Journal of Pharmaceutical Research and Integrated Medical Sciences (JPRIMS)
ISSN: 3049-1681 | Vol. 03, Issue-05, May-2026 | pp.-18-31

ORIGINALARTICLE https://aktpublication.com/index.php/jprims/index

# A Comprehensive Review of Progress and Persistence in Neglected Tropical Diseases (NTDS): Next-Generation Diagnostics Integrating Animal and Environmental Strategies for NTD Control

**Yash Srivastav[1*], Vikash Kumar Mehta[2], Shivani Singh[1], Sonakshi Raj[1]**

[1]D.K.R.R Pharmacy College (Dev Kumari Rajaram Pharmacy Shikshan Sansthan), Amberpur, Sitapur (Uttar Pradesh), India.

[2]Mahadeva Lal Schroff College of Pharmacy, Aurangabad, Bihar, India

***Corresponding Email: yashsrv.108@gmail.com**

## Abstract:

NTDs persist in animals' populations because of complicated interactions between livestock and wildlife reservoirs, vectors, and the environment. The present review offers the in-depth analysis of the current developments and the current issues in the control of NTDs with particular attention to the animal-based data and environmental determinants. It outlines the importance of animal reservoirs in perpetuating transmission cycles and explores how ecological factors like climate variability, land-use alterations and the dynamics of vectors affect disease persistence. The review also analyzes the progress of next-generation diagnostics, such as molecular, biosensors, and environmental DNA (eDNA), which have contributed to a considerable enhancement in the accuracy of detection and surveillance. Nevertheless, constraints connected to field applicability, expensive nature, and disjointed surveillance systems remain a barrier to successful implementation. The results highlight the need to consider the incorporation of both animal health surveillance and environmental surveillance to improve early detection and control interventions. Moreover, review indicates important gaps in research such as the underrepresentation of wildlife reservoirs and the lack of scalable and cost-effective diagnostic tools. On the whole, it highlights the need to implement interdisciplinary and combined solutions to ensure sustainable and effective management of NTDs in animals.

**Keywords:** Neglected Tropical Diseases, Animal Reservoirs, Environmental Factors, Vector Dynamics, Molecular Diagnostics, eDNA, Surveillance Systems, One Health Approach

**Received: Feb. 23, 2026** **Revised: March 26, 2026** **Accepted: April. 25, 2026** **Published: May 02, 2026**

**DOI**: https://doi.org/10.64063/3049-1681.vol.3.issue5.2

https://aktpublication.com/index.php/jprims/issue/archive

## 1. INTRODUCTION

Neglected Tropical Diseases (NTDs) refer to a category of infectious diseases and are mostly prevalent in tropical and subtropical areas due to intricate relationships among animal vectors, hosts, and environmental factors[1]. Trypanosomiasis and other parasitic infections are some of the diseases that are sustained in animal populations by livestock and wildlife reservoirs which frequently serve as asymptomatic hosts and perpetuate the cycle of transmission within an ecosystem. Disease distribution and persistence is further affected by environmental determinants such as climate variability, land-use changes, and the ecology of vectors. Despite the recent breakthroughs in next-generation diagnostics, including molecular, biosensors and environmental DNA (eDNA) techniques, issues of field applicability and incorporation of surveillance systems remain a barrier to effective control.

**Figure 1:** Neglected Tropical Diseases[2]

The purpose of this review is to investigate the current developments and ongoing challenges in the NTD control with respect to animal and environmental aspects as well as the application of the latest diagnostic methods. It emphasizes the need to combine animal surveillance and environmental surveillance to gain a better understanding of the dynamics of transmission and enhance the management of the disease. This review highlights the importance of creating scalable, cost-effective, and sustainable ways of controlling NTDs by identifying the gaps that exist and the necessity to adopt interdisciplinary approaches[3].

### 1.1 Background and Context

NTDs are a heterogeneous family of infectious diseases that continue to thrive primarily in tropical and subtropical areas due to the intricate interactions between hosts, vectors, and the environment. Diseases like trypanosomiasis and parasitism are also perpetuated in animal populations by livestock and wildlife reservoirs which can be the silent carriers of the disease and which also perpetuate the cycle of infection within an ecosystem. Climate variability, land-use changes, and ecology of vectors are also environmental determinants that can affect the

distribution and persistence of diseases. Even when recent developments in next-generation diagnostics, including molecular tools, biosensors, and environmental DNA (eDNA), have enhanced the accuracy of detection and the ability to detect at an earlier stage, issues pertaining to field implementation, infrastructure, and integration of surveillance systems still remain a challenge to effective control[4].

