Review Article
DOI: https://doi.org/10.70749/ijbr.v2i02.327

INDUS JOURNAL OF BIOSCIENCES RESEARCH
https://induspublisher.com/IJBR
ISSN: 2960-2793/ 2960-2807

Crossref

OPEN ACCESS

Pets Diseases and Public Health: Zoonosis, Transmission and Treatment: A Review

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ARTICLE INFO

Keywords

Zoonotic Diseases, Companion Animals, Urbanization, Veterinary Practices, Public Health, One Health, Zoonotic Transmission.

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Declaration

Author's Contributions: All authors contributed to the study and approved the final manuscript.
Conflict of Interest: The authors declare no conflict of interest.
Funding: No funding received.

Article History

Received: 07-10-2024
Revised: 25-11-2024
Accepted: 05-12-2024

ABSTRACT

Zoonotic infections transferred from pets to humans constitute an escalating public health issue exacerbated by the surge in pet ownership worldwide, especially in urban environments. Companion animals operate as reservoirs for several diseases, including viruses, germs, and parasites, which can be transmitted to humans, presenting substantial dangers to animal and human health. This review examines the transmission dynamics, prevention, and treatment techniques associated with zoonotic diseases in companion animals, focusing on the influence of veterinary practices, environmental factors, and human-animal interactions. The main aim of this review is to consolidate existing knowledge, pinpoint significant gaps in the field, and offer insights into successful techniques for managing zoonotic risks linked to pets. The review examines trends and conclusions from recent studies, concentrating on growing zoonotic hazards and the efficacy of preventative methods, including immunization, parasite management, and veterinary surveillance. Literature indicates substantial disparities in zoonotic disease prevalence influenced by regional, social, and environmental factors. Urbanization is a significant component in the proliferation of zoonotic illnesses, as high pet populations and heightened human-animal interactions intensify transmission risks. Moreover, despite advancements in veterinary diagnostics and therapies enhancing the management of zoonoses, there persists a necessity for stronger integration of One Health strategies and more focused research in resource-limited environments. This review culminates in recommendations for future research, specifically regarding the influence of cultural practices on pet care, the effects of climate change on zoonotic transmission, and the significance of cross-sector collaboration in public health and veterinary domains.

INTRODUCTION

Zoonotic diseases transmitted from pets to humans constitute a significant global public health issue with extensive ramifications for both animal and human populations (Cortez Nunes et al., 2022). Diseases produced by viruses, bacteria, parasites, and fungi present significant health threats due to the growing connections between people and companion animals (Kheirallah et al., 2021). The increase in pet ownership, especially in urban areas, has heightened the danger of zoonotic transmission, rendering this a significant concern in veterinary medicine, public health, and epidemiology (Obiegala et al., 2021). Despite the considerable study on zoonoses, substantial gaps persist in our comprehension, particularly concerning the precise dynamics of disease transmission in companion animals and the efficacy of preventive strategies (Hobbs & Reid, 2021). This review seeks to consolidate existing information regarding the transmission, prevention, and treatment of zoonotic diseases in pets, emphasizing critical elements such as pet health, veterinarian practices, and environmental effects that facilitate the dissemination of zoonoses (Elton et al., 2021).

Recent research has highlighted the rising incidence of zoonotic infections in companion animals, particularly in densely populated urban regions. Studies indicate that the urbanization of pet populations, together with environmental alterations and heightened human-animal interactions, has facilitated the proliferation of zoonotic diseases, including rabies, Leptospira, and parasitic infections (Zheng et al., 2019). Research in major urban areas has shown an increased prevalence of zoonotic infections in pets, attributed to inadequate sanitation and restricted access to veterinary services (Ribeiro et al., 2019). Nevertheless, although these studies have substantially advanced the discipline, they also need to be more comprehensive in comprehending how socioeconomic and cultural factors, especially in resource-limited environments, affect the frequency and management of zoonoses (Heylen et al., 2021). Addressing this deficiency is crucial for developing more effective public health policies and veterinary practices.

