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Review Article

Combating Emerging Zoonotic Diseases Using One Health Strategies To Curb Local, National, Regional And Global Transmission And Mortality: A Scoping Review

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Abstract

Background: Emerging zoonotic diseases account for 75% of new infectious threats worldwide due to increasing human–animal–environment interactions, land-use change, wildlife trade, and climate variability. The COVID-19 pandemic underscored the need for integrated, joint approaches such as One Health to strengthen prevention, early detection, and response to zoonotic risks. The study objective is to synthesize evidence on the burden, drivers, challenges, and One Health strategies for combating emerging zoonotic diseases, and to identify actions to improve implementation at local, national, regional, and global levels.
Methodology: A systematic literature search was conducted across PubMed, EMBASE, Scopus, and Google Scholar. Studies were included if they examined zoonotic diseases using a One Health approach and were published in English. Data were synthesized thematically to identify key patterns, intervention strategies, and gaps.
Results: Zoonotic diseases impose morbidity, mortality, and economic losses. Evidence shows that One Health interventions such as integrated surveillance, joint outbreak investigations, and targeted vaccination have improved detection and control of diseases. However, implementation remains hindered by fragmented communication across sectors, policy inconsistencies, limited laboratory and surveillance capacity, inadequate cross-border cooperation, and limited funding. Vulnerabilities are particularly pronounced in low- and middle-income countries.
Conclusion: Effective implementation needs improved governance, sustainable financing, aligned policies, robust surveillance and laboratory systems, and meaningful community engagement. Investing in interdisciplinary research, early warning systems, and integrated response mechanisms will enhance preparedness and reduce zoonotic disease transmission. A well-resourced One Health framework is essential to protect human, animal, and environmental health.

Keywords: One Health; Zoonotic diseases; Emerging Infections; Surveillance; Prevention; Global Health

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Introduction

Zoonotic diseases constitute a group of infectious diseases that have been transmitted from animals to humans.[1] Available evidence suggests that up to 75% of emerging infectious disease agents are of animal origin, particularly from wildlife, which has resulted in approximately 2.5 billion cases of human disease and 2.7 million cases of death globally every year.[2] These pathogens include bacteria, viruses, fungi, protozoa, mycoplasma, parasites, and prions.[3] These pathogens can spill over to humans through direct or indirect contact after being established with domestic, agricultural, or wild animals, including vertebrates or arthropod vectors.[2, 4]

The groups of people most vulnerable to these infections include agricultural workers and people living at interfaces with sylvan ecosystems or in semi-urban areas with a significant presence of wildlife.[5, 6] Zoonotic diseases constitute an emerging public health problem worldwide. In Africa, owing to land-use intensification in response to development needs, climate change issues, and the proliferation of vectors,[7] there is an increasing risk of zoonotic spillover and disease outbreaks. Indeed, the dramatic increase in outbreaks on the continent could be attributed to a variety of reasons, including being the fastest-growing population in the world, which translates to a growing demand for animal-based food such as meat, poultry, eggs, and milk. Moreover, the growing population has resulted in rapid and unplanned urbanization and intensified land use in response to development needs, which are marked by the intrusion of wildlife habitats with an increasing risk of pathogen spillover from wildlife to humans.[8] As an example, from 2001-2011 to 2012-2022, there was a 63% increase in the number of zoonotic outbreaks in Africa.[6] Furthermore, between 2001 and 2022, 1,843 substantiated public health events were recorded in the WHO African region. Thirty percent of these events were zoonotic disease outbreaks.[6] In that sense, threats such as the monkeypox virus, Ebola virus, or other (re)emerging arboviruses are among the most likely to (re)emerge in the human population.

The rise of zoonotic diseases, such as the most recent COVID-19, which resulted in major local, national, regional, and global human mortality and economic losses, emphasizes the interconnectedness of human, animal, and environmental health.[9] This calls for a multidisciplinary approach beyond traditional boundaries. In that sense, the WHO has recommended a One Health approach that combines the strengths of multiple disciplines to address zoonotic emerging diseases. The One Health concept offers a comprehensive framework to address the challenge posed by increasing incidences of zoonotic diseases[10] across fostering capacities in pathogen surveillance, laboratory infrastructure, and human resources for enhanced prevention, preparedness, and response to zoonotic threats. It is a holistic approach, in response to a demand for a paradigm shift in zoonotic disease control, that encourages communication, coordination, and collaboration among human, animal, and environmental health experts as well as other relevant partners and stakeholders, such as policy and decision-makers, social scientists, industry, and local communities.[11]

On the premise of this approach, there is an urgent need to fully comprehend the environmental, socioeconomic, and cultural contexts of the emergence and transmission of zoonoses as well as evaluate their diffusion and impact. This review presents salient, untapped, and innovative approaches and strategies under the One Health umbrella that can sustainably combat emerging zoonotic diseases, particularly in the African context.

Methods

Study Design: This study was conducted as a scoping review to map existing evidence on emerging zoonotic diseases and the application of One Health approaches across human, animal, and environmental health systems. The review followed the methodological framework by Arksey and O'Malley[12] and incorporated enhancements proposed by Levac *et al.*[13*]* The reporting structure adhered to the PRISMAScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines.[14]

Protocol and Registration: The protocol for this scoping review was not prospectively registered, as registration is not mandatory for scoping reviews. All methods were defined a priori and applied consistently throughout the review process to ensure transparency and reproducibility.

