

One health approach in combating zoonotic parasitic diseases: Integrating human, animal, and environmental health.

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Abstract

Zoonotic parasitic diseases pose a significant threat to global health, affecting humans, animals, and the environment. The One Health approach recognizes the interconnectedness between these three domains and emphasizes the need for collaborative efforts to combat zoonotic parasitic diseases. This paper explores the importance of the One Health approach in addressing the challenges posed by these diseases, highlighting the integration of human, animal, and environmental health. We discuss the role of surveillance, prevention, control measures, and interdisciplinary collaborations in mitigating the impact of zoonotic parasitic diseases. By adopting a holistic approach that transcends traditional disciplinary boundaries, we can achieve better disease control, promote sustainable ecosystems, and safeguard public health.

Keywords: Parasitic Diseases, Human Diseases, Animal Diseases, Environmental health.

Introduction

Zoonotic parasitic diseases are a significant global health concern, impacting both human and animal populations while also affecting the environment. These diseases, caused by parasites that can be transmitted between animals and humans, have far-reaching consequences for public health, animal welfare, and ecosystem stability [1]. Historically, efforts to combat these diseases have been fragmented, with limited integration of human, animal, and environmental health perspectives. However, the One Health approach recognizes the interconnectedness of these domains and emphasizes the need for collaborative, interdisciplinary efforts to address zoonotic parasitic diseases comprehensively [2]. Zoonotic parasitic diseases have been a persistent challenge throughout human history, often causing devastating outbreaks and epidemics. Malaria, for example, has plagued humanity for centuries and remains a major health burden in many tropical and subtropical regions. Leishmaniasis, another zoonotic parasitic disease, continues to affect millions of people globally, particularly in impoverished communities with limited access to healthcare resources [3]. These examples underscore the urgency and importance of finding effective and sustainable strategies to combat these diseases.

Problem statement

The conventional approach to combating zoonotic parasitic diseases has primarily focused on either human or animal health, often neglecting the interconnected nature of these diseases. This fragmented approach hinders our ability to

understand the complex dynamics of disease transmission and to develop holistic prevention and control measures. The lack of collaboration and information sharing among human health professionals, veterinarians, ecologists, and environmental scientists further exacerbates the challenges of addressing zoonotic parasitic diseases. As a result, the global burden of these diseases persists, and their impact on human health, animal populations, and ecosystem stability remains a pressing concern.

Objective

The objective of this paper is to highlight the significance of the One Health approach in combating zoonotic parasitic diseases. By recognizing the interdependence of human, animal, and environmental health, we can devise more effective and sustainable strategies for disease surveillance, prevention, and control [4]. Through the exploration of case studies and existing literature, we aim to demonstrate the benefits of interdisciplinary collaboration and underscore the need for integrating various perspectives in combating zoonotic parasitic diseases [5]. Additionally, we seek to identify the challenges hindering the implementation of the One Health approach and propose recommendations for future directions to strengthen global efforts in combating these diseases.

Zoonotic Parasitic Diseases

Zoonotic parasitic diseases are infectious diseases caused by parasites that can be transmitted between animals and humans(6). These parasites include various microorganisms

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such as protozoa, helminths (worms), and arthropods. Zoonotic transmission occurs through different mechanisms, including direct contact with infected animals, consumption of contaminated food or water, and vector-borne transmission by arthropods like mosquitoes, ticks, and flies. The complexity of zoonotic parasitic diseases arises from their ability to cycle between animal hosts and humans, making them a challenge to control and eradicate.

Protozoal infections: These diseases are caused by single-celled parasites known as protozoa. Examples include malaria (*Plasmodium spp.*), leishmaniasis (*Leishmania spp.*), toxoplasmosis (*Toxoplasma gondii*), and giardiasis (*Giardia intestinalis*) [7].

Helminth Infections: Helminths are multicellular parasitic worms. Zoonotic helminthic diseases include echinococcosis (*Echinococcus spp.*), cysticercosis (*Taenia solium*), and schistosomiasis (*Schistosoma spp.*).

Arthropod-Borne Diseases: These diseases are transmitted to humans through the bites of infected arthropod vectors. Examples include dengue fever (transmitted by *Aedes* mosquitoes), Chagas disease (transmitted by *triatomine* bugs), and Lyme disease (transmitted by ticks).

