



TOWARDS ZERO BY 2030: STRENGTHENING RABIES CONTROL IN INDIA THROUGH A ONE HEALTH APPROACH

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ABSTRACT

Globally, rabies claims around 59,000 lives annually, with India accounting for approximately one-third of these deaths. Rabies is a fatal zoonotic disease that is fully preventable with timely medical intervention. Although both human and animal vaccines are now effective, rabies remains a serious public health concern, particularly in low- and middle-income nations. Most human rabies infections originate from dog bites, emphasizing the need for strong veterinary engagement. In the past, treating human cases of rabies after exposure has received more attention in India than stopping the disease's spread at its source. A more comprehensive and long-lasting strategy for rabies eradication is provided by a One Health approach, which links the environmental, animal, and human health systems. The significance of rabies for Indian public health, the justification for implementing a One Health approach, and important interventions such as widespread dog vaccination, improved availability to post-exposure prophylaxis (PEP), and public education are all highlighted in this paper. Case studies from India and other endemic nations demonstrate how decentralized planning and cross-sector collaboration can enhance results. However, insufficient finance, a lack of veterinary infrastructure, and fragmented administration make implementation difficult. Strengthening India's National Rabies Control Programme (NRCP) through coordinated One Health actions is vital not only for achieving the WHO target of "Zero by 2030," but also for building long-term capacity to manage zoonotic threats.

KEYWORDS : Rabies, One Health, Zoonosis, Dog Vaccination, Public Health, India, NRCP, PEP

INTRODUCTION

Rabies is a zoonotic viral encephalitis that affects the central nervous system and can be prevented by vaccination. Once clinical symptoms start to show up, the disease is nearly always fatal. Rabies remains a serious public health concern even with the availability of very effective vaccines for both humans and animals, especially in low- and middle-income countries (LMICs) in Asia and Africa. Over 150 nations and territories have recorded cases of the disease, which results in tens of thousands of deaths each year, with children under the age of 15 making up about 40% of the fatalities (World Health Organization, 2023).

An estimated 18,000 to 20,000 people die from rabies each year in India alone; while underreporting and incorrect classification probably understate the actual toll. (Sudarshan et al., 2007). The estimated annual economic cost of rabies worldwide is around USD 8.6 billion (Hampson et al., 2015) which includes direct medical costs, lost productivity, and expenses related to post-exposure prophylaxis (PEP) and dog population management.

Up to 99% of all human rabies transmissions can be attributed to dogs, underscoring the zoonotic origin of the disease and the critical necessity for preventive measures at the animal-human interface (World Health Organization, 2023). Children are particularly vulnerable, as they are more inclined to engage in play with animals, sustain bites to high-risk anatomical regions such as the face and neck, and may omit reporting exposures in a timely fashion. (World Health Organization, 2023), (Dodet et al., 2008).

Historically, rabies control strategies in India have concentrated on managing human cases post-bite (Wallace et al., 2019). However, this reactive approach has limited long-term efficacy. A more sustainable and efficacious solution resides in the adoption of the One Health framework, which advocates for integrated action across human, animal, and environmental health sectors. Preventive strategies such as mass dog vaccination, community education, environmental sanitation, and intersectoral collaboration are vital to disrupting the transmission cycle.

This narrative review examines the necessity of a One Health approach for rabies elimination, highlights successful programmatic models, analyzes current barriers, and proposes evidence-based recommendations for policy and implementation aligned with global targets, including the WHO's goal of "Zero by 2030" (World Health Organization, 2018).

Why One Health is Essential for Rabies Control

Rabies exemplifies a One Health challenge, as it originates in animals, affects humans, and is influenced by environmental and socioeconomic conditions. Dog bites account for over 99 percent of human rabies cases, highlighting the need of canine population control

and vaccination in preventative measures¹. The risk of transmission is increased by environmental variables such unchecked urban growth, inadequate waste management, and growing numbers of stray dogs, particularly in low- and middle-income countries with dense populations (Taylor, Latham, & Woolhouse, 2001)

The One Health framework—endorsed by the World Health Organization (WHO), Food and Agriculture Organization (FAO), World Organisation for Animal Health (WOAH), and United Nations Environment Programme (UNEP)—promotes cross-sectoral collaboration to tackle zoonotic diseases like rabies (FAO, UNEP, WHO, & WOAH, 2022) In practice, this involves coordination among human healthcare workers, veterinarians, municipal authorities, educators, and urban planners.

