ORIGINAL ARTICLE

Effectiveness of Continuing Medical Education on Rabies Prevention and Post-Exposure Prophylaxis in Healthcare Professionals at a Northern Himalayan Tertiary Care Hospital

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ABSTRACT

Background: Rabies remains a significant public health issue in India, and gaps in healthcare professionals' knowledge are linked to preventable deaths. The current study aimed to evaluate the effectiveness of a well-structured Continuing Medical Education (CME) program focused on rabies prevention and post-exposure prophylaxis at AIIMS Rishikesh. **Methods:** The CME was organized among 50 healthcare professional like physicians, nurses, medical students, and residents. Each participant was evaluated for pre- test assessment using a pre-set questionnaire followed by full 4-hour CME knowledge session on rabies epidemiology, clinical management, and prevention measures. After the interactive session a post- test assessment was evaluated. **Results:** The mean knowledge scores increased significantly from 10.50 ± 2.32 points increased to 13.54 ± 0.89 points ($p < 0.001$), with a mean improvement of 3.04 points. This effect size was large with a Cohen's d of 1.308. Improvement in scores was seen in 86.0% of participants (43 out of 50). The greatest change was in participants' knowledge of post-exposure prophylaxis guidelines, risk assessment, and immunoglobulin administration. **Conclusions:** The structured CME program was highly effective in improving medical workers' knowledge related to rabies prevention. The large effect size and high participant satisfaction support the use of similar educational interventions to meet continuing medical education needs. These findings can inform evidence-based strategies to increase rabies prevention awareness and help India achieve the WHO goal of eliminating dog-mediated human rabies deaths by 2030.

KEYWORDS

Post-exposure prophylaxis, Continuing medical education, Healthcare professionals, Knowledge assessment, Rabies.

INTRODUCTION

Rabies remains one of the deadliest infectious diseases known to humanity, with a case fatality rate of nearly 100 percent once clinical symptoms appear(1). An estimated 59,000 people die from rabies worldwide each year, with Asia and Africa accounting for almost 95% of these deaths (2). India has the greatest burden, contributing to 18,000–20,000 rabies deaths annually, or around 36% of all rabies deaths worldwide(3). As a neglected tropical disease, rabies disproportionately affects people from underprivileged backgrounds. Even though there are effective vaccines and immunoglobulins, the most at-risk individuals cannot easily acquire or afford them (4).

There are two main clinical manifestations of rabies: paralytic (dumb) and encephalitic (furious). The encephalitic form present with Hydrophobia, agitation, hallucinations, autonomic dysfunction, aerophobia, and spasms while paralytic form manifests with flaccid paralysis and resembles with Guillain-Barré syndrome (5). Rabies is nearly always lethal once clinical signs manifest, which emphasises the significance of prevention by prompt wound care, immunisation, and, where necessary, rabies immunoglobulin delivery.

The three main pillars of rabies prevention are prompt rabies immunoglobulin injection, proper wound care, and following the entire vaccine regimen. The National Center for Disease Control consulted experts to revise the PEP guidelines against rabies in 2002, 2007, 2013, 2015 and 2019(6). The World Health Organization issued updated recommendations in 2018 to reinforce post-exposure prophylaxis (PEP) (7).

Healthcare professionals play critical role in rabies prevention, case recognition, and correct PEP administration. However, research regularly shows that many healthcare professionals are not sufficiently knowledgeable about basic rabies protocols(8). These shortcomings may lead to poor treatment choices, which may result in needless medical expenses and deaths.

Continuing medical education (CME) activities serve as a vital source of learning that keeps medical professionals challenged and up to date in the ever-evolving practice of

medicine. The positive effect of CME interventions on clinical knowledge and practice across most medical specialties is supported by substantial evidence(9). However, there are very limited studies that have examined the impact of organized CME on improving healthcare professional's knowledge of rabies prevention in India.

Northern Himalayan region of India has unique geographical and infrastructural challenges as well as a significant population that depends on domestic and stray animals, make rabies prevention a serious concern. However, there is little data on how well continuing medical education prepares medical personnel in these areas with the necessary rabies management skills. Consequently, the objective of the present investigation is to assess the influence of continuing medical education (CME) on the implementation of post-exposure prophylaxis and the prevention of rabies among healthcare professionals in a tertiary care facility situated in the Northern Himalayan region.

Material & Methods

Study Design and Setting: The study was pre-post questionnaire-based research conducted at the All-India Institute of Medical Sciences (AIIMS) Rishikesh, Uttarakhand, India. The research aimed to evaluate the effectiveness of a systematic Continuing Medical Education (CME) program on rabies prevention and post-exposure prophylaxis. The CME activity took place in July 2025 on World Zoonoses Day by the Centre for Excellence/Regional Coordinator under the National One Health Program for the prevention and control of zoonoses, AIIMS Rishikesh.