Global Burden and Impact

Zoonotic parasitic diseases have a significant impact on global health, particularly in resource-limited regions with poor healthcare infrastructure and sanitation conditions. Millions of people worldwide are affected, leading to substantial morbidity and mortality. The burden of these diseases is not limited to human health; they also have profound consequences on animal populations, agricultural productivity, and ecosystem balance.

The economic impact of zoonotic parasitic diseases is substantial, affecting both individuals and entire communities. Lost productivity due to illness, treatment costs, and the burden on healthcare systems strain economies, especially in regions where these diseases are endemic. Furthermore, zoonotic parasitic diseases can disrupt agricultural practices, reduce livestock productivity, and impact food security in affected areas [8].

Examples of Zoonotic Parasitic Diseases

Malaria: Caused by Plasmodium parasites and transmitted through the bites of infected Anopheles mosquitoes, malaria is one of the most prevalent and deadly zoonotic parasitic diseases globally. Sub-Saharan Africa bears the brunt of malaria cases, but it also affects parts of Asia, Latin America, and the Middle East.

Leishmaniasis: This disease is caused by various species of the Leishmania parasite, which are transmitted through the bites of infected sandflies. Leishmaniasis occurs in different forms, including visceral, cutaneous, and mucocutaneous, with varying degrees of severity. It is prevalent in regions with favorable conditions for sandfly breeding, such as parts of Africa, Asia, the Middle East, and South America.

Toxoplasmosis: Caused by the protozoan parasite Toxoplasma gondii, toxoplasmosis can be contracted by consuming undercooked meat or through contact with contaminated cat feces. While most cases are asymptomatic or mild, it can lead to severe complications in immunocompromised individuals and pregnant women. Toxoplasmosis is found worldwide and affects a significant proportion of the human population.

Echinococcosis: Echinococcosis is a zoonotic helminthic disease caused by the Echinococcus tapeworms. It is transmitted to humans through contact with the feces of infected carnivores, such as dogs and foxes. Echinococcosis is prevalent in regions where livestock farming coexists with free-ranging carnivores, with significant public health and economic implications [9].

These examples highlight the diversity and geographical distribution of zoonotic parasitic diseases, emphasizing the need for a coordinated and holistic approach to their control and prevention. The One Health approach plays a crucial role in understanding the complexity of these diseases and developing effective strategies to mitigate their impact on human, animal, and environmental health.

The one health approach

The One Health approach is a collaborative and interdisciplinary strategy that recognizes the interconnectedness of human, animal, and environmental health. It emphasizes the mutual dependence of these three domains and aims to promote the well-being of all, recognizing that the health of humans, animals, and the environment are intrinsically linked. The principles of the One Health approach include:

Interdisciplinary Collaboration: The One Health approach encourages experts from diverse fields, such as human medicine, veterinary medicine, ecology, epidemiology, public health, and environmental science, to work together. By fostering interdisciplinary collaboration, the approach leverages the strengths of each discipline to tackle complex health challenges more effectively.

Holistic Perspective: One Health takes a holistic view of health, acknowledging that human health cannot be separated from animal health and the environment. This broader perspective allows for a comprehensive understanding of disease dynamics and potential risk factors, leading to more targeted interventions.

Prevention-Oriented: The approach emphasizes proactive measures and prevention rather than solely focusing on reactive responses to outbreaks. By identifying and addressing risk factors at their source, the One Health approach seeks to reduce the occurrence and impact of zoonotic parasitic diseases.

Early Detection and Rapid Response: One Health promotes early detection and rapid response to emerging diseases, enabling a swift and coordinated reaction to contain outbreaks before they escalate into larger-scale health crises.

Sustainability: The One Health approach recognizes the importance of maintaining the ecological balance and

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sustainable practices to prevent disease emergence and protect public health in the long term.

Importance of One Health in Combating Zoonotic Parasitic Diseases:

The One Health approach is particularly relevant in combating zoonotic parasitic diseases due to the intricate relationships between human, animal, and environmental factors in disease transmission. Here are some key reasons why the One Health approach is vital in addressing these diseases:

Understanding Disease Transmission: Zoonotic parasitic diseases involve complex cycles of transmission between animals and humans. The One Health approach facilitates the identification of the reservoir hosts, vectors, and environmental factors involved in disease transmission, leading to more targeted and efficient control measures [10].