This review aims to fill this vacuum by thoroughly studying the literature on zoonotic illnesses in companion animals, emphasizing the significance of preventative veterinary practices, diagnostic innovations, and the influence of socioeconomic and environmental factors (Sabra et al., 2021). Despite much research in this domain, a deeper comprehension of the intricate relationships among pets, their owners, and their habitats in spreading zoonotic illnesses still needs to be improved (Fasina et al., 2021). This study seeks to enhance zoonotic disease prevention and control by combining existing research and emphasizing underexplored areas, promoting public health and veterinary practices (Waugh & Mullaney, 2019).

The Landscape of Zoonotic Diseases in Pets

Emergence and Prevalence of Zoonotic Diseases in Companion Animals

In particular, because of their rising frequency and the complicated interaction of environmental, ecological, and human behavioral elements, emerging zoonotic diseases in companion animals have attracted interest recently. Studies show that while they improve human-animal interactions and help pathogen transmission, urbanization, climate change, and the intensification of agriculture significantly contribute to the increase in these diseases (Garoma & Diba, 2022). For example, shifting climate patterns that extend the habitats of disease vectors have been associated with the emergence of vector-borne diseases in dogs, including Lyme disease and dirofilariasis (Borthakur et al., 2014; Irwin, 2014).

Recent studies have underlined how veterinarian education and public awareness help reduce zoonotic dangers. According to surveys, pet owners frequently lack awareness of zoonotic diseases, which might increase transmission rates (Alho et al., 2018; Lee & Devlin, 2022). Moreover, as observed for diseases such as rabies and toxoplasmosis, illegal wildlife trade and worldwide travel aggravate the spread of zoonotic viruses (Fooks & Johnson, 2014). Developing sensible surveillance and prevention plans against newly occurring zoonotic illnesses in companion animals depends on awareness of these dynamics (Waugh & Mullaney, 2019).

Pet ownership patterns, urbanization, and healthcare infrastructure affect global variance in the frequency of zoonotic infections in companion animals. Zoonotic diseases, including leptospirosis

and toxoplasmosis, are common in areas with high pet ownership, such as North America and Europe, and are usually aggravated by urban environments where close human-animal interactions occur (Cross et al., 2019). On the other hand, differing management strategies and less veterinarian access in rural locations could cause varied disease loads (Cleaveland et al., 2017).

Research contrasting urban and rural environments has shown notable differences in the frequency of zoonotic diseases. For example, studies conducted in Ghana found that urban dogs had more gastrointestinal helminths than their rural counterparts, partly attributed to cleanliness and healthcare variations (Johnson et al., 2015). In contrast, an Ethiopian study underlined the financial load of zoonotic illnesses and how urbanization and poor healthcare systems lead to increased disease incidence (Mekonnen et al., 2021). These results highlight the importance of customized public health campaigns considering regional variations in pet ownership and healthcare facilities.

Transmission Pathways and Mechanisms of Zoonotic Diseases

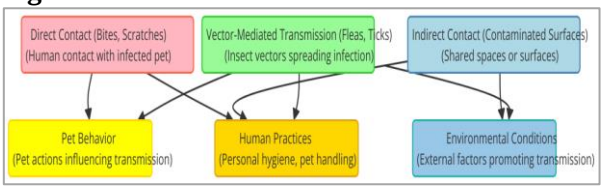
There are two ways in which zoonotic diseases can spread from pets to people: directly and indirectly as shown in Figure 1. Bite wounds and scratches are common means of direct transmission of infections, including Bartonella henselae, the causal agent of cat scratch disease (CSD) (Nakamura et al., 2022). Contact with pet excretions can cause indirect transmission, whereby diseases can remain in the environment and endanger humans, especially in metropolitan areas where cleanliness may be impaired (Nelson et al., 2018).

New research has highlighted these channels of transmission. For instance, a systematic study found that pet shop settings might help zoonotic transmission through animal interaction and excretion (Halsby et al., 2014). Another study emphasizing the need for environmental factors in disease dissemination showed that feral cats in metropolitan areas are significant reservoirs of zoonotic infections (Taetzsch et al., 2018). Public health campaigns aimed at reducing zoonotic disease risks associated with companion animals depend on awareness of these transmission dynamics (Loh et al., 2015).

