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Original Research Article

Determinants of delay in initiating rabies post-exposure prophylaxis among animal bite victims: a hospital-based cross-sectional study from central India

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ABSTRACT

Background: Rabies is an almost invariably fatal yet preventable disease. Timely post-exposure prophylaxis (PEP) is essential, but delays remain common. This study assessed factors associated with delayed PEP initiation among animal bite victims attending an anti-rabies clinic in central India.
Methods: A hospital-based cross-sectional study was conducted from May to mid-June 2025 at a tertiary care hospital in central India. A total of 323 animal bite victims were recruited by consecutive sampling. Data were collected using a pre-tested semi-structured questionnaire. Delay was defined as receiving the first anti-rabies vaccine dose after 24 hours. Data were analysed using Jamovi with descriptive statistics and Chi-square test.
Results: Dogs caused 96% of bites. Most participants were male (67%), rural residents (61.5%), and 30.5% were illiterate. PEP initiation was delayed in 41% of cases. Delay was significantly associated with distance >10 km from the vaccination centre ($p<0.001$), monthly income <₹5000 ($p=0.004$), and increasing age ($p=0.041$). Major reasons for delay were work-related barriers (48.7%), lack of awareness (27.7%), and clinic closure on holidays (23.6%).
Conclusions: Delay in PEP initiation was common and mainly linked to access, socioeconomic, and awareness-related barriers. Strengthening community education, improving rural access, and ensuring uninterrupted anti-rabies services may reduce delays.

Keywords: Animal bite, Delay, Post-exposure prophylaxis, Rabies

INTRODUCTION

A deadly viral zoonotic disease, rabies continues to pose a serious threat to public health around the world, especially in nations like India where dog-mediated transmission is extremely common. About 36% of rabies deaths worldwide occur in India, where stray dog populations are the main source of the virus.[1] Rabies still kills people even though it is 100% preventable with prompt and appropriate Post-Exposure Prophylaxis (PEP), highlighting serious gaps in public awareness and healthcare access.[2]

The mainstay of rabies prevention after an animal bite is rabies post-exposure prophylaxis (RPEP), which consists of prompt wound cleaning, the administration of rabies immunoglobulin (RIG) (for severe exposures), and a full course of rabies vaccine (RV).[3,4] One important factor that determines survival is how quickly this prophylactic is started. Since any delay gives the virus more time to move from the wound site to the central nervous system, where it causes irreversible damage, current guidelines stress that RPEP should be started as soon as possible after exposure to maximize its protective efficacy.

Unfortunately, in real-world settings, there are often considerable delays in the initiation of RPEP. Numerous factors can contribute to these delays, such as a lack of public awareness of the disease's severity and the need for prompt care, reliance on ineffective home or traditional remedies, difficulties in accessing healthcare facilities geographically, financial limitations associated with treatment costs, and flaws in the healthcare system itself, such as staff training deficiencies or vaccine stock-outs. These potential obstacles are especially noticeable in the context of central India, a region that is frequently distinguished by socioeconomic disparities and a diverse healthcare infrastructure. There is a lack of region-specific data from central India, despite the fact that numerous studies have looked at the factors that contribute to delay in other parts of the world. Designing focused, successful public health interventions and awareness campaigns requires an understanding of the precise factors causing delayed presentation in this geographic and sociocultural context.

Therefore, this study aimed to examine the factors influencing delays in initiating rabies post-exposure prophylaxis among patients bitten by animals who present to a tertiary care hospital in central India. Using a cross-sectional, hospital-based design, we systematically examined how sociodemographic characteristics, healthcare-seeking behaviours, and wound management factors influence the time required for patients to receive their first dose of RPEP. Ultimately, the research will provide crucial evidence to local and regional health authorities regarding key modifiable factors, leading to improved patient outcomes and reduced rabies-related mortality.

METHODS

Study design and setting

This was a hospital-based, cross-sectional study conducted at the anti-rabies clinic (ARC) in the out-patient department (OPD) of a tertiary care teaching hospital located in central India. The facility serves as a major referral centre for animal bite victims from both the surrounding metropolitan area and extensive rural hinterlands. The study was carried out prospectively over a period of six weeks, from May to mid-June 2025.

Study population and sampling

The study population consisted of all individuals presenting to the ARC for initiation of rabies post-exposure prophylaxis (RPEP) following an animal bite or scratch.

Inclusion criteria

All individuals presenting for the first dose of RPEP following an animal bite or scratch requiring prophylaxis. Patients of all age groups (or specify the age range studied, if any). Individuals who provided informed consent (or assent in case of minors) to participate.

Exclusion criteria

Patients presenting for follow-up doses of RPEP. Patients with incomplete information regarding the time of animal bite.

