



‘One Health’ Approach to Infectious Diseases and Prevention of Antimicrobial Resistance: A Review

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Abstract

This review paper aims to provide an understanding on current concepts of ‘One Health’ approach in the field of public health with a special focus on infectious diseases and prevention of antimicrobial resistance. ‘One Health’ is an approach to designing and implementing programmes, policies, legislation, and research in which multiple sectors communicate and work together to achieve better public health outcomes. The scope of ‘One Health’ includes zoonotic diseases, antimicrobial resistance, food safety and security, vector-borne diseases that come from insect bites or animals, environmental contamination, and other health threats shared by people, animals, and the environment. The World Health Organization (WHO) is working closely with the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) to promote multi-sectoral responses to food safety hazards, risks from zoonoses, and other public health threats at the human-animal-ecosystem interface and provide guidance on how to reduce those risks for a better living in our planet Earth. Our medical education curriculum should also offer a first exposure to both the concepts of ‘One Health’ and the collaborative processes required to manage issues associated with human, animal, and environmental health.

Keywords: One health; public health; zoonotic disease; antimicrobial resistance; ecosystem

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Introduction

To many of us ‘One Health’ might be a new term, One Health is a global ‘movement’ for challenge driven ‘teamwork’ over decades though. One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked

and inter-dependent. According to the Centers for Disease Control and Prevention (CDC), “One Health is a collaborative, multisectoral, and transdisciplinary approach working at the local, regional, national, and global levels with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment¹.”

The importance of the connection among humans, animal and the environment on our planet is not new; however, to respond the current challenges that we are facing in our recent times, the integrated vision that we are all linked together has never been so important. The global public health community felt it so crucial that the concept of collaboration among multiple disciplines came at the frontline and recognized by the

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World Health Organization (WHO). Giving an emphasis on 'One Health', WHO defines it as “an approach to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes”².

'One Health' Approach to Infectious Diseases

The areas of work in which a 'One Health' approach is particularly relevant include food safety, the control of zoonotic diseases (diseases that can spread between animals and humans, such as flu, rabies, Ebola, Rift Valley fever etc.), laboratory services, neglected tropical diseases, environmental health and combatting antibiotic resistance (when bacteria change after being exposed to antibiotics and become more difficult to treat)². One Health is not a new approach; however, it has more recently been drawn attention and put into action because of influenza A (H1N1) in 2009, Ebola virus in 2013, and Zika virus in 2015. As highlighted by the CDC, in the last decade, “many factors have changed interactions between people, animals, plants, and our environment”¹. Some of the factors are described below:

Firstly, human populations are growing and expanding into new geographic areas. As a result, more people live in close contact with wild and domestic animals, both livestock and pets. Animals play an important role in our lives, whether for food, fibre, livelihoods, travel, sport, education, or companionship. Close contact with animals and their environments provides more opportunities for diseases to pass between animals and people^{1,3-5}. Secondly, the earth has experienced changes in climate and land use, such as deforestation and intensive farming practices. Both the natural and man-made disruptions in environmental conditions and habitats can provide new opportunities for diseases to pass to animals^{1,4,6,7}. Finally, the movement of people, animals, and animal products has increased from rapid urbanization causing higher population density as well as from international travel and trade. As a result, diseases can spread quickly across borders and around the globe^{1,8-10}. We have experienced such phenomena in several outbreaks in recent times.

Many countries have already recognized the benefits of taking a 'One Health' approach that is multisectoral and multidisciplinary to build national mechanisms for coordination, communication, and collaboration to address health threats at the human - animal - environment interface^{3,4}. A One Health approach is

also important for national and global health security, in implementing the World Health Organization's International Health Regulations 2005¹⁰ and to contribute to many of the Sustainable Development Goals and the 2030 Agenda^{4,11}. This review paper aims to provide an understanding on current concepts of 'One Health' approach in the field of public health.