Urbanization, climate change, and human-animal interactions affect how zoonotic illnesses are transmitted from pets to people. Higher population density and tighter interactions between humans and pets help urbanization improve the possibility of zoonotic transmission, thereby enabling the spread of diseases, including toxoplasmosis and leptospirosis (Cross et al., 2019). By changing the habitats of vectors and reservoirs, climate change aggravates these hazards and causes stronger interactions with zoonotic diseases (Sipari et al., 2022).

New research has highlighted how disease transmission dynamics depend on environmental changes. For example, research has shown that habitat loss and deforestation might increase human contact with zoonotic illnesses by bringing people closer to wildlife reservoirs (Morand & Lajaunie, 2021). Urban settings can also provide conditions suitable for spreading vectors, including rodents connected to diseases such as hantaviruses (Tian et al., 2018). Developing good public health plans to lower zoonotic disease risks depends on awareness of these elements.

Figure 1



This flowchart illustrates the transmission pathways of zoonotic diseases from pets to humans, highlighting the key routes of infection: direct contact (such as bites and scratches from infected pets), indirect contact (like contaminated surfaces shared with pets), and vector-mediated transmission (via insects like fleas and ticks). It also emphasizes the role of various factors that influence disease spread, including pet behavior**,** environmental conditions, and human practices (such as hygiene and pet handling), offering a comprehensive view of how these elements interact to increase the risk of zoonotic infections.

Veterinary Practices in Zoonotic Disease Control

Preventive Veterinary Measures and Interventions

In companion animals, the prevention of zoonotic diseases depends critically on vaccination and

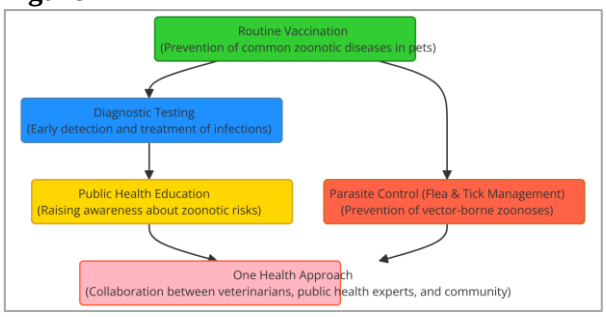
parasite management. New vaccines and parasite treatments developed from recent improvements in veterinary techniques have greatly helped prevent diseases as shown in Figure 2. For example, creative rabies vaccines have shown better efficacy, and fewer doses are needed for successful immunization (Dodds, 2021). Furthermore, they are beneficial against common ectoparasites and endoparasites, and new formulations of antiparasitic drugs have been developed, lowering the risk of zoonotic transmission (Dantas-Torres et al., 2020).

Over the past ten years, important research has assessed the success of these preventative policies. For instance, a study showed that thorough vaccination campaigns considerably lowered rabies incidence in metropolitan dog populations, lowering human contact as shown in Figure 2 (Ghai et al., 2022). Another study underlined the need for consistent parasite control to preserve the health of companion animals, thereby reducing zoonotic risk (Dantas-Torres et al., 2020). These results highlight the need to include immunization and parasite control in public health plans to reduce the spread of zoonotic diseases.

Regional differences in veterinary preventative policies greatly influence the treatment of zoonotic illnesses, particularly in low- and high-resource environments. Effective preventative interventions are hampered in low-resource locations owing to limited veterinary infrastructure, poor education, poor access to healthcare, and limited veterinary practice. For instance, a study conducted in Ethiopia found that farmers' need for knowledge about zoonotic illnesses resulted from inadequate awareness-raising efforts by veterinary departments and public health authorities, raising disease transmission risks (Zhang et al., 2019). Conversely, firm veterinary services and public health education help high-resource environments by enabling improved disease management and preventive techniques (Belay et al., 2021).

