



# Bio Vet Innovator Magazine

Volume 2 (Issue 9) SEPTEMBER 2025

WORLD RABIES DAY - 28<sup>th</sup> SEPTEMBER

POPULAR ARTICLE

## Rabies Unmasked: Challenges and Solutions in India

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### Introduction:

Rabies is one of the deadliest zoonotic diseases known to humankind, with a case fatality rate that approaches one hundred percent. India carries the highest global burden, recording the greatest number of human deaths and disability adjusted life years lost each year. Despite decades of research and the availability of effective vaccines, rabies remains a major public health challenge because its transmission cycle is complex and resilient. The One Health framework, which integrates human, animal, and environmental health, provides a clear path toward control and eventual elimination.

To understand why rabies continues to persist, we reviewed scientific publications, grey literature, and publicly available reports from 2012 to 2022. Our research highlights several persistent drivers. A large and mostly unvaccinated stray dog population accounts for nearly 97% of human cases through dog bites. Limited public awareness leads many bite victims to seek traditional remedies, and gaps in access to or completion of post exposure prophylaxis contribute to fatalities, particularly in economically disadvantaged communities. Occasional vaccine failures related to reduced potency, unusual wound types, or improper administration further complicate prevention efforts. These findings emphasize the urgent need for coordinated and multisectoral action to break the cycle of rabies transmission in India.

### Rabies Burden and Risk Factors in India:

Globally, an estimated 59,000 human deaths occur annually due to dog-mediated rabies, with India accounting for approximately 35 percent of these fatalities (WHO, 2018). In India, more than three-quarters of cases are reported from rural areas where access to diagnostic facilities and post-exposure prophylaxis is limited, both of which are critical for preventing the onset of disease (Sudharshan, 2007). Dog bites are responsible for over 95 percent of human rabies cases, reflecting the presence of an estimated 60 million stray and free-ranging dogs in the country (Gompper, 2007). Many cases remain

undiagnosed, misdiagnosed or under-reported. Children constitute a particularly vulnerable population, representing over one-third of cases in recent studies. Despite the availability of safe and effective vaccines, awareness of and access to post-exposure prophylaxis, including rabies immunoglobulin, remain inadequate (Mani *et al.*, 2016).

### Historical Accounts of Rabies in Pre-Independence India:

Rabies, one of the most ancient zoonotic diseases known to humanity, was well recognised in early Indian medical and historical literature (Tarantola, 2017). The *Susruta Samhita*—a foundational Ayurvedic text compiled between 1000 BCE and the first or second century CE—describes various ailments and surgical interventions and provides a detailed clinical depiction of rabies-like illness in humans following bites from rabid dogs or wild animals, noting its inevitably fatal course once symptoms emerge (Wasik and Murphy, 2007). Later chronicles indicate that the Mughal emperor Jahangir (1569–1627) recorded similar manifestations of rabies in an elephant from his royal menagerie (Parpia, 2018). It is also likely that numerous regional languages across the Indian subcontinent contained parallel descriptions of the disease, reflecting its long-standing recognition in traditional knowledge systems.

### Current Status of Human Rabies Incidence in India:

Multiple epidemiological investigations and national reports provide estimates of human rabies mortality in India (Suraweera *et al.*, 2004; Sudarshan, 2007).

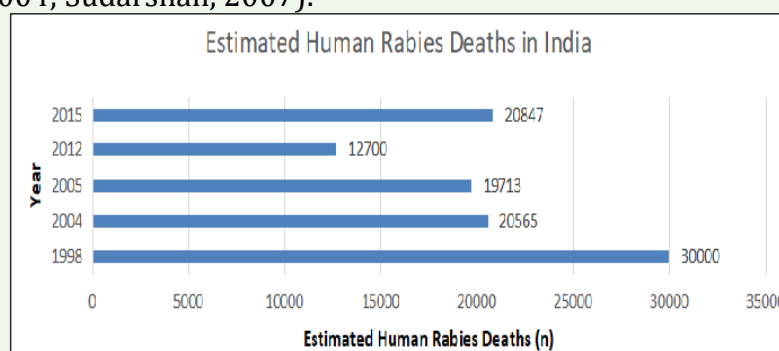


Figure 1: Longitudinal Analysis of Estimated Human Rabies Cases in India

Monitoring of human rabies cases by the Central Bureau of Health Intelligence (CBHI, 2021) is reflected in the reported death trend illustrated in Figure 2.

