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Review Article

Interface of One Health and Society: An Overview

Swarup K. Chakrabarti[1]* and Dhrubajyoti Chattopadhyay[1,2]

[1]HP Ghosh Research Center, India

[2]Sister Nivedita University, India

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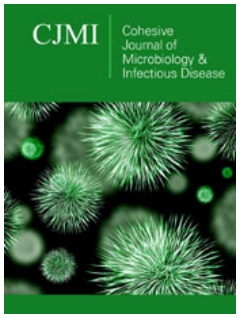

***Corresponding author:** Swarup K. Chakrabarti, HP Ghosh Research Center, HIDCO (II), EK Tower, New Town, Kolkata, West Bengal 700161, India

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Abstract

In conjunction with a set of strategic goals known as the "Manhattan Principles," the phrase "One Health" (OH) was first used in 2003–2004 during the outbreak of Severe Acute Respiratory Syndrome (SARS) in early 2003 and the following spread of highly pathogenic avian influenza H5N1. Although the concept of OH is not entirely new and has evolved over the past 200 years since its original conception as "One Medicine," "One World, One Health," and eventually "One Health". According to the One Health Commission and the US Centers for Disease Control and Prevention, "One Health is defined as a collaborative, multisectoral, and transdisciplinary approach-working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes," taking into account the connections between people, other animals, plants, and their shared environment. Among the many advantages of OH, the COVID-19 pandemic is an intriguing illustration of how OH can be especially important for preventing, predicting, identifying, and responding to risks to global health. OH also has a significant impact on how food safety and antibiotic resistance are regulated, which reduces the burden of communicable and non-communicable diseases in society. Together with OA's significant association with the Social Determinants of Health, OA contributes to the achievement of several Sustainable Development Goals. OH is essential for global health governance, as demonstrated by its significant commitment to the endeavor of pandemic preparedness on a worldwide scale. The success of OH depends on its ability to evaluate its performance, which is done using normative, qualitative, quantitative, and mixed-methods analysis to assess its influence across disciplines, sectors, species, paradigms, and demographics, and integrates at many spatial scales. Despite several challenges, the OH strategy can: Improve food safety and security; Prevent zoonotic disease epidemics in humans and animals; fewer diseases brought on by microorganisms that are resistant to antibiotics, and better health for both people and animals; Conserve biodiversity and ensure the safety of the world's health.

Introduction

A number of concepts when combined give the correct definition of "One Health

The term "One Health" (OH) was first used in 2003–2004 during the outbreak of Severe Acute Respiratory Syndrome (SARS) in early 2003 and the subsequent spread of highly pathogenic avian influenza H5N1 [1]. This was done in conjunction with a set of strategic goals known as the "Manhattan Principles," which were developed at a meeting of the Wildlife Conservation Society in 2004 in the United States and explicitly recognized and underlined the potential connection between human and animal health as well as the threats that diseases may pose to food supplies and economies [2]. Long before this, in the nineteenth and early twentieth century, researchers like Louis Pasteur and Robert Koch and physicians like William Osler and Rudolph Virchow overcame the customary barriers between animal and human health [3]. Thus, the idea of OH is not entirely new and has developed over the past 200 years from its initial conception, originally as "One Medicine", followed by "One World, One Health", and finally "One Health" [4,5]. Having said that, despite numerous suggestions, there is still no universally accepted definition of OH [1,6]. The most well-known definition is that shared by the US Centers for Disease Control and Prevention and the One Health Commission, according to which "One Health is defined as a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes," taking into account the connections among

humans, other animals, plants, and their shared environment [1]. According to the One Health High-Level Expert Panel (OHHLEP), OH is a comprehensive, unified strategy that seeks to balance the health of people, animals, and ecosystems optimally and sustainably [7]. Consequently, it essentially acknowledges that the wellbeing of people, domestic and wild animals, plants, and the larger extrinsic environment (including ecosystems) is closely related to and interdependent, bringing in the spheres and convergence of multidisciplinary, interdisciplinary, and transdisciplinary research for the holistic governance of the global health [8,9]. A much more concise and useful interpretation of these two definitions is provided by the One Health Institute at the University of California, Davis, which states that "One Health is an approach to ensure the well-being of people, animals, and the environment through collaborative problem solving—locally, regionally, nationally, and globally" [1]. In addition, from the perspective of public health policy, OH is acknowledged as a broad conceptual framework that builds a global view of public health by integrating human and animal health, as well as the environment [10,11]. This calls for consideration of collective inputs from bottom-up and top-down perspectives to be integrated in the policy draft, facilitated by an inclusive government and supported by vibrant interactive science across all scientific disciplines. All things considered, the concept of OH must take into account how the relationship between people and animals, as well as the global climate, is constantly evolving.