Recent studies have highlighted these differences. Studies conducted in Zimbabwe found that rural communities had knowledge gaps regarding zoonotic illnesses, including brucellosis, emphasizing the need for focused educational interventions (Ndengu et al., 2017). Furthermore, a systematic evaluation revealed that, especially in resource-limited environments, integrated One Health initiatives could improve disease control by encouraging cooperation between the veterinary and public health sectors (Welburn et al., 2015). These results show the urgent need for customized plans to correct regional variations in veterinary practices.

Figure 2



This flowchart illustrates the key veterinary interventions for preventing zoonotic disease transmission, highlighting essential strategies such as routine vaccination**,** parasite control (flea and tick management), diagnostic testing**,** and public health education. It also emphasizes the One Health approach, which fosters collaboration between veterinarians, public health professionals, and the community to effectively manage and reduce the risk of zoonotic diseases.

Veterinary Surveillance and Diagnostic Advances

Recent developments in diagnostic techniques for zoonotic illnesses in companion animals have greatly enhanced veterinary practice. Rapid diagnostic approaches, including serological assays and PCR-based procedures, have improved the speed and accuracy of illness identification. Using PCR techniques, pathogens, including Ehrlichia ewingii and Brucella canis, can be quickly identified, enabling timely treatment and management (Yan et al., 2022).

Crucially for public health surveillance, serological assays have also been developed to produce consistent findings for diseases, including toxoplasmosis and leptospirosis (Cong et al., 2018). By allowing the viewing of disease manifestations in animals, imaging technologies, such as ultrasound and advanced imaging, have further enhanced these diagnostic techniques, thereby supporting thorough assessments (Abroug et al., 2021)

Studies have indicated that these developments not only increase the general efficiency of zoonotic disease surveillance in veterinary clinics but also improve diagnostic accuracy, thereby helping to improve public health outcomes (Goryoka et al., 2021). Combining these technologies emphasizes the need for rapid reaction systems to prevent zoonotic infections.

The early identification and control of animal zoonotic outbreaks depend critically on veterinary surveillance systems. These systems have changed dramatically over the past ten years, including digital health data, participatory surveillance, and international cooperation. Real-time data collection and analysis made possible by digital health technology speeds and accuracy of outbreak detection improves (Wendt et al., 2016). Participatory surveillance helps communities report health hazards, enhances data quality, and encourages local ownership of health projects (Smolinski et al., 2017).

Important research has demonstrated how well these developments work. For example, a study conducted in Jordan revealed effective mapping of networks to identify priority zoonoses, highlighting the advantages of combined monitoring strategies (Sorrell et al., 2015). Another study underlined the need for worldwide cooperation in controlling zoonotic diseases and showed how common data may help enhance response plans (Qiu et al., 2023). These developments highlight the need for a One Health strategy that combines environmental, animal, and human health to control zoonotic diseases effectively.

Socioeconomic and Environmental Factors Influencing Zoonotic Disease Spread

Socioeconomic Determinants of Zoonotic Disease Prevalence

The frequency of zoonotic diseases in pets is greatly influenced by human socioeconomic situations, especially life expectancy and access to healthcare. Better pet health management in high-income nations corresponds to better healthcare access and increased life expectancy, which reduces zoonotic infection rates (Lee & Devlin, 2022). On the other hand, in low-income nations, inadequate healthcare resources and lower life expectancy help explain the more excellent incidence rates of zoonotic diseases, as research stressing the lack of awareness and preventive activities among pet owners shows (Corrales et al., 2021).

Recent research has looked at these relationships and found that pet owners who know more about zoonotic diseases usually follow more efficient preventive actions, lowering infection rates (Li et al., 2022). For instance, a study conducted in Ethiopia revealed that pet care techniques were significantly improved by higher public knowledge of zoonosis (Kiflu et al., 2016). These results highlight the importance of socioeconomic elements in determining public health results on zoonotic infections in both low- and high-resource environments.

