Review Article

One Health and Emerging Infectious and Viral Diseases: Insights from Host-Pathogen Research

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Abstract | To reduce the dangers of newly developing and reemerging infectious diseases (EIDs), "One Health" calls on health scholars and practitioners working at the interfaces between humans, animals, and the environment to collaborate. More and more people are realising that effective EID management and mitigation require a One Health strategy that emphasises inter-disciplinary collaboration. However, this kind of One Health strategy must address certain ethical, legal, and socially and politically problems. EID events are made up of complex and conditioned sets of relationships that pertain to socioeconomic and social and political life. drivers and consequences, the latter of which go beyond the effects of the disease, according to the intellectual review and evaluation of scholarship surrounding the concept and application of One Health. As a result, the implementation of One Health-based policies and their conformity to or change of societal values determine their efficacy. Even with a compelling justification, putting a One Health strategy into practice thoughtfully and holistically can be difficult, particularly when there seems to be a crisis. The global health is at risk due to the current coronavirus disease 2019 (COVID-19) pandemic, which is producing unprecedented financial, social, and political disturbances. Using a comprehensive One Health (OH) approach to implement interventions at the interface of humans, animals, and the environment is one option to stop such a pandemic. To assess the development of the OH strategy, including the identification of critical OH activities implemented for prevention, response, and control, this systematic literature review recorded the three coronavirus epidemics, namely SARS, MERS, and COVID-19.

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Introduction

A comprehensive approach known as "One Health" places emphasis on the need to comprehend and control the environmental setting (human-animal ecosystem interaction) of disease onset and manifestation, but it does not stop there. EIDs are distinguished by their intricacy and lack of confidence regarding their origins, outcomes, and possible remedies. The emergence and cross-species Transmission of numerous emerging viruses, like the Ebolavirus (EBOV) and H7N9, are mostly caused by human activities, including altered land use, increased international trade and travel, and more intensive animal husbandry methods. Our comprehension of the biochemistry and demography of H7N9 has advanced quickly, which highlights how much better we've become over the past several decades at responding to emerging EID threats (Wiberg *et al.*, 2010). The fact that EID occurrences involve more than just diseases hopping species boundaries contributes to the persistence of EID dangers despite scientific advancements. The threats posed by EIDs are made up of intricate and dynamic relationships between socioeconomic and sociopolitical factors and their effects, which go beyond the disease's effects. Zoonoses have major social, cultural, and economic effects (Rabinowitz and Conti, 2010). Sound evidence should be the foundation for policy decisions, but when it comes to EIDs, the necessary data is frequently lacking or ambiguous. EID occurrences frequently involve dynamic circumstances that are marked by uncertainty. New evidence is produced as the events develop. As a result, choices based solely on available data may be deemed incorrect in the future. Previous zoonotic disease outbreaks, including avian influenza (HPAI), pandemic influenza (H1N1), and severe acute respiratory syndrome (SARS), have demonstrated the need for new approaches at the human-animal ecosystem boundary (Dvorak *et al.*, 2013). These approaches should focus on improving early diagnosis, surveillance, monitoring, prevention, and control of infectious diseases, while also lowering the risks of these and other zoonotic diseases to the public's animal health. Therefore, the avoidance and treatment of infectious diseases are greatly aided by the one health approach (Schwabe, 1978).

To address the issue, one health principles gather data from several research across various dimensions and disciplines, which is then combined for improved collaboration and union.

The concept of health

Many researchers examine the idea and definition of health from three perspectives, namely level, the environment, and the population as well as group level degree of environment (Lemer and Berg 2015). To begin with, there are two considerations: human health and animal health. wellness. However, there is still a conversation in animal medicine and discipline in the care of animals (Bekoff ,1994). The refer to all animals by the moniker of non-human creatures. species but mankind or people has been used for a long time and moreover often employed in our day-to-day employment, researcher, of science who also advocate for animal rights. In general, animals exhibit a vast diversity of living forms and grouping them as a single entity appears as dubious (Derrida, 2008).

