THE ECONOMIC BURDEN OF RABIES IN INDIA: A COMPREHENSIVE ANALYSIS

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Abstract

Rabies remains a significant yet neglected public health threat in India, contributing to nearly 36% of global human rabies deaths. With an estimated 18,000–20,000 annual fatalities, the disease imposes a substantial economic burden through direct medical expenses, indirect productivity losses, and wider societal costs. Post-exposure prophylaxis (PEP), while lifesaving, is financially burden for many families, with treatment costs ranging from ₹2,000 to over ₹20,000 depending on vaccine adherence and use of rabies immunoglobulin. Non-adherence to vaccination schedules, largely due to high treatment costs, preventable mortality and disease transmission. Beyond human health, rabies affects livestock productivity, causing significant financial losses to farmers and cascading effects on local economies. The disease also undermines tourism and workforce productivity, amplifying its hidden economic toll. Despite national programs such as the National Rabies Control Program, systemic barriers including underreporting, inadequate vaccine supply, and fragmented inter-sectoral coordination hinder effective management. Success stories like Goa's integrated dog vaccination and public awareness initiatives demonstrate the potential of cost-effective, prevention-driven strategies. Achieving India's goal of rabies elimination by 2030 requires a paradigm shift from treatment-centric approaches toward a sustainable "One Health" model emphasizing mass dog vaccination, robust surveillance, and community education. A prevention-focused strategy not only reduces disease transmission but also represents a sound economic investment, alleviating the long-term financial burden on individuals, agriculture, and the national economy.

Keywords: Rabies, Economic burden, Post-Exposure Prophylaxis, One Health, Dog vaccination, India

Introduction

Rabies, a viral encephalomyelitis caused by a Lyssavirus, is a disease with a near-universal case fatality rate of almost 100% once clinical symptoms manifest [1] Preventable through vaccination, this zoonotic disease continues to exert a heavy toll on human populations, particularly in Asia and Africa. Globally, it is estimated to cause approximately 59,000 human deaths annually, with dog-mediated transmission accounting for the majority of these fatalities [1]. India carries a disproportionate share of this global burden. The nation accounts for a significant portion of the world's rabies deaths, with estimates ranging from 35% to 36% of the global total [1]. Estimated 18,000 to 20,000 human deaths each year [1]. Dog bites are the principal vector for transmission, responsible for over 96% of mortality and morbidity associated with rabies in India [3]. This high incidence is fundamentally linked to the country's large and often unvaccinated population of dogs, which serves as the primary reservoir for the disease [6]. The prevalence is also high among children, accounting for 60% of reported cases and deaths in India [4].

Defining the Economic Burden: Direct, Indirect, and Societal Costs

The economic impact of rabies extends far beyond human death. It is a complex interrelation of direct, indirect, and broader societal costs that collectively impose a substantial financial burden on individuals, households, and the national economy. This report deconstructs the economic burden into a multifaceted framework to provide a comprehensive analysis.

- **Direct Costs:** These are the measurable financial outlays for medical care. They include the costs of Post-Exposure Prophylaxis (PEP) components such as anti-rabies vaccines (ARV) and rabies immunoglobulin (RIG), as well as expenses for medical consultations and wound care [8]
- **Indirect Costs:** This category comprises non-medical expenses and productivity losses incurred by affected individuals and their families. It includes costs such as lost wages due to missed work days and travel expenses for multiple clinic visits [8]
- **Societal Costs:** These are the broader macroeconomic and social impacts that affect the entire nation. They are quantified through metrics such as Disability-Adjusted Life Years, which measure the total years of healthy life lost due to disease and premature death. Societal costs also include significant losses in the agricultural sector, particularly livestock mortality, and the uncalculated humanistic toll of psychological distress [3]

The full magnitude of the economic burden of rabies in India remains a subject of ongoing exploration, with wide variations in reported costs and a significant gap between estimated and officially reported cases [9]

Direct Medical Costs: A Breakdown of PEP and Its Components

The financial strain imposed by the need for Post-Exposure Prophylaxis (PEP) following an animal bite can be substantial, particularly for individuals from lower socio-economic backgrounds [8]. The cost of PEP varies considerably depending on the type of treatment required, the specific brand of vaccine, and the healthcare facility where treatment is administered. A complete course of 4 to 5 doses of the anti-rabies vaccine can cost between ₹2,000 and ₹5,000 in the private sector [13].The price of a single ARV dose can range from as low as ₹210 to as high as ₹5,000 or more, with many common brands falling in the ₹250 to ₹400 range[14] The cost of treatment for Category III bites, which require the administration of rabies immunoglobulin (RIG) in addition to the vaccine. The cost of RIG alone can add up to ₹9,000 to the total cost [13]. A study analyzing prophylaxis costs found that for a 60 kg person, a regimen including immunoglobulin could amount to ₹22,894[1].