Cultural practices and attitudes toward pet care strongly influence zoonotic disease propagation. Where pets are seen chiefly as friends, there is usually more investment in veterinary care and cleanliness standards, lowering zoonotic risks (Alho et al., 2018). On the other hand, in societies where pets are less included in family life—that is, in some low-income areas—inappropriate veterinary care and poor cleanliness might result in higher frequency rates of zoonotic infections (Zanen et al., 2022).

New research highlights these differences. Research conducted in Qatar, for example, found that awareness and control strategies for zoonotic diseases among dog and cat owners were directly affected by cultural attitudes toward pet ownership (Alho et al., 2018). Another Ontario, Canada study revealed that pet owners sometimes showed little awareness about zoonotic hazards, which emphasizes the necessity of better pet management instruction (Stull et al., 2013). These results highlight the need for culturally appropriate public health policies to reduce the spread of zoonotic diseases.

Urbanization and its Impact on Zoonotic Disease Dynamics

Through pet ownership, especially in highly populated regions, urbanization significantly affects zoonotic disease transmission. Because of closer human-animal contact and environmental conditions, the likelihood of zoonotic illnesses spreading increases as urban pet numbers rise. For example, a study conducted in Hong Kong indicated that increases in urban pet ownership are linked with more excellent rates of zoonotic

diseases since pets regularly contact wild and stray animals, increasing pathogen exposure (Lee & Devlin, 2022).

Furthermore, the risk of zoonotic infections is aggravated by restricted space and resources in urban environments, which can result in insufficient veterinarian treatment and hygienic procedures (Steele & Mor, 2015). Studies conducted in Malaysia found that urban settings help zoonotic parasites spread since high human density contacts contaminated animals (Mohd-Qawiem et al., 2022). These results highlight the importance of efficient public health policies addressing the particular difficulties caused by urbanization in controlling zoonotic disease risks related to pet ownership.

The transmission of zoonotic illnesses is significantly influenced by environmental changes brought about by urbanization, including habitat fragmentation, temperature change, and human intrusion into animal areas. Habitat fragmentation disturbs ecosystems, hence increasing human-wildlife interactions and enabling pathogen spread. According to research, the broken edges of forests can act as zoonotic pathogen corridors, increasing the risk of disease spread from animals to humans (Rulli et al., 2017).

Climate change intensifies these hazards by changing habitats and extending the range of disease vectors, such as ticks and mosquitoes, which grow in urban settings (Hassett & Thangamani, 2021). Recent studies have connected urban ecological changes to the rise of zoonotic diseases in companion animals, thereby stressing the public health consequences of increased interaction between humans and wildlife reservoirs (Chowdhury et al., 2021). Urbanization has been linked to more excellent rates of tick-borne infections in suburban regions, emphasizing the importance of integrated surveillance and control measures to lower zoonotic disease risks in urban settings (Remesar et al., 2023).

Treatment and Control Strategies for Zoonotic Infections in Companion Animals

Therapeutic Advances for Zoonotic Diseases in Pets

Antibiotics, antivirals, and anti-parasitic medicines are among the several drugs currently used in treatments for zoonotic illnesses in companion animals. While antiviral drugs are used for viral illnesses such as canine parvovirus, antibiotics are routinely administered for bacterial infections, including leptospirosis and Staphylococcus pseudintermedius infections (Alho et al., 2018). Managing infections caused by parasites such as Toxocara and fleas requires anti-parasitic medications, including dewormers and topical ectoparasite medicines (Suu-Ire et al., 2021).

These treatments have changed over the past ten years as drug formulations and delivery techniques have been developed, enhancing safety and efficacy. Recent research on the efficacy of these treatments shows that prompt intervention dramatically lowers the risk of zoonotic transmission (Pal et al., 2023). For example, a study underlined the need for consistent deworming policies to lower the zoonotic parasite prevalence in animals (Meade et al., 2019). These developments highlight veterinary treatment's importance in controlling zoonotic infections and safeguarding public health.

Creative therapeutic methods for zoonotic infections in companion animals include gene therapy, immunotherapy, and new antibiotics. Targeting particular infections, gene therapy has shown promise in providing long-term remedies for diseases, including leishmaniasis (Boyle et al., 2019). Mainly, monoclonal antibody usage is under investigation to boost the immune response against zoonotic illnesses, such as those brought on by Leptospira and Brucella (Lee & Devlin, 2022).