Eligibility Criteria: We included peer-reviewed studies, reviews, and relevant grey literature that focused on emerging or re-emerging zoonotic diseases; applied or discussed a One Health framework or multisectoral approach, or provided evidence related to surveillance, prevention, detection, response, policy, or system implementation, and were published in English. We excluded commentaries without substantive analysis, conference abstracts without full text, and papers unrelated to zoonoses or One Health.

Information Sources and Search Strategy: A comprehensive search was conducted across PubMed, EMBASE, Web of Science, and Google Scholar. Search terms combined controlled vocabulary and keywords related to zoonotic diseases, emerging infections, and One Health. These keywords included the following: "zoonotic diseases", "One Health", "emerging infectious diseases", "pandemic preparedness", "public health", "animal health", "environmental health", "surveillance", "prevention", "control", "treatment", and "Africa". A combination of Boolean operators ("AND", "OR", "NOT") and truncation symbols was used to refine the search and identify relevant studies. Reference lists of included articles were also screened to identify additional relevant sources.

Study Selection: All records identified through the database search were imported into a reference manager, where duplicates were removed. Titles and abstracts were screened for relevance, followed by full-text assessment against the eligibility criteria. Screening was conducted independently by two reviewers, with disagreements resolved via a third independent reviewer as a tie breaker and through discussion.

Data Charting Process: A structured data-charting form was developed to extract key variables, including study characteristics (author, year, country), zoonotic disease focus, One Health components, surveillance or response strategies, challenges, and implementation gaps. Data extraction was performed by two reviewers to ensure consistency.

Synthesis of Results: Extracted data were synthesized thematically. Findings were grouped into key domains: disease burden, drivers of emergence, One Health interventions, implementation challenges, and gaps requiring policy or operational strengthening. Given the scoping nature of the review, no metaanalysis or quantitative pooling of data was performed.

Ethical and Reporting Considerations: This study is a scoping review of published literature and did not involve human, animal, or environmental subjects; therefore, ethical approval was not required. To ensure transparency and reproducibility, all methodological steps, including eligibility criteria, search strategy,

screening, and data charting, were defined a priori and reported in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines.[14]