Association of one health and one medicine

Numerous international, national, and regional organisations and governments—such as the AVMF, CDC, OIE, WHO, WVC, One Health Network, One Health Initiative, and others—promote the connection between and significance of One Health and One Medicine. This is the reason that there are a lot of exciting plans, projects, and continuing studies throughout the world (FAO, 2010). There are numerous reasons why one's health and one's medications are related, including (a) comparable biology, **a**nimals and humans are united under the kingdom animally, (b) therapeutic trials like trials include novel vaccinations, novel medications, dietary supplements, nutritional decisions, and medical equipment and procedures, (c) since the bulk of infectious diseases originate in animals, current research focuses on creating a single medication that can be used by both people and animals to prevent and treat zoonotic infections (Pieracci *et al.*, 2016), (d) minimises duplication of effort and promotes one manpower, one laboratory setup and facilities, one instances to help focus on mutual benefits and fight zoonotic diseases, for we can build a single planet, one health, and one medicine and impact the global health and (e) the rule of one health and one medicine in university.

Multifactorial and non-communicable chronic diseases [Toxic risk to ONE HEALTH]

Multifactorial diseases are caused due to multiple genes along with the effects of environmental factors

(Duarte *et al*., 2013).Multifactorial or polygenic diseases describe the architecture of sickness causing genetic factor (Plomin *et al*., 2009).Some common multifactorial diseases include type 2 diabetes, arthritis. Multifactorial conditions tend to run in families because they are partly caused by genes. Diarrhoea and other multifactorial diseases in animals (Ellington *et al*., 2020).These diseases are caused by pollutants in the environment produced by human activities.

Non communicable diseases are long phase diseases which are leading cause of death in our society (Wahi *et al*., 1965).NDCs have a prolonged treatment. Their complete cure is rarely achieved. Some common NCDs are cardiovascular and chronic respiratory diseases, cancer and diabetes. NCDs are cause of 74 percent deaths globally (Wynder *et al*., 1957). Oral cancer includes cancer of the lips, tongue, gum, floor of mouth, palate, cheek mucosa and vestibule of the mouth. Tobacco use, alcohol consumption, human papillomavirus infection, High blood glucose level are risk factors for oral cancer (McCoy GD , 1978). Conventional methods for improvement of oral health have been proved to be ineffective and costly (Petersen *et al*., 2005). Angina is serious cardiac disorder caused by atherosclerosis which leads to stenosis of coronary arteries (Arrica *et al*., 2017).It is a chest pain which happens when some part of your heart doesn't get enough blood and oxygen (Chandra *et al*., 2006). Angina may be caused by anaemia, diabetes, some coronary diseases (Angina *et al*., 1998). Exclusive doses of aspiring, ranolazine, calcium channel blockers, nitrates, and nicorandil are utilized by the patients to reduce the threat of angina (Patrono *et al*., 2004).Hypertension is high blood pressure in vessels which imparts an increased risk of stroke, myocardial infarction and renal failure. Low sodium and high potassium levels in diet can reduce blood pressure in vessels (He *et al*., 2013).

Diabetes is characterized by high blood glucose level Diabetes type 1 and type 2 are two types of diabetes. Diabetes type 1 is an autoimmune disorder followed by selective destruction of insulin secreting cells while Diabetes type 2 is characterized by peripheral insulin resistance and impaired insulin secretion (Manson *et al*., 1992).Diabetes mellitus may be caused by anxiety and depression. Diabetes mellitus particularly damages blood vessels, eyes, kidney, heart and nerves. Prevention and treatment of diabetes mellitus include insulin intake, regular exercise and healthy food (Helmrich *et al*., 1991).

