Zoonotic Parasitic Diseases: An Emerging Global Threat to Human and Animal Health

AUTHORS DETAIL

Ali Raza[1*], Akhter Zaman[1], Kaleem Ullah[1], Arif Sohail[1], Umair Hamza[1], Bilal Ahmad[1], Hafiz Ghulam Nabi[1], Ali Hussnain[1]
[1]Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan; Pakistan
*Corresponding author: ar892534@gmail.com

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Abstract

Zoonotic diseases pose a significant threat to global health, with profound impacts on both public health and economies. Factors such as deforestation, urbanization, global trade and travel, and modern agricultural practices contribute to the emergence and spread of these diseases. Recent outbreaks, including piroplasmosis, fasciolosis, echinococcosis, toxoplasmosis, and anaplasmosis, have led to considerable morbidity, mortality, and financial losses, with over $500 million in direct economic costs due to parasitic diseases. Each year, zoonotic diseases cause approximately 2.5 billion illnesses and 2.7 million deaths globally. To mitigate these threats, a One Health approach, involving collaboration across veterinary medicine, public health, environmental sciences, and social sciences, is crucial. Effective control strategies should focus on improving biosecurity, strengthening veterinary and public health systems, and enhancing surveillance. Coordinated efforts in surveillance, research, prevention, and intervention are essential to reduce the risk of emerging zoonotic diseases and prevent future outbreaks.

Keywords: Emanating, Zoonosis, Deforestation, Urbanization, Surveillance, One Health

1. Introduction

Those diseases which are spread from animals to humans are called as zoonotic diseases.

What is One Health Approach?

The building of plans and strategies for the mitigation of the zoonotic impact from the region with help of multidisciplinary approach including animals, human and the environment (Erkyihun and Alemayehu, 2022).
Parasitic zoonosis circulating in the world is the most alarming threat all around because of its deleterious effects on the health and economy as well. This is originated and transmitted by different factors including deforestation, urbanization, climatic changes global trade and travel all around the world. As a result of these factors many parasitic zoonotic diseases like as, piroplasmosis, fasciolosis, echinococcosis, toxoplasmosis, anaplasmosis are top trending all over the world. Owing to this zoonotic impedance there was great loss in the form of mortality, morbidity and economical loss. In the research it is clearly figured out that due to parasitic zoonosis there was about $500 million loss recorded alongside 2.2 billion illnesses and 2.7 million deaths worldwide. Keeping these records in mind there should be a multidisciplinary approach (One Health Approach) to eradicate that treacherous menace. This multidisciplinary approach can be achieved by the collaboration of multiple disciplines including, veterinary medicine, public health, environmental sciences and also social sciences to address the root causes of disease outbreaks and spread (Mbuthia, 2020).

2. Factors for Parasitic Zoonosis:

Following is some worst factors that cause the emergence of threat of parasitic zoonosis day by day all over the world as shown in Figure 1.

Fig. 1 Factors enhancing zoonotic diseases

2.1. Deforestation

Deforestation is the one of the most dangerous and horror factors that absolutely affect vector and parasitic populations. When soil erosion is started because of the cutting trees the devastation changes in the soil type, precipitation and latitude are seen which lead forests to perturbation. when forests are cut down, they usually get transformed into smaller farms, villages, places for animals to graze, or just open spaces. It's a big change to the land and can have bad impacts on the environment and the people living nearby. When the forest ecosystem undergoes changes, it can have a domino effect on the entire environment. This can result in the arrival of new vectors, which are organisms that can transmit diseases, leading to parasitic infestations. Additionally, the altered environment can create favorable conditions for existing parasites and their vectors to flourish. It's crucial to consider the consequences of these ecosystem changes on the delicate balance of nature. As I have discussed that these lands are changes to the grazing areas and human settlements so definitely parasites attack both animals and humans imparting zoonotic effect (Salifko et al., 2000).

