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Review Article

One Health approach and zoonotic diseases in Indonesia: Urgency of implementation and challenges

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Abstract

The urgency of implementing the One Health approach to overcome zoonotic diseases cannot be overstated. By recognizing the interconnectedness of human health, animal health, and the environment, we can effectively prevent and respond to emerging infectious disease threats. This review article provides information on the importance of generating research on zoonotic diseases, especially in Indonesia, where research is still relatively scarce. The Indonesian government has taken steps to implement the One Health by establishing the One Health Coordinating Unit and the National Zoonosis Committee; however, implementation has not been optimal. The urgency and challenges are focused on critical implementation aspects in the community. The urgency of implementing One Health includes that Indonesia has experienced several outbreaks of zoonotic diseases; high environmental degradation; and the antimicrobial resistance issue in Indonesia has increased. The challenges faced in implementing One Health are overcoming fragmentation due to incohesive communication between important sectors, securing funding and resource investment, aligning policies to eliminate regulation barriers, capacity building to increase awareness and professionals, and addressing critical socioeconomic factors. By prioritizing implementing the One Health approach and addressing existing challenges, Indonesia can build a more resilient and integrated system to protect the well-being of all species, protect ecosystems, and prevent the devastating effects of zoonotic diseases on global health. In this review, we present the urgency of One Health implementation and its challenges comprehensively.

Keywords: One Health, zoonotic diseases, communicable disease, Indonesia, tropical disease

Introduction

Zoonotic diseases are infections caused by pathogens that can be transmitted from animals to humans [1-3]. This disease has long been part of human history, as have rabies, influenza, and Japanese encephalitis originating in animals. However, the emergence of new zoonotic diseases in recent years, such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), Ebola, Zika, dengue, schistosomiasis, and mpox, has highlighted the urgent need for a comprehensive approach to disease prevention and control [4-8]. One critical aspect of this linkage is the emergence and spread of zoonotic diseases, which significantly threaten human health. Understanding health principles and the complexity of zoonotic diseases is critical to maintaining global health and preventing future pandemics [9-11].

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The presence and development of zoonotic diseases in Indonesia have had an alarming impact on public health and pose a significant national health burden over time [1]. This is evident from massive prevention and control efforts, accompanied by the need for considerable resources and funding every year. In addition, the high interaction between humans and animals facilitates the transmission of zoonotic diseases, which have been studied through the sylvatic cycle (pathogenic invasion into non-human primates) [7]. Zoonotic diseases that are a priority for handling in Indonesia today include avian influenza, including bird flu (H5N1) and swine flu (H1N1), which have been infecting poultry since 2003 and are highly pathogenic to poultry, causing losses to the poultry sector in Indonesia [12]. In addition, SARS-CoV-2 and MERS-CoV infections, which have resulted in a worldwide pandemic with reported mortality reaching 161,918 in Indonesia, have had devastating impacts and paralysis in various sectors [8,13]. Furthermore, zoonotic tuberculosis disease is included as a priority program that generally affects cattle (*Mycobacterium bovis*) and zoonosis in humans and domestic animals [14,15]. These three zoonotic diseases tend to affect the respiratory system [16].

Another priority zoonotic disease is rabies, which is endemic in 26 of 34 provinces in Indonesia and causes 99% mortality in animals and humans [17]. In recent months, rabies cases have experienced a spike in Indonesia, such as Bali, Kalimantan, and Sulawesi, resulting in death within just <48 hours after being bitten [18,19]. In addition to infectious diseases caused by viruses, bacterial zoonoses have also had a negative impact on farmers, one of which is anthrax, which in recent months has experienced a resurgence in various provinces of Indonesia [1]. The last zoonotic disease that is a priority is leptospirosis, which is transmitted through rodents. High climate change, poor sanitation, and flooding in several regions of Indonesia have great potential for causing this disease [20,21]. These six priority diseases are included in the Regulation of the Coordinating Minister for Human Development and Culture of the Republic of Indonesia Number 7 of 2022, concerning Guidelines for the Prevention and Control of New Zoonoses and Infectious Diseases [22].