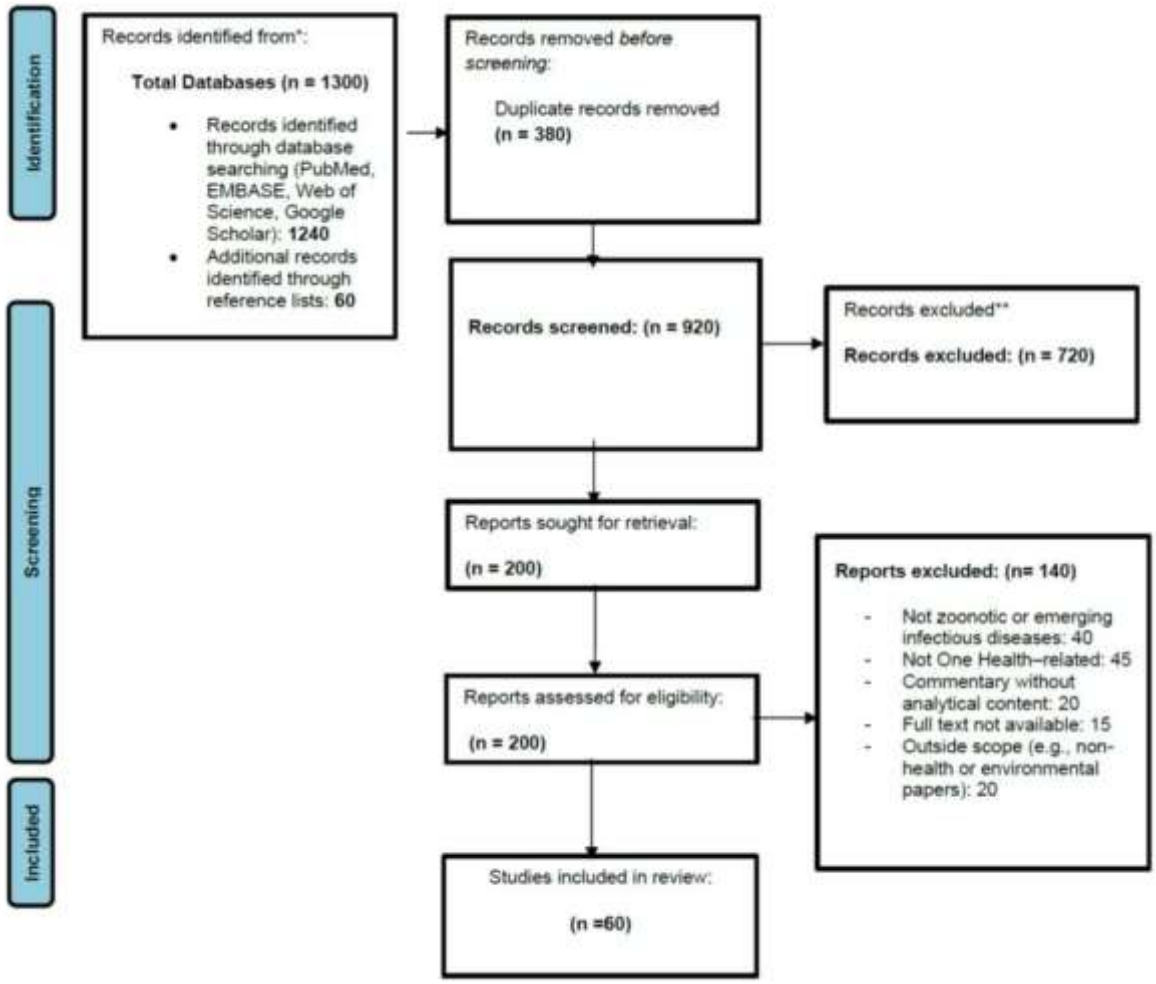

Figure 1: PRISMA-ScR Flow Diagram of Study Selection

Findings

Database identification: We identified 1,240 records through database searches (PubMed, EMBASE, Web of Science, and Google Scholar) and 60 additional records through screening of reference lists, yielding a total of 1,300 records as shown in **Figure 1.** After removing 380 duplicates, 920 unique records remained for title and abstract screening, of which 720 were excluded as clearly not relevant. The full texts of 200 articles were assessed for eligibility, and 140 were excluded because they did not address zoonotic or emerging infectious diseases (n = 40), were not One Health–related (n = 45), were commentaries without

substantive analytical content (n = 20), had no accessible full text (n = 15), or fell outside the scope of health or One Health (n = 20). A total of 60 studies met the inclusion criteria and were included in the final scoping synthesis.

The One Health Approach

The One Health approach requires collaboration among diverse stakeholders to address zoonotic diseases. The key players include government ministries, international organizations, universities, NGOs, and communities.

Key Stakeholders involved in the One Health approach: The ultimate beneficiaries of One Health are the patients for which health solutions are sought, i.e. animals, people, and the environment. The well-being of these population is provided by others, and those providers will be the focus of this discussion.[15] They include government ministries, international organizations, and professional bodies; however, the inclusion of organizations and ministries that are not ordinarily associated with health issues is vital to designing high-impact activities and successful interventions via the One Health approach. The key to modern health problem-solving is fostering effective partnerships and collaborations at the local, national, regional, and global levels, considering the challenge of infectious disease control.[16]

Multilateral organizations: The leading international organizations in global health, such as the World Health Organisation (WHO), the World Organisation for Animal Health (WOAH), and the Food and Agriculture Organization (FAO), have acknowledged that the most effective way to safeguard health security and enhance overall global well-being is by collaborating across different fields and boundaries in conjunction with established governance structures to address complex health issues.[17] Owing to this shared understanding of the value of the One Health approach, these organizations devised the Tripartite Concept Note at an International Ministerial Conference on Animal and Pandemic Influenza in Hanoi (Vietnam) in April 2010. The Tripartite Agreement provides a strategic framework for jointly developing global measures to harmonize public, animal, and environmental health policies, aiming to decrease the risks of infectious diseases at the animal-human– ecosystems interfaces.[18]

Regional networks and international donors: In addition to Tripartite organizations, other regional networks emerge that bring together multiple sectors based on trust. These networks help to enhance disease surveillance and promote collaborative efforts for coordinated interventions across borders. For example, the East African Integrated Disease Surveillance Network aims to reduce sickness and death caused by common communicable diseases in Tanzania, Uganda, and Kenya. Similarly, the Southern African Centre for Infectious Disease Surveillance serves as a virtual hub for One Health collaboration, connecting academic and research institutions in southern Africa focused on infectious disease surveillance. These networks capitalize on a common, regional disease experience that does not respect political borders or disciplinary divisions.[18, 19]

Ministries, policymakers, and collaborating organizations: One of the roles of ministries and policymakers involves ensuring that the necessary systems to support One Health are established and operational. This often involves developing the capacity, skills, and confidence within national services.[20] Furthermore, they play a key role in developing policies, laws, regulations, and guidelines for disease prevention and control. Ministries are also involved in mobilizing resources and coordinating the use of resources. They are also involved in allocating funds to partners and research institutions, particularly

programs aimed at improving the capacity for early detection, identification, management, and monitoring of toxic, zoonotic, and emerging diseases.[20]

The primary ministries involved in One Health efforts are typically those responsible for health, agriculture, and the environment. Departments under these ministries can include veterinary services, public health, and wildlife services, which are tasked with planning, coordinating, and implementing joint or linked surveillance programs. They also conduct joint outbreak investigations and oversee the monitoring and evaluation of health interventions.[15]

Universities and Academic Institutions: Universities and academic institutions play key roles as stakeholders in the One Health approach. The academic Institution facilitates the training of personnel who can implement the One Health approach. Universities help conduct research in this field (One Health), demonstrate the importance of such research, establish priorities, bring together key stakeholders, and translate knowledge into practical action. Health research plays a vital role in ensuring that proposed disease management strategies are firmly rooted in scientific evidence, thus making interventions costeffective, sustainable, and environmentally conscious.[17, 20] Furthermore, universities serve as hubs for fostering collaboration across various professional disciplines, including environmental studies, agriculture, wildlife, and public health. They facilitate such collaborations by establishing centers of excellence for education and training, promoting cooperation among different colleges and schools, incorporating One Health topics into the curriculum, and encouraging students to pursue advanced scientific training in fields relevant to global health challenges.