Deforestation can have serious consequences, leading to an increased risk of waterborne and foodborne parasitic infestations in animals and humans. When tropical forests are destroyed, it can result in contaminated water and food sources, which in turn can contribute to the transmission of zoonotic parasitic diseases like giardiasis and cryptosporidiosis. These diseases can have a significant impact on both animal and human communities, emphasizing the need to protect and preserve our forests for the well-being of all (Lallo, 2012).

2.2. Urbanization:

The prevalence of additional diseases and the health burden are increasing globally due to urbanization. The emergence of novel infectious diseases, alongside parasitic zoonoses, is significantly influenced by the global movement of people, animals, and food. Urbanization is not the sole factor contributing to the emergence of diseases or zoonotic incidents. Transmission often occurs in unhygienic areas like slums where people reside. By maintaining stringent checks and balances and ensuring urban development adheres to strict hygiene protocols, the likelihood of zoonotic or other diseases can be effectively reduced. Prioritizing cleanliness and health protocols in urban planning is essential to mitigate disease risks (Ahmad et al., 2019).

2.3. Modern Agricultural Practices & Intensification:

Modern agricultural practices and intensification have been linked to the emergence and escalation of zoonotic diseases. Despite this correlation, definitive evidence remains elusive. The sylvatic cycle of potent zoonotic pathogens, coupled with the close interaction between humans, livestock, wildlife, and vectors, is fundamentally altering ecosystems. These changes are primarily attributed to modern agricultural practices and intensification. If there should check and balance is maintained then we can see stop loss (Jones et al., 2013).

2.4. Climatic Effect:

In the last two decades there is potential change seen in the climate due to various factors. These changes are embarking the devastating effect on the environment, people and animals within that tertiary (Nwankwoala, 2015). The one of most notorious factors is increase in the temperature due to global warming. The greenhouse gases including methane, carbon dioxide, ozone and nitrous oxide have negative and damaging effect on the environment (Cassia et al., 2018). These gases sometimes increase the temperature dramatically and may lead to the different sort of problems. Likewise, if the temperature of the one place

increase in the cooled area, then this abnormality may cause the appearance of the mosquitoes and ticks or any other biological vectors of the parasitic zoonotic diseases (Gajadhar and Allen, 2004).

Changes in freshwater ecosystems due to climate variability can significantly impact the distribution and abundance of freshwater organisms, including Biomphalaria spp., a key host for Schistosoma spp., the causative agent of schistosomiasis (Stensgaard et al., 2019). Such alterations in the habitat of these snails could facilitate the transmission of Schistosoma to humans, posing a public health risk. Similarly, climate-induced changes in freshwater environments may also affect other parasitic species, such as Fasciola, Clonorchis, and Opisthorchis, which are responsible for liver and lung fluke infections. These parasitic diseases are zoonotic and can lead to widespread outbreaks, resulting in severe economic and health consequences. Therefore, climate-induced disruptions to freshwater habitats may exacerbate the spread of these and other parasitic diseases, with significant implications for both public health and economies (Yadav and Upadhyay, 2023).

3. A Silent Threat Amplified by Global Trade:

Parasitic zoonoses, diseases transmitted between animals and humans via parasitic organisms, represent a significant yet often underappreciated global health threat (Shah and Khan, 2019). The expansion of international trade, particularly in animals and animal products, has inadvertently exacerbated the transmission of these diseases (Rohr et al., 2019). As global trade networks continue to expand, they facilitate the movement of parasitic pathogens across borders, exposing populations to new diseases that may have previously been geographically isolated (Baker et al., 2022).

3.1. Live Animal Trade

The trade in live animals is a major pathway for the transmission of parasitic zoonoses. Animals, especially those from regions with high parasite burdens, can serve as reservoirs for various parasitic organisms. These can include internal parasites like roundworms and tapeworms, as well as external parasites such as ticks, fleas, and lice. The risk of transmission to humans can occur through direct contact with infected animals, consumption of contaminated meat, or through intermediate vectors, including ticks and mosquitoes (Fong and Fong, 2017).

