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COMMUNITY KNOWLEDGE, ATTITUDES, AND PRACTICES REGARDING RABIES: A CROSS-SECTIONAL STUDY IN SARPANG DZONGKHAG

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ABSTRACT: *Despite global progress in prevention, rabies continues to cause preventable deaths in both humans and animals worldwide. In Bhutan, the disease remains a significant public health concern in high-risk regions such as Sarpang Dzongkhag, where recent outbreaks have resulted in animal infections and a human fatality. This study aimed to assess the knowledge, attitudes, and practices (KAP) related to rabies prevention and control among residents of Sarpang. A community-based cross-sectional study was conducted over a one-month period, employing a simple random sampling technique among 294 residents from Tareythang, Chhuzaggang, and Umling Gewogs. Data were collected using a structured questionnaire and analyzed using univariate binary logistic regression and Pearson's Chi-square test to examine associations between socio-demographic variables and KAP outcomes. Results showed that 86.4% of respondents possessed adequate knowledge, 99.3% demonstrated positive attitudes, and 90.5% reported good preventive practices. Education level, age, profession, and history of animal bites were significantly associated with higher levels of knowledge ($p < 0.05$). However, despite the overall high level of awareness, 45.9% of respondents were unaware that rabies is 100% fatal, some relied on traditional treatment methods, and 56.8% had not participated in any rabies awareness programs. These findings underscore the need for strengthened, targeted community-based interventions to enhance rabies prevention and control efforts. Moreover, the findings identify key gaps to guide policy and programs in Bhutan, particularly in strengthening risk communication, community engagement, and equitable access to rabies prevention services in high-risk areas.*

Keywords: Knowledge; NADPM-RCP; Outbreak; Rabies; Sarpang

1. INTRODUCTION

Rabies is one of the most fatal zoonotic diseases known to mankind (Konzing et al. 2026). It is a viral zoonotic disease caused by the *Lyssavirus* genus within the *Rhabdoviridae* family and is primarily transmitted through dog bites (Liu and Cahill 2020). It affects almost all mammals and is 100% fatal once clinical symptoms appear (Ung et al. 2021). Globally, approximately 59,000 people die from rabies each year, with 95% of these deaths occurring in Africa and Asia (Briggs et al. 2012; Hampson et al. 2015; Ung et al. 2021). An estimated US$ 583.5 million is spent annually on rabies in these regions, largely on post-exposure prophylaxis (PEP) (Desa et al. 2020), yet mortality persists due to inadequate awareness, limited access to healthcare, and underreporting (Eriso et al. 2024).

In Bhutan, rabies remains endemic and poses a continuous public health concerns (Radhakrishnan et al. 2020). The country reports an average of 7,000 dog bites annually and recorded 20 human rabies deaths between 2006 and 2022 with an estimated annual expenditure of Nu. 9.3 million on PEP (Ministry of Health 2023).

Rabies outbreaks are predominantly reported in southern regions due to cross-border movement of dogs from neighboring Indian states of West Bengal and Assam (Tenzin and Dhand 2019). Although Bhutan has made substantial progress through the Nationwide Accelerated Dog Population Management and Rabies Control Programme (NADPM-RCP), achieving full sterilization of free-roaming dogs, persistent transboundary transmission and recurring outbreaks indicate that biomedical interventions alone are insufficient for sustainable control (WOAH 2025).

A critical gap remains in the lack of empirical evidence on community-level KAP related to rabies prevention in high-risk areas of Bhutan, particularly in southern endemic zones. While a few KAP studies on rabies have been conducted in southern Bhutan, these were limited to student populations, and no studies to date have comprehensively assessed KAP at the broader community level. A rabies outbreak in Tareythang, Chhuzaggang, and Umling in June 2023 resulted in infections in several animals and a human fatality (Dorji et al. 2023), underscoring the continued vulnerability of these communities. KAP studies provide a systematic framework for assessing public awareness, behavioral patterns, and socio-cultural determinants of disease prevention, thereby supporting the design of targeted and evidence-based public health interventions (Launiala 2009; Sambo et al. 2014). Evidence suggests that inadequate knowledge and misconceptions about rabies are associated with delayed healthcare-seeking behavior and increased mortality risk (Zone 2020). However, such data remain scarce in the Bhutanese context, particularly in outbreak-prone communities. Therefore, this study was conducted to address this gap by assessing KAP related to rabies prevention among residents in high-risk areas of southern Bhutan, with the aim of identifying knowledge gaps, behavioral risks, and informing more effective community-based rabies control strategies.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted in Tareythang, Chhuzaggang, and Umling Gewogs under Sarpang Dzongkhag, located in the southern region of Bhutan, with an elevation ranging from 190–400 meters above sea level. This region is epidemiologically significant due to its consistently higher incidence of rabies, largely attributed to porous international borders with India, which facilitate cross-border movement of free-roaming dogs and increase the risk of disease transmission.

