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Evidence in Context

• Advocates a One Health approach linking human, animal, and environmental health. • Emphasizes integrating veterinary, medical, and environmental sciences to enhance health outcomes. • Highlights One Health's role in ensuring sustainable food systems and food safety. • Discusses enhancing global health security by improving disease surveillance and emergency response. • Calls for ongoing research and policy integration to support a sustainable, healthier world.

To view Article

Abstract

The One Health concept highlights the interdependence of human, animal, and environmental health, advocating for a collaborative, multi-sectoral, and interdisciplinary approach to attain the best possible health outcomes. This review comprehensively explores the One Health framework, highlighting its relevance in addressing contemporary global health challenges such as zoonoses, climate change, antimicrobial resistance, and neglected tropical diseases (NTDs). It examines the role of International Health Regulations (IHR) in implementing One Health strategies, promoting health education, and identifying gaps in practices to strengthen health systems globally. The review discusses the human-animal interface, the impact of climate change on vector-borne diseases, and the importance of integrating veterinary, medical, and environmental sciences to enhance public health outcomes. Additionally, it addresses the significance of food safety and nutrition, outlining the contributions of One Health in ensuring safe and sustainable food systems. The review also demonstrates the effectiveness of One Health initiatives in mitigating the spread of infectious diseases and enhancing global health security. The integration of One Health principles in clinical practice and public health policy is essential for a resilient and responsive health system capable of addressing the complex interplay of factors affecting health. The review calls for continued research, interdisciplinary collaboration, and the implementation of One Health strategies to foster a healthier, more sustainable world.

Keywords: *one health; intersectoral approach; antimicrobial resistance; public health; zoonosis; sustainable development; food safety; ecosystem health; veterinary medicine*

Introduction

'One Health' is an approach that is being shared more in recent years, which recognises that humans' wellbeing is in a close interplay with the health of other species and our common environment, i.e. planet Earth. Vector-borne illnesses, neglected tropical diseases, endemic zoonotic diseases, antibiotic resistance, new and reemerging infections, food safety and security, climate change, environmental threats, and concerning health issues that affect people, animals, and the environment collectively are just a few of the many health paradigms. For instance,

01. **Multi-drug resistant microorganisms** spread rapidly through the food supply, interaction in the communities, trade links, healthcare centres, travel, and environment (soil, water) thus making certain infections difficult to treat in both people and animals.
02. **The incidence of vector-borne diseases is increasing with hotter temperatures** and ever-expanding vector habitats.
03. **Animal diseases can endanger economies, livelihoods, and supply.**
04. **The link between humans and animals may support mental health.**
05. **Drinking, playing, and other uses of unclean water can infect humans and animals.**

Chronic health conditions, mental health, occupational health, neglected zoonotic disease, and other non-communicable diseases can also be tackled through the One Health approach if there is interdisciplinary collaboration across all sectors [1].

The basic foundation for the One Health approach includes- interaction, harmonisation, teamwork and capacity building among human, animal, environmental health, and other relevant stakeholders [2].

One Health Initiative

One Health is a worldwide movement that seeks to foster collaboration among healthcare professionals, veterinarians, dentists, and experts in health and environmental sciences. Its focus is to enhance the welfare of all creatures by fostering relationships between people, animals, plants, and their shared environment [3-5]. By doing this, it recognises the innate link between ecological, animal, and human health and works to promote and defend the welfare of all species [4]. Over 985 globally renowned scientists, doctors, and veterinarians have extended their support to this initiative. Furthermore, to coordinate activities in the areas of environmental, animal, and human health, the World Health Organization (WHO) launched its own One Health Initiative [5–6]. WHO is aggressively promoting the One Health concept implementation in national, regional, and global health policy in collaboration with partner organisations. This is achieved through multidisciplinary leadership, operational strategies, capacity building, and vigilance in monitoring and responding to emerging pathogens [7]. The efficacy of this strategy in addressing health issues involving the interaction of environmental, animal, and human variables is becoming more recognised. This covers the control of zoonotic illnesses both nationally and internationally [8].