The risk of transmission is heightened when transportation conditions and quarantine protocols are inadequate. Unsanitary environments in livestock markets and transportation hubs can facilitate the spread of parasites. Furthermore, the movement of animals across regions with different parasite burdens increases the likelihood of cross-contamination, enabling the spread of zoonotic diseases (Pavlin et al., 2009).

3.2. Food Trade

Global food trade, encompassing the exchange of meat, fish, dairy, and other animal products, significantly contributes to the transmission of parasitic zoonoses. Inadequately processed, undercooked, or contaminated food products can harbor parasites (Fegan et al., 2022). For instance, meat from infected animals can carry larvae or cysts from parasites such as Trichinella or Toxoplasma gondii. As food products travel internationally, the risk increases that contaminated goods will reach new markets, potentially exposing populations to infections that were previously uncommon in those regions (Han et al., 2021).

The movement of food also introduces the possibility of invasive species carrying parasites. Infected snails, fish, and other animals, whether for consumption or ornamental purposes, can introduce new parasitic threats to regions where they were not previously endemic (Latif et al., 2023).

3.3. Travel and Tourism

International travel is another contributing factor in the spread of parasitic zoonoses. Travelers visiting endemic areas may be exposed to parasites they would not encounter in their home countries. Regions with poor sanitation and limited access to healthcare present elevated risks for parasitic infections. Additionally, vectors such as mosquitoes and ticks can transmit parasites to humans, further increasing the risk of zoonotic transmission. As travelers return home, they may unknowingly introduce these parasites to areas where they had not been previously encountered (Fooks and Johnson, 2014).

4. Major Parasitic Zoonoses and Their Global Impact

4.1. Echinococcosis

Echinococcosis, caused by tapeworms of the genus Echinococcus, is a serious zoonotic disease that can result in life-threatening infections (Brozova et al., 2021) The rade in livestock, particularly sheep and dogs, has contributed to the global spread of Echinococcus larvae. Humans typically become infected through exposure to contaminated animal feces or by consuming undercooked meat from infected animals (Pardhan et al., 2023). In regions where livestock and pet management practices are suboptimal, the disease remains a significant public health challenge.

4.2. Toxoplasmosis

Toxoplasma gondii, the causative agent of toxoplasmosis, is one of the most widespread parasitic infections globally (Dubey et al., 2021). Transmission occurs primarily through contaminated food, water, or by handling the feces of infected cats. The global trade in meat and animal products, along with the movement of infected cats, has facilitated the spread of Toxoplasma to new regions. Toxoplasmosis can cause severe complications, particularly in pregnant women and immunocompromised individuals (Wang et al., 2017).

4.3. Trichinellosis

Trichinellosis is caused by roundworms of the genus Trichinella, and humans typically become infected by consuming undercooked meat, particularly pork (Mechouk et al., 2024). The global trade in meat products, particularly pork, has increased the risk of exposure to Trichinella larvae. Inadequate meat inspection and improper food safety practices further amplify the risk, particularly in regions where regulatory oversight is weak (Hoffman et al., 2019).

4.4. Schistosomiasis

Schistosomiasis, caused by parasitic flatworms of the genus Schistosoma, remains a major health threat in many tropical and subtropical regions (Noya et al., 2015). While primarily waterborne, the spread of schistosomiasis has been facilitated by the global movement of water resources, agricultural products, and even tourists. The introduction of infected freshwater snails through international trade has contributed to the spread of schistosomiasis into new geographic area (Habib et al., 2021).

4.5. Fascioliasis

Fascioliasis is caused by liver flukes of the genus Fasciola, particularly Fasciola hepatica and Fasciola gigantica (Li & Liu, 2024). These flukes primarily infect livestock such as cattle and sheep, but humans can become infected through the consumption of contaminated water plants or undercooked meat. The movement of livestock and agricultural products across borders, combined with the global trade in water plants, has increased the risk of fascioliasis in regions where it was not previously common (Alba et al., 2021).