The Gewogs were chosen using purposive sampling, based on reported rabies outbreaks in 2023, including a fatal human case. Furthermore, limited empirical data on community-level KAP regarding rabies prevention in these outbreak-prone settings necessitated focused investigation. This selection was therefore guided by outbreak history, public health significance, and the need to generate context-specific evidence to inform targeted rabies control strategies.

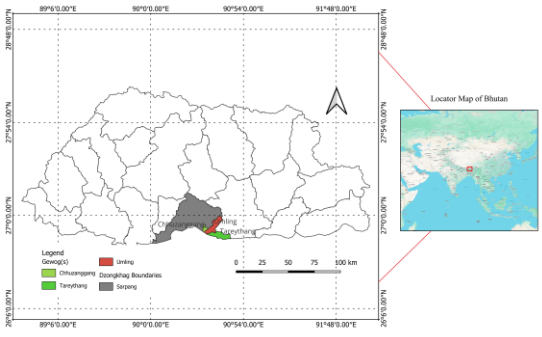

Figure 1: Study site.

2.2 Sampling method and sample size

A total of 294 individuals were surveyed, comprising 160 households from Chhuzaggang, 38 from Tareythang, and 96 from Umling. The required sample size was determined using the single population proportion formula, assuming a 95% confidence level, a margin of error of 0.05, and an expected awareness level of 70% (Ali et al. 2013; Sambo et al. 2014).

$$n = \frac{\hat{P}(1 - \hat{P}) \times 1.96^2}{0.05^2}$$

Where:

n = required sample size

$\hat{P}$ = estimated proportion of population

1.96 = Z-score corresponding to 95% confidence interval

0.05 = desired margin of error

2.3 Questionnaire design

The questionnaire contained questions about knowledge, attitude and practices, and potential socio-demographic factors that could affect the community study areas. The questionnaire was adapted from previously published surveys (Lhendup and Wangdi 2022), with additional questions developed de novo. The questionnaire comprised four sections: socio-demographic information including age, gender, education, occupation, history of animal bites, PEP, and exposure to suspected rabid animals or humans; knowledge-related questions on rabies transmission, symptoms, treatment, and prevention with "Yes/No" responses; attitude statements measured using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree); and practice-related questions focusing on rabies prevention with response limited to "Yes/No". The questionnaire was pretested among 42 individuals using Google Forms, which revealed difficulties in understanding certain scientific terms such as "fatality of the disease." Based on this feedback, necessary revisions were made to improve clarity, eliminate ambiguity, avoid repetition, and estimate the time required for administration.

2.4 Validation

The questionnaire was developed based on relevant literature and previous KAP studies on rabies. Questionnaire validation was ensured through review by two veterinary officers, a livestock extension officer, and a human health worker, each with at least five years of professional experience. The structured questionnaire was pre-tested on 15% sample size outside study area for consistent understanding of the survey. Based on their feedback, redundant questions were removed and additional items were incorporated to improve clarity and simplicity, ensuring applicability across different age groups, education levels, and professions. However, formal statistical reliability analysis, such as the use of Cronbach's alpha, was not performed.

2.5 Sampling procedure

A community-based cross-sectional study was conducted over a one-month period from 7 January to 9 February 2024 in selected areas. The study areas were purposively selected due to their high risk of rabies occurrence. Face-to-face interviews were conducted with one respondent from each of the 294 households included in the study. Households were selected through simple random sampling and respondents aged 10 years and above were selected using convenience sampling based on their availability and willingness to participate during the survey period.

Only residents of the selected Gewogs were considered eligible for participation. From each household, one respondent was

selected, preferably the individual who spent most of their time at home. Individuals below 10 years of age were excluded from the study. Visitors, non-residents, household members temporarily returning home for vacations, and individuals unwilling to participate were also excluded.

