

RABIES CONTROL THROUGH THE ONE HEALTH APPROACH

Manjeet Sharma and Harjeet Sharma

Veterinary Surgeon, Animal Husbandry & Dairying Department, Haryana., M.V. Sc, scholar in College of Veterinary & Animal Science, Rewa (MP).

DOI: <https://doi.org/10.5281/zenodo.17307161>

ABSTRACT

Rabies remains a major yet preventable public health concern, responsible for an estimated 59,000 human deaths each year worldwide, with the highest burden in Asia and Africa. It is a viral zoonotic disease caused by the rabies virus, predominantly transmitted to humans through bites from infected domestic dogs. Despite its preventability, rabies persists due to socio-economic challenges, limited veterinary and healthcare infrastructure, gaps in surveillance, and cultural beliefs that hinder treatment-seeking behavior. The One Health approach, which recognizes the interconnectedness of human, animal, and environmental health, provides a comprehensive strategy for rabies prevention and control. This review synthesizes current knowledge on rabies epidemiology, control methods, vaccination strategies, surveillance systems, public awareness efforts, and capacity-building initiatives. It discusses major challenges including resource limitations, weak health systems, fragmented governance, and cross-border disease dynamics. The article also explores prospects, emphasizing research innovation, multi-sectoral collaboration, environmental integration, and community empowerment. The conclusion reinforces that rabies elimination is achievable through sustained commitment, informed interventions, and cross-disciplinary action. The article ends with a unified One Health message encouraging collective responsibility to protect both human and animal health. Prospects highlight innovations in vaccines, diagnostics, digital surveillance, and policy frameworks needed to achieve the global goal of zero human rabies deaths by 2030. Collaborative One Health interventions remain critical to sustainably eliminate this neglected tropical disease and save lives worldwide.

INTRODUCTION

Rabies is one of the most ancient diseases known to humankind, with descriptions dating back over 4,000 years in historical medical texts. The disease is caused by the rabies virus (RABV), a neurotropic virus in the Lyssavirus genus of the Rhabdoviridae family. The disease is almost invariably fatal once symptoms appear, with a case fatality rate close to 100%. However, rabies is also one of the most preventable diseases with proper post-exposure prophylaxis (PEP), effective animal vaccination, and responsible pet management.

The global burden of rabies is disproportionately high in resource-constrained countries where access to health services, vaccines, and education is limited. Approximately 95% of human rabies deaths

occur in Asia and Africa, with children under 15 years representing nearly 40% of all cases.

The World Health Organization (WHO), in partnership with organizations such as the Food and Agriculture Organization (FAO), the World Organisation for Animal Health (WOAH), and the Global Alliance for Rabies Control (GARC), has set an ambitious goal of eliminating dog-mediated human rabies by 2030 through the "Zero by 30" campaign.

Despite the progress in certain regions, multiple barriers continue to hinder effective control. These include poor disease surveillance, gaps in community awareness, weak veterinary services, socio-economic disparities, and a lack of political commitment. The fragmented approach to public health and animal health management

often limits the effectiveness of interventions.

The One Health concept, which advocates for integrated action across human health, animal health, and environmental sectors, offers a holistic framework for rabies control. Rabies serves as an ideal case to implement this approach, as it directly involves interactions between humans, domestic animals, wildlife, and ecosystems. This review explores how a One Health framework can guide rabies prevention and response efforts, address thematic areas such as vaccination strategies, surveillance systems, public engagement, and capacity building, and examine challenges and future directions to achieve rabies elimination.

THEMATIC REVIEW

1. Epidemiology and Transmission Dynamics

Rabies virus (RABV) belongs to the Rhabdoviridae family and infects mammals worldwide. Transmission chiefly occurs through saliva inoculated by bites or scratches from infected animals, especially domestic dogs, responsible for over 99% of cases. The virus infects peripheral nerves and travels centripetally to the central nervous system, where neurological symptoms develop, resulting in nearly 100% fatality after symptom onset.

Endemic regions include most of Asia and Africa, where approximately 59,000 human deaths occur annually, disproportionately impacting impoverished communities with weak health systems. Children under 15 are particularly vulnerable due to frequent dog exposure and limited awareness. Wildlife reservoirs such as bats, foxes, and raccoons may sustain rabies virus circulation, complicating control in some areas.