Vector-Borne Diseases in a Changing Climate

Rising temperatures have a big impact on safety, wellbeing, and health worldwide. Its effects are rooted in our environment and impact our wellbeing. We can see how extreme weather events like heat waves, floods, and wildfires are directly impacted by climate change. These events, in turn, have indirect consequences on various aspects of our lives, including infectious disease transmission, air quality, food and water security, and mental health [9-10]. It is important to note that climate change affects different populations in distinct ways, with older individuals, children, and people of colour often being more susceptible to issues such as malnutrition and vector-borne diseases. Therefore, addressing these diverse health impacts necessitates a comprehensive approach that includes primary, secondary, and tertiary interventions [11]. Climate change is anticipated to worsen malnutrition problems, particularly in the United States. This is primarily due to disruptions in crop yields caused by climate-related factors such as high temperatures, unpredictable rainfall patterns, and extreme weather events. These disruptions lead to increased food and economic insecurity. Additionally, the lack of access to affordable

And nutritious diets contributes to poor health and diet-related diseases [11]. Taking into consideration the complicated interplay of numerous causal elements, a holistic strategy is necessary to effectively address the complex issue of climate change and its influence on human health. Governments and private agencies must provide broad scope of this challenge and understand that it lacks simple solutions and quick fixes. Climate change is a multifaceted policy concern with numerous contributing factors, a need for effective strategies, and significant disagreements about the problem [12]. If we can connect climate change with well-known health issues such as asthma, allergies, and infectious diseases that affect local communities, we have the potential to enhance public awareness and engagement. By framing the issue as a matter of public health concern, we bring it closer to home and emphasise its urgency, motivating individuals to take action to mitigate its adverse effects [13]. Climate change poses a severe threat to human health, and addressing this issue will require a multifaceted strategy that emphasises the importance of increasing awareness and implementing preventative measures.

Human-Animal Interface Team

The human-animal interface constitutes a pivotal component of the One Health paradigm, which advocates a collaborative, multisectoral, and transdisciplinary approach to achieve better health outcomes by acknowledging the fine interconnectedness of all species dwelling on the Earth and their shared environment [14-15]. This interface denotes the diverse ways in which humans and animals interact, serving as a conduit for the transmission of diseases. Such interdependent interactions between humans and animals significantly contribute to the emergence and dissemination of infectious diseases, emphasising the imperative adoption of a One Health strategy to tackle this challenge [7, 14-18]. One Health contributes to global health security by providing a complete framework for disease control that encompasses prevention, detection, readiness, response, and management by integrating humans, animals, and the environment [7]. This approach encompasses the realms of public health, veterinary science, and environmental sectors [5]. The human-animal interface serves as a reservoir for diseases with implications for public health, with diseases transmissible from animals to humans being designated as zoonoses [4-5]. Notable examples of zoonotic diseases include rabies, Ebola virus, and avian influenza [4]. Moreover, this interface can also pose chronic disease risks to both human and nonhuman animal populations [19]. One Health is particularly important when it comes to food and water safety, environmental control, zoonotic disease prevention, nutrition, and the fight against antibiotic resistance [5]. It can be applied at several levels, such as local, subnational, national, regional, and international, provided good governance, coordination, communication, and teamwork are in place [7]. In summation, the human-animal interface constitutes a pivotal element of the One Health approach, and its adoption is indispensable in combatting infectious diseases that emanate and propagate through this interface.

International Health Regulations (IHR)

A legal declaration IHR (2005) was released by the WHO in 2005 [20]. It issues a framework guideing various member states in handling public health emergencies of pandemic potential such as COVID-19 and Mpox. Although a variety of actions need to be taken to control such a widespread disease, these international regulations legally bind WHO's member countries, which include the 194 Member States. These also define which particular health event constitutes a "public health emergency of international concern (PHEIC)". The IHR states the need to create a 'National Focal Point' for constantly being in touch with the WHO to build core capacities for surveillance and action, at the exit as well as entry points. It also defines regulations and necessities for cross-border travel and transport, such as health documents. Various threats to both humans and the environment exist today, including zoonoses, the use of potentially carcinogenic products, widespread resistance to antimicrobial agents, bioterrorism, food and waterborne infections, nuclear spills or leaks, and chemical spills or attacks. The health sector must collaborate to actively control these hazards. The World Health Organization (WHO) facilitates this through the WHO IHR Monitoring and Evaluation Framework, comprising annual reporting, joint external evaluation, after-action review components, and simulation exercises. WHO advocates for multidisciplinary approaches to monitor and assess a country's capacities under the IHR.