### 1.2 Objectives of the Review

This review aims to:

- To analyze the role of animal reservoirs and environmental factors in sustaining NTD transmission dynamics
- To evaluate current and emerging methodologies, including next-generation diagnostics, in animal-based NTD surveillance
- To examine key findings from animal-based studies regarding disease persistence and ecological interactions
- To identify strengths, limitations, and gaps in existing research and surveillance systems
- To propose integrated animal–environmental strategies and policy approaches for effective and sustainable NTD control

### 1.3 Importance of the Topic

All efforts to address NTDs should be integrated through a holistic approach, where animal hosts, environmental factors and sophisticated diagnostic systems are all considered intertwined. The animal reservoirs and ecological conditions are critical in the maintenance of these diseases and there is need to go beyond the traditional methods of control. Combining the next generation diagnostics and animal and environmental surveillance also gives a promising avenue to early detection, better intervention and long-term management of diseases. Thus, the subject is very crucial in coming up with viable, sustainable and long term solutions to alleviate the burden of NTDs[5].

## 2. ANIMAL-BASED NTD RESEARCH: ADVANCES, METHODOLOGIES, AND KEY INSIGHTS

Animal studies indicate that NTD is maintained in the animal and wildlife reservoirs by a series of intricate interactions between living organisms and their environment. State-of-the-art diagnostics enhances the detection, yet the field constraints, expensive nature, and poor surveillance integration are some of the challenges[6].

### 2.1 Overview of Animal-Based NTD Research

Studies involving animals have been critical to the development of knowledge on Neglected Tropical Diseases (NTDs), especially regarding disease ecology, transmission, and reservoir biology. Research into livestock infections, including animal African trypanosomiasis, has been able to clearly show how intricate interactions between vectors (e.g., tsetse flies) and animal hosts maintain endemic cycles of transmission in tropical ecosystems. These studies emphasize that livestock are not only reservoirs of infection but also amplifiers of infection; hence, facilitating the persistence of diseases[7].

Correspondingly, wildlife research has put significant emphasis on the role of sylvatic reservoirs as a means of hosting parasitic life cycles not dependent on domesticated animals. Different wild mammals are long-term carriers of pathogens, which do not always show any clinical signs, hence are silent reservoirs. These results highlight the importance of including domestic and wild animals in surveillance systems to comprehend the NTD transmission pathways comprehensively.

### 2.2 Methodologies in Animal-Based NTD Studies

A wide range of methodologies has been employed in animal-based NTD research to improve detection, monitoring, and understanding of disease dynamics:

- **Parasitological techniques:** Conventional microscopic techniques are still essential to detect parasites directly on blood, tissue or fecal samples. These are cost-effective but have a low sensitivity particularly when there is low parasitemia.
- **Serological tests:** ELISA and other widely used techniques are used to identify antibodies in livestock and wildlife populations, which can give a history of exposure and prevalence of infection. Nevertheless, they might not be able to differentiate between past and active infections.
- **Molecular diagnostics:** Molecular diagnostics, including Polymerase Chain Reaction (PCR) and quantitative PCR (qPCR), have greatly enhanced detection sensitivity by detecting pathogen-specific genetic material. These are very sensitive and specific methods but demand laboratory facilities[8].
- **Environmental sampling:** Indirect detection of pathogens through analysis of soil, water, and vectors (e.g., insects) can be used to map ecological hotspots of disease transmission.

Recent technological advancements have further enhanced diagnostic capabilities:

- **Loop-mediated isothermal amplification (LAMP):** An efficient, fast, inexpensive molecular method that can be used in the field allowing detection of pathogens in animals on-site.
- **Metagenomic sequencing:** Simultaneously identifies multiple pathogens in a sample, providing detailed information on the diversity of pathogens in animals.
- **Environmental DNA (eDNA):** Non-invasive method that identifies the presence of pathogen DNA released into the environment, avoiding the necessity of physical contact with animals and allowing the practice on a large scale to monitor the ecology.

### 2.3 Key Findings from Animal Studies

Animal studies have always proved that animal reservoirs are the determinants of the persistence and transmission of NTDs. The livestock and wildlife populations both play a role in ensuring the continuation of the infection cycles and in most cases, they are the carriers that are asymptomatic and spread the infection freely[9].

The cover of the vegetation, humidity, and temperature have been found to have a significant impact on the distribution and survival of vectors, therefore, impacting the prevalence of diseases. As an example, climatic conditions directly affect the breeding habitats and seasonal abundance of vectors, which results in changes in animal populations in terms of infection rates.

Also, there has been an increase in contact between animals and livestock, which has been brought about by habitat encroachment, agricultural growth, and environmental alterations, hence exacerbating cross-species transmission. Such an interface opens up new routes of pathogen circulation and makes it more difficult to control the disease.