Non-governmental organizations (NGOs) and communities: Non-governmental organizations (NGOs) play a key role in promoting and advocating for important global health issues. They participate in various activities, such as resource mobilization, generation, utilization and management of knowledge, capacity development, intervention design, and hands-on implementation. In collaborating with other stakeholders, NGOs focus on health concerns by forming partnerships with governments, universities, communities, and development agencies.[15, 21]

Communities, especially rural and indigenous groups, play a vital role in the One Health approach. They are not only users but also essential elements of the web of interactions that sustain the functioning of the natural environment.[22] Consequently, communities are directly impacted by disruptions caused by poor health and disease. Creating healthy conditions for wildlife, people, and domestic animals that people depend on for their livelihoods can reduce key threats to public health.[23] Community engagement and empowerment are therefore crucial for the success of One Health initiatives.

Landscape of Zoonotic Diseases

The major zoonotic diseases that, at various times in the recent past, have affected, have continued to affect and weaken various local, national, regional, and global health structures, together with their public health impacts, are presented in **Supplementary Table 1** and **Table 2.**

Supplementary Table 1: Recent global snapshot and disease summary of some notable re-emerging zoonotic diseases as reported by the World Health Organization

Disease	Recent outbreaks (regions)	Disease summary

COVID-19 (SARS-CoV-2)	Global Pandemic	Originated in bats, likely jumped to humans through an intermediate animal. Caused respiratory illness and death
Ebola Virus Disease (EVD)	West and Central Africa	Spreads through contact with infected bodily fluids. Causes severe bleeding and fever
Henipavirus (Nipah Virus)	South and Southeast Asia	Transmitted through bats or infected animals (pigs). Causes encephalitis (brain inflammation) and respiratory illness.
Lyme Disease	North America, Europe, Asia	Spread by ticks feeding on infected animals (rodents, deer). Causes fever, rash, and joint pain
West Nile Virus (WNV)	North America, Europe, Asia, Africa, Australia	Transmitted by mosquitoes feeding on infected birds. Causes fever, headache, muscle aches, in some cases neurologic illness
Avian Influenza (Bird Flu)	Global (especially in Asia, Africa, Middle East)	Strains can infect humans, primarily through poultry contact. Can cause respiratory illness in varying severity
Rabies	Global (except Antarctica)	Spread through bites of infected mammals. Causes fatal neurological illness
Brucellosis	Global (most common in developing countries)	Transmitted through contact with infected animals or contaminated animal products. Causes fever, sweats, and fatigue
Leishmaniasis	Parts of Asia, Africa, the Americas, Europe	Spread by sandflies. Causes skin sores, fever, and organ enlargement (depending on type)
Taenia Solium (Pork Tapeworm)	Global (endemic in some regions)	Consuming undercooked pork infected with larvae leads to intestinal infection. Can cause seizures or neurologic problems if larvae migrate to the brain
Sources: Data derived from WHO Disease Fact Sheets and Situation Reports for COVID-19, Ebola virus disease, Nipah virus, Lyme borreliosis, West Nile virus, avian influenza, rabies, leishmaniasis, and taeniasis/cysticercosis.[2, 6, 16, 24, 25, 27, 28, 41, 42, 44]		

Recent global surveillance reports from the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) highlight a growing spectrum of re-emerging and emerging zoonotic diseases that pose substantial threats to local, national, regional, and global health security.[24] **Supplementary Table 1** summarizes major re-emerging zoonotic diseases that have continued to cause outbreaks across multiple continents. These include globally significant pathogens such as SARS-CoV-2, which emerged from animal reservoirs and resulted in an unprecedented pandemic; Ebola virus disease, which continues to reappear in West and Central Africa with high case fatality rates; and Nipah virus, linked to bat and pig exposures in South and Southeast Asia, known for severe encephalitis and high mortality.[25] Vector-borne re-emerging diseases including Lyme disease, West Nile virus, and avian influenza demonstrate how changing ecological and climatic conditions are reshaping pathogen transmission. Long-

standing zoonoses such as rabies, brucellosis, leishmaniasis, and Taenia solium infections also persist worldwide, driven by gaps in vaccination, sanitation, vector control, and food safety.[26]

Supplementary Table 2: Emerging zoonotic diseases that threaten global health with attendant local, national, and regional consequences as reported by the World Health Organization and the Centre for Disease Control and Prevention