One Health in yearly reports- The IHR has made Annual Reporting essential in order to advance the idea of One Health. It requires consideration of 13 basic capacities and input from a variety of sectors, most notably the animal health industry. A manual created by WHO and the

World Organization for Animal Health (WOAH) directs Veterinary Services in evaluating their performance.

One Health in the Joint External Evaluation (JEE) - JEE is a multisectoral process through which the WHO assists countries in determining their capacity levels for 19 technical areas. WHO and the WOAH have also developed a handbook facilitating the assessment of veterinary services that contribute to the implementation of the IHR.

One Health in Simulation Exercises (SimEx) - Simulation exercises that facilitate testing capabilities of emergency systems with simulated public health emergencies help in binding the various sectors and stakeholders together, for these exercises are a must for an unbeaten zoonoses outbreak response

One Health in After Action Reviews (AARs)

AAR is one of the basic components of the IHR Framework. It provides a review of actions taken to respond to an emergency after analysis by identifying gaps in practices and the lessons learned. Also, by bringing collaboration among various sectors, this activity allows enhanced collective action to mitigate various risks. This is how the IHR is strengthened through a One Health Approach [21]. The WHO successfully implemented the IHR by actively encouraging collaboration among diverse sectors, specialities, and fields of activity through a One Health strategy. The WHO collaborated with the WOAH, the Food and Agriculture Organization of the United Nations (FAO), and other national and international partner agencies. The Performance of Veterinary Services Pathway is one mechanism for coordinating efforts amongst stakeholders in animal and human health systems. The execution of the essential capabilities listed in the IHR is accelerated by the integration of all these strategies into the National Action Plans of the participating nations for Health Security. As a result, One Health is essential to every IHR MEF component [22].

The International Health Regulations must be modified to solve global health security concerns, and adopting a One Health strategy is essential (IHR). Implementing a One Health strategy by balancing multiple standards within the IHR can streamline the evaluation process for various governments, minimising redundancies. The IHR is essential for addressing the man-animal–environment interface and improving overall health. The SARS-COV2 pandemic serves as a stark reminder that to effectively mitigate the threat of emerging zoonoses and infectious disease outbreaks,

One Health approach, when collaborated with the tools listed above allows for improved surveillance, healthier information sharing, joint risk assessment, and field investigation. Maintaining One Health momentum is an intimidating task, and a driving force like IHR is a must to implement it at national and international levels [23].

Neglected Tropical Diseases (NTDs)

The connection between animal, environmental, and human health is actively recognised and integrated by One Health. Its objective is to maintain ecosystems and human and animal health at their best [24]. Neglected Tropical Diseases (NTDs) have continuously been reported as chronically disabling and deforming diseases compromising the health and wellbeing of populations. Between 2003 and 2005, stakeholders coined the term "NTD" during meetings held in Berlin, Germany, to establish the groundwork for global NTD initiatives [25]. The CDC defines NTDs as a range of parasitic, viral, bacterial, fungal, and other illnesses affecting over one billion people worldwide, especially those in impoverished and disenfranchised communities [26]. As per WHO's classification criteria, NTDs comprise over 20 infections or conditions that affect impoverished populations, leading to significant morbidity and mortality. This justifies a global response. Public health interventions can benefit individuals afflicted with NTDs, particularly those residing in tropical and subtropical regions with limited access to healthcare. However, these NTDs receive relatively less attention and funding from both the public and private sectors compared to the scale of the health challenges they present [27].