The widespread benefits of One Health approach in lowering the burden of communicable and non-communicable diseases in society

The COVID-19 pandemic is an interesting example of how OH might be particularly crucial for preventing, predicting, detecting, and responding to risks to world health [12,13]. The large body of evidence that has accumulated over time has a tendency to heavily rely on the dogma that different pathogens typically continue to circulate in animals living in unbalanced habitats in milder forms, but if the balance is upset, they move out of their natural distribution and come into contact with human population, where they typically jump the interspecies barrier by undergoing mutations and then infect humans and other species. For instance, recent outbreaks of zoonoses like the avian flu or the Ebola and Zika viruses have demonstrated the significance of the interconnectedness between human health, animal health, and environmental health [14,15]. Despite the fact that animals do not appear to be particularly important in the likely spread of the SARS-CoV-2 virus among humans during the ongoing COVID-19 pandemic, OH-related investigations, and in particular animal surveillance, are crucial in assessing the transmission of the virus between humans and animals. The hypothesized zoonotic transmission of SARS-CoV-2 to humans that led to the initial outbreak of COVID-19 disease cannot be completely ruled out in this case, despite the paucity of strong data supporting this a priori theory [16]. Moreover, OH approach is especially critical as world populations are growing and expanding into new geographic areas, compelling a vast majority of people live in close proximity with wild and domestic animals, increasing the propensity towards close interactions with animals along with environments, to aggravate the risk of disease transmission between animals and people [17]. Also, over the decades, the world has periodically witnessed noticeable changes in climate and land use, as a result of large-scale deforestation and intensive farming practices, causing disruptions in environmental conditions and habitats, to further escalate opportunities for endemic diseases to pass to animals and humans [18,19]. Additionally, this is compounded by the fact that the movement of people, animals and animal products for human consumption has escalated significantly over recent decades due to increased international travel and trade, resulting in greater likelihood of disease spread at an astounding pace across borders and around the globe [20,21]. This has caused in part the spread of existing or known (endemic) and new or emerging zoonotic diseases that can spread between animals and people. Thus, strict adherence to OH will deepen our understanding of the variety of animals that can be infected by a pathogen in terms of potential establishment of new hosts and reservoirs, where the new pathogen such as virus could hide, mutate, and potentially re-emerge as a new lethal variant in the global population. This will help to better aid in the management of infectious disease spread throughout the population.

One Health's crucial role in regulating food safety and antimicrobial resistance

More importantly, the developing world is likely to experience the greatest acceptance of OH and its benefits because of its potential to significantly improve food safety [22] and the management of infectious diseases, particularly the eradication of Antimicrobial Resistance (AMR) [23]. To elaborate, the public's rising scrutiny and concerns about the safety of our food have led to an increase in the frequency, cost, and globalization of food-borne illnesses. A stringent application of OA would be beneficial in this area because there are still differences over how to increase food safety, mostly because there isn't a complete, integrated plan for implementation in many nations worldwide. Moreover, pets, farm animals, farmed fish in aquaculture systems, bees, and other species all benefit from the use of antibiotics. Antimicrobials are crucial in the production of animals because they can be utilized for a variety of functions, including prophylaxis, animal growth, and therapeutic objectives. It's interesting to note that compared to human use, a significantly greater amount of antimicrobials are believed to be utilized on animals worldwide [24]. More importantly, because many antimicrobials, including those used therapeutically in plants (such as tetracycline, triazoles, and streptomycin), are also used in humans and other animals, AMR is easily spread between and among different habitats and populations, leading to resistant zoonotic bacteria found in the soil, where they can then infect plants, vegetables, and fruits [25].

Additionally, given the effects of climate change and environmental degradation, which increase stress on animal behavior due to habitat loss and cause a global imbalance that has far-reaching effects on society, it is anticipated that there will be an increase in newly emerging unknown infections and Non-Communicable Diseases (NCDs) [26] in the near future. Particularly,

the burden of NCDs is being carried disproportionately by Low-And Middle-Income Countries (LMICs), underscoring the need for NCD prevention as an element of development initiatives by strictly observing the principles of OA. This is corroborated by the connection between NCDs and novel zoonoses and recent concerns about food safety, such as the environment-feed-food cycle and toxic exposures of animals used for food production [27]. The etiology of some NCDs, for instance, has been linked to mycotoxins that contaminate feeds and agricultural goods [28].

The achievement of multiple sustainable development goals is aided by one health

As opposed to the siloed approach in healthcare, OH actively engages and mobilizes diverse sectors, disciplines, and communities at various levels of society to work together to promote the well-being of people, animals, and the environment and manage emerging threats to public health and ecosystems, while attending to the needs specific to each sector, such as adequate provision for clean water, energy, and air, safe and nourishing food, prevention of infectious diseases, taking action on climate changes, work on sustainable agriculture, plant, forest, aquaculture health, among others, and contributing to the fulfillment of multitude of major Sustainable Development Goals (SDGs) [29,30].