One health in the context of coronavirus and canine parvo virus outbreaks

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a novel beta coronavirus that caused a global pandemic and public health emergency of international significance towards the end of 2019 (Zhong *et al*., 2003). It crossed the animal-human barrier. This is the third time in the last 20 years that beta coronaviruses have broken down the animal-human species barrier, leading to significant zoonotic outbreaks, following the Middle East Respiratory Syndrome coronavirus (MERS-CoV) in 2012 (Demmler and Ligon, 2003) and the severe acute respiratory disorder coronavirus (SARS-CoV) in 2002/2003 (Bailey *et al*., 2018). With 300 cases of pneumonia with unusual symptoms, the Guangdong Province, China, saw the start of the first SARS outbreak in late 2002 (Knobler *et al*., 2004). SARS spread to "5 countries within 24 hours and to more than 30 countries on 6 continents within 6 months" despite the Chinese government and the World Health Organisation (WHO) taking action to stop the transmission (WHO, 2005). Between 2002 and 2003, there were over 8000 cases worldwide and a 10% fatality rate. Wild mammals sold for human food in nearby markets were identified as the main source of infection. A spectacular concerted response got the pandemic under control, but it had a huge social, political, and economic impact on 36 countries. Middle of 2012. Human contact with dromedary camels infected with MERS-CoV caused the outbreak of MERS in Saudi Arabia (Zumla *et al*., 2016). Through additional human-to-human transmission, it reached 27 nations worldwide, resulting in 2519 laboratory-confirmed cases and a 34.3% case-fatality rate through January 2020. Vigorous contact tracing, isolation of the cases, and quarantine were all part of the control and prevention measures for MERS (Chafekar and Fielding, 2018). The first incidence of a novel atypical pneumonia was identified in Wuhan City, China, on December 8, 2019, and it has since spread around the globe. As of September 2020, many million cases have been confirmed in about 188 countries. Different tactics have been used to contain the pandemic, according on the circumstances and capabilities of the various countries. These tactics include the identification of cases, which are then followed by contact tracking and isolation; preventing close human contact (e.g.,

by physically separating) through lockdown procedures; implementing Water, Sanitation, and Hygiene (WASH) interventions, especially regarding hand hygiene; using personal protective equipment; and augmenting the capacity of the healthcare system (Kasem *et al.*, 2018). The risk of cross-species infections and spillover events has increased due to an increase in human-animal contact. The human-animal interface is linked to the three coronavirus epidemics by epidemiological connections, underscoring the significance of taking preventative measures with an integrated strategy, like "One Health." Through multi-sectoral cooperation, the One Health (OH) approach considers the interdependence of humans, animals, and the environment (Raj *et al.*, 2014). It acknowledges that preventative and "zoonotic disease control programmes are most effective when broader socioeconomic and biological aspects of health are included." Since it was originally discovered in 1978, an enteric virus known as canine parvovirus type 2 (CPV-2) has grown to be the most significant canine disease in both the wild and the home. Every continent showed seroprevalence of the virus (Dik *et al.*, 2022). Within a few decades, three antigenic variations known as CPV-2a, CPV-2b, and CPV-2c have emerged due to genetic changes. Additionally, the expansion of the host area and subsequent dissemination in wild predators have been linked to antigenic alterations (Abuseir *et al.*, 2023). In younger canines, canine parvovirus type 2 (CPV-2) has been linked to incredibly high rates of morbidity and mortality. Several molecular and serological assays can be used to diagnose CPV illness. Multivalent live attenuated virus vaccines for canine immunisation are now available in Pakistan. Control and prevention of this disease, however, have grown even more complicated due to the emergence of novel varieties that can affect both domestic cats and wildlife carnivores. Numerous DNA, peptide, and recombinant vaccines have been developed to mitigate the danger of an unexpected outbreak. To be more specific, kennel tight hygienic measures and widespread immunisations against stray, domestic, and wild dog populations could help prevent the spread of disease.

One Health in education

One Health can be used in a classroom setting as well. No matter what university programme a public health professional is enrolled in, it is important to emphasise in their education and training why these various disciplines naturally intersect in practice. Currently, one can obtain an MSc or PhD in One Health in several regions of the world (Kahn, 2011).

A growing array of textbooks on One Health are available for university students studying health and veterinary sciences, with an emphasis on zoonotic illnesses, epidemics, and toxicants. At first, it seems that the One Health conversation was primarily focused on animals used for food production, but there is currently a growing interest in highlighting the significance of zoonoses from a pet ownership perspective as well (Gibbs, 2005). Even more radical ideas have been put forth for a brand-new educational system built around the One Health concept. Calvin Schwabe introduced a brand-new curriculum that a veterinary school may use to start offering fresh instruction. The three subject areas of biology, people, and population were described. A more contemporary attempt to design a combined curriculum would assign these subjects and their students to public health schools. Establishing a new curriculum within the established disciplines carries the risk of having a similar outcome to that of Natterson-Horowitz & Bowers when they analysed One Health and instead proposed the term zoobiguity, which refers to the use of one discipline's knowledge by another without any reciprocal exchange.