Early Detection of Emerging Diseases: Zoonotic parasitic diseases, like many other zoonoses, have the potential to emerge in new areas or change their epidemiological patterns. The One Health approach enhances disease surveillance and allows for early detection of emerging threats, enabling timely intervention and containment.

Integrated Control Strategies: By considering human, animal, and environmental health together, the One Health approach enables the development of integrated control strategies. This may include vaccination campaigns, vector control measures, improved sanitation practices, and health education to address all aspects of disease transmission.

Antimicrobial Resistance: Zoonotic parasitic diseases are often treated with similar drugs in humans and animals. The improper use of antibiotics and antiparasitic drugs can lead to the development of antimicrobial resistance. The One Health approach promotes prudent use of these medications to mitigate the risk of resistance development.

Wildlife Conservation: Many zoonotic parasitic diseases involve wildlife reservoir hosts. Integrating wildlife conservation efforts within the One Health framework is crucial to maintaining biodiversity while also safeguarding public health.

Socio-Economic Impact: Zoonotic parasitic diseases can have profound socio-economic consequences, particularly in vulnerable communities. The One Health approach addresses the interconnectedness of health and socio-economic factors, providing more effective and sustainable solutions for disease control and poverty reduction.

In conclusion, the One Health approach is indispensable in combating zoonotic parasitic diseases. By promoting collaboration, holistic thinking, and proactive measures, the approach enables a comprehensive and integrated response to these complex health challenges. Implementing the One Health approach is crucial in safeguarding human health, animal welfare, and environmental sustainability in the face of zoonotic parasitic diseases.

Integrating human, animal, and environmental health

Effective surveillance and monitoring systems are fundamental in the One Health approach to combating zoonotic parasitic diseases. This involves the collection and analysis of data on disease incidence, prevalence, and risk factors in both human and animal populations. By integrating surveillance efforts for humans, domestic animals, and wildlife, health authorities can detect disease outbreaks early, track their spread, and identify potential reservoirs and vectors. Furthermore, environmental surveillance can provide insights into the ecological factors influencing disease transmission. Integrated surveillance helps to establish a more comprehensive understanding of the epidemiology of zoonotic parasitic diseases, enabling targeted control measures.

Public education and awareness campaigns play a crucial role in preventing zoonotic parasitic diseases. By increasing knowledge about disease transmission, risk factors, and preventive measures, communities can take proactive steps to protect themselves and their animals. Educational initiatives should focus on promoting proper hygiene practices, safe food preparation, responsible pet ownership, and the importance of seeking medical and veterinary care when necessary. Targeted awareness campaigns should reach vulnerable populations in endemic areas and address cultural practices that may contribute to disease transmission.

Vaccination is a vital tool in preventing zoonotic diseases that have effective vaccines. For example, vaccines have played a significant role in reducing the burden of diseases like rabies and brucellosis. Ensuring widespread vaccination coverage in both human and animal populations can break the transmission cycle and prevent outbreaks. Additionally, timely and appropriate treatment of infected individuals and animals is crucial in reducing the severity of disease and preventing further transmission.

Many zoonotic parasitic diseases, such as malaria and leishmaniasis, are transmitted through vectors like mosquitoes and sandflies. Effective vector control measures are essential to reduce vector populations and interrupt disease transmission. Integrated vector management approaches may include insecticide-treated bed nets, indoor residual spraying, environmental modifications to eliminate breeding sites, and the use of insecticides in targeted areas. Integrating vector control efforts across human and animal health sectors can lead to more efficient and sustainable control strategies.

Collaboration among professionals from various disciplines is central to the One Health approach. Veterinarians, physicians, ecologists, epidemiologists, entomologists, and environmental scientists must work together to address zoonotic parasitic diseases comprehensively. Interdisciplinary teams can share knowledge, expertise, and resources, leading to a deeper understanding of disease dynamics and innovative solutions. Academic institutions, governmental agencies, non-governmental organizations (NGOs), and international bodies must foster partnerships and facilitate communication to strengthen the One Health network [11].

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Effective policies and regulations are essential in implementing the One Health approach. Governments and international organizations should develop and enforce regulations related to disease surveillance, reporting, and control measures. Policies should encourage collaboration between health sectors and establish frameworks for information sharing and joint decision-making. Additionally, policies should address issues such as antimicrobial resistance, wildlife conservation, and land-use planning to promote sustainable ecosystems and prevent disease spillover events.