Importance of 'One Health' Approach

We have mentioned earlier that the scope of 'One Health' includes zoonotic diseases, antimicrobial resistance, food safety and security, vector-borne diseases that come from insect bites or animals, environmental contamination, and other health threats shared by people, animals, and the environment. In recent times, to protect human health, public health experts are focusing their attention on preventing the emergence and spread of new and existing diseases - diseases such as H1N1, Avian Influenza, Lyme disease, West Nile virus, Monkeypox and Mad Cow Disease (also called bovine spongiform encephalopathy)^{3,12-20}. The World Health Organization (WHO) is concerned about health issues at the human-animal-environment interface. It is assumed that the problem cannot be effectively 'addressed' by one sector alone. WHO elaborates that “to address means to prevent, detect, respond to, prepare for and assess, and reduce risks from zoonotic diseases at country, regional and global levels”⁴. Many of the same microbes infect animals and humans, as they share the ecosystems they live in¹²⁻²⁰. Efforts by just one sector cannot prevent or eliminate the problem. These diseases are complicated by the fact that their spread from animals to humans is influenced by many factors related to animal, human and ecosystem health. West Nile virus is a good example. This virus is transmitted to people through the bite of a mosquito and can lead to paralysis or death^{18,19}. Public health experts must consider the dynamics of mosquito populations (abundance, length of breeding season, breeding conditions), the types of birds that carry the virus and their migration patterns, and environmental conditions (climate change) that create favourable mosquito breeding conditions¹⁷. In this case, public health experts need to look at strengthening areas of animal health and the environment in order to protect human health^{3,17}. For instance, rabies in humans is effectively prevented only by targeting the animal source of the virus (for example, by vaccinating dogs)²⁰. Similarly, information on influenza viruses circulating in animals is crucial to the selection of

viruses for human vaccines for potential influenza pandemics.

'One Health' Approach to Prevent Antimicrobial Resistance

Antimicrobial resistance (AMR), which is increasing in an alarming trends, especially in the developing countries - as resistance can arise in humans, animals, or the environment, and may spread from one to the other, and from one country to another as well²¹⁻²⁵. Drug-resistant microbes can be transmitted between animals and humans through direct contact between animals and humans or through contaminated food, so to effectively contain it, a well-coordinated approach in humans and in animals is required²¹⁻²⁵.

Besides, some of those diseases posed a potential pandemic threat with significant economic repercussions in recent times. Trade disruption and the decline in international tourism were estimated to cause billions of dollars in global economic losses in addition to significant social impacts across the globe²⁶⁻²⁸. 'One Health' is both a call to action and a method. It involves breaking down the silos between the animal health, environmental health, and human health sectors so that we can track diseases wherever they are found and help prevent and quickly respond to outbreaks. For an example, a 'One Health' approach to public health surveillance involves governments implementing systems that track diseases in animals as well as humans, so that infection like avian flu is detected as soon as it appears in birds, before it has the chance to infect entire flocks of chickens and threaten people's livelihoods, and before it has the chance to infect people. Besides, intergovernmental collaboration, communication and coordination may help to spread and stop such disease⁴.

Since we have found that the emerging zoonotic diseases or antimicrobial resistance impacts on a global scale, One Health interventions have the potential to be more effective and generate more equitable benefits for human health and livelihoods, particularly middle- and low-income countries especially in rural areas. This strategy is more effective and economical than approaches that rely exclusively on treatment of human cases^{29,30}.

Thus, the 'One Health' concept clearly focusses on consequences, responses, and actions at the animal-human-ecosystems interfaces, and especially emerging and endemic zoonoses, antimicrobial resistance and overall protection of health and wellbeing. The scope of One Health as envisaged by

the international organizations (WHO, FAO, OIE, etc.), the World Bank, and many other non-governmental organizations also clearly embrace other disciplines and domains, including environmental and ecosystem health, economics, social sciences, ecology, wildlife, land use, and biodiversity through decades^{3,31-34}.