Control of viral diseases and zoonoses by One Health

Fear was the foundation of One Health and its driving force. Concerns about a zoonotic illness called HPAI H5N1 causing a pandemic in humans that might match or even surpass the estimated 50 million deaths from Spanish influenza at the conclusion of World War I were widespread in 2004 (Hasler *et al.*, 2006). The One Health initiative allowed national authorities and international organisations (FAO, OIE, WHO, and the World Bank) to work together as equal partners in finding solutions to the threats posed by this extremely virulent strain of influenza (FAO, 2011). It also gave these organisations a means of interinstitutional and interdisciplinary collaboration to address the threat of emerging zoonotic diseases. The World Bank, the European Commission, and the Chinese government co-hosted, coordinated, and funded the international ministerial and committing conference in Beijing in January 2006, which served as the catalyst for the start of the world's response to avian influenza against the backdrop of One Health. This resulted

in agreement on the command of avian influenza for the next five years amongst important political players (the United Nations, the United States, and the European Union [EU]). In response to these gatherings, the World Bank released a framework in 2010 that outlines the use of One Health concepts to prevent animal influenzas. According to estimates from the World Bank, 4.3 billion US dollars were committed for the global management of HPAI between 2005 and 2009 (World Bank, 2010). The value of the approach is demonstrated by the One Health collaboration that was formed to control HPAI H5N1.

It was acknowledged that the One Health strategy had broader applications during this time when avian influenza was the centre of attention for international organisations. The FAO released a framework in October 2008 to lessen the hazards of infectious diseases in the border between animal and human environments (FAO, 2008).

FAO/OIE/WHO/UNICEF/WorldBank/World Bank and the UN System Influenza Coordination, primarily focused on emerging zoonoses, but also addressed emerging illnesses with the potential for substantial socioeconomic or transboundary implications developing at the animal-human ecosystem interface. The zoonoses that originate from domestic animals used for food are the main emphasis of the instances above, but One Health's implications for nature and small animals also demand consideration (Gibbs *et al*., 2002).

"One Health" is an interdisciplinary strategy to researching public health issues in people, animals, and their habitats, according to the World Health Organisation (W.H.O.). This is achieved by putting into practice carefully thought-out programmes and cross-sector research initiatives (Chakraborty *et al*., 2022).

In essence, one health acknowledges that human health is inextricably linked to the health of animals and the environment, and vice versa. The five main pillars of the «One Health» action framework are water contamination, zoonoses, antibiotic resistance, food safety, and the relationship between humans and animals (Horefti, 2023). There are numerous cases where One Health has succeeded in mitigating zoonotic infections.

The Hendra virus, which causes 60% of human deaths and 75% of horse deaths, is spread by bats from horses to humans. In 1994, the virus was discovered for the first time in Brisbane, Australia, where it infected 21 horses and two humans, one of whom died. Between 1995 and 2023, there were nearly 100 reported instances of Hendra virus in horses, all of which resulted in death (Middleton *et al*., 2014). In contrast, there were only 7 cases of the virus in humans. The Australian government's Hendra surveillance programme for horses and the development and testing of a vaccine for the disease both contributed to the mitigation of Hendra in horses.

Author's Contribution

Muhammad Usman: Revised and developed the study strategy, created the search query, and conducted the literature search.
Hussain Abbas and Zulqarnain Haider: Developed the search query, compiled the data, and reviewed the article before submission.
Riffat Maqsood: Did before submitting the work, screened the articles, authored, evaluated, prepared, and cleared the final draft.
Muhammad Awais Nadeem: Compiled the data and screened the article before submission.
Muhammad Wasif Gulzar: Reviewed the final draft of the article and analyzed the final draft before submission, proofreading, file submissions, and uploads.
Abdul Hanan Shazal and Muhammad Zain: Wrote the original draft and editing it before submission.
Ali Usman and Muhammad Suleman: Wrote and finalized the manuscript.
Amna Hameed and Haram Shahid: Screened the articles and wrote, reviewed, prepared, and approved the final draft of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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