In conclusion, integrating human, animal, and environmental health is critical in combating zoonotic parasitic diseases. Through surveillance and monitoring, prevention and control measures, interdisciplinary collaborations, and well-defined policies and regulations, the One Health approach offers a comprehensive and sustainable strategy to mitigate the impact of these complex diseases. By acknowledging the interdependence of human, animal, and environmental health.

Case Studies

Malaria: An Example of Successful One Health Implementation

Malaria serves as a compelling example of successful One Health implementation in combating a zoonotic parasitic disease. Malaria is caused by Plasmodium parasites, transmitted through the bites of infected Anopheles mosquitoes. Historically, malaria has been a significant global health burden, particularly in sub-Saharan Africa, where the majority of malaria-related deaths occur.

Interdisciplinary Collaboration: In the fight against malaria, collaboration between human health experts, entomologists, epidemiologists, and environmental scientists has been crucial. They work together to understand the disease transmission cycle, study mosquito breeding habitats, and design effective vector control strategies.

Surveillance and Monitoring: Integrated surveillance systems track both human malaria cases and mosquito populations. Data collected through this approach allow for early detection of outbreaks and informed decision-making for targeted interventions.

Vector Control: One Health efforts have prioritized the use of insecticide-treated bed nets and indoor residual spraying to reduce mosquito populations. Additionally, environmental modifications, such as draining stagnant water, are implemented to eliminate mosquito breeding sites.

Education and Awareness: Public health campaigns raise awareness about malaria prevention, symptoms, and treatment. These campaigns focus on educating communities about the importance of using bed nets, seeking prompt medical care, and participating in vector control efforts.

Vaccination and Treatment: Although no fully effective malaria vaccine exists yet, progress has been made in developing vaccines. One Health collaborations have facilitated research and clinical trials to advance vaccine

development. Meanwhile, effective antimalarial drugs are distributed and administered to infected individuals, and multidrug resistance is closely monitored [12].

The implementation of the One Health approach has yielded significant progress in malaria control. According to the World Health Organization, malaria-related deaths have decreased by over 40% globally between 2000 and 2020. This reduction is largely attributed to integrated efforts that address the disease from multiple angles, considering the complex interactions between humans, mosquitoes, and the environment.

Leishmaniasis: Challenges and Opportunities for One Health

Leishmaniasis presents challenges and opportunities for the successful implementation of the One Health approach. Leishmaniasis is caused by Leishmania parasites and transmitted through the bites of infected sandflies. The disease occurs in different forms, including visceral, cutaneous, and mucocutaneous, each presenting unique challenges.

Zoonotic Complexity: Leishmaniasis transmission involves multiple mammalian reservoir hosts, including humans, domestic animals (e.g., dogs), and wildlife. The complexity of the transmission cycle poses challenges in identifying all reservoirs and designing control strategies.

Vector Ecology: Sandfly vectors have specific ecological requirements, making them challenging to control. Their habitat preferences and behavior vary between species and regions, necessitating tailored approaches for effective vector control.

Limited Resources: Many regions affected by leishmaniasis have limited resources and healthcare infrastructure. Implementing the One Health approach requires overcoming resource constraints and ensuring equitable access to healthcare services.

Integrated Vector Management: The One Health approach allows for the integration of various vector control methods, including insecticide-treated nets, indoor residual spraying, and environmental modifications. By combining these strategies, One Health efforts can maximize the impact on sandfly populations.

Reservoir Control: One Health collaborations can focus on identifying and managing reservoir hosts. For example, vaccination campaigns for dogs in endemic areas could help reduce the transmission of visceral leishmaniasis.

Research and Surveillance: The One Health approach emphasizes the importance of data collection and sharing. Comprehensive surveillance systems can track both human cases and reservoir hosts, providing essential information for targeted interventions and early detection of outbreaks.

Awareness and Education: Public awareness campaigns can enhance understanding of leishmaniasis transmission, prevention measures, and the importance of seeking medical care. Community engagement is crucial for success in controlling this disease.

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Benefits and challenges of one health approach

Comprehensive Understanding: The One Health approach fosters a more comprehensive understanding of the complex interactions between human, animal, and environmental health factors. This holistic perspective allows for a more accurate assessment of disease dynamics and risk factors, leading to better-informed and targeted interventions.