The relationship between the social determinants of health and one health

In order to more precisely calculate the epidemiological risk assessment across spillover interfaces, OH also looks at the economic and social factors that might underpin these complex relationships between human, animal, and environmental health, underscoring the significance of a "System Society" approach [31] and emphasizing the need for an integrated approach to achieving universal health goals around the world. In reality, a growing body of research indicates that socioeconomic factors like income, wealth, and education are the root causes of a wide spectrum of communicable disease and non-communicable disease-related health outcomes [32,33]. As a result, "Social Determinants of Health" [34] are seen as a crucial aspect of OH that primarily deals with non-medical factors (e.g., resistance to a particular medical intervention like a vaccine due to socioeconomic, political, and religious factors), which can be regulated by social policies and health economics, and shape population health in an all-encompassing way.

For instance, it is often believed that in addition to the highly anticipated environmental and ecological factors, the origins of many Emerging Infectious Diseases (EID) are correlated with socioeconomic factors and sociopolitical drivers [35]. The latter extends beyond the impact of the disease, negating the normative (value-based) assessment of a health policy decision and further interfering with quantitative, qualitative, and mixed-methods analyses of accumulated OH data. Thus, in essence, OH consults with experts from a variety of fields, including human and veterinary medicine, economics, sociology, ecology, public health, and data science, to explore potential solutions to support national-level zoonotic disease management [36] decisions and better address risks related to the intricate interconnections between biodiversity, ecosystem services, and human health. Overall, the OH approach is not primarily focused on zoonotic disease or antimicrobial resistance and can address the full spectrum from prevention, health improvement, and health promotion to the detection, preparedness, response, and recovery from health crises-a one-stop solution to save people and animals as well as the habitats of the planet from major disasters.

A succinct description of the various one health efforts in terms of their global governance

The various types of OH initiatives are categorized based on the work framework of the World Federation of Public Health Associations (WEPHA) [37]. It focuses primarily on bolstering the fundamental principles of public health, including: governance (e.g., legislation, policy); knowledge (e.g., population health surveillance, research, dissemination); protection (e.g., environmental health, health education); promotion (e.g., health determinants, including social issues and population behaviors); prevention; people-centered health care, including their pets and wildlife; and advocacy (e.g., community engagement and outreach programs), and and lastly capacity (e.g., workforce development, personnel training). Overall, the pillars encompass services, such as protection, prevention and control, as well as enabler functions like knowledge development, governance, advocacy, among others.

One health contributes to the global effort of pandemic preparedness

In 2009, the US Agency for International Development (USAID) launched the Emerging Pandemic Threats (EPT) Program's PREDICT (Pandemic Preparedness for Global Health Security) [38] Project. PREDICT makes use of an OH approach that emphasizes improving laboratory capacity in EID "hotspots" as well as zoonotic virus surveillance. Furthermore, PREDICT offers a platform with cross-sectoral surveillance through open data sharing, which enhances the ability to respond to disease outbreaks in sync with any new national OH platforms in cooperation with government and university partners to address challenging health issues. This is especially crucial because many EID are zoonotic [39], meaning they develop in animals before spreading haphazardly into the human population through different routes like food-borne, vector-borne, or air-borne. Examples of these include Spanish flu (air-borne), Severe Respiratory Syndrome Coronavirus (SARS-CoV), Middle Eastern Respiratory Syndrome Coronavirus (MERS-CoV), and Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). In fact, more than 30 human infectious pathogens have emerged in the last three decades [40]. Among them, 75% were transmitted from animals to humans via diverse means. Contrarily, some pathogens with human origins, such as Mycobacterium tuberculosis, can spread from humans to animals [41]. This highlights the significance of platform-based close monitoring of the human-animal-environmental interfaces through multi-sectoral collaboration between numerous disciplines, in order to significantly reduce the risk of inter-transmission and be in line with OH principles [42].