4.6. Anaplasmosis

Anaplasmosis is a bacterial infection caused by Anaplasma species, which primarily affects livestock and, in some cases, humans (Dantas-Torres & Otranto, 2017). The disease is transmitted by ticks, with species such as Ixodes spp. being the primary vectors. The global trade in livestock, especially cattle, has facilitated the spread of anaplasmosis to new regions. The movement of infected ticks along with livestock during transport exacerbates the risk of cross-border transmission (Tatenda, 2020).

4.7. Piroplasmosis

Piroplasmosis is caused by protozoan parasites from the genera Babesia and Theileria. These parasites infect red blood cells, causing symptoms like fever and anemia in affected animal (Hussen, 2020). The spread of piroplasmosis has been facilitated by the global trade in cattle, as infected ticks can be carried across borders along with livestock. Piroplasmosis poses a significant threat to livestock industries, particularly in regions where tick control measures are insufficient (De la et al., 2023).

5. Prevention and Control Strategies

A comprehensive approach is required to mitigate the global health threat posed by parasitic zoonoses:

a) Enhanced Food Safety Practices: Strengthening food safety protocols, particularly concerning the processing, handling, and cooking of meat and other animal products, is crucial in reducing the risk of parasitic infections. This includes rigorous inspection systems, proper hygiene, and public education on safe food practices (Gabriel et al., 2023).

b) Vector Control: Effective control of vector populations, such as ticks and mosquitoes, is essential in reducing the transmission of vector-borne parasitic diseases. Measures like insecticide-treated nets, larvicides, and better vector surveillance are critical to preventing zoonotic transmission (Rani et al., 2023).

c) Veterinary Health Programs: Strengthening veterinary public health systems, including regular screening of livestock and the implementation of quarantine measures, is vital for preventing parasitic infections in animals. This can help to reduce the transmission risk to humans and local wildlife (Lane et al., 2024).

d) Public Health Education: Educating the public about the risks of parasitic infections and promoting preventive measures, such as proper hygiene and safe food handling, can significantly reduce the incidence of zoonotic diseases (Corrales, 2023).

e) International Cooperation: Given the global nature of animal and agricultural trade, international cooperation is essential for the monitoring and control of parasitic zoonoses. Countries must collaborate to share data, implement disease control measures, and enforce regulations to prevent the spread of parasitic infections across borders (Wangdi et al., 2015).

6. How to mitigate the impact of emerging parasitic diseases:

The alarming rise of emerging parasitic diseases underscore the urgent need for a one health approach recognizing the interconnectedness of the human, animal, and environmental health. By adopting a unified strategy, we can effectively mitigate the impact of these diseases and foster a healthier future for all. (Mubareka et al., 2023).

To combat the growing threat of parasitic diseases, comprehensive control master plans must be developed and implemented. These plans should include measures such as: Enhancing biosecurity control, strengthening public health systems and implementing robust surveillance program.

6.1. Enhancing biosecurity control:

The animal production and poultry production industries face significant biosecurity challenges, with inadequate strategies and compliance posing a high risk of disease outbreaks in the flocks and herds. To address this critical issue, rigorous studies must be conducted to identify and implement best practices in the animal and poultry farming (Tilli et al., 2022).

This may involve adopting innovative approaches to enhance biosecurity measures such as:

- Implementing robust disease surveillance systems
- Enhancing farm level biosecurity protocols
- Developing effective vaccination
- Improving animal health management practices

By considering these protocols we can enhance the biosecurity and save animals from the parasitic or any type of zoonotic and non-zoonotic disease (Georgiev et al., 2017).