In addition to these six priority diseases, other examples of zoonotic diseases have become a concern in all related sectors, namely vector-borne diseases, including dengue hemorrhagic fever, chikungunya, yellow fever, Japanese encephalitis, malaria, and Zika, which are reported to occur and fluctuate throughout the year [7,23-27]. Zoonotic diseases that pose a health burden in Indonesia include salmonellosis, brucellosis, trichinosis, trematodoses, toxoplasmosis, Ebola, psittacosis, echinococcosis, and bovine spongiform encephalopathy, which can have a negative impact nationally if not addressed [28-30].

The One Health approach recognizes that human, animal, and environmental health are interconnected [31]. It recognizes that the health of each sector is affected by the other and calls for collaborative efforts among human health professionals, veterinarians, ecologists, environmental scientists, and policymakers to address complex health challenges effectively. By integrating knowledge and expertise from different disciplines, One Health seeks to prevent and control zoonotic diseases at their source, mitigating their impact on public health. This review seeks to explain the urgency of implementation and challenges of implementing the concept of One Health in efforts to prevent and control zoonotic diseases in Indonesia.

Urgency of applying the One Health concept to zoonotic diseases in Indonesia

Zoonotic diseases are infectious diseases that can be transmitted between animals and humans through direct contact with infected animals, ingestion of contaminated food or water, or exposure to vectors such as fleas, mosquitoes, snails, and others [32,33]. Zoonotic diseases that until now have not been appropriately handled in Indonesia include dengue virus infections, malaria, rabies, chikungunya, leptospirosis, bubonic plague, brucellosis, and others [34-36]. The Indonesian government has taken steps to implement the One Health approach. The country has established the One Health Coordinating Unit and the National Zoonosis Committee, demonstrating the government's commitment to comprehensively address zoonotic diseases [37,38]. However, field implementation has not been optimal. This can be seen from the results of the Joint External Evaluation (JEE) assessment, which is used as a standard assessment of a country in the implementation of One Health concept, including detection, prevention, and response. The result is that Indonesia's capacity reaches only 63% of the ideal capacity value of

100% [39]. This indicates that detection, prevention and response to outbreaks or extraordinary events have not been going well.

For example, the high number of rabies cases in various endemic provinces, one of which is Bali, has not even received services. If there is a case report of handling in the field that does not directly carry out surveillance of zoonotic diseases but awaits confirmation from an agency that has the authority to do so, in addition to the prevention side, the community has not evenly obtained information related to control and prevention. As a result, if there is a bite in humans, early prevention is not carried out, which results in handling delays that cause mortality and morbidity. The last thing is the lack of coordination between agencies related to the procurement of anti-rabies vaccines (VAR) or pre-exposure prophylaxis (PrEP) vaccines for animals, resulting in high fatalities caused by rabies virus infection and pets with a high potential for transmitting or contracting the rabies virus from infected animals, as a result of which cases of Rabies Infectious Animal Bites (GHPR) increase throughout the year [40-42].

The contrast of policies with the results of implementation in the field highlights the importance of the Indonesian government in implementing policies that lead to efficient program improvements. Limited monitoring and reporting systems, low funding, healthcare infrastructure, and trained resources are the main areas of improvement. The lack of coordination between agencies, including control of wildlife trafficking practices and consumption of wildlife meat that contributes to transmitting zoonotic diseases, is of particular concern and must be corrected starting at the household level. Weak policies and terms of reference have resulted in failures in the prevention and control of zoonotic diseases in Indonesia [39,43-45].

This is evident from the assessment of the Zoonotic Diseases Action Package (ZDAP), which includes surveillance systems, veterinary or animal health workforce, and mechanisms for responding to zoonoses and potential zoonoses obtained by Indonesia, only 53% of the ideal capacity value of 100% [39]. This can also be seen from the various studies we analyzed using bibliometric analysis. We found that the research focus related to One Health, especially in Indonesia, is minimal (32 articles) from 2016 to 2022 and has shifted, primarily focusing on the latest issues, so that the topic of One Health is only associated with and not employing One Health as the research foundation [46,47].