One health's oversight of the treatment of non-communicable diseases

Although OH-based approaches to managing EID have grown in popularity and momentum in recent years, policymakers worldwide have also been paying close attention to the NCDs that can result from environmental risks and how OH can successfully intervene in this. Animal sentinels, for instance, can offer crucial information on a range of alarming human NCDs, including malignancies, obesity, developmental anomalies, and neuropsychiatric disorders [43]. Methylmercury poisoning, for instance, was discovered to be the source of a perplexing neuropsychiatric condition in humans in Minamata, Japan, based on the peculiar behavior noticed in the local cats [44]. Thus, surveillance of animal kingdom can provide public health professionals with early warnings of environmental carcinogens. Moreover, over 25% of deaths from ischemic heart disease have been linked to environmental causes, such as fine particulate matter [45]. Importantly, atherosclerosis has been found in a variety of animals in wild, captive, companion, and agricultural settings. This likely indicates the need for surveillance of animal populations for the potential occurrence of NCDs in the human population due to environmental pollutants, etc. In addition, a rising number of environmental toxins are now thought to increase the likelihood of congenital disorders in people [46]. It's likely that monitoring congenital illnesses in animals in tandem with congenital abnormalities in people would reveal previously unrecognized connections between environmental contaminants and congenital abnormalities in people. The risk of Cardiovascular Diseases (CVDs) in humans is known to grow with diet and physical inactivity, and it is also thought that companion and captive birds are at an increased risk for CVDs [47]. Obesity and its associated complications have also been linked to diet and levels of activity in humans, cats, dogs, and other species [48].

Performance evaluation of one health programs

The OH approach is comprehensive, inclusive, and value-based in contrast to other approaches that are primarily specific, concentrate primarily on a set of specified quantifiable goals, and are reductionist in terms of outcome measurements and the number of individuals that are positively impacted [49]. Essentially, OH uses normative, qualitative, quantitative, and mixed-methods analysis to assess its influence across disciplines, sectors, species, paradigms, and demographics, and integrates at many spatial scales (e.g., locally, regionally, nationally, and globally) [50,51]. Normative assessment typically aims to evaluate the degree of conformity of the initiative structures, processes, or results with norms, personal standard or defined criteria [52]. The other evaluative methods use more complex approaches and rely on different types of analysis:

A. Strategic analysis, which emphasizes the applicability of the justification for the intervention and the targeted population(s).

B. Intervention analysis, which assesses the suitability of the connection between the proposed intervention's goals and its implementation specifics.

C. Productivity analysis evaluates how effectively resources are allocated to implement an intervention and produce its results.

D. Impact analysis evaluates the outcomes of the intervention's activities.

E. Performance analysis examines the cost-benefit of resources used in the intervention; and

F. Implementation analysis looks at how a strategic intervention's implementation's resiliency and the surrounding factors affect its outcomes. Additionally, "Network for Evaluation of One Health" (NEOH) [53] was established to build a framework for scientifically evaluating OH that may be used with a number of case studies. The NEOH framework employs a systems approach that combines several OH functional qualities from many disciplines and industries with thorough evaluation of the results brought about by a specific initiative.

Summary & Conclusion

It is increasingly clear that in order to achieve the best possible health for people, animals, and the environment, it is necessary to combine multidisciplinary, interdisciplinary, and transdisciplinary approaches. This requires bringing together diverse expertise from different disciplines and domains through collaborative efforts involving governmental, non-governmental, and educational agencies. As a result, the "One Health" strategy is firmly focused on ensuring global health security by addressing common health concerns that arise at the interfaces between humans, animals, and the environment, such as zoonotic illnesses, NCDs, antibiotic resistance, food safety, and others. To date, however, the fragmented framework of Global Health Governance (GHG) [54] for people, animals, and the environment—which is based on a linear approach to resolving current, long-standing health issues—is not sufficiently addressing today's global health challenges, let alone being sustainable. This is made even worse by the lack of extensive evidence-based support for OH's successful implementations up to this point, making it more challenging for public health specialists to advocate for its advantages. Therefore, additional OH case studies that are successful will be useful to build momentum for OH globally. However, from a theoretical standpoint, OH has the potential to improve the health of people, animals, and the ecosystem through such initiatives as disease surveillance, prevention, and response to emerging and chronic diseases; zoonoses and neglected tropical diseases; pandemic preparedness; vaccine equity; antimicrobial resistance; food safety, etc. [55].

Additionally, OH can revolutionize how clinical medicine is practiced through public policy, regulation, globalizing OH leadership, and its decolonization. Importantly, the OH, which tends to regard human health as inextricably linked to the health of the world as a whole, has recently become more relevant and has called for urgent global support at all levels for its institutionalization from mere conception. A sound conceptual framework and logical assessment methodology are essential for the implementation of OH as integrated approaches to health with adequately defined performance indicators that are easily adaptable to specific social-

ecological environments. Using these elements will provide more details on the real-world scenario. Lastly, the OH faces some significant difficulties. The participation of numerous stakeholders under the OH approach might lead to conflicts because of their disparate agendas and interests, among other considerations that are outside the purview of this article. Also, the strong collaborative foundation of OH frequently results in power imbalances, conflicts of interest, and coordination deficiencies. However, despite numerous obstacles, the OH approach can: Prevent zoonotic disease outbreaks in humans and animals; Improve food safety and security; Decrease infections caused by antimicrobial-resistant organisms and improve human and animal health; Protect global health security; and Protect biodiversity and conservation.

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