

Review Article

India's sustaining challenges to combat rabies elimination: a comprehensive review

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ABSTRACT

Rabies is one of the fatal zoonotic diseases wreaking havoc on humanity since antiquity. India continues to suffer the greatest rabies burden of any country, both in terms of annual human deaths and disability-adjusted life years. While modern rabies management emphasizes the importance of achieving zoonotic disease control and prevention through a One Health approach, the disease remains challenging as its persistence is invariably multifaceted. Therefore, it is imperative to examine the enduring reasons for the increasing incidence of rabies in India. Between 2012- 2022, a systematic search of scientific publications, popular search engines like Google, as well as in the grey literature regarding rabies was carried out. Since rabies elimination boils down to addressing the reasons, it is first seen related to the large and unvaccinated stray dog population, where 97% of cases are by dog bites. A second finding is that many bite victims resorted to indigenous treatment practices due to insufficient awareness and knowledge about the disease. Incomplete treatment practices also led to some deaths, especially because rabies vaccines are not affordable or accessible to poverty-stricken populations. Rarely, vaccine failures were caused by a lack of vaccine potency, a wound type, or ineffective administration methods. Even with all these data incorporated, there was no information on prevalence/incidence estimates of dog bites in recent years through national data. Therefore, without intensified surveillance, sustained political commitment, enormous mobilization of resources, and rabies education, the epidemic waves of this fatal disease will continue in India.

Keywords: Rabies, Challenges, India

INTRODUCTION

The true human burden of neglected zoonotic diseases remains underestimated, particularly in the case of rabies; a fatal viral zoonosis caused by an RNA virus belonging to the family Rhabdoviridae of the genus *Lyssavirus*.¹ The disease is spread by saliva from an infected animal, either through wounds or mucosal contamination. The virus can infect any mammalian species, but dogs have been considered to be the main source of infection.² Rabies is present throughout the world, and the number of human deaths globally due to dog-mediated Rabies is estimated to

be 59000 annually, with an associated loss of 3.7 million DALYs, which is more attributed than any other single zoonotic disease.³ Generally, the highest risk is found in developing countries across Asia (including Bali in Indonesia), Africa, and Central and South America.⁴ Rabies continues to be a major burden in Asia, with an estimate of 35,172 human deaths per year in which 95% of cases are disproportionately borne in underserved populations and 40% of cases in children below 15 years of age in the year 2018.^{5,6} Even though being a preventable disease, it consistently causes the deaths of many humans and animals around the world, including in India, every year. According to WHO, the true burden of rabies in India

is not fully known; although as per available information it continues to be a serious public health problem causing 18000-20000 deaths every year that accounts for 36% of the global and 65% of the human Rabies deaths in the South East Asia region.⁷ Given the persistent nature of rabies in India, this review outlines the burden of the disease in the country and the reasons behind its persistence for elimination.⁵

A literature review was conducted to gather information from various articles relating to the rabies elimination. Various databases were searched, including original studies, reviews, commentaries, and government guidelines from two electronic databases: PubMed and Search engines (Google Scholar and Google). The relevant keywords used in the search were “Rabies”, “challenges”, and “Elimination”. Information and guidelines posted on the World Health Organization and Ministry of Health website were also used. Articles were included if they were in the English language, articles in languages other than English, with no full text were excluded.