Related terms that have changed annually and the focus on topics that still need further development and research are presented in **Figure 1**. The concept of One Health is not directly a central topic [48]. However, it is only associated with it, so future research is essential to understand disease dynamics through a One Health approach [49,50]. Our findings consisted of 11 clusters containing "One Health" in 32 research articles obtained in PubMed and Scopus (**Figure 1A**). This indicates that the One Health topic still needs to be studied more deeply. Co-occurrences that are immensely discussed are "leptospirosis," "malaria primates," "primates," "human infections," "anthrax," "rat," and "village" (**Figures 1A** and **Figure 1B**). These zoonotic diseases are emerging, but a comprehensive approach has yet to be widely taken. Furthermore, density visualization analysis showed that current research focuses on diseases originating in rural areas, especially "primates," by identifying isolates and prevention and control strategies (**Figure 1C**). Finally, based on the distribution and network of the authors, one network was obtained, which indicates that only this group of authors contributed to the development of the concept of One Health in zoonotic diseases.

The concept of One Health is very relevant to zoonotic diseases in Indonesia due to the country's unique ecological and socioeconomic characteristics, with a large population and rich biodiversity, making it vulnerable to zoonotic disease outbreaks. By adopting the One Health approach, Indonesia can collaborate with interdisciplinary approaches to enhance its preparedness, surveillance, and response to zoonotic diseases [51,52]. Thus, improving the health and well-being of people and animals, ensuring a safer and healthier future for the country.

There are several reasons why the government, society, and related sectors must implement the concept of One Health throughout Indonesia. First, Indonesia has a high burden of zoonotic diseases. Along the way, Indonesia has experienced several outbreaks of zoonotic diseases, such as bird flu, rabies, and especially the coronavirus disease 2019 (COVID-19) pandemic. These infectious diseases originate in animals and can spread rapidly to humans. By addressing the

health of animals and their ecosystems, we can effectively detect, prevent, and respond to these emerging threats [27,53].