Studies showing better performance and safety profiles than conventional treatments have centered recent developments in antimicrobial medicines on creating medications that fight resistant strains of zoonotic infections (Li et al., 2021). Research has shown, for example, that new antibiotics can successfully treat peet-resistant diseases, thereby lowering zoonotic risk (Belay et al., 2021). With research from the previous five years showing their possibility to improve outcomes for pets sick with zoonotic infections and increase public health safety, these innovative treatments represent a significant advancement in veterinary medicine (Choo et al., 2023).

Public Health Strategies for Zoonotic Disease Prevention in Pets

Community-based education programs can help significantly minimize zoonotic infections in companion animals by encouraging pet care,

immunization, and safe handling techniques. Effective public health initiatives, such as those in Nigeria, concentrate on mass vaccination campaigns against rabies and careful pet ownership (Abubakar et al., 2024). These campaigns have shown notable increases in community awareness and involvement, lowering zoonotic hazards.

Recent studies have evaluated the effect of such instructional initiatives. For example, a study conducted in Canada underlined the success of focused educational initiatives in enhancing safe pet food handling habits, which are vital in preventing zoonotic diseases such as campylobacteriosis (Raschkowan et al., 2018). Emphasizing the need for hygiene measures in lowering zoonotic transmission in petting zoos, another study argued for further public education on handwashing and safe animal contact (Hall et al., 2023). These results highlight the need for community participation and education to reduce zoonotic disease hazards related to pet ownership.

The One Health approach is crucial in reducing zoonotic illnesses by including the veterinary, medical, and environmental sectors in public health policy. Recognizing the interdependence of human, animal, and environmental health, this cooperative structure helps enable coordinated reactions to zoonotic hazards. For example, a study in Guinea revealed how a One Health assessment enhanced inter-ministerial cooperation on zoonotic disease control, thereby promoting information exchange and combined action plans (Standley et al., 2019).

Recent studies have demonstrated the success of this combined strategy. Emphasizing the requirement of multidisciplinary cooperation to manage zoonotic threats properly, a systematic review of brucellosis is underlined. Furthermore, research conducted in Kenya revealed the effective development of a coordination system between public health and animal welfare sectors, thus improving surveillance and reaction to zoonotic infections (Munyua et al., 2019). Although the One Health concept has great advantages, issues such as resource allocation and intersectoral communication still exist; therefore, constant efforts are necessary to promote cooperation and enhance outcomes for human and animal health (Zheng et al., 2019).

CONCLUSION

This review highlights the increasing importance of zoonotic illnesses in companion animals and their implications for public health. Emerging zoonoses, including rabies, Leptospira, and numerous parasitic illnesses, persistently pose significant dangers, particularly in metropolitan environments with high pet populations. This review examines primary transmission routes, such as bite injuries, pet excretions, and vector-mediated transmission, highlighting the intricacy of disease transmission from dogs to humans. Veterinary interventions, including immunization and parasite management, are essential for mitigating zoonotic risks, although their efficacies differ geographically, especially in resource-limited settings. Socioeconomic and environmental factors, including human life expectancy, urbanization, and climate change, affect the prevalence and transmission of zoonoses. The One Health strategy, which unifies human, veterinary, and environmental health, is crucial for managing zoonotic illnesses. This study highlights considerable deficiencies in the literature, namely the absence of studies on pet ownership in low- and middle-income nations, the influence of cultural factors on pet care, and the enduring efficacy of veterinary therapies. Future studies must concentrate on comprehending the obstacles in resource-limited environments, examining the influence of climate change on zoonotic illnesses, and analyzing the implications of cultural practices on disease transmission. Further research is required on incorporating cross-sector collaboration within public health programs. This review underscores the urgent need for international cooperation and improved surveillance systems to combat the escalating threat of zoonotic illnesses in companion animals despite progress in diagnostic tools, therapies, and preventative strategies.

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