Participants: The CME program included healthcare professionals such as residents, medical students, scientists, nurses, research assistants, tutors, health and sanitary inspectors, and social workers from various departments at AIIMS Rishikesh. Their participation was voluntary.

CME Program Structure: This CME course was developed as a comprehensive 4-hour presentation covering: - Global and Indian prevalence and epidemiology of rabies, a one health and eco health approach to rabies, Clinical features and identification of rabies, Potential outcomes assessment and wound classification, Post-exposure prophylaxis guidelines and procedures, Rabies immunoglobulin injections and handling protocols, Scheduling and dosing of vaccines and managing side effects, Preventive measures and community health strategies, Clinical case discussions and interactive exercises. The course utilized various teaching methods such as lectures, case presentations, and discussion groups. Faculty members were experts in the departments of Community Medicine, Microbiology, and Veterinary.

Data Collection

Pre-test Assessment

Before the CME program began, all participants completed a structured pre-test questionnaire. The assessment was a multiple-choice test on rabies prevention and management. Questions were based on established WHO guidelines for current rabies interventions and post-exposure prophylaxis guidelines against rabies by the NCDC (National Centre for Disease Control).

Post-test Assessment

Immediately after completing the CME program successfully, the same post-test assessment was administered to measure knowledge acquisition. Additionally, subjects were surveyed about their satisfaction with the program and the usefulness of the topics.

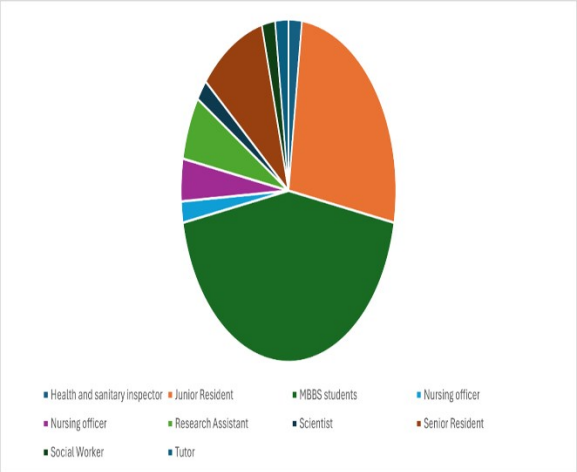
Statistical Analysis: Statistical evaluation was conducted utilizing Python (version 3.x). Descriptive statistics were computed for the demographics of participants and their corresponding test scores. The primary outcome measure was the enhancement in knowledge scores derived from both the pre-test and post-test evaluations. Mean scores from the pre-test and post-test were analyzed through paired t-tests; a p-value of less than 0.05 was deemed to be statistically significant. The impact of the educational intervention was measured as effect size using Cohen's d.

Ethical Considerations: The research was conducted to adhere to the ethical standards of educational research. Participation was voluntary, and all data was recorded anonymously. The evaluation was considered part of routine educational assessment and improvement activities within the institution.

Results

Participant Characteristics: A total of 50 healthcare professionals participated in the CME course and completed both the pre-test and post-test. The participants' demographics reflected the diverse healthcare workforce at AIIMS Rishikesh, including residents, medical students, scientists, nurses, research assistants, tutors, health and sanitary inspectors, and social workers across various clinical units.

Fig. 1 illustrates the diverse participation of healthcare workers in CME.

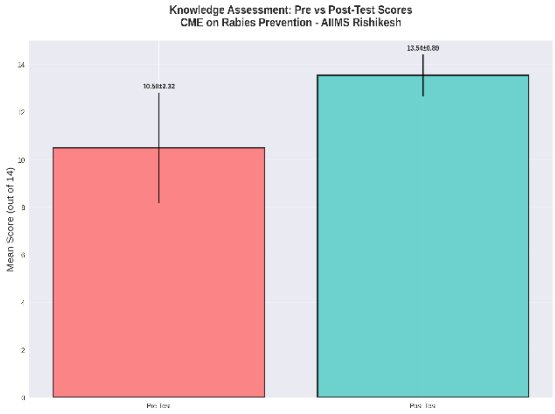


Knowledge Assessment Outcomes

Pre-test and Post-test Score Comparison

The mean pre-test score was 10.50 ± 2.32 (out of 14) and significantly increased to 13.54 ± 0.89 (out of 14) after the post-test. This represents a significant improvement of 3.04 points (95% CI: 2.41-3.67, $p < 0.001$) resulting from the CME intervention.

Fig. 2 shows the analysis of pre-test and post-test scores, revealing significant increases in the participants' knowledge levels.



Individual Participant Performance

The analysis of individual performance showed that 43 out of 50 (86.0%) participants improved in knowledge after the CME program. 7 participants (14.0%) showed no improvement or a decline in performance. The extent of the improvement also varied across participants, with 31 (62%) showing significant gains (>2 points increase)."