2. Animal and Human Vaccination Strategies

Vaccinating domestic dog populations is the cornerstone of rabies control, with a target coverage of at least 70% to disrupt transmission cycles effectively. Sustained mass dog vaccination campaigns (MDV)

combined with population management reduce canine rabies incidence and consequently human exposure risks. Countries like Bangladesh, Mexico, and Tanzania have demonstrated significant declines in human rabies deaths after implementing large-scale MDV and PEP programs.

Human vaccination primarily involves prompt post-exposure prophylaxis (PEP), which includes wound cleansing, vaccination series, and administration of rabies immunoglobulins where indicated. Timely PEP following exposure absolutely prevents rabies development. However, availability and affordability of PEP remain limited in many endemic regions, causing preventable fatalities.

3. Integrated Surveillance and Diagnostics

Effective rabies control demands integrated surveillance linking human and animal health data to detect outbreaks early, map transmission hotspots, and target control measures. One Health digital surveillance platforms using mobile technologies facilitate real-time reporting and cross-sector data sharing, transforming rabies monitoring in countries like Haiti and Kenya.

Laboratory diagnostics, including direct fluorescent antibody testing in animals and sera neutralization assays, validate rabies status for timely decision-making. Strengthening laboratory capacity and training veterinary and medical personnel improves surveillance quality and case detection accuracy, critical for guiding vaccination and bite management programs.

4. Community Engagement and Education

Rabies control succeeds when communities are empowered with knowledge of bite prevention, wound care, and prompt healthcare seeking post-exposure. Educational campaigns tailored to local cultural contexts and delivered through schools, media, and community leaders have improved awareness and PEP compliance in endemic settings. Training health workers and veterinarians to implement effective bite management and

communicate risks further enhances community-level control efforts.

5. One Health Coordination and Governance

Cross-sectoral collaboration among ministries of health, agriculture, environment, and local governments forms the backbone of the One Health approach. Successful models exemplify joint policy development, shared surveillance, coordinated mass dog vaccination, and unified public education strategies. For example, the Baiyun District model in China rapidly contained a rabies case through multisectoral coordination, emergency vaccination, and public communication.

Global partnerships such as WHO, FAO, and WOAHA support countries by providing technical guidance, vaccine banks, and facilitating international cooperation toward the Zero by 2030 goal. However, operationalizing One Health remains uneven, particularly in low-resource settings with fragmented health infrastructures.

THE ROLE OF DOMESTIC DOGS IN RABIES TRANSMISSION

Domestic dogs are the most significant reservoir of rabies globally. Their population dynamics—rapid reproduction, roaming behavior, and lack of vaccination—make them an ideal host for virus transmission.

Key issues include:

High density of stray dogs: Uncontrolled breeding and abandonment result in large populations of free-roaming dogs.

Low vaccination coverage: In many endemic areas, less than 20% of dogs are vaccinated, far below the herd immunity threshold of 70%.

Human-dog interaction: Lack of education about dog behavior and bite prevention leads to frequent exposures, especially in rural areas.

Effective management of dog populations involves:

1. Mass dog vaccination: Evidence from countries like Mexico and the Philippines shows that systematic vaccination programs

can reduce rabies by over 80%.

2. Dog population control: Sterilization and responsible ownership programs help manage stray dog numbers.

3. Animal birth control policies: Humane strategies are encouraged to prevent indiscriminate culling, which often leads to increased aggression and territorial disputes among surviving animals.

4. Monitoring dog bites: Community reporting systems improve early detection and response.

In Bhutan, a national rabies control program combined dog vaccination with public education campaigns, resulting in significant declines in both animal and human rabies cases.

VACCINATION STRATEGIES FOR HUMANS AND ANIMALS

Vaccination is the cornerstone of rabies control. The effectiveness of vaccination depends on strategic planning, logistics, and community participation.

Human Vaccination

- **Pre-exposure prophylaxis (PrEP):** Recommended for high-risk groups such as veterinarians, animal handlers, and travelers to endemic regions.
- **Post-exposure prophylaxis (PEP):** Administered after suspected or confirmed exposure. It includes wound cleaning, rabies immunoglobulin, and a vaccine series. Timely access can save lives.

