

Knowledge, attitudes and practices among human rabies surveillance professionals: cross-sectional study, Nghe An province, Viet Nam, 2025

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Objective: To evaluate knowledge, attitudes and practices (KAP) of health professionals regarding rabies surveillance in Nghe An province, Viet Nam, and identify associated factors.

Methods: A cross-sectional, descriptive and analytical study was conducted from 6 May to 30 June 2025. A structured questionnaire was distributed online to staff of preventive medicine, clinical and vaccination service units involved in rabies surveillance in Nghe An. For association analyses, KAP scores were categorized as adequate ($\geq 70\%$) or inadequate ($< 70\%$). Descriptive statistics and logistic regression were performed.

Results: Overall, 29.2% (69/236) of respondents had inadequate knowledge scores, 5.1% (12/236) had inadequate attitude scores and 35.2% (83/236) had inadequate practice scores. Among preventive medicine staff, major gaps included 80.6% (79/98) reporting that they did not share bite-victim data with veterinary services and 60.2% (59/98) reporting that they did not use data-analysis tools. Altogether, 77.3% (85/110) of district-level staff and 78.5% (51/65) of private-facility staff were rated as having adequate knowledge compared with 50% (28/56) of commune-level staff. Having received training in the past 12 months was strongly associated with adequate practices (OR: 5.09, 95% CI: 2.86–9.05). In the adjusted model, adequate practices were associated with training in the past 12 months (aOR: 3.27, 95% CI: 1.46–7.34), district/provincial-level work (aOR: 3.16, 95% CI: 1.26–7.90), working at a private facility (aOR: 7.86, 95% CI: 1.98–31.24) and bachelor's level or higher education (aOR: 2.29, 95% CI: 1.02–5.14).

Discussion: Substantial gaps in surveillance-specific knowledge and practices were observed among surveillance professionals in Nghe An, particularly in preventive medicine and commune-level settings. Targeted training, routine use of data-analysis tools and stronger intersectoral data-sharing in line with existing national regulations are urgently needed to support Viet Nam's goal of eliminating dog-mediated human rabies deaths by 2030.

Human rabies remains a neglected zoonotic disease and a major public health concern in more than 150 countries. The disease causes an estimated 59 000 human deaths annually, predominantly in Asia and Africa where dog-mediated transmission accounts for more than 99% of cases.^{1,2} Although safe and effective vaccines are available for human post-exposure prophylaxis (PEP) as well as animal vaccination, multiple barriers hinder progress towards elimination.³ In Viet Nam, rabies is an endemic, notifiable disease

requiring response and reporting within 48 hours.^{4,5} During 2018–2024, Viet Nam recorded an annual average of approximately 80 human deaths and more than 600 000 people receiving PEP following dog bites (National Institute of Hygiene and Epidemiology, unpublished data, 2018–2024), resulting in a substantial economic burden. Nghe An, the largest province by land area in the northern region with a population exceeding 3.5 million, consistently reported the highest number of human rabies cases nationally during 2018–2024.^{6,7} In

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response to high human rabies incidence and PEP use, provincial authorities launched a rabies control plan for 2022–2030 targeting zero human deaths by 2030.⁸

Viet Nam has national guidelines on human rabies surveillance and prevention, and general communicable disease regulations issued by the Ministry of Health. Strengthening surveillance is a central component of rabies control because it supports early detection of suspected cases, and encourages reporting within 48 hours, epidemiological investigation, identification of exposed persons, and coordination with veterinary authorities during outbreak investigation and response.^{4,5,9}

Evidence from other rabies-endemic countries, such as Bangladesh, Ethiopia, Mozambique and Senegal, suggests that weaknesses in knowledge, attitudes and practices (KAP) among health professionals may hinder rabies prevention and surveillance.^{10–13} In Viet Nam, an evaluation of rabies surveillance in southern provinces identified delayed reporting, challenges in assessing the timeliness and completeness of data, and limited use of surveillance data, but did not assess the KAP of front-line health workers responsible for implementing surveillance activities.¹⁴ Upon a preliminary literature review, we found that there is a research gap in the area of health-care workers' KAP related to human rabies surveillance in Nghe An province and elsewhere in Viet Nam, particularly in the context of Viet Nam's National Rabies Control Programme 2022–2030 that aims to support the Global Strategic Plan to Eliminate Dog-Mediated Human Rabies by 2030.^{15,16}

This study aimed to characterize the KAP of health-care professionals involved in human rabies surveillance in Nghe An province and to examine factors associated with adequate KAP.