Disease	**Recent Outbreaks (Regions)**	**Local Impact**	**National Impact**	**Regional/Global Impact**
Nipah Virus (Henipavirus)	South & Southeast Asia	Encephalitis, respiratory illness, and high mortality	Healthcare strain, economic losses	Potential for regional spread
Crimean-Congo Hemorrhagic Fever (CCHF)	Africa, Asia, Europe	Hemorrhagic fever, high mortality	Healthcare strain, economic losses	Potential for regional spread
Rift Valley Fever (RVF)	Africa, Middle East	Fever, bleeding, and fetal death in animals	Livestock losses, economic hardship	Potential for regional spread
Hendra Virus (Henipavirus)	Australia	Encephalitis, respiratory illness, and high mortality	Healthcare strain, economic losses	Potential for regional spread
Monkeypox (Mpox)	Central & West Africa	Skin lesions, fever, potential for serious illness	Healthcare strain, economic losses	Potential for regional/global spread
Langya Henipavirus	China	Fever, cough, fatigue (limited data)	Healthcare strain, potential economic impact	Monitoring for potential spread
Middle East Respiratory Syndrome (MERS)	Arabian Peninsula	Respiratory illness, high mortality	Healthcare strain, economic losses	Potential for regional/global spread

Severe Acute Respiratory Syndrome (SARS)	Southern China	Respiratory illness, high mortality	Healthcare strain, economic losses	Global alert due to potential pandemic
Lassa Fever	West Africa	Hemorrhagic fever, high mortality	Healthcare strain, economic losses	Potential for regional spread
Chagas Disease	Latin America	Fever, fatigue, long-term heart & digestive issues	Healthcare strain, economic losses	Regional burden, potential for spread

(Trypanosomiasis)				
Lyme Disease	North America, Europe, Asia	Fever, rash, joint pain, potential long-term complications	Healthcare strain, economic losses	Growing concern in new regions
West Nile Virus (WNV)	North America, Europe, Asia, Africa, Australia	Fever, headache, muscle aches, in some cases, neurologic illness	Healthcare strain, economic losses	Global concern due to the spread
Avian Influenza (Bird Flu)	Global (especially Asia, Africa, the Middle East)	Respiratory illness in varying severity, potential pandemic strain	Poultry industry losses, public health concerns	Global alert for pandemic potential
Rabies	Global (except Antarctica)	Fatal neurological illness	Public health campaigns, animal control	Ongoing global control efforts
Leishmaniasis	Parts of Asia, Africa, the Americas, and Europe	Skin sores, fever, organ enlargement (depending on type)	Healthcare strain, economic losses	Regional burden
Brucellosis	Global (most common in developing countries)	Fever, sweats, fatigue	Healthcare strain, livestock losses	Ongoing global control efforts
Leptospirosis	Global (more common in the tropics)	Fever, headache, muscle aches, kidney/liver failure	Healthcare strain, economic losses	Regional burden
Hantavirus Pulmonary Syndrome (HPS)	North & South America, Europe, Asia	Fever, respiratory failure	Healthcare strain, economic losses	Potential for regional spread
Seoul Virus (Hantavirus)	East & Southeast Asia	Fever, kidney failure	Healthcare strain, economic losses	Regional concern
Hendra Virus (Hendravirus)	Australia	Fever, muscle aches, neurological illness	Healthcare strain, economic losses (horses)	Regional concern
Nipah Like Virus (Nipah virus)	Malaysia, Singapore	Encephalitis, respiratory illness, and high mortality	Healthcare strain, economic losses	Potential for regional spread

Schistosomiasis	Sub-Saharan Africa, Asia, South America	Abdominal pain, diarrhea, and blood in the urine	Healthcare strain, economic losses	Regional burden

(Blood Fluke)				
Toxoplasmosis	Global (except Antarctica)	Flu-like symptoms, eye problems (congenital cases)	Limited local impact, potential for serious congenital cases	Global concern for pregnant women
Echinococcosis (Hydatid Disease)	Global (especially in sheep-raising regions)	Cysts in organs, potential for serious complications	Healthcare strain, economic losses (livestock)	Regional burden
Japanese Encephalitis	Southeast Asia	Fever, headache, seizures, coma	Healthcare strain, economic losses	Regional burden

Source: Data derived from WHO Emerging Diseases Bulletins, WHO Zoonotic Priority Pathogens List, and CDC High-Consequence Pathogens & Emerging Zoonoses Database. [2, 7, 16, 24, 25, 27, 28, 29, 41, 42, 44]

Supplementary Table 2 expands this view by detailing newly emerging or increasingly recognized zoonotic threats and their multi-level consequences. Diseases such as Nipah virus, Crimean-Congo hemorrhagic fever, Rift Valley fever, and Hendra virus highlight the severe local clinical impact often characterized by high mortality, neurologic involvement, or hemorrhagic manifestations as well as the strain they impose on national health systems through hospitalization surges, economic disruption, and livestock losses.[27] Respiratory pathogens including MERS, SARS, and high-risk avian influenza strains represent persistent pandemic threats due to their transmissibility and cross-border spread.[24] Other zoonoses such as Lassa fever, leishmaniasis, brucellosis, leptospirosis, hantavirus infections, and schistosomiasis demonstrate how environmental changes, population mobility, and animal–human interface pressures sustain endemicity and drive geographic expansion. Globally distributed infections like toxoplasmosis and echinococcosis further underscore the silent but substantial burden of parasitic zoonoses that continue to affect vulnerable populations.[28]

Supplementary Table 3: PRISMA-ScR Checklist	
PRISMA-ScR Item	**Description for Your Review**
Title	Identifies the report as a scoping review.
Abstract	Structured abstract summarizing background, objectives, methods, results, and implications.