Although molecular diagnostic tools have enhanced the sensitivity and specificity of detection, their use is still not as effective in field-based surveillance because of the logistical limitations, which indicates a discrepancy in technology development and feasibility[10].

### 2.4 Strengths and Weaknesses of Current Research

**Strengths**

Molecular techniques have greatly increased the accuracy and reliability of detecting pathogen in animal hosts, and animal studies have provided additional insight into the dynamics of transmission, the reservoir ecology, and the interactions between vectors and hosts. Also, there are developments in non-invasive techniques, including environmental DNA (eDNA) and environmental sampling, that reduced the necessity to handle animals directly, and thus, surveillance methods have become more ethical, efficient, and can be scaled[11].

**Weaknesses**

Nevertheless, there are still tremendous challenges such as difficulty in scaling diagnostic tools in resource-constrained field environments because of the lack of infrastructure. The high costs and technical expertise demands also limit their widespread use, whereas the disjointed surveillance systems and the lack of data on wildlife make understanding and adequate long-term control of NTDs challenging[12].

## 3. ANIMAL AND ENVIRONMENTAL DYNAMICS IN NTD TRANSMISSION

The NTD transmission is maintained by the complex interactions between the host and the vectors in the form of animal reservoirs and environmental conditions. Advanced diagnostics and embedded surveillance enhances detection and control but has challenges in field level implementation[13].

### 3.1 Animal Reservoirs and Disease Persistence

Neglected Tropical Diseases (NTDs) depend on animal reservoirs as a component of their ecosystem maintenance and persistence, both in livestock and wildlife species. Such reservoirs tend to harbor pathogens over a long time, and in many cases, they do not show any apparent clinical signs, thus becoming silent vectors of infection that perpetuate the cycle of infection. As an illustration, the transmission of the pathogens by chronic infection in animals may persist even without the active outbreaks of the disease[14].

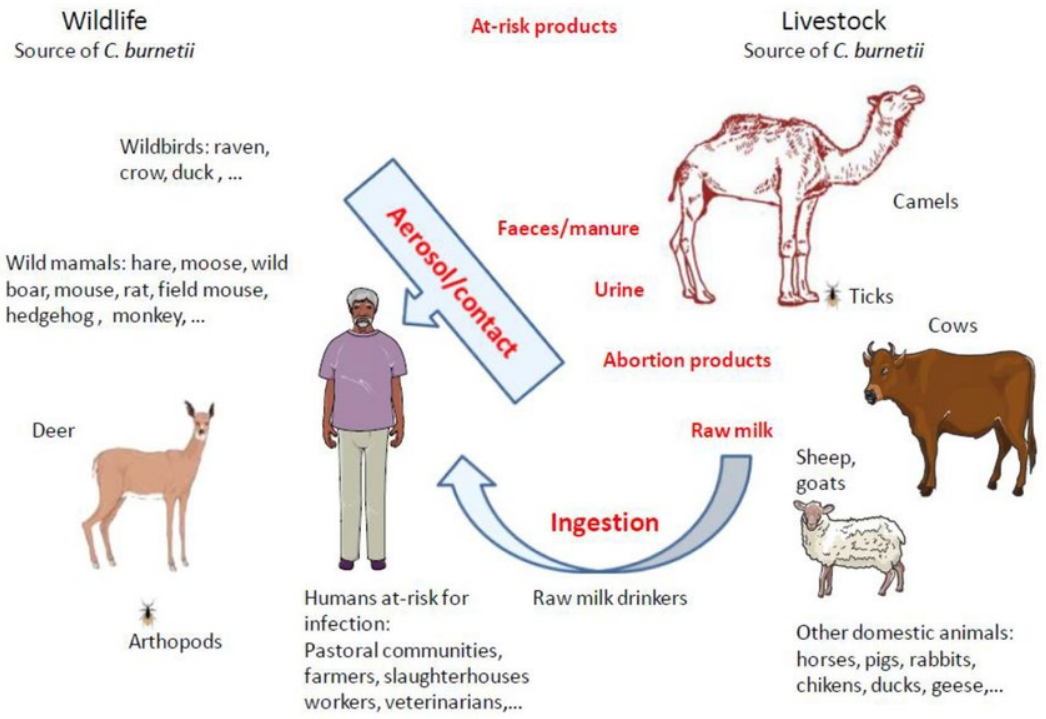


**Figure 2:** Animal Reservoirs Diversity[15]

The competence of a species to acquire, retain and transmit a pathogen is known as reservoir competence; this differs greatly among the animal species. Other species are incidental hosts with low transmission potential and some are highly efficient reservoirs. This diversity makes it hard to control the disease, because interventions designed to affect a single host species might fail to affect the entire transmission cycle[16].