A study conducted at a private healthcare facility in Bhubaneswar, Odisha, provided a more detailed breakdown of these costs. The analysis found that the total direct medical cost, which included expenses for immunoglobulin, vaccination, medical consultations, and wound care, was a mean of Rs. 2968 ± 1095[8]. This figure was higher than the total indirect cost for patients. The study also highlighted the difference in expenses based on adherence to the vaccination schedule; those who were fully vaccinated spent a mean of Rs. 4750 ± 152 on ARV, significantly more than those who were only partially vaccinated [8].

The High Cost of Non-Adherence: Economic and Social Barriers to Completing Treatment

A critical finding from a study in Bhubaneswar is that the high cost of treatment was the primary reason for non-adherence to the recommended PEP schedule, accounting for 88.5% of cases [8]. This financial barrier creates a self-perpetuating cycle of public health failure. The initial cost of a single vaccine dose may appear affordable, encouraging bite victims to seek the first shot. However, the cumulative expense of the full regimen, particularly with the addition of RIG, quickly becomes prohibitive for individuals, especially those from lower socio-economic backgrounds [9]. This leads to a high rate of incomplete vaccination, which is a significant factor in mortality and continued disease transmission.

The financial pressure to complete vaccination series results in a prolonged period of treatment also manifests in lost productivity. The Bhubaneswar study found that participants who were only partially vaccinated had higher lost wages, with a mean of Rs. 3532 ± 440, compared to the mean of Rs. 2160 ± 994 for all participants [9]. This indicates that failing to complete the disability or time away from work, which further exacerbates the economic impact on the individual and their family.

The Indirect Burden: Lost Wages, Travel Expenses, and Psychological Impact.

Beyond the direct medical expenses, the indirect costs of rabies exposure form a substantial part of the economic burden. These include lost wages and travel expenses, which can accumulate over the multiple clinic visits required for the PEP regimen [8]. The psychological and behavioral impacts of a rabies exposure incident also have an uncalculated but profound humanistic and economic. A study in Bhubaneswar found that 72.8% of participants reported being scared of animals after the incident, leading to notable behavioral changes [8]. For example, a significant number of individuals began avoiding streets and parks where they might encounter dogs and changed their attitude towards existing pets. These behavioral shifts, born from fear and anxiety, can have far-reaching effects on an individual's quality of life and social interactions, representing a hidden but very real burden of the disease.

Table summarizes the key cost findings from the Bhubaneswar study, illustrating the significant financial burden on individuals seeking PEP.[8][9]

Deconstructing the National Burden: An Examination of the $8.6 Billion Figure

The economic burden of rabies extends far beyond the individual, impacting the national economy on a macroeconomic scale. India's heavy burden of rabies deaths is said to result in a "substantial economic cost"[3]. The global economic burden of canine rabies is often cited as being an estimated US$8.6 billion annually, encompassing lost lives, lost livelihoods, and high treatment costs [3]. It is crucial to note that this figure represents a global estimate, primarily calculated based on the cost of human life lost using disability-adjusted life years (DALYs)[17]. While India's contribution to the global burden is immense, accounting for approximately 35% of deaths [3]. The $8.6 billion figure is not a specific cost attributed to India alone. Rather, it represents the worldwide financial consequence of dog-mediated rabies, with India bearing a very significant portion of that global financial and human burden.

The Overlooked Burden: The Economic Impact on Agriculture and Livestock

The economic consequences of rabies outbreaks are particularly severe for India's agricultural sector, a pillar of the national economy. For small-scale farmers, the disease poses a profound and often overlooked threat. Direct losses arise from livestock mortality, which can have a devastating effect on a farmer's income, as well as diminished milk yields from surviving animals [18].

Case studies from various Indian states reveal the tangible financial consequences of these outbreaks. An outbreak in Punjab's dairy farms, for example, resulted in the death of 30 cows, causing a direct economic loss of approximately ₹2.5 lakhs and additional expenses for huma PEP for those in contact with the animals [18]. Similarly, an outbreak in Maharashtra led to the loss of 50 cattle on a single farm, resulting in a direct economic loss of ₹4 lakhs, in addition to reduced milk yields and increased veterinary and labor costs [18]. Further examples include a 2021 outbreak in Gujarat affecting 20 cattle, leading to direct losses of ₹1.8 lakhs and a temporary halt in milk production [18].