Sample size and sampling technique

The minimum sample size was calculated based on the expected proportion of delayed RPEP initiation. Assuming a prevalence of delay, a confidence level, and an absolute precision, the required sample size was determined. Accounting for a non-response/incomplete data rate, the final target sample size was set at participants.

$$n = \frac{\left(Z^2 \times p \times (1 - p)\right)}{d^2}$$

Where,

Z =1.96 (for 95% confidence level)

p = assumed prevalence of delay in initiating PEP =30%.[5]

d = absolute precision =5%

$$n = \frac{\left(1.96^2 \times 0.30 \times (1 - 0.30)\right)}{0.05^2}$$

$$= 0.8067 / 0.0025 = 323$$

Consecutive sampling was used to recruit eligible participants.

Operational definitions

Rabies post-exposure prophylaxis (RPEP) initiation: the time of administration of the first dose of the Rabies Vaccine.

Delay in PEP initiation (outcome variable): defined as the time interval between the time of animal bite/exposure and the time of RPEP initiation being greater than 24 hours.

Income: categorized based on self-reported total household monthly income. The threshold of was used to differentiate between lower-income and higher-income groups for analysis.

Distance to centre: categorized based on the self-reported distance from the participant's residence to the Anti-Rabies Clinic. The threshold of was used to differentiate near and far residence.

Data collection

Data were collected by trained investigators using a pre-tested, semi-structured questionnaire administered via face-to-face interviews. The questionnaire captured details on: Socio-demographic characteristics: age, gender, residential area (rural/urban), education, and monthly income. Exposure characteristics: type of biting animal, time of bite, and type of wound. Healthcare-seeking behavior: time of presentation, initial wound management, and distance from residence to the clinic. Reasons for delay: self-reported primary and secondary reasons for delayed presentation to the ARC.

Interviews were conducted in a standardized manner after obtaining informed consent and following the administration of the first dose of RPEP to prevent any interference with immediate clinical care.

Statistical analysis

Data were collated and entered into a spreadsheet program (Microsoft Excel) and subsequently analyzed using Jamovi Statistical Software version 2.3.28.0

Descriptive statistics: continuous variables were summarized using mean and standard deviation (SD) or median and interquartile range (IQR), while categorical variables were presented as frequencies and percentages.

Bivariate analysis: the primary analysis focused on identifying factors associated with the outcome variable: delay in PEP initiation (>24 hours). The Chi-square test was employed to determine the association between various socio-demographic, exposure, and healthcare-seeking characteristics and the delay in RPEP initiation.

A p value <0.05 was considered statistically significant.

RESULTS

Socio-demographic and exposure characteristics

A total of 323 animal bite victims were enrolled and included in the final analysis.

The majority of the study participants were male (67%), and a significant proportion (61.5%) resided in rural areas. Regarding education, of the subjects were reported as illiterate. The most common animal involved in the exposure was the dog, accounting for 96% of all reported bites (Table 1).

Prevalence and associated factors of delay in PEP

Delay in the initiation of RPEP (>24 hours) was observed in (41%, n=132) of the total cases. Bivariate analysis using the Chi-square test revealed statistically significant associations between delay in PEP initiation and the following factors.

Participants residing more than 10 km from the vaccination centre were significantly more likely to experience a delay compared to those residing closer p<0.001 Individuals reporting a monthly household income of less than 5000 INR showed a significantly higher frequency of delay (p=0.004).

Table 1: Socio-demographic and exposure profile of study participants.

Variables	Category	Frequency	Percentage
Sex	Male	219	67.8
	Female	104	32.2
Residence	Rural	194	60.1
	Urban/Semi-urban	129	39.9
Age group (years)	0-10	72	22.3
	11-20	87	26.9
	21-30	54	16.7
	31-40	41	12.7
	41-50	31	9.6
	>50	38	11.8
Type of biting animal	Dog	307	95.0
	Monkey	10	3.1
	Others (e.g., cat, rat)	6	1.9
Animal ownership	Stray	214	66.3
	Pet	109	33.7
WHO exposure category	Category I	7	2.2
	Category II	106	32.8
	Category III	210	65.0

Table 2: Prevalence and distribution of delay in PEP Initiation (n=323).

Parameters	Category/range	Frequency	Percentage
PEP initiation timing	Within 24 hours	196	60.7
	>24 to 48 hours	57	17.6
	>48 hours to 7 days	61	18.9
	More than 7 days	9	2.8
Median time to PEP initiation	-	19 hours	-
Minimum time to PEP initiation	-	1 hour	-
Maximum time to PEP initiation	-	10 days	-
Proportion with delay (>24 hours)	-	127	39.3

Table 3: Factors associated with delay in PEP initiation (n=323).