There is also the special challenge of wildlife reservoirs as they are mobile, ecologically diverse and difficult to monitor. The presence of the pathogens in these populations results in an unending source of infection which can cross over to domesticated animals further justifying the use of extensive surveillance systems which encompass both the wild and domestic hosts[17].

### 3.2 Environmental Determinants of NTD Transmission

The environmental factors are important determinants of the dynamics of distribution and transmission of NTDs in animals. Ecological conditions including temperature, humidity and water availability are very important in the presence, abundance and activity of vectors[18].

- **Vector breeding habitats:** There are numerous vectors that survive only under certain environmental conditions, e.g., stagnant water bodies or wet vegetation. The alterations in the rainfall patterns and water availability directly affect the population density of vectors and, thus, the intensity of disease transmission.
- **Land-use changes:** This includes deforestation, urban sprawl and agriculture increase, which alters the natural habitats and introduces wildlife, livestock and vectors into closer proximity. This augmented interface augments prospects of intraspecific pathogen transmission.

- **Seasonal changes:** Seasonal changes have a great influence on the dynamics of infections. An example of this is that wet seasons can cause more breeding of vectors and hence more animals are infected, whereas dry seasons can cause less intense transmission.

Environmental surveillance, such as remote sensing and ecological mapping, has emerged as a tool that is necessary in order to establish the high-risk areas and forecast the disease outbreaks. Environmental indicators provide researchers with the ability to predict changes in disease trends and take preventive measures in time[19].

### 3.3 Next-Generation Diagnostics in Animal NTD Surveillance

The latest development in diagnostic technologies has changed the face of animal NTD surveillance by making it more accurate, quick and comprehensive in detecting pathogens[20].

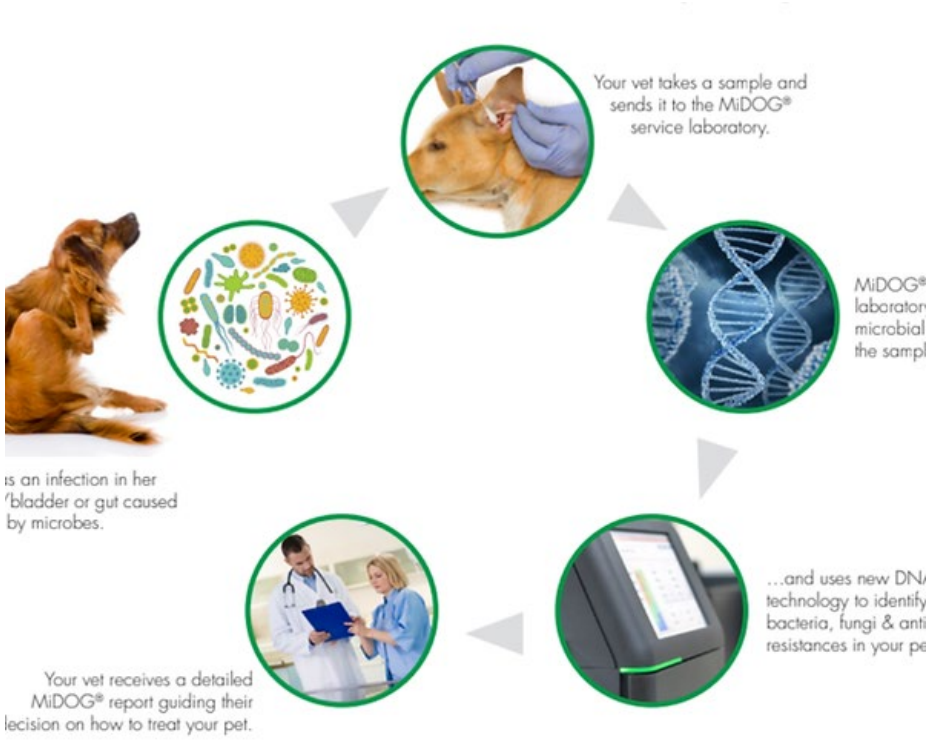


**Figure 3:** Next-Generation Diagnostics in Animal[21]

- **Molecular Diagnostics:** PCR, quantitative PCR (qPCR), and CRISPR-based assays are techniques offering very sensitive and specific detection of genetic material of a pathogen. Such techniques enable the detection of infections early even when the pathogen load is low and this is very important in the control of the disease spread in animals.
- **Point-of-Care Tests (POCT):** Portable diagnostic tests have been created to support field tests on a fast and on-site basis. These devices limit the necessity of centralized laboratory facilities and allow making decisions in real-time in the livestock management and disease control.