The economic effects of rabies in livestock extend beyond the immediate farm-level losses. The death of productive animals reduces a farmer's income, leading to effect throughout the local and regional economy [11]. This decline in income reduces consumer spending and can lead to a fall in spending in other sectors, illustrating how an animal health crisis can cascade into a broader human economic problem with cascading impacts on income and employment for individuals not directly at risk [11].

The Silent Threat to Livelihoods and Tourism

In addition to direct and indirect costs on individuals and the agricultural sector, rabies has a pervasive but often unquantified impact on the wider workforce and on international tourism. The lost wages from missed work days while seeking treatment represent a direct blow to the economic output of the nation [8]. This is compounded by premature mortality, which results in a reduction in non-health GDP, similar to the economic loss caused by other fatal diseases [19]. For the tourism industry, the impact is a "soft cost" that is difficult to measure but is significant. Rabies is common in India, even in urban areas, and travel advisories frequently highlight this risk [20]. The need to seek pre-travel vaccination or the expense of PEP in-country can be a deterrent for international travellers [20]. The lack of readily available RIG in many parts of the country can be particularly problematic for travellers, who may have to change their travel plans, a costly exercise, particularly for families [22].

The Economics of Prevention: Investing in a Rabies-Free India

National Control Programs: Budgets and Challenges

Recognizing the public health threat, the Indian government has initiated various control programs. The National Rabies Control Program (NRCP) was launched with the objective of ensuring the regular availability of free anti-rabies vaccines and RIG in all districts [3]. Early efforts were piloted during the 11th Five-Year Plan with a allocation of ₹8.65 crores [7]. Subsequent budgets for pilot schemes have fluctuated, with a notable reduction from ₹40 crores to ₹25 crores in consecutive years [7]. Despite these efforts, systemic challenges persist, undermining the effectiveness of the programs. There is an acute shortage of vaccines, with national and international manufacturers generating 28 million doses annually against an estimated annual requirement of 3.5 crore doses [6]. Furthermore, financial restrictions and debt at the local government level can lead to insufficient procurements, forcing individuals to seek treatment from private suppliers who charge higher prices [6].

State	Year of Outbreak	Number of Animals Lost	Direct Economic Loss (Approximate)
Andhra Pradesh	2017	12 cattle	₹1 lakh
Assam	2019	25 cattle	₹2.8 lakhs
Bihar	2020	16 cattle	₹1.9 lakhs
Gujarat	2021	12 cattle	₹1.5 lakhs
Haryana	2020	30 animals	₹3.5 lakhs
Himachal Pradesh	2020	18 cattle	₹2 lakhs
Jharkhand	2018	12 cattle	₹1.4 lakhs
Karnataka	2020	25 cattle	₹3 lakhs
Odisha	2018	14 cattle	₹1.5 lakhs
Punjab	2021	10 animals	₹1.3 lakhs
Rajasthan	2021	20 cattle	₹2.4 lakhs
Tamil Nadu	2021	18 cattle	₹2.2 lakhs
Uttar Pradesh	2018	15 animals	₹1.2 lakhs
West Bengal	2019	22 cattle	₹2.7 lakhs
State	Year of Outbreak	Number of Animals Lost	Direct Economic Loss (Approximate)
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Bihar	2020	16 cattle	₹1.9 lakhs
Gujarat	2021	12 cattle	₹1.5 lakhs
Haryana	2020	30 animals	₹3.5 lakhs
Himachal Pradesh	2020	18 cattle	₹2 lakhs
Jharkhand	2018	12 cattle	₹1.4 lakhs
Karnataka	2020	25 cattle	₹3 lakhs
Odisha	2018	14 cattle	₹1.5 lakhs
Punjab	2021	10 animals	₹1.3 lakhs
Rajasthan	2021	20 cattle	₹2.4 lakhs
Tamil Nadu	2021	18 cattle	₹2.2 lakhs

Uttar Pradesh	2018	15 animals	₹1.2 lakhs
West Bengal	2019	22 cattle	₹2.7 lakhs

Success Stories and Pilot Programs: Lessons from the Goa Model

The state of Goa has demonstrated that a sustained, coordinated effort can lead to tangible results. Through a partnership with an international organization, the state implemented a multi-pronged strategy that included mobile dog vaccination teams and public awareness campaigns [6]. This initiative led to a remarkable 92% decrease in confirmed canine rabies cases between 2014 and 2019, from 10.6 cases per month to just 0.8 cases per month [27]. Furthermore, pilot studies have explored more efficient vaccination methods. A test in Goa compared oral rabies vaccination (ORV) with conventional injectable vaccination and found that the fixed cost of ORV was one-quarter of the traditional method, with a faster daily vaccination rate [28]. This indicates that the path to a rabies-free India may be even more affordable and scalable than previously thought.