Research demonstrates that preventative measures including community education, mass dog vaccination, and sterilization are more sustainable and economical than depending only on human post-exposure prophylaxis (PEP). According to modeling studies, rabies transmission can be stopped and dog-mediated human fatalities can be eliminated if 70% of the overall dog population is vaccinated³. Additionally, a cooperative strategy between the human and animal health sectors called integrated bite case management (IBCM) increases the precision of surveillance and the prudent use of PEP (Wallace et al., 2019)

Hence, rabies control requires a shift from reactive medical interventions to proactive, multisectoral collaboration. The most efficient and financially feasible option to reach the worldwide goal of having no dog-mediated human rabies fatalities by 2030 is through the One Health strategy.

Key Components of a One Health Rabies Strategy
Human Health Sector

The key to preventing human rabies is timely and appropriate post-exposure prophylaxis (PEP), which includes rabies immunoglobulin (RIG) for severe exposures, a series of rabies immunizations, and urgent wound washing (Briggs & Moore, 2011). Even though PEP is almost 100% effective when used properly, its efficacy is nonetheless limited by gaps in awareness, training, and access (Meslin, Fishbein, & Matter, 1994).

In India, rural health facilities frequently face shortages of vaccines and RIG, particularly in endemic states (Gogtay et al., 2023). Healthcare workers in primary care settings may lack adequate training in classifying animal bite exposures or in administering RIG appropriately (Rao et al., 2018). Cold chain and logistical challenges further hinder effective service delivery, especially in hard-to-reach areas (Sambo et al., 2014).

PEP awareness in the community is frequently low. Many bite

sufferers choose to use traditional cures, postpone or skip treatment, or prematurely stop receiving vaccinations (Singh & Choudhary, 2005). Long travel distances, lack of expertise, injection anxiety, and financial limitations are all contributing factors (Hutin, Rana, & Pande, 2017). Reducing rabies mortality in India requires increasing provider training, strengthening PEP availability, and funding focused public education.

Animal Health Sector

Interrupting the rabies transmission cycle at its source necessitates mass dog vaccination, particularly free-roaming and community-owned dogs, with at least 70% coverage required to establish herd immunity and sustainably reduce transmission (World Health Organization, 2018). However, achieving and maintaining this threshold remains a major challenge in India. The country has an estimated 60 million stray dogs, yet no standardized or centralized dog census system exists to guide or monitor vaccination efforts (Gompper, 2014).

India's Animal Birth Control–Anti-Rabies (ABC-AR) programme, mandated under the Prevention of Cruelty to Animals (Dog Rules), 2001, is the primary strategy for sterilization and anti-rabies vaccination of street dogs. Despite its legal mandate, implementation is uneven across states and municipalities, often hampered by inadequate veterinary manpower, lack of inter-departmental coordination, and insufficient funding (Animal Welfare Board of India, 2001). In many regions, there is no consistent cold chain management, limited post-vaccination surveillance, and absence of dog-tagging or microchipping, making it difficult to track coverage or revaccination needs (Reece, Chawla, & Hiby, 2013).

Moreover, collaboration between municipal authorities and veterinary services is often weak, and the public health sector rarely engages in dog vaccination campaigns, despite the zoonotic link. Some successful pilot models—like the Jaipur and Sikkim initiatives—have demonstrated that coordinated multi-sectoral approaches can achieve high dog vaccination coverage and reduce human rabies deaths (Tiwari et al., 2019).

To align with the WHO's Zero by 2030 target, India must prioritize mass dog vaccination, integrate dog population management with public health planning, and establish robust monitoring frameworks.

Environmental and Community Sector

Environmental factors such as open garbage dumps, unregulated meat waste, and poor urban planning significantly contribute to the proliferation of stray dogs, thereby sustaining rabies transmission cycles (World Health Organization, 2018). Urban ecosystems that provide uninterrupted access to food waste support high-density dog populations, particularly in low-resource settings (Vanak & Gompper, 2009). In India, municipal bodies are legally and operationally responsible for urban waste management, yet waste segregation and timely disposal are often inadequate, indirectly sustaining the growth of free-roaming dog populations (India State-Level Disease Burden Initiative Collaborators, 2021).