Factors	Adjusted odds ratio (AOR)	95% CI	P value
Distance ≥10 km	2.80	1.70-4.60	<0.001*
Monthly income <₹5000	1.90	1.10-3.30	0.022*
Lack of awareness about PEP	3.20	1.80-5.60	<0.001*
Clinic closed (holiday/weekend)	1.70	1.00-2.90	0.045*
No local transport available	1.50	0.80-2.80	0.184
Female sex	1.10	0.65-1.85	0.720

Table 4: Factors associated with delay in PEP initiation (n=323).

Reported barrier	Frequency	Percentage
Work-related obligations	53	41.7
Anti-rabies clinic closed on holidays/weekends	49	38.6
Lack of awareness about the urgency of PEP	44	34.6
Lack of money for transport or visit	28	22.0
No one to accompany the patient	26	20.5
Referred to multiple clinics	17	13.4
No local transport available	12	9.4
Religious or cultural beliefs against treatment	8	6.3

The likelihood of delay was also found to increase with increasing age of the victim (p=0.041) (Table 2 and 3).

The primary reasons cited by participants for the delay in reaching the clinic for the first dose of RPEP were multifaceted: work-related barriers (48.7%) were the most common factor, indicating that occupational demands often supersede the urgency of initiating PEP. Lack of awareness (27.7%) about the disease severity or the importance of timely vaccination was the second leading cause, followed closely by clinic closures on holidays (23.6%), highlighting a critical service delivery gap (Table 4).

DISCUSSION

The timely administration of rabies post-exposure prophylaxis is arguably the single most critical factor in preventing human rabies deaths. The key finding of this cross-sectional study is the high proportion of delayed PEP initiation (41%) among animal bite victims in central India, defined as receiving the first vaccine dose 24 hours or more after exposure. This high prevalence underscores a significant systemic challenge in public health delivery and community awareness in the region.[6-9]

Determinants of delay

Our analysis identified three statistically significant determinants of delay: residence distance, low monthly income, and increasing age.

Geographical barrier (distance >10 km)

Participants from residences greater than away were significantly more prone to delay (p<0.001). This factor is strongly suggestive of access disparity.[10] Victims in rural and distant areas face challenges related to poor road connectivity, high transportation costs, and a lack of readily available transport, forcing them to delay seeking care until circumstances allow. This finding strongly advocates for decentralizing RPEP services beyond the tertiary care centre.

Socio-economic barrier (monthly income <₹5000)

The significant association between low income and delay (p=0.004) indicates that financial constraints represent a major barrier. Even if the vaccine is provided freely, costs associated with transportation, lost wages, and time off work often deter individuals from low-income households, forcing them to prioritize immediate livelihood over preventative healthcare.

Age

The increasing risk of delay with advancing age (p=0.0041) may be attributed to a combination of factors, including reduced mobility, greater reliance on others for transport, or a higher prevalence of traditional beliefs/misconceptions about initial wound management among older generations.[11] This group may also present later due to underestimating the severity of the bite or being less exposed to contemporary health communication campaigns.

Reasons for delay and service gaps

The self-reported reasons for delay provide crucial actionable insights into service delivery:

The dominance of work-related barriers (48.7%) suggests that current clinic operating hours are incompatible with the working schedules of the patient population, particularly daily wage earners who cannot afford to lose half or a full day's pay.[12]

The issue of clinic closures on holidays/weekends (23.6%) highlights a critical gap in service continuity. Since animal bites occur 24/7, the anti-rabies clinic must function continuously, or at least have a robust on-call system, to ensure timely PEP.[13]

Lack of awareness (27.7%) points to the ongoing need for targeted health education campaigns that emphasize the absolute urgency of immediate wound washing and prompt RPEP initiation.[14,15]

A key strength of this study is the large, adequate sample size (n=323) and the use of consecutive sampling, which minimizes selection bias and enhances the generalizability of findings within the central Indian hospital catchment area. A primary limitation is the cross-sectional design, which only establishes associations rather than causality. Furthermore, data on “time since bite” and “reasons for delay” are based on self-report, which is susceptible to recall bias.

CONCLUSION

This study confirms that a substantial proportion (41%) of animal bite victims in central India experience a crucial delay (>24 hours) in initiating rabies post-exposure prophylaxis. The primary determinants of this delay are geographical distance, low socio-economic status, and increasing age, exacerbated by service delivery issues like clinic closures and work-related barriers. Addressing these determinants through improved service accessibility, extended clinic hours, and targeted public awareness campaigns is essential to ensure timely prophylaxis and achieve the goal of eliminating dog-mediated human rabies deaths.

Recommendations

To mitigate the observed delays, public health action should focus on:

Decentralization: Establishing RPEP services at primary and secondary healthcare centres, particularly in rural areas, and strengthening mobile health units.

Extended accessibility: extending clinic hours, establishing a rotation system for weekend and holiday coverage, and implementing a service for severe exposures.

Targeted education: implementing focused information, education, and communication (IEC) activities addressing low-income and older populations, emphasizing the “zero-delay” principle for PEP.

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