Data were collected through face-to-face interviews using a structured questionnaire developed in English and verbally translated into local dialects during the interview process. Prior to data collection, participants were informed about the objectives of the study and assured of the confidentiality of their responses. Oral informed consent was obtained from all participants before the interviews were conducted. Interviews were carried out in local languages, including Lhotsamkha, Sharchopkha, and Dzongkha, while responses were recorded in English.

2.6 Data management and analysis

Data were collected using the EpiCollect5 application version 5.1.4. The collected data were subsequently managed, cleaned, and organized using Microsoft Excel before being exported to IBM SPSS Statistics version 23 for statistical analysis. Descriptive statistics were used to calculate the frequency and distribution of socio-demographic factors. The Chi-square test was performed to assess the association between categorical variables. Furthermore, bivariate logistic regression analysis was conducted to determine the association between dependent and independent variables. Variables with a *p*-value of ≤0.20 in the bivariate analysis were included in the multivariate logistic regression model for further analysis and univariate logistic regression for estimation of odds ratios. Variables with a *p*-value of <0.05 were considered statistically significant.

The KAP responses were scored and dichotomized into good (≥70%) and poor (<70%) levels following methods adopted in previous studies. For knowledge and practice-related questions, correct responses were assigned a score of 1, while incorrect responses were assigned a score of 0. Respondents who achieved a score of 70% or above were categorized as having adequate knowledge and good practices towards rabies, whereas those scoring below 70% were considered to have poor knowledge and practices.

Attitude-related questions were assessed using a five-point Likert scale, where responses were scored as 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. The total attitude score was calculated by summing the scores of all attitude-related questions. Respondents obtaining scores of ≥70% were categorized as having a positive attitude, while those scoring <70% were categorized as having a negative attitude towards rabies.

3. RESULTS AND DISCUSSION

3.1 Demographic and socio-demographic characteristics of the respondents

Table 1 shows that, from a total of 294 respondents, 67% (n=196) were females. A majority 68% (n=201), were aged above 36 years, 27% (n=80) had basic education (Primary and Secondary Education), 13% (n=37) had adequate education (Higher and University Education) and approximately 60% (n=177) had no education. 15% (n=43) of the participants were employed, 11% (n=31) were students, and majority (75% (n=220) were self-employed farmers.

3.2 Respondents' knowledge about rabies

The study revealed that 254 (86.4%) of the respondents had adequate knowledge about rabies, with 248 (84.4%) being aware that it

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is a viral disease and 270 (91.8%) recognizing stray dogs as the primary source of transmission. Most respondents, 284 (96.6%), were aware that rabies is transmitted through bites and scratches, and 265 (90.1%) identified saliva as a mode of transmission. While 232 (78.8%) were knowledgeable about symptoms in animals, only 158 (53.7%) knew the symptoms in humans. Additionally, 288 (98.0%) acknowledged the importance of vaccinating pets, but only 135 (45.9%) knew that rabies is fatal if left untreated (Table 2).

Table 1: Sociodemographic information of the respondents of Tareythang, Chhuzaggang and Umling.

Variables	Categories	Frequency (n%)
Gender	Male	98 (33)
	Female	196 (67)
Age group	<18	23 (8)
	19-35	70 (24)
	<36	201 (68)
Education level	Literate: Basic Education (Primary & Secondary)	80 (27)
	Literate: Adequate Education (Higher & University)	37 (13)
	No education	177 (60)
Profession	Employed	43 (15)
	Student	31 (11)
	Self-employed	220 (75)

Table 2: Respondents' knowledge on transmission, symptoms, treatment and prevention of rabies.