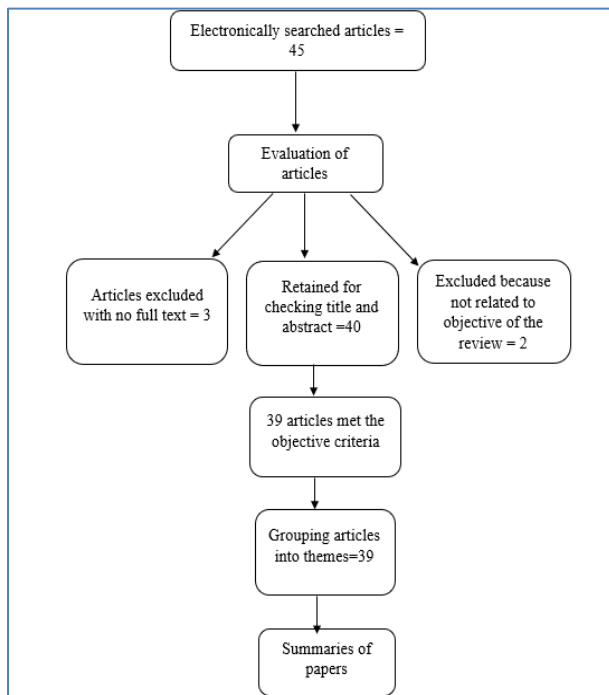


Figure 1: Flowchart of the review process.

PREVAILING RABIES SITUATION IN INDIA

The condition is prevalent in all states and union territories of the country except Andaman and Nicobar and Lakshadweep. An enhanced verbal autopsy survey within Million Death Study (MDS) projected 12,700 symptomatically identifiable rabies deaths in India in 2005 and further reported that 91% of these deaths occur in rural areas, 62% in males, and 50% in children below 15 years of age. In 2010 through probability decision tree approach by Partners for Rabies Prevention (PRP) estimated 16,450 rabies deaths in the country. Overall mortality was

estimated to be 1.1 deaths per 1,000,000 populations, with one-third of these deaths occurring in Uttar Pradesh and three-fourths occurring in seven central and south-eastern states.⁸ According to estimates, 17.5 million people are bitten by animals every year in India.⁹ The integrated disease surveillance programme (IDSP) reported an increase in animal bites from 4.2 million in 2012 to 7.4 million in 2018 with dogs.¹⁰ According to the National Health Profile 2018, West Bengal and Karnataka account for more than half of all Indian Rabies cases. From 2016-2017, 73 people in West Bengal lost their lives to Rabies, an occurrence that exceeds that of any other state by almost four times. Moreover, Karnataka's 37 deaths are almost twice as many as that of other Indian states.¹¹ In Maharashtra the rabies cases doubled during the first year of COVID-19 Pandemic. A dedicated rabies care facility in the Pune district had three deaths in 2020 followed by 19 deaths in 2021. Between June to July 2022, five people died of rabies and 6,691 people sought treatment for dog bites at 23 state-run medical colleges and hospitals in Maharashtra.¹² According to the Kerala Animal Husbandry department, there has been a two-fold increase in rabid dogs in the past five years and according to the state data, there were five deaths reported in 2020, 11 people succumbed to rabies infection in 2021, while 14 deaths have been reported in 2022 already.^{13,14} In Tamil Nadu, from 2021, thirty-seven people were succumbed and died from rabies. On an average around ten rabies cases, a year are reported across the state.¹⁵ By the National Rabies Control Program, 6644 clinically suspected Human Rabies cases and deaths have been reported from 2012 to 2020 as per the reports received from the states and UTs.¹⁶

RABIES ELIMINATION APPROACH IN INDIA

The Ministry of Health and Family Welfare approved National Rabies Control Programme (NRCP) in the 12th Five-Year Plan for rollout in the entire country. the objectives of the National Rabies Control Program were to prevent human deaths due to Rabies by capacity building, advocacy for scaling up inoculation of anti-rabies vaccine by ID route for Rabies and PEP (Post-Exposure Prophylaxis), increasing awareness in the general community, strengthening surveillance of animal bites and Rabies cases and strengthening Rabies diagnostics and inter-sectoral coordination. The program is being continued with an expanded vision & goal of elimination of Human Rabies by 2030 with dedicated financial and technical support to the State Governments. The program involves the following activities: Advocacy for maintenance of a regular uninterrupted supply of Anti Rabies Vaccine (ARV) and Anti Rabies Serum (ARS) up to PHC level for timely Anti Rabies PEP for all Animal bite victims and utilization of funds available under NFDI for procurement of ARV and ARS. Establishment of Model Anti Rabies Clinics at District Level. Training on appropriate Animal bite management, prevention and Control of Rabies, Surveillance, and Inter-sectoral coordination. Strengthening Surveillance of Animal Bites and Rabies deaths reporting. Creating Awareness about Rabies

prevention. Strengthening inter-sectoral coordination with veterinary, Municipal Corporation, and Panchayat Raj Institutions. Support to the states under NHM for state and district level operationalization of the program activities as envisaged under NAPRE.