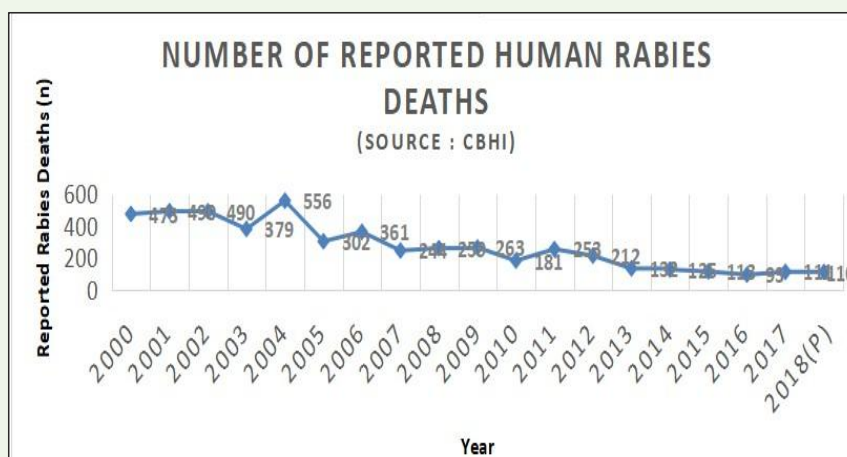


Figure 2: CBHI Data on Human Rabies Mortality in India

## Nationwide Burden Assessment:

In 2023, the National Institute of Epidemiology (NIE), Indian Council of Medical Research, Chennai, conducted a population-based study to assess the burden of human rabies and animal bites across India. Annual human rabies deaths were estimated using a decision tree probability model, integrating data from community surveys and laboratory-confirmed rabies cases in suspected dogs.

## Key Challenges in Rabies Control in India:

### 1. Availability of Rabies Vaccine and Immunoglobulin:

Timely access to rabies vaccines and immunoglobulin is critical for preventing human rabies. However, procurement, distribution, and availability vary widely across states, as responsibility rests with individual state authorities. Studies have reported insufficient facilities for proper wound washing and a preference for the more expensive intramuscular vaccination route over the cost-effective intradermal method. Occasional stock-outs of vaccines and immunoglobulin have also been documented. Recently, two rabies monoclonal antibodies developed by the private sector have become available and are currently under post-marketing surveillance (Hanumanthaiah and Haradhanalli, 2019).

### 2. Epidemiological Surveillance:

A significant gap exists between the actual number of human rabies cases and those estimated or reported. Given the absence of effective treatment and the high fatality of clinical rabies, many victims die at home without receiving hospital care. This underreporting results in underestimation of the health and economic burden, limiting evidence-based policymaking. Strengthening surveillance systems is essential to determine the true scale of the problem and to map the distribution of human and animal cases across states.

### 3. Laboratory Surveillance:

Accurate and timely laboratory diagnosis of human and canine rabies is essential for reliable surveillance and for guiding post-exposure prophylaxis (PEP). However, the infrastructure and utilization of laboratory diagnostic services remain inadequate.

### 4. Public Awareness:

Rabies affects both rural and urban populations, yet many bite victims consult traditional healers instead of seeking proper PEP at healthcare facilities. Engaging communities and raising awareness are crucial for successful rabies control programs.

### 5. Capacity Building:

Ongoing education and training of healthcare professionals on PEP protocols are necessary to ensure quality medical care for individuals exposed to potentially rabid animals.

### 6. Intersectoral Coordination:

Rabies control involves multiple ministries, but inadequate coordination and collaboration among

these agencies often result in insufficient technical and financial resources, limiting the effectiveness of control measures.

### Conclusions:

Rabies remains a preventable yet nearly invariably fatal zoonotic disease that imposes a substantial health and economic burden in India. Evidence from national surveys and published literature demonstrates that dog-mediated transmission continues to account for the vast majority of human cases, while underreporting and diagnostic gaps obscure the true incidence. Critical impediments to elimination include an extensive unvaccinated stray dog population, inconsistent availability of vaccines and rabies immunoglobulin, limited laboratory and epidemiological surveillance and insufficient public awareness of post-exposure prophylaxis. These factors, compounded by fragmented intersectoral coordination, perpetuate sustained viral circulation despite the availability of effective preventive measures. Progress toward the national goal of zero human deaths from dog-mediated rabies requires a robust One Health approach integrating human, animal, and environmental health systems. Key priorities include mass canine vaccination and population management, reliable vaccine and immunoglobulin supply chains, community education on bite management, capacity building of healthcare personnel, and strengthened laboratory and epidemiological surveillance. Implementation of these coordinated, evidence-based strategies is essential to disrupt transmission and achieve eventual elimination of dog-mediated human rabies in India.

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