METHODS

A cross-sectional study was conducted from 6 May to 30 June 2025 among health-care workers involved in human rabies surveillance in Nghe An province, Viet Nam.

Study population

The study population comprised health-care professionals directly engaged in rabies surveillance, classified by their role in rabies surveillance into three functional groups:

(1) preventive medicine units (provincial Center for Disease Control and Prevention [CDC], district health centres, commune health stations); (2) clinical units (provincial and district hospitals); and (3) vaccination service units (public and private PEP providers).

Sample size was calculated using the single population proportion formula, assuming an estimated 71.4% proportion of professionals with adequate KAP based on a previous study,¹⁷ a 95% confidence interval (CI) and 5% margin of error. The initial sample size was adjusted for the finite population of 654 professionals in Nghe An province and a 10% non-response rate was estimated, resulting in a minimum required sample size of 236 participants.

Convenience sampling was used. A list of units involved in human rabies surveillance or care in Nghe An province was compiled and professionals responsible for rabies surveillance, case management or reporting at each eligible unit were invited to participate. Participants came from Nghe An provincial CDC, four provincial hospitals, five private hospitals, all 20 district health centres, all seven district hospitals and all 79 private vaccination clinics. At the commune level, two communes were randomly selected per district. Each commune has one health station, and one professional responsible for rabies surveillance from each selected health station was invited to participate. In Viet Nam's administrative system at the time of data collection, before the administrative reorganization implemented in July 2025, districts were intermediate administrative units between the provincial and commune levels, while communes were the lowest administrative level, where commune health stations provide primary health care and participate in routine surveillance.

Data collection

Structured questionnaires were developed based on the *Guidelines for assessing nutrition-related knowledge, attitudes and practices* from the United Nations Food and Agriculture Organization (FAO) and the World Health Organization's *Communicable disease surveillance and response systems: guide to monitoring and evaluating*.^{18,19} Items were mapped to the core surveillance functions specified in Viet Nam's national guidelines for the surveillance and prevention of rabies in humans.^{4,19} All participants responded to the

sections on demographics/professional characteristics (6 questions), knowledge (13 multiple-choice questions) and attitudes (14 questions using a single 5-point Likert scale, 1 = strongly disagree to 5 = strongly agree, with higher scores indicating stronger agreement with the attitude statements). Questions about practices were role-specific and based on the responsibilities and core surveillance functions described in the national guidelines (preventive medicine: 13 questions; clinical: 8 questions; vaccination: 14 questions).¹⁹ The questionnaire was reviewed by the research team and pre-tested with selected professionals from northern Viet Nam before the survey was implemented.

The questionnaire was administered online using Google Forms, and responses were collected anonymously. The first page provided information about the study's purpose, voluntary participation, anonymity and confidentiality; participants could stop at any time before submitting the form and were required to provide informed consent before accessing the questionnaire. A brief instructional video and the survey link were sent to all selected participants through Zalo, an instant messaging application commonly used in Viet Nam. The research team created a Google Sheet to monitor responses, established a Zalo messaging group for participants, and sent reminders to participants every 2 days until the end of data collection. Received survey data were stored in password-protected files accessible only to the study team.