In order to limit environmental factors that increase the risk of rabies and to provide safer shared places, a One Health strategy requires cooperation between public health experts, veterinary services, and municipal authorities. Human-animal conflict may be decreased by urban design that incorporates trash management, green spaces, and animal birth control centers (Jackman & Rowan, 2013).

In order to prevent and control rabies, community involvement is essential. When it comes to reporting dog bite cases, participating in widespread dog vaccination programs, and practising responsible pet ownership—which includes prompt vaccination and sterilisation (Ichhpujani et al., 2008)—locals play a crucial role. Education and awareness are important tools for changing behavior.

Information, Education, and Communication (IEC) and Behavior Change Communication (BCC) campaigns, when culturally adapted, can dispel persistent myths, improve health-seeking behavior post-bite, and reduce stigma associated with seeking biomedical care (Tiwari, Vanak, & Robertson, 2019). Mass media, school-based programs, and community health workers are important channels for delivering accurate rabies information (Sudarshan et al., 2006).

A holistic rabies control programme must therefore address the social

determinants of health, including knowledge, attitudes, and practices, while aligning environmental health interventions with veterinary and human healthcare strategies

Case Studies: One Health in Action

Goa, India

Goa stands out as a successful example in India's efforts to eliminate rabies, being the first state to report zero human rabies deaths in recent years. This success is attributed to a One Health partnership involving the Government of Goa, Mission Rabies, and the World Veterinary Service. The program implemented mass dog vaccination, GPS-enabled surveillance, 24/7 bite response, and community education. Between 2013 and 2019, more than 95,000 canines received vaccinations each year, resulting in over 70% coverage and a 92% decrease in the incidence of canine rabies. A dedicated rabies helpline and school-based education campaigns helped further reduce exposure and improve PEP adherence (Gibson et al., 2022).

Sri Lanka

Human rabies mortality in Sri Lanka have decreased by more than 90% in recent decades, with less than 30 cases reported year by 2021 compared to roughly 400 in the late 1970s (Acharya et al., 2024). The country's national rabies control strategy includes free universal access to PEP, annual dog vaccination, and intersectoral collaboration coordinated through district-level task forces. A revised National Strategic Plan (2022–2026), aligned with the WHO's "Zero by 2030" framework, emphasizes IBCM, enhanced surveillance, and community participation (World Health Organization, 2022).

Other International Examples

In the Philippines, the use of mobile vaccination clinics, community dog registration, and school-based awareness campaigns has led to marked reductions in rabies incidence. Similar results have been reported in Tanzania, where an integrated approach involving veterinary services, health workers, and NGOs improved dog vaccination and bite management in rural areas (Ahmed et al., 2023). These models underline the importance of grassroots implementation, NGO-government partnerships, and multisectoral training for sustained impact.

Barriers to One Health Implementation Siloed Operations

In India, ministries like Health, Animal Husbandry, and Urban Development frequently function independently even though they are acknowledged at the policy level. Even while more than 60% of 29 national policy papers address zoonotic diseases, less than 20% offer explicit cross-sector coordination mechanisms, which results in the fragmented implementation of One Health initiatives, according to a new analysis. According to experts, planning is still uneven and important zoonotic diseases like rabies frequently receive little attention in the absence of a single policy and well defined departmental roles (Sridhar et al., 2021).

Funding Limitations

Veterinary public health in India suffers from chronic underfunding. One study using intervention mapping revealed that canine rabies vaccination programs receive limited financial backing and are secondary to human health priorities. Similarly, the Animal Birth Control–Anti-Rabies (ABC-ARV) initiative is frequently under-resourced and fragmented due to lack of dedicated budgets and long-term planning (Tiwari, Vanak, & O'Dea, 2021).

Data Gaps and Poor Surveillance

Dog bite registrations and rabies cases do not have an integrated national database. Data indicates that less than half of rabies exposures are recorded by the Integrated Disease Surveillance Programme (IDSP), which frequently overlooks or fails to record cases that are reported to private facilities (Jha et al., 2019). Actionable insights are thus severely limited by the independent, unstructured operation of simultaneous human and animal monitoring systems (Cleaveland et al., 2021). Planning and resource allocation for rabies control are still insufficient in the absence of trustworthy epidemiological data.

Operational Gaps in Vaccination Programs

India's mass dog vaccination initiatives are often short-lived, underfunded, and run by local municipalities with little coordination. A recent assessment showed that many campaigns lack consistent cold chain management, revaccination protocols, and community engagement, resulting in low national coverage (< 15%)—far below the 70% needed to break rabies transmission (Tiwari & Vanak, 2014).