NTDs impose a significant psychological and economic burden on both larger communities and the individuals affected. Zoonotic NTDs, due to their nature, present a challenge for eradication as animal reservoirs serve as a constant source of re-infection. This leaves population elimination as the sole and most feasible public health goal [28]. It emphasises the need for a fundamental change from holistic cross-cutting approaches to disease-specific interventions collaborating with multiple disciplines. By considering the links between the health systems of humans and animals in their shared environment as well as the larger social and economic context,

The approach goes beyond traditional disease control models [29]. To address every element that contributes to the spread of NTDs, the One Health strategy is crucial. To stop and prevent zoonotic NTDs like rabies, guinea worm disease, and Chagas disease, it emphasises the need for multi-sectorial coordination, ethical considerations, and an understanding of transmission pathways. Collaboration between human and veterinary health services is also necessary, as are environmental protection programmes that provide safe drinking water and practise basic hygiene [30].

The WHO NTD ROAD MAP for NTDs is a highly strategic document that aims at strengthening the programmatic response to these diseases. While recognising the advantages of cooperation, it establishes the necessity of a One Health strategy to meet control and elimination targets through wiser investments [31] to innovate and develop new strategic methods for NTD control. For this, point-of-need diagnostics, using genomic technologies to track changes in parasite distribution and vector dynamics, and integrating efforts between waterborne parasitic infections are taken, for instance, widespread preventative care, integrated vector control, creative and enhanced disease management, veterinary health, and access to clean water, hygienic conditions, and sanitation [32].

Nutrition and Food Safety

The phrase "One Medicine," which was the forerunner of "One Health," was first used in 1964 by veterinary specialist Dr. C. Schwabe in his book "Veterinary Medicine and Human Health." Dr. Schwabe is recognised as the One Health concept's initial visionary. He pointed out the similarities in treatments and the existence of essentially one medication when he suggested that traditional healers did not distinguish between treating ailments in people and animals. Their mutual reliance encourages cooperation for the achievement of social justice and public health, highlighting the link between health and having access to clean water, food, and sanitary living conditions [33]. It emphasises developing international standards for food safety through the FAO/WHO Codex Alimentarius, aiming to build global leadership and facilitate investment. This involves coordinating evidence-based action across multiple sectors, supporting member countries in achieving sustainability with a balanced distribution of responsibilities among stakeholders The International Food Safety Authorities Network provides adequate infrastructure for handling food safety emergencies. Unsafe food can cause over 200 ailments, from deadly cancer to mild diarrhoea, by harbouring hazardous bacteria or chemicals to maintain life and advance wellbeing, it is essential to make sure that there is an adequate supply of healthy food. To guarantee food safety and fortify food systems, governments, producers, and consumers must work together effectively.

• Bacteria: The most prevalent foodborne pathogens are bacteria, including Salmonella, Campylobacter, and Enterohaemorrhagic Escherichia coli, which can cause serious and even fatal illnesses. Each year, millions of people are affected by these bacteria. Enterohaemorrhagic Escherichia coli can lead to symptoms like fever, migraine, nausea, vomiting, stomach pain, and diarrhea. The contamination sources include fresh produce, undercooked meat, and unpasteurised milk. Salmonellosis outbreaks, associated with eggs, poultry, and other animal products, can result in severe illness. The main causes of campylobacter poisoning include polluted drinking water, raw or undercooked poultry, and raw milk.

• Listeria is the deadliest foodborne infection, especially for young children and elderly people. It can cause abortion in pregnant women or even death in neonates. Unpasteurised dairy products and ready-to-eat meals are the sources of the infection, and Listeria can grow in lower temperatures.

Contaminated food or water can expose people to the Vibrio cholerae infection, which can cause symptoms like vomiting, diarrhoea, severe dehydration, and occasionally even death. Emergencies of cholera have been associated with the eating of seafood, vegetables, rice, and millet gruel. Furthermore, certain viruses, such as the Norovirus and Hepatitis A, can spread through food consumption and cause symptoms like nausea, vomiting, seizures, diarrhoea (watery), and pain in the abdomen. Prions, infectious proteinaceous particles, are linked to neurodegenerative diseases such as Creutzfeldt-Jakob disease (vCJD) in humans and Bovine Spongiform Encephalopathy (mad cow disease) in cattle. Eating meat items that contain contaminated brain tissue exposes one to prion agents.