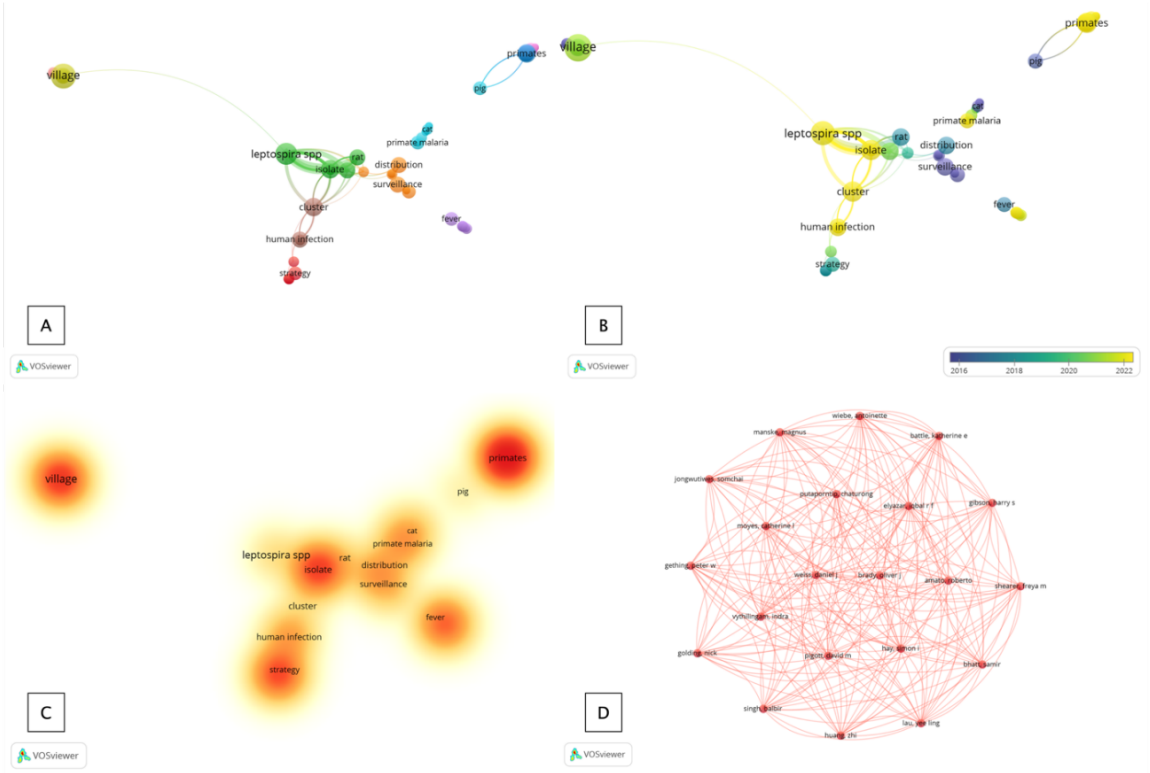

Figure 1. Mapping and visualization of the term "co-occurrence" (One Health) in its application to zoonotic diseases. Description: (A) clusters and terms used as keywords; (B) overlay visualizations related to developments and changes in research topics from 2016–2022; (C) density visualizations related to the depth of the One Health concept in each research topic; and (D) author networks on the topic of one-health and zoonotic diseases.

Second, there has been high environmental degradation, mediated by rapid urbanization, deforestation, and wildlife trafficking, contributing to habitat loss, increased human-wildlife interaction, and an overflow of zoonotic diseases. Consumption of meat contaminated with viruses or pathogens can result in new sources of outbreaks that endanger human health. Zoonotic disease outbreaks have severe economic consequences impacting various sectors, including agriculture, tourism, and high public health spending. One Health approach can help mitigate these economic losses by preventing and controlling zoonotic diseases at their source and considering efficiency and effectiveness in their implementation [54,55].

Third, the antimicrobial resistance issue in Indonesia has increased [53,56-58], so efforts are needed to reduce it. Zoonotic diseases contribute significantly to the emergence and spread of antimicrobial resistance [53]. Overusing and abusing antimicrobials in human medicine and animal husbandry contribute to the development of drug-resistant pathogens. The One Health approach promotes responsible antimicrobial use, surveillance, and coordinated action to combat antimicrobial resistance effectively. One Health recognizes these interconnected drivers and emphasizes the importance of a holistic and collaborative approach to disease surveillance, prevention, and response [59,60]. By strengthening surveillance systems at the human-animal-environment interface, potential outbreaks can be detected and contained before escalating into a full-blown pandemic.

Challenges of implementing the One Health concept in Indonesia

Despite the high urgency of implementing One Health in Indonesia, several challenges contribute to the slowdown in implementing this approach. First, the approach and communication could be more cohesive since the various sectors involved are fragmented, including human health, veterinary medicine, and environmental conservation. These sectors have traditionally operated

independently, resulting in a need for coordination and information sharing [44,60,61]. This has been conveyed and negotiated in meetings and discussions on the global implementation of the concept of One Health in each country. As outlined in the policy brief, Indonesia's current condition has not been able to realize the integration of one datum (interconnectivity) between one ministry and another and ineffective collaboration between institutions, so that the absorption of information related to cases of emerging and emerging diseases, mitigation, and control efforts that tend to be different, and the urgency and priorities of each sector are different direct obstacles to the implementation of One Health in Indonesia [61]. Moreover, effective communication and collaboration among these sectors are critical for successful implementation.