There has been a fragmented and uncoordinated approach to eradicating Rabies. The WHO/FAO/OIE in 2015 declared a vision for eliminating dog-mediated Rabies by 2030 and called for action by setting a global goal of zero human dog-mediated Rabies deaths by 2030, contributing to SDG 2. It is also in line with SDG 1 to "end poverty in all its forms" and Member States' commitment to "leave no one behind" to eliminate human deaths caused by Rabies. As the One Health Approach is the globally acknowledged means and a rational way of solving complex issues and challenges, the Rabies prevention and control by "One Health Approach" seems challenging in the Indian Context due to varied administrative structure and priorities across sectors involved at the National and sub-national level. To address these challenges, "The National action plan for dog mediated rabies elimination" was developed and is based on One Health Vision that spells out the role and responsibilities of all for the states/stakeholders to develop their action plan, specific to their needs with a vision to achieve zero human deaths due to dog-mediated rabies by 2030.

WHY INDIA IS STILL PLAGUED BY RABIES?

Only a few countries (Japan, the United Kingdom, Australia, New Zealand, Andaman, and the Nicobar Islands) have managed to completely eradicate the disease, by their geographical isolation and excellent governmental initiatives to control rabies. Several countries in Western Europe and the Americas have made significant advances in eliminating rabies. They have recognized it to be a public health concern and acted upon it with long-term and sustained investment. Unfortunately, rabies in India continues to be under-prioritized in public health discussions despite its high burden of dog-mediated human rabies deaths. Though rabies is considered very challenging to eliminate, the reasons why One Health-oriented rabies initiatives have not borne out their full promise are invariably multifactorial.

LACK OF AWARENESS

One of the reasons attributed to the high number of rabies deaths is the lack of awareness in the population about this fatal disease and its prevention. A major part of rural India is still lacking awareness and basic knowledge regarding the appropriate management of animal bite wounds and vaccine administration.¹⁷ After a dog bite, their first aid measures seem to be worse, as there are myths and misconceptions about the initial home management of wounds, such as the application of red chili, lime, tobacco leaves, or the visit to a tantric or local temple to perform some or other religious customs.¹⁸ In the state of Maharashtra, an 8-year-old male child residing in a rural

village died within 24 hours of admission due to improper primary management where the wound was not washed followed by noncompliance with the anti-rabies vaccination schedule and immunoglobulin administration, which indicates rabies awareness gap in the community.¹⁹ Also, in Kerala, a state with a higher literacy rate, a 19-year-old student and a 60-year-old man, died of rabies infection. Lack of awareness is largely responsible for such tragic deaths, as people mostly ignored pet bites.¹⁴

UNCONTROLLED CANINE POPULATION

In India, according to a report (Rabies on the Indian Subcontinent) published in 2013, there was a dog for every 36 people, with only 20% of these dogs being pets.²⁰ With the population of India estimated to be 1.28 billion in 2013, this equates to 36 million dogs.²¹ In contrast, a livestock survey conducted in India in 2012 estimated that the combined population of dogs, including stray dogs, in rural and urban India was 11.67 million.²² Also, a business survey that monitors the marketing of dog feed and accessories claimed that the owned dog population in India grew by 58% between 2007 and 2012, making it the fastest-growing canine population worldwide. Among the lowest rates of dog ownership in the world, India has only four dogs per 1,000 people, attributed to the largely rural and poor population.²³