- **Biosensors:** New biosensor technologies have the potential to identify pathogen-specific biomarkers in animal fluids like blood, saliva or milk. These systems can be used to monitor in real-time and can have prospects of constant monitoring on farms[22].
- **Environmental DNA (eDNA):** eDNA methods allow the identification of the genetic material of pathogens in the environment (water, soil, or in the habitat of vectors). This is a non-invasive technique, which is especially useful to monitor diseases in the population of animals when direct sampling is challenging.

In spite of their merits, these technologies have several problems associated with their cost, field flexibility, and the necessity to be proved in a variety of ecological conditions. Overcoming the barrier between the laboratory innovation and field implementation is a priority[23].

### 3.4 Integration of Animal and Environmental Surveillance

Animal and environmental surveillance integration is a multifaceted way of comprehending and managing NTDs. This strategy will offer a better overview of the dynamics of the disease and strengthen the system of warning in the early stage by integrating various sources of data[24].

Common features of integrated surveillance systems are:

- **Animal health monitoring:** Routine screening of livestock and where feasible, wildlife populations in order to identify infections and monitor disease occurrence.
- **Surveillance of the vectors:** Distribution, density, and infection status of the vectors to learn about the patterns of transmission.
- **Analysis of environmental data:** Inclusion of climatic factors, water resources, vegetation cover and land-use patterns to determine the ecological factors that drive the spread of diseases[25].

With this type of integrated frameworks, disease outbreaks can be predicted through modulation of environmental changes in relation to the change in the populations of both vectors and hosts. This method is used to support specific interventions, like vectors control or habitat management, and enhance the effectiveness of the resource allocation[26].

Nevertheless, to be successfully integrated, there needs to be a close coordination between veterinary, ecological and environmental sectors and creating common data collection and sharing procedures. These interdisciplinary connections need to be strengthened to promote sustainable and effective NTD control strategies[27].

## 4. CHALLENGES AND POLICY IMPLICATIONS IN ANIMAL-BASED NTD CONTROL

The use of animals to control Neglected Tropical Diseases (NTDs) has multiple operational and structural issues, which restrict the potential of the existing policies. The major ones include the lack of proper infrastructures to support surveillance and diagnostics in remote and resource restricted locations where most NTDs have been common. Sophisticated diagnostic devices, though very sensitive, are usually costly and need a skilled workforce and lab facilities, which are hard to implement at the field level. Moreover, livestock and wildlife mobility makes it

difficult to monitor, resulting in reporting gaps in disease reporting and delays in interventions. Further constrained by the insufficient representation of wildlife reservoirs in surveillance programs, a more comprehensive knowledge of disease persistence and transmission cycles is not possible[28].

Policy wise, there is a lack of coordination and fragmented governance between the veterinary, environmental and agricultural sectors that act as a major obstacle in successful NTD control. The current policy tends to put more emphasis on the livestock health and ignore the fact that wildlife and other environmental conditions are of importance in the perpetuation of the diseases. This compartmentalization leads to inadequate strategies which do not take into consideration the ecological nature of NTDs. In addition, a gap in data integration and lack of standardized surveillance systems are impediments to evidence-based decision-making and prompt action against the emergent disease risks.

To overcome these issues, there is urgent need to have integrated and multidisciplinary policy frameworks that harmonize animal health and environmental monitoring. Infrastructure reinforcement at field level, investments in affordable and transportable diagnostic solutions, and fostering data exchange across sectors are critical towards bettering the surveillance systems. Long-term monitoring of the wildlife reservoirs should also be a priority of policies and collaboration between research should be encouraged to fill in knowledge gaps. These all-inclusive and well-coordinated strategies are vital in sustainable and effective control of NTDs in animals[29].

**Table 1:** Summary of Selected Literature on NTDs[30]

| Author(s) & Year | Study Title | Focus Area | Methodology | Key Findings |
|---|---|---|---|---|
| **Paniz-Mondolfi & Ramírez (2024)[31]** | FDA's proposed rule and its regulatory impact on emerging and reemerging neglected tropical diseases in the United States | Regulatory frameworks and policy impact on NTDs | Policy analysis and review | Regulatory policies significantly influenced the development, approval, and accessibility of diagnostics and therapeutics, improving preparedness and disease control strategies |
| **Roadmappers (2020)[32]** | A roadmap for the development of ivermectin as a complementary malaria vector control tool | Vector control using ivermectin | Strategic framework and conceptual analysis | Ivermectin showed potential in reducing vector populations and interrupting transmission cycles when integrated with |

| | | | | |
|---|---|---|---|---|
| | | | | vector control strategies |
| **Rohde & Rupprecht (2020)[33]** | Update on lyssaviruses and rabies: progress towards elimination | Rabies surveillance and elimination | Review study | Highlighted advancements in surveillance and vaccination, but emphasized the need for sustained efforts and coordination for global eradication |
| **Rupprecht & Salahuddin (2019)[34]** | Current status of human rabies prevention | Vaccine accessibility and prevention challenges | Analytical review | Identified disparities in vaccine availability and affordability, stressing improved distribution and policy support for disease elimination |
| **Sargsyan et al. (2025)[35]** | Intracellular parasitic infections and vaccine advances | Parasitic infections and transmission dynamics | Narrative review | Emphasized complexity of parasite life cycles and the need for integrated approaches combining diagnostics, surveillance, and immunological strategies |

## 5. DISCUSSION

The interactions between the animal reservoirs, environment and vectors lead to the persistence of the NTD transmission even though better diagnostics have been achieved. Effective control requires integrated surveillance, increased field applicability, and targeted research of wildlife and ecosystems[36].