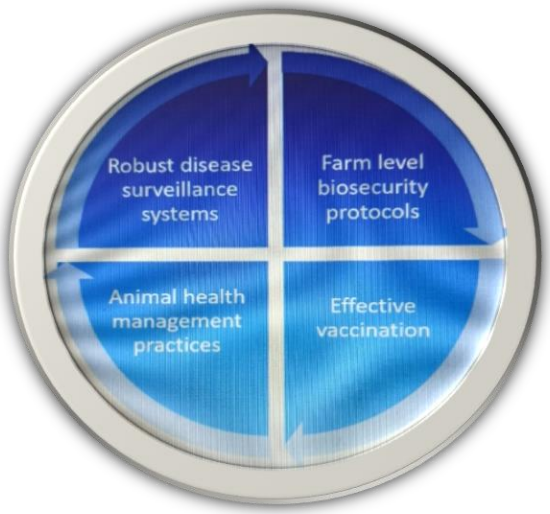


Fig. 2 Important Biosecurity Measures

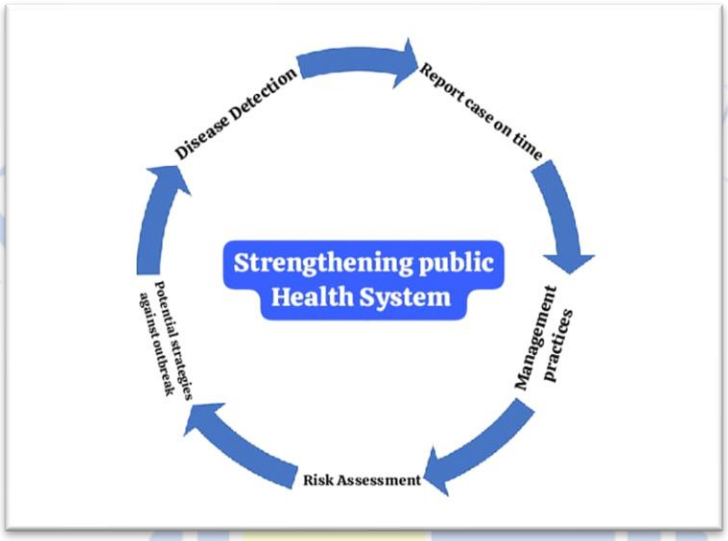
6.2. Strengthening public health systems:

The world health Organization (WHO) has conducted research and concluded that addressing the intersection of the animals and human health, known as the animal human interface is crucial to control the spread of the disease. The rapid urbanization,

and globalization, and migration of populations have led to the emergence of the new and dangerous disease threats, posing significant risk to global public health (Nsubuga et al., 2010).
To mitigate these risk, robust surveillance programs must be implemented, focusing on:

- Enhancing disease detection and reporting
- Improving animal health management practices
- Conducting regular risk assessments and research
- Developing effective response strategies to the potential outbreaks

(Sawford, 2011).



7.3. Implementing Robust Surveillance Program:

Implementing robust surveillance program can help in controlling the zoonotic diseases in such a way:

- Enhancing detection and rapid response
- Improved data quality & Collaborations
- Disease Trend Analysis & Evaluation

So, by robust surveillance program adaptation there is the chance for mitigating parasitic zoonosis (Yemshanov et al., 2017).

7. Conclusion

The rooting zoonotic diseases would be a major relief for global health. A collaborative approach is essential, involving the animal, human, and environment sector, to eliminate current outbreaks and the future ones. By synchronizing efforts across the domains, we can effectively combat the diseases. Epidemiologist can play role through enhanced surveillance, while research analysists can contribute by studying diseases in greater depth and can help in finding the root cause of the disease and it will be more helpful to mitigate that cause. Veterinarians, farmers, and fomites in region with direct or indirect contact with the animal must also engage in prevention and control strategies. Only through this collective approach we can mitigate the impact of the zoonotic disease on the public health and then we can say that we have controlled the global health issue. This is the duty of everyone to contribute in that regard.

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