The following table visualizes the stark difference in cost between treating a human bite victim and preventing a dog from transmitting the disease.[16]

Intervention Type	Cost per Individual/Animal (Approximate)
Human Post-Exposure Prophylaxis	US$108
Dog Vaccination	US$4

A Comparative Cost Analysis: Rabies vs. Tuberculosis (TB)

To fully appreciate the scale of the economic burden of rabies, it is useful to compare it with other endemic diseases that are widely recognized as major public health challenges. Tuberculosis (TB), for example, is a well-established priority in India. A study on the economic burden of TB deaths in India in 2021 estimated a reduction in non-health GDP by US$9.1 billion[19].

Critical Gaps and Systemic Challenges

The Problem of Underestimation: Inadequate Surveillance and Reporting

A fundamental challenge in addressing the economic burden of rabies is the pervasive issue of data underestimation. The research indicates a "considerable gap" between the actual number of human rabies cases and the estimated and reported cases[3].Due to the severity and rapid progression of the disease, most rabies victims die at home rather than in a hospital, leading to unreported deaths.[3] This is compounded by the fact that rabies is not a notifiable disease in India, and a structured surveillance system is yet to be fully put in place.[7] The lack of precise and reliable data on the true scale of the problem hinders effective public health policymaking and resource allocation, making it difficult to justify the necessary investments in control and prevention.

The Imperative of a "One Health" Framework

The current approach to rabies control is often fragmented, lacking coordination and collaboration between the various line agencies involved, such as the Ministry of Health and the Department of Animal Husbandry [3]. The success of a disease elimination program is contingent upon a holistic "One Health" approach that acknowledges the vital link between human, animal, and environmental health [16]. Without a coordinated, inter-sectoral strategy, the national goal of rabies elimination by 2030, while ambitious, appears difficult to achieve[2].

Recommendations for Sustainable Elimination

Based on the analysis of the multifaceted economic and systemic burden of rabies in India, the following recommendations are put forth to guide a more effective and sustainable elimination strategy.

- **Strategic Funding and Resource Mobilization:** The central and state governments must commit to a long-term, sustained funding model that prioritizes a proactive, prevention-focused strategy. This requires a significant shift of resources from human PEP to mass dog vaccination and sterilization campaigns. A dedicated and ring-fenced budget for rabies elimination should be established to ensure

continuity and overcome the challenge of short-term political cycles.

- **Strengthening Surveillance and Data Infrastructure:** To accurately quantify the true burden of the disease and inform evidence-based policy, rabies should be made a notifiable disease across all states. A robust, nationwide surveillance system, integrating both human and animal health data, must be established. This will provide policymakers with the necessary information to allocate resources effectively and measure the progress of elimination efforts.
- **Inter-Sectoral Collaboration for Integrated Control:** A formal, well-funded "One Health" coordinating body should be created with a clear mandate to bridge the gap between human and animal health departments. This body would facilitate information sharing, joint planning, and integrated implementation of control measures, ensuring a cohesive and efficient approach to disease elimination.
- **Enhancing Public Awareness and Education:** A nationwide public awareness campaign is essential to change public behavior and improve health-seeking practices. This campaign should educate the public on the importance of timely wound washing, the need to complete the full PEP regimen, and the benefits of responsible pet ownership, including animal vaccination.

Conclusion

The economic impact of rabies in India is profound, multifaceted, and currently underestimated. The analysis reveals a substantial burden stemming not only from the direct costs of treatment but also from indirect losses in productivity, significant damages to the agricultural sector, and a cascade of socio-economic ripple effects. The current system, which relies heavily on a reactive, treatment-centric model, is economically inefficient and unsustainable, perpetuating a cycle of high out-of-pocket expenses, non-adherence, and continued mortality. The evidence is clear: the path to sustainable rabies elimination lies in a strategic paradigm shift. By embracing a proactive, prevention-focused "One Health" approach centered on mass dog vaccination, India can achieve its ambitious goal of a rabies-free nation by 2030. The success of pilot projects, like the one in Goa, provides a compelling blueprint for a scalable national strategy. This shift from an economically burdensome treatment model to a cost-effective prevention model is not merely a public health imperative but also a sound economic investment in the nation's future. It requires sustained political will, cohesive inter-sectoral collaboration, and a commitment to address the systemic challenges that have long hindered progress.

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