Second, the country has limited funding and resources; implementing the One Health approach requires adequate financial investment and resources. However, its initiation still needs improvements, hampering its implementation and sustainability [62,63]. This has been conveyed in the T20 policy brief related to implementing and financing One Health, in which it is stated that the hampering of implementing One Health is caused by inadequate financing capabilities, with a score of 66 out of 100 [61]. In addition, a previous study explained that the estimated financing for pandemic primary prevention is about $20 billion, less than one-tenth of the global pandemic financing [64]. These data indicate a lack of interest in countries investing in infectious disease prevention programs (emerging and re-emerging) with a one-health approach, in addition to the fact that the funding allocated annually is inadequate [61]. In addition to the prevention side, adequate health resources also require sufficient funding, so governments, international organizations, and stakeholders should prioritize funding and resource allocation for research, surveillance, capacity building, and infrastructure development.

Third, policy and regulatory barriers exist; current policies and regulations often must align with the One Health approach. Harmonizing regulations and developing cross-sector policies encouraging collaboration and data sharing are necessary. Overcoming bureaucratic hurdles and encouraging interdisciplinary cooperation can be challenging but critical for effective implementation.

Fourth, capacity building and education need improvements. Increasing the capacity of professional resources in human and animal health is critical to successful implementation. This requires training programs that foster interdisciplinary collaboration and knowledge exchange. In addition, public awareness and education campaigns are needed to promote understanding and support for One Health.

Fifth, socioeconomic factors that are hard to change. Many communities depend on livestock for their livelihoods, and their economic concerns may conflict with disease control measures such as culling or restrictions on movement. Balancing economic considerations with public health priorities is a complex challenge that requires careful navigation [2,48].

Key to the successful implementation of the One Health concept in Indonesia

Based on the urgency and challenges identified, several recommendations have become critical aspects of the One Health concept in relation to zoonotic diseases, especially in Indonesia, including the need for multidisciplinary collaboration. The One Health approach brings together experts from various fields to work with synergy. These include human and veterinary medicine professionals, epidemiology, ecology, environmental science, and others [2,37].

Furthermore, disease surveillance and early warning systems are needed, which is possible by implementing One Health to establish a comprehensive disease surveillance system to monitor animal and human populations [10,36]. By detecting and reporting disease outbreaks early, interventions can be implemented immediately to prevent further spread. Regarding research and data sharing, the One Health approach encourages zoonotic disease research, including their origin, transmission dynamics, and prevention strategies. Sharing data and findings across disciplines and institutions enhances our understanding of the disease and informs evidence-based interventions [50].

Other vital considerations to successfully implement the One Health concept include preventive and control measures. The One Health concept emphasizes preventive actions to reduce the risk of zoonotic diseases [65]. These include promoting animal vaccination programs, improving hygiene practices, improving biosecurity measures in livestock production, and

controlling disease vectors. In addition, considering the environment is vital because the health of ecosystems and the environment is significant for preventing zoonotic diseases. One Health recognizes the impact of environmental factors, such as deforestation, climate change, and biodiversity loss, on disease emergence. Protecting natural habitats and promoting sustainable practices can help reduce these risks [38,47].

Finally, public awareness and education contribute to applying this concept by advocating for public awareness and education campaigns to promote a better understanding of zoonotic diseases and their prevention [33,46]. By increasing knowledge and changing behavior, individuals can adopt practices that reduce the transmission of zoonotic diseases.

Conclusion

One Health offers a comprehensive framework to address the complex challenges posed by zoonotic diseases. This approach fosters collaboration, information sharing, and coordinated action across disciplines by recognizing the interconnectedness of human, animal, and environmental health. Implementing the One Health principle is imperative as we continue to address the impact of the COVID-19 pandemic and prepare for future health threats. Through a holistic and integrated approach, we can protect the well-being of all species, protect ecosystems, and prevent the devastating effects of zoonotic diseases on global health. In the future, it is expected that many studies will generate the concept of One Health to eradicate zoonotic diseases and improve the quality of the concept so that it can be used sustainably.

Ethics approval

Ethics approval was waived for this study because no patient data were reported.

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Competing interests

The author states that there is no conflict of interest in this manuscript.

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Underlying data

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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