Structural Barriers to Intersectoral Collaboration

An evaluation of Integrated Bite Case Management (IBCM) in Asia revealed that ministries generally lack personnel trained to work across health and veterinary sectors; inter-departmental communication channels are weak; and power imbalances favor human health over animal and environmental sectors (Cleaveland et al., 2020). Without a shared vision and systematic feedback loops, One Health activities struggle to gain traction beyond pilot projects.

Opportunities for Policy Integration

India's National Action Plan for Dog-Mediated Rabies Elimination (NAPRE 2021) embodies a comprehensive One Health strategy, entrusting task forces at national and state levels, strengthening surveillance protocols, and urging cross-sectoral training (Ministry of Health & Family Welfare, 2021). "To implement these goals, NAPRE (2021) outlines State Action Plans for Rabies Elimination (SAPREs) and helpline services, developed through a collaboration between the United Nations Development Programme (UNDP) and the National Centre for Disease Control (NCDC), establishing the basis for decentralized rabies control." (UNDP India, 2021).

The Integrated Disease Surveillance Programme (IDSP)—now evolving into the Integrated Health Information Platform (IHIP)—includes rabies within its monitored conditions. Further enhancement of IDSP is needed to ensure standardized bite and rabies reporting, unified vaccine stock monitoring, and digital alerts for both human and animal health systems (Blanchard et al., 2023).

Digital innovation offers additional support: bite-case tracking apps and GIS-based dog population mapping tools (e.g., Goa's "Mission Rabies" app) now support rapid response (Gibson et al., 2022). Scaling these tools under NHM or Mission Indradhanush can enhance coverage and early detection.

Recommendations

In order to improve rabies control in India using an integrated One Health approach, the following policy measures may be suggested:

- The establishment of One Health coordination cells at district and municipal levels is essential. These cells should include representatives from the departments of Health, Animal Husbandry, Urban Development, and local governance to enable cohesive planning, timely resource allocation, and joint outbreak response activities. This aligns with the NAPRE 2021 framework and global best practices in zoonotic disease governance (Ministry of Health & Family Welfare, 2021).
- The implementation of cross-sectoral training programs for frontline health workers, veterinary professionals, and municipal officers under existing schemes like the National Rabies Control Programme (NRCPP) and the Animal Health Information and Disease Management System (AHIDMS) will improve clinical management of dog bites and harmonize reporting standards (Gibson et al., 2022).
- The provision of dedicated funding and institutional support to ensure $\geq 70\%$ annual vaccination coverage of the dog population is critical for achieving herd immunity. This should be supported through public-private partnerships, involving NGOs such as Mission Rabies, and real-time monitoring using GPS and mobile tools (PMEC & Ministry of Health, 2023).
- The development of integrated surveillance platforms that combine human rabies cases, dog bite registries, and vaccination status across sectors is urgently needed. This should build upon the Integrated Health Information Platform (IHIP) and utilize community-based reporting tools to improve detection and response (PMEC & Ministry of Health, 2023).
- The integration of One Health concepts into core curricula for medical, veterinary, nursing, and public health education will foster interdisciplinary understanding and sustainable workforce capacity for rabies and other zoonotic threats (Raut et al., 2023).

CONCLUSION

Despite being preventable, rabies still kills thousands of people year, primarily as a result of disjointed policies and efforts from several sectors. For significant and long-lasting development, embracing a One Health approach—which integrates environmental, animal, and human health—is not only advantageous but also necessary.

With over 36% of all rabies deaths worldwide, India has the largest rabies burden in the world. However, the nation also possesses the resources, momentum, and infrastructure necessary to reverse the

trend. A solid policy basis is provided by national initiatives like the NAPRE and the NRCPP. But how well they are implemented locally will determine how much of an influence they have.

Enhancing cross-sector cooperation, guaranteeing regular dog vaccination campaigns, increasing availability to PEP, and fostering broad rabies awareness and education—from community health workers to schools—are all essential steps in the fight for elimination. The WHO has set a goal of having no human deaths from dog-mediated rabies by 2030, which India may achieve with dedicated leadership, consistent investment, and concerted action. This would showcase how integrated, equity-focused One Health approaches can successfully address zoonotic threats like rabies.

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