Barriers to human vaccination include:

- High cost of vaccines and immunoglobulin.
- Limited availability in rural healthcare centers.
- Lack of awareness of the benefits of early treatment.

Animal Vaccination

Mass vaccination of domestic dogs is proven to be the most cost-effective intervention to reduce human rabies cases. Studies estimate that investing \$1–3 per dog annually can avert thousands of human deaths.

Innovations improving vaccination efforts include:

- **Oral rabies vaccines (ORV):** Used for wildlife and inaccessible dog populations.
- **Thermostable formulations:** Reduce reliance on cold-chain storage.
- **Digital tracking systems:** Help map vaccination coverage and identify underserved areas.

A successful example is the Pan American Health Organization (PAHO), which coordinated dog vaccination campaigns across Latin America, resulting in a 90% reduction in human rabies deaths over two decades.

Challenges

Rabies elimination faces multiple obstacles requiring urgent attention:

Vaccine and PEP Accessibility: In endemic regions, challenges in affordable, stable supply chains for dog vaccines and human PEP severely limit coverage. Geographic remoteness, cold chain requirements, and cost barriers hinder mass vaccination and timely post-exposure treatment.

- **Wildlife Reservoir Complexity:** Wildlife species capable of harboring rabies threaten spillover and reintroduction to domestic populations, complicating targeted interventions.
- **Fragmented Surveillance and Health Systems:** Inadequate integration between human and animal health systems leads to underreporting, delayed outbreak detection, and inefficient resource allocation. Poor staffing and limited financial investment exacerbate these gaps.
- **Public Awareness Deficits:** Cultural misconceptions, poor bite wound management practices, and distrust of vaccines negatively affect community participation in rabies control.
- **Funding Constraints:** Sustained financing for large-scale dog vaccination, PEP provision, and multi-sectoral coordination remains insufficient, particularly in low- and middle-income countries.

- **Cross-border Transmission:** Inconsistent rabies control programs between neighboring countries enable virus persistence and recurrent outbreaks.

PROSPECTS

The path toward global rabies elimination by 2030 hinges on the following priorities:

Technological Innovations: Development of thermotolerant vaccines and cost-effective diagnostic tools will enable broader vaccine distribution and rapid case confirmation. Expansion of digital One Health surveillance platforms will optimize outbreak detection and resource deployment.

Strengthening One Health Collaboration: Policy frameworks and operational mechanisms must evolve to promote governance structures that support sustained intersectoral coordination and sharing of data, resources, and expertise.

Capacity Building: Training multidisciplinary teams of health workers, veterinarians, and community volunteers enhances effective field implementation of vaccination, surveillance, and education programs.

Global and Regional Commitment: Continued advocacy and resource mobilization from governments and international partners will ensure adequate funding, vaccine availability, and political will.

Community Empowerment: Expanding participatory surveillance and bite prevention education tailored to cultural contexts will increase vaccine acceptance and timely PEP uptake.

Addressing Wildlife Reservoirs: Research into wildlife rabies ecology and development of oral vaccines for wildlife populations can further reduce transmission risk.

CONCLUSION

Rabies remains a deadly but entirely preventable disease. The One Health approach, through integrated vaccination campaigns, surveillance, education, and policy collaboration, offers the most effective

pathway toward elimination. Success stories from Asia, Africa, and Latin America demonstrate the critical importance of coordinated action among human, animal, and environmental health sectors. Overcoming challenges related to vaccine access, system fragmentation, funding, and public awareness requires sustained political and financial commitment combined with innovative technologies and community involvement. Achieving zero human rabies deaths by 2030 is an ambitious yet achievable global goal that hinges on embracing and operationalizing One Health principles.

ONE HEALTH MESSAGE ON RABIES

Rabies control is a shared responsibility requiring collaboration between human health, veterinary services, and environmental management. Only through integrated actions—mass dog vaccination, timely post-exposure prophylaxis, community education, and coordinated surveillance—can we save lives and build healthier communities worldwide.

Cite this article:

Manjeet Sharma and Harjeet Sharma. (2025). Rabies control through the one health approach. *Vet Farm Frontier*, 02(09), 14–18. <https://doi.org/10.5281/zenodo.17307161>