Knowledge and practice scores were calculated as the number of correct responses divided by the total number of scored items for each respondent and expressed as percentages. Scores for attitudes were calculated as the sum of the 14 Likert-item scores divided by the maximum possible score of 70 and expressed as a percentage. KAP levels were categorized as poor (<70%), average (70–90%) or good (>90%), adapted from the FAO guidelines.¹⁸

Statistical analysis

Descriptive statistics were calculated (frequencies and percentages for categorical variables; mean and standard deviation for continuous variables). Age was categorized into four groups (<30, 30–39, 40–49 and ≥50 years) to allow comparisons across younger, middle-aged and older participants while maintaining sufficient numbers

in each group. For association analyses, KAP scores were dichotomized as adequate (≥70%) or not adequate (<70%). Differences in KAP levels by sex, age group, education, work experience, workplace level and role in rabies surveillance were assessed using χ^2 tests. Because multiple bivariate comparisons were conducted, these analyses were considered exploratory; no formal adjustment for multiple testing was applied, and findings were interpreted with emphasis on effect sizes, CIs and consistency with multivariable models. Differences in group sizes were addressed by presenting both frequencies and percentages for each group and by using statistical tests appropriate for small expected counts. Multivariable analyses were performed using binary logistic regression to estimate crude and adjusted odds ratios (OR, aOR) with 95% CIs. Data were managed in Microsoft Excel and analysed using Stata version 17.0 (StataCorp LLC, College Station, Texas, United States of America).

RESULTS

Descriptive analysis

Study population

A total of 245 professionals in human rabies surveillance in Nghe An province were invited to complete the survey, of whom 236 responded (96.3%).

Sociodemographic characteristics

Females comprised 157 (66.5%) participants. The mean age was 39.9 ± 8.7 years. The largest age group was 30–39 years (113, 47.9%), followed by 40–49 years (56, 23.7%). College/associate degrees were held by 112 (47.5%) and bachelor's degrees by 101 (42.8%). Experience in rabies surveillance of 1–5 years was reported by 116 (49.2%) and 6–10 years by 53 (22.5%) (Table 1).

Overall distribution of KAP levels

Overall, 69 (29.2%) respondents were assessed as having poor knowledge, 135 (57.2%) as having average knowledge and 32 (13.6%) as having good knowledge (Table 2). Rabies knowledge was most comprehensive for transmission routes (100% of participants responded correctly), etiological agent (233, 98.7% correct) and

Table 1. Demographic characteristics of human rabies surveillance professionals, Nghe An, Viet Nam, 2025 (N = 236)

Variable	n	%
Age, years		
<30	21	8.9
30–39	113	47.9
40–49	56	23.7
≥50	46	19.5
Sex		
Male	79	33.5
Female	157	66.5
Education		
High school	3	1.3
College/associate degree	112	47.5
Bachelor's degree	101	42.8
Postgraduate (Master's/PhD)	20	8.5
Experience in rabies surveillance, years		
<1	20	8.5
1–5	116	49.2
6–10	53	22.5
11–15	29	12.3
>15	18	7.6
Workplace level		
Provincial	5	2.1
District	110	46.6
Commune	56	23.7
Private health care	65	27.5
Role in rabies surveillance		
Preventive medicine	98	41.5
Clinical	45	19.1
Vaccination service	93	39.4

main sources in Viet Nam (227, 96.2% correct). The largest knowledge gaps were in understanding of the outbreak definition (79, 33.5% correct), early outbreak detection activities (114, 48.3% correct) and the specimens used for laboratory confirmation (122, 51.7% correct) (**Table 3**).

Overall attitude scores are shown in **Table 2**. In item-level results, agreement with attitude statements were generally high. The largest proportions of participants agreed or strongly agreed that training courses improve the quality of rabies surveillance and control (227, 96.2%) and raising community awareness is crucial for rabies prevention and control (225, 95.3%), and they expressed

willingness to participate in rabies outbreak response when needed (225, 95.3%). The lowest-scoring item was whether the current surveillance system was simple and feasible at the respondent's level, with 188 (79.7%) agreeing or strongly agreeing (**Table 3**).