Statistical Significance and Effect Size

The paired t-test analysis revealed a statistically significant disparity between the Pre-test and post-test scores ($t = 9.715$, $df = 49$, $p < 0.001$). The calculated effect size (Cohen's $d = 1.308$) suggests a substantial effect, indicating that the CME intervention had a pronounced influence on the participants' knowledge levels.

Figure 3 Comprehensive statistics and progress details for each participant.

Knowledge Improvement Categories

The participants were divided based on their level of improvement:

- Significant Improvement (>3 points): 21 participants (42.0%)
- Moderate Improvement (1 to 3 points): 22 participants (44.0%)
- No Change or Decrease (<= 0 points): 7 participants (14.0%)

DISCUSSION

This investigation elucidates that a systematic Continuing Medical Education (CME) program can significantly augment the knowledge of healthcare professionals regarding rabies prevention and post-exposure prophylaxis (PEP). The average score enhancement of 3.04 points (from 10.50 ± 2.32 to 13.54 ± 0.89 out of 14) accompanied by a substantial effect size (Cohen's $d = 1.308$) reflects both statistical and practical relevance. In comparison to CME initiatives in the management of tuberculosis and HIV, which have documented effect sizes ranging from 0.6 to 1.2, our program demonstrated even more pronounced educational outcomes, thereby emphasizing its efficacy in the domain of infectious disease education (10,11).

The observation that 86% of participants exhibited improvements in their post-test scores is particularly promising, considering the diverse array of professional backgrounds represented—from physicians and residents to nurses, health inspectors, and social workers. Previous research has consistently highlighted a significant knowledge gap among healthcare workers in the realm of rabies management. In South Africa, a study revealed that 52.87% of queries to the National Institute for Communicable Diseases were related to rabies PEP, indicating a high demand for guidance among HCWs (12). For instance, surveys conducted in India and Southeast Asia disclosed that fewer than half of surveyed physicians were capable of accurately classifying animal bites or prescribing appropriate prophylaxis (13,14). *Sudarshan et al* investigation in South India revealed that merely 42.1% of medical officers were able to identify WHO Category I exposures, and less than 50% could distinguish between intradermal and intramuscular vaccine protocols (15). Similarly, a survey in Washington, DC, found that less than half of physicians correctly identified the PEP schedule, highlighting a critical lack of knowledge that could lead to fatal consequences (16). In Côte d'Ivoire, 73.9% of HCWs had not received rabies training, which limited their involvement in managing rabies exposure (17). In this context, our program achieved considerable advancements across all participant groups, indicating that multimodal, interactive educational methodologies may be superior to traditional didactic lectures in bridging enduring knowledge deficits.

When evaluated against other Continuing Medical Education (CME) assessments, our outcomes are commendable. A systematic review of CME programs focusing on zoonotic diseases recorded average score enhancements ranging from 1.5 to 2.8 points, accompanied by moderate effect sizes (18). Our achievement of a 3.04-point increase, in conjunction with a substantial effect size, indicates that the meticulous design of this CME—incorporating assessment, didactic lectures, and interactive case discussions—was instrumental in realizing a more significant impact.

Nevertheless, 14% of the participants exhibited no observable improvement or deterioration. This emphasizes the variability in learning outcomes and accentuates the necessity for adaptive methodologies. Empirical evidence derived from previous Continuing Medical Education (CME) studies indicates that recurrent reinforcement, collaborative small-group engagements, and longitudinal follow-up are critical components for the retention of knowledge and transformation of behavior (19,20). The integration of digital instruments, refresher modules, and periodic evaluations may prove beneficial

in maintaining and amplifying the advantages of single-session interventions.

In accordance with the One Health perspective, enhancing the capabilities of healthcare practitioners to administer timely and appropriate Post-Exposure Prophylaxis (PEP) complements concurrent initiatives in canine vaccination, surveillance, and community outreach. Given that rabies persists as an endemic concern in India and significant portions of Asia, the expansion of such CME interventions has the potential to expedite advancements toward the World Health Organization's objective of eradicating dog-mediated human rabies fatalities by 2030 (21).

Conclusion

This investigation substantiates that systematically designed, multimodal continuing medical education (CME) initiatives markedly augment healthcare practitioners' comprehension of rabies prevention and post-exposure prophylaxis (PEP), particularly in pivotal areas such as bite classification, vaccination protocols, and the administration of immunoglobulin. By yielding substantial, clinically significant advancements across varied professional groups, our intervention illustrates that CME constitutes a scalable and efficacious approach for environments endemic to rabies.

Recommendation

The integration of such initiatives into standard medical education and their expansion across various institutions will be crucial to maintain advancements and support the global objective of achieving zero human rabies fatalities by 2030 (21).

Authors Contribution

All authors have contributed equally.

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Nil

Conflict of Interest

There are no conflicts of interest.

Declaration of Generative AI and AI Assisted Technologies in the Writing Process

The authors haven’t used any generative AI/AI assisted technologies in the writing process.

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