How 'One Health' Approach Works

Many professionals with a range of expertise who are active in different sectors, such as public health, medicine, animal health, plant health and the environment, should join forces to support One Health approaches^{30,35}. Since interdisciplinary collaboration is crucial in One Health concept, the medical community has been much slower to fully engage; however, the veterinarian community has embraced the One Health concept by engaging in themselves in research and practice. Engaging the medical community more fully in the future may require the incorporation of the 'One Health' concept into the medical school curricula so that medical students see it as an essential component in the context of public health and infectious diseases³⁵. Globally, various academic institutions have established curricula offering graduate degrees in One Health. One Health training opportunities in Asia and Africa have increased and many of the programs are established in partnership with foreign institutions^{36,37}. The application of the "One Health" approach to infectious risk needs to be systematically reinforced with ecobiology expertise. A sustained exchange effort is required from ecologists, evolutionists, epidemiologists, economists, social scientists, and human and animal healthcare specialists with other activity sectors³⁸. Figure 1 shows how 'One Health' approach works through a multidisciplinary contributions and actions. Besides, to effectively detect, respond to, and prevent outbreaks of zoonoses and food safety problems, epidemiological data and laboratory information should be shared across sectors. Government officials, researchers and workers across sectors at the local, national, regional and global levels should implement joint responses to health threats. Collaborative partnerships with existing governmental and non-governmental organizations and institutions to set up a framework for information-sharing, cooperation and awareness raising activities. Neighboring countries should work with each other and with multilateral organizations to make sure that national borders do not become barriers to disease prevention and public health preparedness.

Last but not the least, creating awareness among people through mass communication and social media is important³⁵. On November 3 each year, individuals and groups from around the world, from academic to corporate and non-profit, students to professionals, take the opportunity to implement 'One Health' projects and special events under the auspices of "One Health Day" since 2016.

The World Health Organization (WHO) is working closely with the Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) to promote multi-sectoral responses to food safety hazards, risks from zoonoses, and other public health threats at the human-animal-ecosystem interface and provide guidance on how to reduce those risks^{4,29,30}

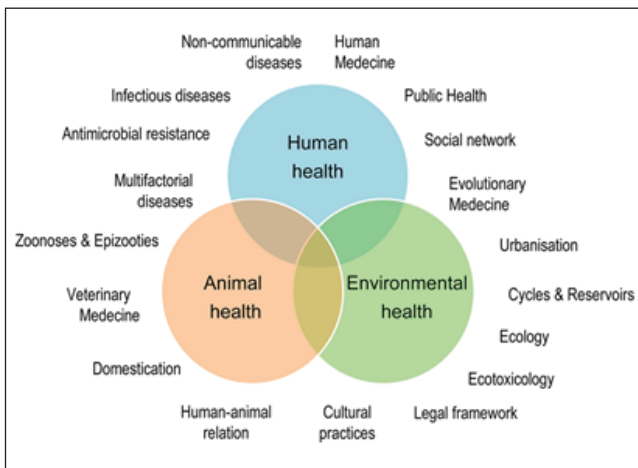


Figure 1: How 'One Health' approach works³⁸

Teaching 'One Health' Concept in Medical Education

As the importance and the use of One Health approaches grows, the demand for well-trained professionals in relevant disciplines is in high demand. Teaching 'One Health' is not only related to animals and environment but also has a significant impact on human health and human well-being^{39,40}. From human illness connected to wild animals, if we think of rabies, HIV or SARS, or even the bioterrorism threats with anthrax exposures, One Health is an important issue. Regarding the other zoonoses, if we think about the awareness and education needed for our farmers living rural areas, healthcare providers in the rural communities need to educate them³⁶. Hence, the medical education curriculum should offer a first exposure to both the concepts of One Health and the collaborative processes required to manage issues associated with animal, human, and environmental health³⁹⁻⁴². We may include 'One Health' in our

medical education through various departments like Public Health, Community Medicine, Microbiology, Virology, Internal Medicine. We may teach 'One Health' through interactive, small-group, case-based learning or problem-based learning or as a project based learning by using it as a problem solving strategy and create actionable classroom objectives via distilling it into a comprehensible concept,^{41,42} or we may do it as a part of integrated teaching amongst departments⁴⁰.

Conclusion

The 'One Health' concept calls for various disciplines to work together to provide new methods and tools for research and implementation of effective services to support the formulation of norms, regulations, and policies to the benefit of humanity, animals, and the environment for current and future generations. Besides, relevant country ministries and agencies may initiate policies with available evidence and good practice guidelines identified from country-level experiences in taking One Health approaches for preparedness, prevention, detection and response to future zoonotic disease threats, antimicrobial resistance, and provide guidance on multisectoral communication, coordination, and collaboration.

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Conflict of Interest

The authors have no conflicts of interest to disclose

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Authors' Contributions

Ali MA conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Jahan SA, Harun-Ar-Rashid AKM contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Kamal MS, Hussain MA, Rahman MM involved in the manuscript review and editing. All authors read and approved the final manuscript.

Data Availability

Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

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