Variable	Category	Frequency (n%)
Rabies is a viral disease	No	15.60
	Yes	84.4
Stray dogs are primary rabies transmitter in Bhutan	No	8.2
	Yes	91.8
Rabies is transmitted through bites and scratches of infected animals	No	3.4
	Yes	96.6
Saliva from a rabid dog can transmit rabies	No	9.9
	Yes	90.1
Consuming milk from rabies-infected cattle can cause rabies	No	7.1
	Yes	92.9
Consuming meat from rabies-infected cattle can cause rabies	No	5.1
	Yes	94.9
Common signs of rabies in animals: excessive drooling, aggressive, and pets unable to recognize their owner	No	21.8
	Yes	78.2
Common signs of rabies in humans include flu-like symptoms, hydrophobia, and paralysis	No	46.3
	Yes	53.7
Vaccinating your pet animal before exposure to the virus is a primary means for rabies prevention	No	2.0
	Yes	98.0

Variable	Category	Frequency (n%)
Even cats can get rabies infection	No	15.3
	Yes	84.7
Individuals who have been potentially exposed to rabies must get vaccinations as scheduled	No	0.3
	Yes	99.7
Rabies is 100% fatal if not treated	No	45.9
	Yes	54.1

3.3 Attitude of respondents towards rabies

A majority of the respondents, 292 (99.3%) showed positive attitude towards rabies. Concern over the frequent rabies outbreaks were high among 287 (97.7%) respondents and 198 (67.2%) believed stray dogs are more involved in transmission than owned or pet dogs. Support for prophylaxis was evident, with 171 (58.2%) backing pre-exposure measures by veterinarians and 165 (56.1%) supporting post-exposure measures by health professionals. Additionally, 165 (56.1%) agreed that vaccination is the most effective preventive measure, and 241 (81.9%) believed that human deaths due to rabies can be eradicated by 2030 (Table 3).

3.4 Practice of respondents towards rabies

The majority of respondents, 266 (90.5%), demonstrated good practices towards rabies prevention, while 28 (9.5%) exhibited poor practices. A small proportion, 26 (8.8%), reported the use of traditional remedies such as turmeric paste, chili, salt, or herbal applications following animal bites. All respondents, 294 (100%), acknowledged the importance of reporting rabies cases to local authorities. However, more than half of the participants, 167 (56.8%), had not attended any rabies awareness programs (Table 4).

3.5 Factors associated with community knowledge on rabies

Univariate binary logistic regression analysis indicated that age group (19–35 years) (p = 0.007), education level (p < 0.05), and profession (students) (p = 0.003) were significantly associated with knowledge of rabies.

3.6 Factors associated with community attitude towards rabies

The *Chi*-square test was used to assess the relationships between the dependent and independent variables and observed that gender exhibited a notable association with females displaying a slightly higher proportion of good attitudes compared to

Table 3: Attitude of respondents towards rabies control and prevention.

Variables	Frequency (n%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am concerned about the frequent outbreaks of rabies in my locality	77.6	20.1	1.7	0.7	0.0
I think stray dogs are more involved in rabies transmission than owned dogs	67.2	31.7	1.0	0.0	0.0
Veterinary professionals vaccinate animals against rabies before exposure	58.2	40.1	1.7	0.0	0.0
Health professionals provide vaccines	56.1	42.9	1.0	0.0	0.0

Variables	Frequency (n%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
to those bitten by rabid animals					
Washing the bite wound with soap and antiseptics can reduce infection risk	49.3	37.4	6.1	5.4	1.7
Rabies is a preventable disease	12.9	48.0	17.0	18.7	3.4
Educational campaigns and advocacy are vital in combating rabies nationwide	39.8	57.8	2.4	0.0	0.0
Authorities conduct enough rabies awareness campaigns in the community	16.3	54.4	13.9	15.3	0.0
You should always visit hospital even for a minor scratch or bite	68.0	32.0	0.0	0.0	0.0
Vaccinating your pet is an effective preventive measure against rabies	56.1	43.2	0.7	0.0	0.0
Rabies education activities improved perceptions on rabies vaccines	54.8	44.2	1.0	0.0	0.0
Individuals must ensure their pets are vaccinated against rabies	69.4	25.5	14.4	0.0	0.0
NADPM-RCP program is primarily an effort to eradicate rabies in the country	10.5	71.4	10.9	5.8	1.4

Table 4: Respondents' practice towards rabies control and prevention.