These are "Five keys to safer food" which include-

1. Hygienic food
2. Separate raw and cooked

3. Thoroughly cooked food
4. Food at a safer temperature
5. Safer water and raw materials

Every year, one in ten people get sick from eating unsafe food. Both food workers and individual customers have a critical role to play in preventing foodborne illnesses. In 2001, an independent body of international scientists validated the "Five Keys to Safer Food" messages to empower global consumers with an easily applicable set of actions to prevent such diseases [34].

Surveillance, Stopping and Managing Antimicrobial Resistance (AMR)

Antimicrobial resistance (AMR) has been recognised as one of the most critical global threats to the health of humans and animals, plants and ecosystems due to the irresponsible and excessive use of antimicrobials in various sectors (agriculture, cattle raising, and human medicine) as well as a threat to the achievement of the Sustainable Development Goals (SDGs). In our globally connected world, resistance to antimicrobials may spread and circulate among humans, animals, plants and the environment, necessitating a "One Health" approach [35]. The increasing emergence and spread of AMR affect our ability to treat infections and manage AMR-associated economic impacts across all sectors. The rapid global spread of multidrug-resistant bacteria causing infections that cannot be treated with current antimicrobials is a major concern. Consequently, a single-sector approach for preventing and controlling AMR is insufficient. Tackling the growing threat of AMR requires a One Health approach [36].

In 2015, the Sustainable Development Goals (SDGs) were updated by all United Nations Member States to enhance global well-being by 2030. SDG 3, "Good health and wellbeing," specifically focuses on the impact of antimicrobial resistance (AMR) across multiple SDGs [37]. In the same year, WHO Member States unanimously accepted the Global Action Plan on Antimicrobial Resistance (GAP-AMR). WHO led the first global collaborative effort to standardize AMR surveillance by establishing the Global Antimicrobial Resistance and use Surveillance System (GLASS) [38]. Furthermore, India developed a National Action Plan (NAP) to tackle antimicrobial resistance [39]. It is imperative to establish a comprehensive One Health research agenda that incorporates perspectives from the environmental, animal, and human domains to address AMR. Key priorities for this research have been identified by four organisations: The World Organization for Animal Health (WOAH, formerly the OIE), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP), and the World Health Organization's AMR division are involved in addressing the issue. The advisory committee makes sure that nations throughout the world carry out integrated surveillance, talking about the usage and ingestion of antibiotics in populations of both humans and animals. Collaboration with One Health has led to the development of many AMR research techniques, interventions, and policies; nevertheless, significant evidence is still needed to understand their efficacy for diverse people and in varied circumstances [40]. Additional research is needed to better understand the dynamics of antimicrobial resistance (AMR), such as the risks of transmission between humans, animals, plants, and the environment, as well as the conditions that promote the emergence of resistant genes and antimicrobial residues at the one health interface. Several environmental drivers of AMR include the excessive or improper use of antimicrobial agents, antimicrobial usage in farm animals, and the presence of biocides such as insecticides, pesticides, fertilisers, and disinfectants. Other contributors include pharmaceutical wastewater, municipal wastewater, hospital effluents, agricultural manure and sludge, and aquaculture [41]. The One Health approach has the capacity to globally address the issue of antimicrobial resistance (AMR) [35,42].

Conclusion

Overall, the index review summarises the concept of One Health approach towards human-animal interplay along with the importance of climate change, human-animal interface, ecological and environmental effects. The role of IHR is significant in implementing the One Health approach by utilising varied core capacities and multisectoral resources, identifying gaps in practices and strengthening through promotion of health education and awareness. In order to promote an integrated approach, it's critical to generate research-based evidence on the One Health approach.

Supporting information

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Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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