Reported practices revealed major operational weaknesses, as shown by the overall score distribution in **Table 2** and selected item-level findings in **Table 3**. Among 98 preventive medicine staff, the largest gaps were not sharing bite-victim information with veterinary authorities (79, 80.6%) and not using data-analysis tools (59, 60.2%). Among 45 clinical staff, 20 (44.4%) responded correctly to the question on signs or symptoms used to

Table 2. Distribution of human rabies surveillance professionals' knowledge, attitude and practice scores by level (poor, average, good)^a and role in rabies surveillance, Nghe An, Viet Nam, 2025 (N = 236)

Category and role	Poor (<70%)	Average (70–90%)	Good (>90%)
Knowledge	69 (29.2)	135 (57.2)	32 (13.6)
Preventive medicine (n = 98)	35 (35.7)	48 (49.0)	15 (15.3)
Clinical (n = 45)	15 (33.3)	27 (60.0)	3 (6.7)
Vaccination service (n = 93)	19 (20.4)	60 (64.5)	14 (15.1)
Attitudes^b	12 (5.1)	125 (53.0)	99 (41.9)
Preventive medicine (n = 98)	4 (4.1)	43 (43.9)	51 (52.0)
Clinical (n = 45)	4 (8.9)	20 (44.4)	21 (46.7)
Vaccination service (n = 93)	4 (4.3)	62 (66.7)	27 (29.0)
Practices	83 (35.2)	122 (51.7)	31 (13.1)
Preventive medicine (n = 98)	51 (52.0)	47 (48.0)	0 (0.0)
Clinical (n = 45)	15 (33.3)	27 (60.0)	3 (6.7)
Vaccination service (n = 93)	17 (18.3)	48 (51.6)	28 (30.1)

Values are n (%).

^a The thresholds for knowledge, attitude and practice levels are based on the Food and Agriculture Organization's 2014 guidelines for assessing nutrition-related knowledge, attitudes and practices.¹⁸

^b For attitudes, "poor," "average" and "good" refer to total attitude scores of <70%, 70–90% and >90% of the maximum possible Likert score, respectively; higher scores indicate stronger agreement with statements supportive of rabies surveillance.

suspect rabies, and 37 (82.2%) correctly identified the information that should be recorded when documenting a suspected rabies case (**Supplementary Table 1**). Among 93 vaccination service staff, only 20 (21.5%) correctly answered the question on management of cases bitten by animals with clinical rabies (**Table 3**).

Bivariate analysis

Bivariate analysis revealed significant associations between adequate knowledge and both work experience ($P = 0.021$) and administrative level of the workplace ($P = 0.001$). By duration of work experience, adequate knowledge was observed in 12/20 (60.0%) respondents with <1 year of experience, 86/116 (74.1%) with 1–5 years, 40/53 (75.5%) with 6–10 years, 22/29 (75.9%) with 11–15 years and 7/18 (38.9%) with >15 years. By workplace level, adequate knowledge was observed in 3/5 (60.0%) provincial-level staff, 85/110 (77.3%) district-level staff, 28/56 (50.0%) commune-level staff and 51/65 (78.5%) private-facility staff (**Table 4**).

No statistically significant association was observed between age group and adequate knowledge, attitudes or practices. Adequate practices were associated with

workplace level ($P < 0.001$). By workplace level, adequate practices were observed in 5/5 (100%) provincial-level staff, 74/110 (67.3%) district-level staff, 19/56 (33.9%) commune-level staff and 55/65 (84.6%) private-facility staff. No significant associations were observed between attitude scores $\geq 70\%$ and sex, age, work experience, education or workplace (all $P > 0.05$) (**Table 4**).

Multivariate analysis

Factors associated with KAP outcomes were assessed by logistic regression (**Table 5**). For knowledge, workplace level was identified as the only independent predictor: compared with commune-level staff, the adjusted odds of adequate knowledge were higher among district/provincial-level staff (aOR: 5.78, 95% CI: 2.18–15.35; $P < 0.001$) and private-facility staff (aOR: 4.58, 95% CI: 1.19–17.56; $P = 0.026$). Other covariates were not significantly associated with adequate knowledge ($P > 0.05$) (**Table 5**).

A multivariable model for attitudes was not fitted because only 12 participants had attitude scores <70%, and some age groups had no participants with attitude scores <70%, resulting in sparse cells and quasi-complete separation (**Table 5**).