Variables	Category	N%
I wash my hands with soap after contacting the animals	No	1.4
	Yes	98.6
I keep safe distance from animals showing unusual behavior	No	0.0
	Yes	100.0
I routinely inform family members about the risk of approaching unknown animals to prevent rabies	No	1.0
	Yes	99.0
I would recommend traditional treatment rather than vaccination to rabid victims	No	91.2
	Yes	8.8
I would advise victims to get vaccinated after a suspected rabid bite	No	0.3
	Yes	99.7
I know the importance of reporting rabies cases to local authorities	No	0.0
	Yes	100.0
I would take the rabies vaccine on schedule if bitten by a rabid animal	No	0.0
	Yes	100.0
How would you take care of the carcass if your pet dies?	Burying	96.9
	Dumping	1.4
	Burn	1.7
Have you ever attended rabies awareness campaign?	No	56.8
	Yes	43.2

Table 5: Univariate binary logistic analysis of demographic and socio-demographic variables associated with community knowledge on rabies.

Variable/Category	SE	Wald	*p*-value	OR
Gender (Female)	0.347	1.731	0.188	0.633
Age group				
19-35	0.511	7.259	0.007*	0.253
>36	0.387	3.501	0.061	0.484
Education level				
Literate: Adequate education	0.384	4.089	0.043*	0.460
No education	0.474	4.054	0.044*	0.385
Profession				
Employed	0.521	0.002	0.960	0.974
Student	0.439	8.933	0.003*	0.269
History of animal bites (Yes)	0.355	1.137	0.286	1.459
Presence of pets (Yes)	0.342	0.669	0.414	0.756
Have seen rabid animal (Yes)	0.344	1.792	0.181	0.631
Have seen rabid human (Yes)	0.752	1.419	0.234	0.408

* Indicates a significant value with $p < 0.05$

Table 6: Chi-square analysis of demographic and socio-demographic variables associated with community attitude towards rabies.

Variables	Category	Good attitude N%	Poor attitude N%	*Chi*-square	*p*-value
Gender	Male	32.65	0.68	4.027	0.045
	Female	66.66	0.00		
Age	<18	7.8	0.00	0.932	0.628
	19-35	23.8	0.00		
	>36	67.68	0.68		
Education level	Literate: Basic Edu	27.21	0.00	1.331	0.514
	Literate: Adequate Edu	12.58	0.00		
	Illiterate	59.52	0.68		
Profession	Employed	14.62	0.00	0.677	0.713
	Student	10.54	0.00		
	Unemployed	74.14	0.68		
History of animal bites	Yes	29.93	0.34	0.371	0.542
	No	69.38	0.34		
Presence of pets	Yes	50.68	0.34	0.001	0.977
	No	48.63	0.34		
Seen rabid animal	Yes	52.38	0.00	2.215	0.137
	No	46.93	0.68		
Seen rabid human	Yes	10.54	0.00	0.237	0.626
	No	88.77	0.68		

males (66.66% and 32.65% respectively), as evidenced by a statistically significant chi-square value ($\chi^2 = 4.027$, $p = 0.045$). Other variables did not show significant associations, yet the overall attitudes (99.8%) of the respondents were positive (Table 6).

3.7 Factors associated with community practices towards rabies control and prevention

Table 7 shows various demographic and socio-demographic variables in relation to good practice towards rabies control and prevention within the community. The results show that respondents with history of animal bites (*OR*=1.101) and those who owned pets (*OR*=1.827) were more likely to show good practices towards rabies.

3.8 Discussion

The present study demonstrated a high level of knowledge regarding rabies among respondents, which is consistent with findings reported by Tenzin et al. (2017), Christopher et al. (2021) and (Tiwari et al. 2019). The high level of knowledge observed in the present study may be attributed to rabies control interventions, particularly NADPM-RCP which is similar to the findings of Dorji (2026). A substantial proportion of respondents demonstrated awareness of rabies and its associated clinical signs, which is in agreement with findings from previous studies conducted in Bangladesh and Tanzania (Khan et al. 2019; Sambo et al. 2014). These findings are in contrast to those reported by Ahmed et al. (2020), where respondents demonstrated low awareness of rabies.

However, significant gaps were observed in respondents' knowledge, with some participants believing that rabies is not fatal even after the appearance of clinical symptoms. Similar patterns have been reported in studies from Tanzania and Ethiopia, indicating that although general awareness of rabies is relatively high, understanding of disease severity remains limited (Guadu et al. 2014). This insufficient risk perception may contribute to delays in seeking appropriate medical care (Ahmed et al. 2020). These findings underscore the need for targeted awareness programs that emphasize the fatal consequences of untreated rabies and the critical importance of timely medical intervention.