Early Detection and Rapid Response: By integrating surveillance systems across human, animal, and environmental health, the One Health approach facilitates early detection of disease outbreaks and emerging threats. This enables a swift and coordinated response to contain and prevent the spread of zoonotic parasitic diseases.

Integrated Control Strategies: One Health collaborations lead to the development of integrated control strategies that address multiple aspects of disease transmission. This includes vector control, vaccination campaigns, health education, and antimicrobial stewardship, resulting in more effective and sustainable disease control measures.

Biodiversity Conservation: The One Health approach recognizes the impact of zoonotic parasitic diseases on wildlife populations. By integrating wildlife conservation efforts, the approach aims to preserve biodiversity while mitigating the risk of disease transmission between animals and humans.

Economic Benefits: Implementing the One Health approach can result in significant economic benefits. By preventing and controlling zoonotic parasitic diseases, healthcare costs decrease, productivity improves, and resources are used more efficiently.

Challenges

Interdisciplinary Collaboration: Facilitating effective collaboration between professionals from diverse disciplines can be challenging due to differences in language, methodologies, and priorities. Overcoming these barriers requires dedicated efforts to promote communication, mutual respect, and shared objectives.

Data Sharing and Integration: Integrating data from various sources, such as human health systems, veterinary records, and environmental monitoring, can be complex. Overcoming technical and administrative challenges in data sharing is essential to harness the full potential of the One Health approach.

Limited Resources: The implementation of the One Health approach requires significant resources, including funding, skilled personnel, and infrastructure. Many regions facing zoonotic parasitic diseases have limited resources, making it difficult to fully implement integrated programs.

Policy and Regulatory Coordination: Aligning policies and regulations across human health, animal health, and environmental sectors can be challenging, especially in different jurisdictions or countries. Policy harmonization is necessary to facilitate the smooth implementation of One Health strategies.

Future Directions and Recommendations

Strengthening Collaboration and Communication

Efforts to promote interdisciplinary collaboration and communication should be prioritized. Establishing platforms for regular meetings, workshops, and information sharing can foster a sense of community among professionals from different disciplines. Public and private sectors, academia, and NGOs should work together to encourage partnerships that facilitate the One Health approach.

Research and Innovation

Investing in research and innovation is crucial for developing new tools and technologies to combat zoonotic parasitic diseases. Funding agencies and research institutions should allocate resources to study disease transmission dynamics, develop effective vaccines, improve diagnostics, and explore novel vector control methods.

Capacity Building

Enhancing capacity at local, national, and international levels is essential for successful One Health implementation. Training programs should be established to build the skills of professionals in various disciplines, including epidemiology, veterinary medicine, ecology, and public health. Community engagement and education should also be prioritized to empower individuals in disease prevention and control efforts.

Policy and Advocacy

Governments and international organizations must promote policies that support One Health initiatives. This includes policy harmonization, funding allocation, and incentives for collaborative research. Strong advocacy efforts are necessary to raise awareness of the benefits of the One Health approach among policymakers, stakeholders, and the general public.

Conclusion

The One Health approach presents a powerful framework for addressing the complex challenges posed by zoonotic parasitic diseases. Its integration of human, animal, and environmental health perspectives offers numerous benefits, including a deeper understanding of disease dynamics, early detection of outbreaks, and the development of integrated control strategies. However, the approach also faces challenges related to interdisciplinary collaboration, resource limitations, and policy coordination. By strengthening collaboration, investing in research and capacity building, and advocating for supportive policies, we can maximize the potential of the One Health approach to combat zoonotic parasitic diseases effectively. Embracing this holistic approach is essential for safeguarding public health, preserving biodiversity, and promoting sustainable ecosystems in the face of emerging and re-emerging zoonotic threats. The One Health approach has proven successful in combating malaria, demonstrating the potential for integrated efforts in addressing zoonotic parasitic diseases. While leishmaniasis presents unique challenges, the One Health approach offers opportunities to improve control strategies through interdisciplinary collaboration, surveillance,

education, and tailored vector and reservoir management. By continuing to embrace the One Health approach, global health efforts can achieve significant progress in combating zoonotic parasitic diseases like leishmaniasis.

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