### 5.1 Interpretation and Analysis of Findings

The results of this review demonstrate that there is a strong influence of animal reservoirs, environmental factors, and vector relationships in the persistence and transmission of Neglected Tropical Diseases (NTDs) in animals. Livestock and wildlife are long-term reservoirs, and they tend to harbor infections without showing any symptoms, which enables the pathogens to keep on circulating in the ecosystems. The environmental conditions, climate variability, land-use alteration, and habitat alteration have additional effects on the distribution of vectors, contact between hosts that perpetuate disease transmission. The next-generation diagnostics are more effective in detection, but the field of usage is limited, which leads to the gap between the technological advancement and the practical use[37].

### 5.2 Implications and Significance

The findings highlight the importance of integrated and multidisciplinary measures to control NTDs. Historical efforts to control transmission by targeting individual host species, or isolated interventions are not enough. Rather, animal health surveillance alongside environmental surveillance and tracking of vectors is very important in managing diseases. The application of the modern diagnostic methods, such as molecular techniques and eDNA, has high potential of early diagnosis and interventions. But their effectiveness is determined by the enhancement of access, affordability and field level implementation which makes capacity building and infrastructure development critical parts of NTD control programs[38].

### 5.3 Research Gaps and Future Directions

In spite of improvements, current research and surveillance systems still have critical gaps[39]. Reservoirs of wildlife are not well represented and this restricts a complete analysis of disease persistence. Also, the inability to have unified data integration and fragmented surveillance systems impedes proper monitoring and response plans. Further studies are required on the development of cost-efficient and field-versatile diagnostic tools and on long-term ecological studies that consider wildlife and the environment. Interdisciplinary cooperation and combining veterinary, ecological, and environmental data will be essential to develop sustainable and efficient strategies to combat NTDs in animal populations[40].

## 6. CONCLUSION

In conclusion, this review highlights that the persistence and transmission of Neglected Tropical Diseases (NTDs) in animal populations are driven by complex interactions among livestock and wildlife reservoirs, environmental conditions, and vector dynamics. Although a lot has been achieved in development of animal based research and the creation of next generation diagnostic methods like molecular based methods and eDNA methods, the issues of field applicability, cost and inconsistent surveillance systems still hamper their use. The results highlight that traditional, segregated control measures are not adequate, and there is an urgent necessity to introduce integrated methods of animal health monitoring and environmental surveillance and control of vectors. It will be necessary to fill the existing gaps, especially underrepresentation of wildlife reservoirs and absence of coordinated data systems, in order to enhance the disease control outcomes. Thus, it is important to embrace interdisciplinary, scalable and cost-effective approaches that are backed up by robust policy frameworks and improved field infrastructures to ensure sustainable and effective control of NTDs in animal populations.

## REFERENCES

1. Adegboye, O., Field, M. A., Kupz, A., Pai, S., Sharma, D., Smout, M. J., ... & Loiseau, C. (2021). Natural-product-based solutions for tropical infectious diseases. Clinical microbiology reviews, 34(4), e00348-20.
2. Adnyana, I. M. D. M., Sudaryati, N. L. G., Eljatin, D. S., Adiwinoto, R. P., & da Cruz, Z. V. (2025). One Health approach worldwide and challenges in collaboration. One Health Integration: Global Perspectives on Animal Health and Sustainable Agriculture, 33-62.