RABIES INSUFFICIENT PROGRAMME

The primary goal of the rabies control program was to improve technical and laboratory capabilities rather than to implement a comprehensive strategy based on the dynamics of the illness. For the Animal Birth Control Program to succeed, 70% of the stray dogs in a given geographic area must be sterilized within six months.²⁴ Since resources are limited, only a few communities have adopted ABC; however, many have not been able to maintain it. And also due to a paucity of epidemiologic data and the heterogeneity of nation-specific definitions of preventive or control strategies like monitoring and surveillance, the ABC-AR operations for the animal interventions were outsourced, and they were only done in a few urban areas, which revealed that just a small percentage of street canines are immunized.²⁵ In the affected areas, where other diseases are given higher priority, there is no proper evaluation and necessary information on the rabies control programme and its vaccine campaigns. Animal interventions are found to be more lacking in rural areas and where the urban regions also came under pressure from NGOs, the surveillance system struggled to identify all cases of dog bites due to the lack of accurate state-specific rabies burden research and insufficient inter-sectoral coordination.²⁶ Though a majority of the states established control Programmes in only a few communities and on a relatively small scale, their information finds no mention on the National Ministry of Health and Family Welfare website or the NITI Aayog. Similarly, a search for the term "rabies" on the Open Government Data Platform, India returns no

results.²⁷ Dog bite and rabies data were incorporated into the state surveillance system by the state government, however, the surveillance apparatus had issues with inconsistent coverage, a lack of precise case definitions, and poor information exchange between directorates.²⁸

IRREGULAR VACCINE SUPPLY

The endemicity of rabies in India can be linked to several factors, including inconsistent supplies of immunoglobulins and anti-rabies vaccines, especially in primary healthcare facilities. According to estimates, India requires 3.5 crore doses of anti-rabies vaccine annually but reeling under an acute shortage. The accessibility of rabies vaccines is relatively challenging; national and international vaccine makers generate 28 million doses of anti-rabies vaccine annually. In addition, manufacturers emphasized that they needed accurate numbers in advance since internal testing takes 45 days and bulk production takes 30-45 days. Suppliers charge exorbitant prices for vaccines and won't deliver them if local governments are in debt resulting in lesser availability of rabies antibodies.²⁹ Also, the availability of vaccines is usually found in urban centres and some capital cities. Financial restrictions in these centres result in insufficient procurements, a lack of regulatory monitoring, higher-market prices, and stock-outs.^{30,31} Hence, the victims are either delayed to receive Pre & Post-exposure from the available centres or rush to receive it from the private stakeholders, resulting in out-of-pocket expenditure. Even though India manufactures anti-rabies vaccines and immunoglobulins, and both are freely available in all public hospitals, India needs to increase its production of contemporary cell-culture vaccines to address these procurement delays in receiving rabies antibodies.

VACCINE FAILURE

Even though State Level Training plans on Animal Bite management and Rabies prophylaxes, and training of medical officers and health workers are being conducted across the states, the ineffective administration of the intradermal rabies vaccine is an uncommon cause of vaccination failure (IDRV). According to WHO, it is expressly forbidden to administer the rabies vaccine intramuscularly in the gluteal region.³² However, the Maharashtra state has reported a post-exposure failure when the rabies vaccine was administered intramuscularly in the gluteal region.^{33,34} In Kerala, questions are being raised on the effectiveness of the vaccine generated, especially the ones given free of cost, since two deaths have been reported in Palakkad and Kozhikode districts after a month of complete anti-rabies vaccination.³⁵ The presence of antibodies against rabies was found in a 12-year old girl, died from a six dog bite wounds at the National Institute of virology in Pune. While the NIV report indicating the presence of antibodies suggests that vaccination was done on the victim, the state health department of Kerala suspected that the location of the bite (near an eye) could have caused the virus to attack the brain

before the vaccine was fully effective.³⁶ As evidenced by these studies, rabies vaccinations can fail in rare cases as a result of the nature of the wound, such as bite sites on highly innervated areas of the face or hands or multiple bite sites and inadequate wound management.³⁷⁻³⁹

CONCLUSION

The elimination of human rabies at the state level in India is still possible, by the development of a "Mission Rabies" program in Goa State between 2013 and 2019 that resulted in a 92% reduction in monthly canine rabies cases through mobile dog vaccination teams, publicised 24/7 "rabies hotline" among the people and government offices to report suspected rabies cases and also by conducting awareness programmes in schools and among community groups. It is therefore inevitable that, without intensified surveillance, sustained political commitment, enormous mobilization of resources, and rabies education, the epidemic waves of this fatal disease will continue in India.

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