Attitudes toward rabies were generally positive and formed a consistent construct, aligning with findings from Ethiopia and Bhutan that associate positive attitudes with preventive intentions (Kebede et al. 2024; Lhendup and Wangdi 2022). It indicates strong community support for rabies prevention and control measures. This is encouraging in the context of Bhutan's national goal to eliminate human rabies deaths by 2030 (Dorji 2026).

In terms of practices, the majority of respondents demonstrated good practices, although the continued use of traditional remedies by a small proportion of participants remains a concern. Similar practices have been reported in studies from India (Arora et al. 2019) indicating that cultural beliefs and accessibility of home remedies continue to influence behavior. However, unlike findings reported from Samtse, Africa, and India, the use of traditional practices such as seeking help from spiritual healers was not observed in the present study (Lhendup and Wangdi 2022; Dabuma et al. 2017; Singh and Choudhary 2005). Such practices may delay appropriate treatment and increase the risk of rabies infection. Despite high awareness levels, more than half of the respondents had not participated in formal rabies awareness

Table 7: Univariate binary logistic analysis of demographic and socio-demographic variables associated with community practice towards rabies control and prevention.

Variable/Category	SE	Wald	*p*-value	OR
Gender (Female)	0.401	2.334	0.127	0.542
Age group				
19-35	0.667	0.401	0.527	0.656
>36	0.469	0.068	0.795	0.885
Education level				
Literate: Adequate education	0.452	0.010	0.921	0.956
Illiterate	0.654	0.081	0.776	1.204
Profession				
Employed	0.533	0.385	0.535	0.718
Student	0.587	0.586	0.444	0.638
History of animal bites (Yes)	0.426	1.051	0.821	1.101
Presence of pets (Yes)	0.413	2.130	0.144	1.827
Have seen rabid animal (Yes)	0.413	3.327	0.068	0.471
Have seen rabid human (Yes)	0.643	0.001	0.975	1.020

programs. This suggests potential gaps in outreach and communication strategies. Strengthening community-based awareness initiatives and ensuring wider participation will be essential for improving knowledge and practices.

The analysis of associated factors revealed that age, education level, and profession were significantly associated with knowledge levels, indicating that socio-demographic factors play an important role in shaping awareness. Although factors associated with attitude and practices were mostly not statistically significant, trends suggest that personal experience, such as animal bites and pet ownership, may influence behavior.

Overall, the findings emphasize the importance of strengthening targeted awareness programs, improving community engagement, and addressing misconceptions to support Bhutan's efforts toward achieving zero human rabies deaths by 2030. Effective control of rabies requires comprehensive health education that highlights the importance of routine dog vaccination and timely post-exposure prophylaxis. Expanding media coverage and strengthening community outreach programs are crucial for improving public knowledge and attitudes. Furthermore, fostering stronger collaboration between health professionals and communities can promote better practices, ultimately reducing the incidence and impact of rabies in affected areas.

4. CONCLUSION

This study demonstrates that community awareness and practices regarding rabies in a high-risk border district of Bhutan are generally good, with 86.4% of respondents showing adequate knowledge, 99.3% displaying a positive attitude, and 90.5% reporting good preventive practices. However, important gaps were identified, particularly limited understanding of the fatal nature of rabies (45.9%), continued reliance on traditional remedies following animal bites (8.8%), and low participation in

rabies awareness programs (56.8% had not attended any).

These findings indicate that although ongoing efforts under the NADPM-RCP have contributed to improved knowledge and prevention behaviors, they have not yet achieved complete behavioral change at the community level. The persistence of knowledge gaps and suboptimal exposure to awareness programs suggests the need for more focused and inclusive interventions.

To address these issues, evidence-based strategies should prioritize strengthening routine community education through sustained, locally tailored awareness campaigns, with emphasis on the fatal outcome of untreated rabies and the urgency of timely post-exposure prophylaxis. Integration of rabies education into existing livestock extension and primary healthcare outreach services would improve coverage and consistency of messaging. In addition, expanding door-to-door awareness activities and engaging schools, local leaders, and community groups can enhance trust, participation, and retention of key messages.

Furthermore, reinforcing cross-border collaboration and surveillance in high-risk border areas is essential to reduce transmission risks. Overall, addressing these specific gaps through targeted, program-aligned, and community-centered interventions will be critical to achieving Bhutan's goal of eliminating dog-mediated human rabies deaths by 2030.

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