3. Álvarez-Rodríguez, A., & Radwanska, M. (2023). Nanobody Technology and New Molecular Biology Methods to Advance Rapid Diagnostic Test for. Rapid Antigen Testing, 129.
4. Ardiles-Ruesjas, S., Lesmo, V., González-Romero, V., Cubilla, Z., Chena, L., Huber, C., ... & Losada, I. (2025). Prevalence and diagnostic accuracy of different diagnostic tests for Chagas disease in an indigenous community of the Paraguayan Chaco. PLOS Neglected Tropical Diseases, 19(2), e0012861.
5. Asare, K. K., Adu-Gyamfi, C. O., Afful, P., Abotsi, G. K., Benyem, G., & Wilmot, D. (2024). Lymphatic Filariasis (LF) Elimination: What Is the Current Situation?. In Mosquito-Borne Tropical Diseases. IntechOpen.
6. Badwal, A. K., & Singh, S. (2025). Current trends in application of CRISPR/Cas9 in gene editing and diagnostics in Neglected tropical diseases (NTDs). Molecular Biology Reports, 52(1), 259.
7. Booth, M., & Clements, A. (2018). Neglected tropical disease control–The case for adaptive, location-specific solutions. Trends in parasitology, 34(4), 272-282.
8. Boro, A., Manoj, M., Arthi, G., Devika, U., Amirthamba, K., Banu, M. J. S., ... & Anand, A. V. (2025). Controlling Emerging Infectious Diseases: Latest Overview of Epidemiology and Therapeutics. In AI and Precision Medicine in Infectious Disease Management (pp. 1-27). CRC Press.
9. Bradley, E. A., & Lockaby, G. (2023). Leptospirosis and the environment: a review and future directions. Pathogens, 12(9), 1167.
10. Chavda, V. P., Vuppu, S., Mishra, T., Sharma, N., Kamaraj, S., Mishra, S., ... & Apostolopoulos, V. (2025). Control measures for neglected tropical diseases: vaccine updates. Expert Review of Vaccines, 24(1), 535-555.
11. Chen, J. T. (Ed.). (2025). AI and Precision Medicine in Infectious Disease Management. CRC Press.
12. da Silva, J. M. F., Silva, D. M. E., de Moraes, J., Tavares, G. D., & da Silva Filho, A. A. (2025). Nanotechnology based approaches to the treatment of schistosomiasis: current status and future perspectives. Nanomedicine, 20(22), 2733-2753.
13. Ferreira, M. D. S., Maldonado, R. A., & Farani, P. S. G. (2025). Chagas Disease in the 21st Century: Global Spread, Ecological Shifts, and Research Frontiers. Biology, 14(11), 1631.
14. Greco, A., Karki, R., Gadiya, Y., Deecke, C., Zaliani, A., & Gul, S. (2024). Pharmacological profiles of neglected tropical disease drugs. Artificial Intelligence in the Life Sciences, 6, 100116.
15. Hasker, E., Cambau, E., Geluk, A., de Jong, B. C., Barreto, J., van Brakel, W., ... & Vollset, M. (2025). Interrupting transmission of Mycobacterium leprae: synthesis of new evidence and research recommendations. Leprosy Review, 96(2), e2025034.
16. Hazra, S., & Patra, S. (2018). Alleviating the neglected tropical diseases: recent developments in diagnostics and detection. Current Topics in Medicinal Chemistry, 18(18), 1559-1574.

**17.** Kafle, A., & Ojha, S. C. (2024). Advancing vaccine development against Opisthorchis viverrini: A synergistic integration of omics technologies and advanced computational tools. Frontiers in Pharmacology, 15, 1410453.

**18.** Khew, C., Akbar, R., & Mohd-Assaad, N. (2025). Progress and challenges for the application of machine learning for neglected tropical diseases. F1000Research, 12, 287.

**19.** Khurana, S., Singh, S., & Mewara, A. (2021). Diagnostic techniques for soil-transmitted helminths–recent advances. Research and Reports in Tropical Medicine, 181-196.

**20.** Lateef, A. M., Oluwadare, F. A., Hamman, M. M., Banwo, O. G., & Agbajelola, V. I. (2025). From neglect to action: scaling up the management of zoonotic helminthoses in Africa: a narrative review. Discover Public Health, 22(1), 867.

**21.** Leonardo, L., Hernandez, L., Magturo, T. C., Palasi, W., Rubite, J. M., de Cadiz, A., ... & Fontanilla, I. K. (2020). Current status of neglected tropical diseases (NTDs) in the Philippines. Acta Tropica, 203, 105284.

**22.** Miller, M., Gómez, M. A., Tanner, R., Vermaak, S., Villarreal-Ramos, B., Almujri, S., ... & Nixon, B. (2025). Workshop report: One Health challenges and knowledge gaps in the control of intracellular infections with a focus on tuberculosis and leishmaniasis. Vaccine, 53, 126929.

**23.** Miserani, I. M. M. (2025). Integrated Surveillance of Pathogens in Vector Insects: Comparative Analysis of qPCR and NGS-Based Amplicon Sequencing (Master's thesis, Quinnipiac University).

**24.** Misra, G., & Srivastava, V. K. (Eds.). (2020). Molecular advancements in tropical diseases drug discovery. Academic Press.