Rationale	The background explains the need to map evidence on zoonotic diseases using One Health.
Objectives	Clear objectives outlining the focus on burden, drivers, challenges, and One Health strategies.
Protocol & Registration	Stated that the review was not prospectively registered, consistent with scoping review guidance.
Eligibility Criteria	Detailed inclusion/exclusion criteria provided.
Information Sources	Four databases: PubMed, EMBASE, Web of Science, and Google Scholar.
Search Strategy	Search terms and keywords related to zoonoses, emerging infections, and One Health.
Selection of Sources	Two-stage screening with independent reviewers; disagreements resolved by a third reviewer and discussion.
Data Charting Process	Standardized form used to extract study characteristics and One Health components.
Data Items	Disease focus, surveillance, response strategies, implementation challenges.
Synthesis of Results	Thematic synthesis without meta-analysis.
Results	Number of included studies and key themes reported.
Discussion	Part of the main text is a summary of the main findings, strengths, and limitations.
Conclusion	Clear implications for policy, systems strengthening, and future work.
Funding	No funding

Factors driving the emergence and transmission of zoonotic diseases

The emergence and sustained local, national, regional, and global spread of zoonotic diseases are driven by a complex interplay of forces at multiple levels. At the local scale, habitat disruption at the local level, including deforestation and encroachment on wildlife habitats, pushes animals closer to human settlements, increasing interactions and creating opportunities for disease transmission. Large-scale animal agriculture also creates crowded conditions, facilitating pathogen mutation and transmission between animals and potentially to humans. In numerous developing nations, rising unsustainable practices such as deforestation, intensive farming, and inadequate waste management are generating ecological imbalances that favor the introduction and amplification of diseases.[28] Importantly, many of these poor regions, particularly those plagued by instability, natural catastrophe, insecurity, and regional warfare, mostly exhibit inadequate capacity to detect and track zoonotic illnesses in animals and humans, thus hampering early intervention and outbreak control.[29]

On a regional scale, illegal wildlife trade and the consumption of wild meat have continued to bring humans into direct contact with novel pathogens harbored by animals. The increased movement of people and animals across borders has facilitated the geographic spread of these zoonotic diseases.[30]From a global perspective, climate change and globalization have sparked a gradual rise in temperature, weather patterns,

and global interconnection, leading to alterations in the distributions and behaviors of viruses and animals, offering new opportunities for their transmission.[31]

Emerging One Health Strategies

The emergence of One Health strategies represents a comprehensive approach to managing zoonotic threats by integrating human, animal, and environmental health disciplines. The One Health concept acknowledges the interconnectedness of these domains, aiming to develop collaborative, multi-sectoral, and transdisciplinary strategies for preventing and controlling zoonotic diseases. Some potential One Health Strategies include the following:

Integrated Surveillance: One Health promotes surveillance systems that encompass human, animal, and environmental health, facilitating early detection and response to zoonotic diseases such as avian influenza and Ebola.[32, 33] This integration helps identify disease patterns and potential outbreaks across species.[32]

Comprehensive Risk Assessment: By considering the interplay between environmental changes, wildlife, and human activities, the One Health strategy can better assess risks and prevent zoonotic threats, such as those posed by vector-borne diseases, such as Zika and West Nile viruses.[34]

Cross-Sectoral Collaboration: By encouraging collaboration among healthcare professionals, veterinarians, ecologists, and policymakers enhance knowledge sharing and coordinate responses to zoonotic outbreaks.[35, 36]

Global Health Security: The One Health framework contributes to global health security by strengthening collaboration between countries, leading to more effective management of transboundary zoonotic diseases.[35]

Proactive Interventions: Focusing on the prevention of zoonotic diseases at the source, such as through improved animal husbandry, wildlife monitoring, and environmental conservation, reduces the likelihood of outbreaks.[34, 37]

Vaccination and Biosecurity: Enhanced vaccination programs and biosecurity measures for both humans and animals are integral to One Health strategies, reducing the risk of disease transmission.[32]

***Interdisciplinary Research*:** One Health fosters interdisciplinary research, leading to innovations in diagnostics, treatments, and vaccines for zoonotic diseases.[34, 37]

Data Integration: This approach encourages the integration of diverse data sources (e.g., environmental, genomic, and clinical) to provide comprehensive insights into disease dynamics and inform public health decisions.

Novel Therapeutics Against Zoonotic Threats: Within the "One Health" approach, developing cheap, sustainable, and effective novel therapeutics plays a critical role in mitigating zoonotic threats. Traditionally, zoonotic disease control has relied heavily on public health interventions and vaccines.[38, 39] While these remain essential, they often take time to develop and deploy during outbreaks. Novel therapeutics developed within the framework of One Health could offer a faster response. These are novel

therapeutics that sustainably target human, animal, and environmental health during zoonotic outbreaks. Repurposing existing drugs for new applications or creating broad-spectrum therapeutics that are safe for other important members of the ecosystem and environmentally friendly could be used to treat a range of emerging zoonotic pathogens. Furthermore, advancements in gene editing and RNA interference hold promise for targeted therapies both in human and animal hosts because they can disrupt the life cycle of pathogens that cause zoonotic diseases.[40] For example, available evidence suggests that infected rodents are a major cause of Lassa fever in humans. The genetic diversity of the Lassa virus (LV) poses a therapeutic challenge in the development of a single drug or vaccine against various LV infections.[41]

However, multitarget broad-spectrum antiviral preparations from natural and structurally complex naturederived antiviral compounds have the potential to offer a disruptive solution,[42] particularly if the primary host (rodents) of the deadly LV is ingeniously targeted in parallel with human treatment. Prevention and treatment strategies for Lassa fever (and other zoonotic diseases) could be revolutionized by developing an innovative anti-Lassa viral natural product both for prevention in humans (sustainable nature-based immune boosters) that can be incorporated into animal food traps and baits. The strategy will be to target the entry and/or replication of the viral particle (virucidal enzyme inhibitors) in the primary host (rats) to stop the rodent-human spread of LV through their urine and feces. Some of these natural products, which are readily and sustainably available in Lassa fever endemic regions, have been scientifically validated to produce potent *in silico* and *in vitro* antiviral potentials against similar envelope viruses.[43] Furthermore, the application of innovations in data science, computational biology, bioinformatics, and integrated omics sciences can be leveraged to shorten the drug discovery pipeline against zoonotic threats. This can be achieved by prioritizing cutting-edge *in silico* drug discovery approaches that can be scaled up experimentally. This will ultimately lead to novel formulations that can be ingeniously incorporated into rodents' baits for the deliberate, gradual eradication of zoonotic pathogens in endemic regions without harm to the animal host or the environment. The development of novel therapeutics is, therefore, a cornerstone of the One Health strategy, as it fosters proactive research into potential zoonotic threats and promotes the development of drugs beforehand, which could significantly improve our preparedness for future disease outbreaks.

Success stories of One Health interventions for specific zoonotic diseases

Avian Influenza: In 2006, Nigeria faced Africa's first case of the highly pathogenic avian influenza (HPAI) H5N1, sparking unprecedented political and financial support for control efforts. The government proactively allocated resources, including a $50 million credit from the World Bank, to combat the outbreak.[44] The Nigeria Avian Influenza Emergency Control Preparedness and Response Project was launched, promoting a One Health approach to minimize the threat of HPAI to humans and increase poultry production.[45] The establishment of the National Technical Committee on Avian Influenza facilitated inter ministerial collaboration, leading to joint workshops, training activities, and enhanced communication between the Ministries of Health and Agriculture.[46] The crisis increased communication and collaboration between sectors. Although functionality varied at the state level, some progress was evident in bridging sectoral gaps. Convincing the medical sector of the value of One Health remains a hurdle, but ongoing programs such as the National Field Epidemiology and Laboratory Training Programme offer hope for increased collaboration and shared goals.[47]

Rabies: One Health initiatives have been successful in reducing the burden of rabies through mass vaccination campaigns for domestic animals, public awareness programs, and improved access to postexposure treatment for humans.[48]

Ebola: During the Ebola outbreak in West Africa, the One Health Approach facilitated collaboration between human and animal health experts, enabling a better understanding of the disease's transmission dynamics and the development of effective control measures.[49]

Challenges and Limitations in Implementing One Health for Zoonotic Disease Control

Systemic and Governance Challenges: Systemic and governance weaknesses remain a major barrier to effective zoonotic disease control and full operationalization of One Health. At the national level, collaboration between human, animal, and environmental health sectors is often ad hoc and project-driven rather than institutionalized, resulting in weak coordination, parallel surveillance systems, and fragmented outbreak responses.[50] In many countries, mandates and responsibilities are distributed across multiple ministries and agencies, leading to policy fragmentation, overlapping roles, and gaps in accountability for zoonotic threats.[51]

Unclear leadership and the absence of formal coordination mechanisms further limit the ability to convene sectors around joint risk assessment, planning, and resource allocation.[35] Regional and global governance challenges compound these gaps: cross-border information sharing is frequently slow or incomplete, and differences in regulations, enforcement capacity, and political priorities between neighbouring countries create cross-border information and response gaps that undermine regional preparedness.[52]

Operational and Technical Gaps: Operational and technical constraints are pervasive, particularly in low- and middle-income countries. Many local and subnational health facilities lack the infrastructure, equipment, and workforce needed for timely detection, confirmation, and reporting of zoonotic events, resulting in weak surveillance capacity and delayed outbreak recognition.[53] Health systems and veterinary services often operate in silos, with limited interoperability of reporting platforms and minimal integration of environmental monitoring, hampering comprehensive situational awareness across the human–animal–environment interface.[35] Poor data integration across sectors and levels of the system makes it difficult to generate real-time, multisectoral intelligence for decision-making.[52] Differences in methods, indicators, and terminology between disciplines complicate joint analysis and interpretation of zoonotic risks.[35] These constraints contribute to slow outbreak detection, delayed risk communication, and missed opportunities for early, coordinated response. Limited numbers of trained epidemiologists, veterinarians, laboratory scientists, and environmental health professionals with One Health competencies further exacerbate these operational gaps, especially in rural and hard-to-reach areas.[53]