**25.** Monjure, T., Rosero, J., Ruley, J. A., Hernandez, A. J., Kima, P. E., & Porras, A. M. (2024). Engineered In Vitro Models to Improve the Mechanistic Understanding and Treatment of Neglected Tropical Diseases Caused by Protozoan Parasites. GEN Biotechnology, 3(4), 228-241.

**26.** Nsakashalo-Senkwe, M. (2021). Developing an integrated implementation plan for control and elimination of NTDs: Nationwide mapping surveys for lymphatic filariasis, schistosomiasis and soil-transmitted helminthiasis in Zambia. The University of Liverpool (United Kingdom).

**27.** Ofori, B., Agoha, R. K., Bokoe, E. K., Armah, E. N. A., Misita Morang'a, C., & Sarpong, K. A. N. (2024). Leveraging wastewater-based epidemiology to monitor the spread of neglected tropical diseases in African communities. Infectious Diseases, 56(9), 697-711.

**28.** Ogwu, M. C., & Izah, S. C. (2025). Technological innovations for managing tropical diseases (pp. 1-356). Springer.

**29.** Osakunor, D. N. M., Sengeh, D. M., & Mutapi, F. (2018). Coinfections and comorbidities in African health systems: At the interface of infectious and noninfectious diseases. PLoS neglected tropical diseases, 12(9), e0006711.

**30.** Oyeyemi, O. T., Ogundahunsi, O., Schunk, M., Fatem, R. G., & Shollenberger, L. M. (2024). Neglected tropical disease (NTD) diagnostics: current development and operations to advance control. Pathogens and Global Health, 118(1), 1-24.

**31.** Paniz-Mondolfi, A. E., & Ramírez, J. D. (2024). FDA's proposed rule and its regulatory impact on emerging and reemerging neglected tropical diseases in the United States. PLoS Neglected Tropical Diseases, 18(5), e0012116.

**32.** Roadmappers, T. I. (2020). A roadmap for the development of ivermectin as a complementary malaria vector control tool. The American journal of tropical medicine and hygiene, 102(2 Suppl), 3.

**33.** Rohde, R. E., & Rupprecht, C. E. (2020). Update on lyssaviruses and rabies: will past progress play as prologue in the near term towards future elimination?. Faculty reviews, 9, 9.

**34.** Rupprecht, C. E., & Salahuddin, N. (2019). Current status of human rabies prevention: remaining barriers to global biologics accessibility and disease elimination. Expert review of vaccines, 18(6), 629-640.

**35.** Sargsyan, T., Stepanyan, L., Tsaturyan, A., Palumbo, R., Vicidomini, C., & Roviello, G. N. (2025). Intracellular Parasitic Infections Caused by Plasmodium falciparum, Leishmania spp., Toxoplasma gondii, Echinococcus multilocularis, Among Key Pathogens: Global Burden, Transmission Dynamics, and Vaccine Advances—A Narrative Review with Contextual Insights from Armenia. Vaccines, 13(11), 1082.

**36.** Suresh, K. E., Abraham, J., Jacob, A. M., & Prakash, C. (2025). BSc MLT, Y3, St. John's National Academy of Health Sciences, Bangalore. 2 Assistant Professor, Department of Family Medicine, St. John's National Academy of Health Sciences, Bangalore. 3 Assistant Professor, Department of Oral Medicine and Radiology, Sri Venkateswara NSVK Dental College, Bangalore. 4 Associate Professor and Unit Head, Department of General Surgery, St. John's National Academy of Health Sciences, Bangalore. Journal homepage: https://gjrpublication. com/gjrms, 5(02).

**37.** Thakur, M. A. (2020). Mathematical Modeling of Systematic Treatment Implementation and Dynamics of Neglected Tropical Diseases: Case Studies of Visceral Leishmaniasis and Soil-Transmitted Helminths (Doctoral dissertation, Arizona State University).

**38.** Vidal-Durango, J. V., Galván-Barrios, J., Reyes-Duque, J. D., & Lozada-Martinez, I. D. (2025). The Role of Big Data in Developing Innovative Predictive Learning Models for Neglected Tropical Diseases within the New Generation of the Evidence-Based Medicine Pyramid. Le Infezioni in Medicina, 33(4), 355.

**39.** Zakiyyah, S. N., Ibrahim, A. U., Babiker, M. S., Gaffar, S., Ozsoz, M., Zein, M. I. H., & Hartati, Y. W. (2022). Detection of tropical diseases caused by mosquitoes using CRISPR-based biosensors. Tropical Medicine and Infectious Disease, 7(10), 309.

**40.** Zhang, H., Yan, R., Liu, Y., Yu, M., He, Z., Xiao, J., ... & Li, Y. (2025). Progress in antileishmanial drugs: Mechanisms, challenges, and prospects. PLoS neglected tropical diseases, 19(1), e0012735.