Economic and Resource Limitations: Economic and resource constraints substantially limit the implementation and sustainability of One Health strategies. Funding for zoonotic disease prevention and control is often insufficient, fragmented, and heavily dependent on short-term external support, constraining investments in surveillance, laboratories, and workforce development.[54] Competing health priorities, such as high burdens of endemic diseases and routine service delivery, frequently divert attention and resources away from upstream, multisectoral prevention efforts.[55] Inequities in resourcing between human, animal, and environmental sectors are common, with veterinary and environmental services

typically receiving less funding and political attention than clinical services.[36] This imbalance makes it difficult to implement genuinely integrated interventions at the human–animal–environment interface. In addition, interventions such as wildlife conservation measures, livestock movement restrictions, or changes in agricultural practices may have immediate economic implications for households and communities, generating resistance when adequate compensation or social protection mechanisms are absent.[56]

Social, Cultural, and Behavioral Barriers: Social, cultural, and behavioural factors critically shape both the risk of zoonotic spillover and the feasibility of One Health interventions. In many communities, awareness of zoonotic diseases and their modes of transmission remains low, reducing demand for preventive services and delaying health-seeking behaviour.[57] Practices such as bushmeat hunting and consumption, informal wildlife trade, and close cohabitation with livestock or peri-domestic animals persist as important livelihood and cultural norms, despite their role in facilitating spillover.[58, 59]

Deeply rooted beliefs, mistrust of authorities, and previous negative experiences with health or veterinary services can undermine trust in government-led programmes and reduce participation in surveillance, vaccination, or biosecurity initiatives.[60] In some settings, communities may perceive One Health measures as externally imposed or misaligned with local priorities, leading to resistance to behaviour change even when risks are recognised.[61] Effective implementation, therefore, requires culturally sensitive risk communication, genuine community engagement, and strategies that align health objectives with local livelihoods and social realities.[62]

Policy recommendations for enhancing One Health collaboration and investment

Enhancing One Health collaboration and investment requires comprehensive policies that address governance, funding, research, community engagement, surveillance, and infrastructure. The implementation of these recommendations can help policymakers foster a more integrated and effective approach to managing zoonotic threats, ultimately improving global health outcomes.

Strengthened governance and coordination: A clear leadership and coordination mechanism must be established at the national and international levels to streamline collaboration among the health, agricultural, and environmental sectors.[63] These bodies should facilitate communication, decisionmaking, and the implementation of One Health initiatives. Furthermore, integrated policies should be formulated to integrate human, animal, and environmental health regulations. This includes harmonizing surveillance systems, reporting standards, and response strategies across sectors.[64]

Secure and sustain funding: There is a need for increased investment in One Health programs with dedicated funding allocated for One Health initiatives, including surveillance, research, and capacitybuilding programs. Public and private sector investments should be encouraged to ensure sustained financial support [32, 51] while international aid and partnerships should be explored to support One Health activities in resource-limited settings.[32]

Promotion of research and innovation: Interdisciplinary research should be supported to bridge human, animal, and environmental health disciplines, with a focus on the development of diagnostics, treatments, and vaccines for zoonotic diseases.[38] Furthermore, collaborative research initiatives and knowledge sharing should be encouraged among scientists from diverse fields. Investment should be made in technologies and platforms that facilitate the integration and analysis of data from multiple sources (e.g.,

genomic, environmental, and clinical) to improve the understanding of zoonotic disease dynamics and inform policy decisions.[65]

Fostering community engagement and education: Educational programs should be developed to raise awareness about the importance of One Health and the role of communities in preventing zoonotic diseases.[32] This information includes those on hygiene practices, safe animal handling, and environmental conservation. Behavioral change campaigns should be launched to encourage behavioral changes that reduce zoonotic risk, such as reducing wildlife consumption and improving waste management practices.[23]

Enhanced surveillance and response systems: Integrated surveillance systems should be established to integrate data from the human, animal, and environmental health sectors, enabling early detection and response to zoonotic threats.[52] This includes investing in diagnostic laboratories and training personnel. Strengthening emergency response is imperative to facilitate robust emergency response plans that include protocols for coordination among health sectors, rapid deployment of resources, and communication strategies during zoonotic outbreaks.[37]

Build capacity and infrastructure: Investment in training programs for professionals across the human, animal, and environmental health sectors to build capacity in One Health approaches should be encouraged. This includes interdisciplinary education and continuous professional development. Finally, the development and maintenance of infrastructure such as laboratories, veterinary services, and healthcare facilities that support One Health initiatives should be prioritized.[36, 37]

Emerging zoonotic diseases continue to highlight the interconnectedness of human, animal, and environmental health and reinforce the need for coordinated One Health approaches. As spillover risks grow due to environmental change, population pressures, and expanding human–animal contact, integrated action becomes increasingly essential.

This review shows that One Health strategies can strengthen surveillance, early detection, and response, but implementation remains inconsistent. Persistent gaps, including weak coordination between sectors, limited laboratory and surveillance capacity, policy fragmentation, and inadequate funding, continue to restrict effective operationalization, particularly in resource-limited settings.

Strengthening One Health will require clearer governance, sustained investment, cross-sector collaboration, and integrated surveillance systems. Prioritizing these areas, alongside stronger community engagement and interdisciplinary research, is critical for building preparedness and reducing zoonotic transmission. A fully institutionalized and well-resourced One Health system is key to protecting populations and ecosystems.

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