Table 3. Selected item-level knowledge, attitude and practice findings among human rabies surveillance professionals by role in rabies surveillance, Nghe An, Viet Nam, 2025 (N = 236)

Category and item		Surveillance role ^a			Total (N = 236)
Knowledge ^a		Preventive medicine (n = 98)	Clinical (n = 45)	Vaccination service (n = 93)	
What is the etiological agent of rabies?	Correct	95 (96.9)	45 (100.0)	93 (100.0)	233 (98.7)
	Incorrect	3 (3.1)	0 (0.0)	0 (0.0)	3 (1.3)
What is the most common source of human rabies in Viet Nam?	Correct	93 (94.9)	44 (97.8)	90 (96.8)	227 (96.2)
	Incorrect	5 (5.1)	1 (2.2)	3 (3.2)	9 (3.8)
What is the primary route of rabies transmission to humans?	Correct	98 (100.0)	45 (100.0)	93 (100.0)	236 (100.0)
	Incorrect	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Which specimen is used for laboratory confirmation of human rabies?	Correct	52 (53.1)	22 (48.9)	48 (51.6)	122 (51.7)
	Incorrect	46 (46.9)	23 (51.1)	45 (48.4)	114 (48.3)
How is a rabies outbreak defined?	Correct	29 (29.6)	15 (33.3)	35 (37.6)	79 (33.5)
	Incorrect	69 (70.4)	30 (66.7)	58 (62.4)	157 (66.5)
When should early outbreak detection activities be initiated?	Correct	48 (49.0)	17 (37.8)	49 (52.7)	114 (48.3)
	Incorrect	50 (51.0)	28 (62.2)	44 (47.3)	122 (51.7)
Attitudes					
The current surveillance system is simple and feasible at my level.	Strongly disagree	4 (4.1)	3 (6.7)	1 (1.1)	8 (3.4)
	Disagree	7 (7.1)	1 (2.2)	2 (2.2)	10 (4.2)
	Neutral	12 (12.2)	6 (13.3)	12 (12.9)	30 (12.7)
	Agree	34 (34.7)	21 (46.7)	42 (45.2)	97 (41.1)
	Strongly agree	41 (41.8)	14 (31.1)	36 (38.7)	91 (38.6)
I am willing to participate in rabies outbreak response when needed.	Strongly disagree	4 (4.1)	3 (6.7)	2 (2.2)	9 (3.8)
	Disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Neutral	0 (0.0)	2 (4.4)	0 (0.0)	2 (0.9)
	Agree	31 (31.6)	18 (40.0)	32 (34.4)	81 (34.3)
	Strongly agree	63 (64.3)	22 (48.9)	59 (63.4)	144 (61.0)
Training courses improve the quality of rabies surveillance and control.	Strongly disagree	4 (4.1)	2 (4.4)	2 (2.2)	8 (3.4)
	Disagree	0 (0.0)	1 (2.2)	0 (0.0)	1 (0.4)
	Neutral	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Agree	24 (24.5)	14 (31.1)	21 (22.6)	59 (25.0)
	Strongly agree	70 (71.4)	28 (62.2)	70 (75.3)	168 (71.2)
Raising community awareness is crucial for rabies prevention and control.	Strongly disagree	4 (4.1)	4 (8.9)	2 (2.2)	10 (4.2)
	Disagree	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Neutral	0 (0.0)	0 (0.0)	1 (1.1)	1 (0.4)
	Agree	18 (18.4)	13 (28.9)	17 (18.3)	48 (20.3)
	Strongly agree	76 (77.6)	28 (62.2)	73 (78.5)	177 (75.0)
Practices^a					
Do you share information on bite victims who go for rabies vaccination with veterinary authorities? ^b	Correct	19 (19.4)			19 (19.4)
	Incorrect	79 (80.6)			79 (80.6)
Do you use any tool to analyse data? ^b	Correct	39 (39.8)			39 (39.8)
	Incorrect	59 (60.2)			59 (60.2)

When suspecting a rabies case, which signs or symptoms do you rely on for diagnosis? ^b	Correct	20 (44.4)	20 (44.4)
	Incorrect	25 (55.6)	25 (55.6)
How do you manage cases bitten by animals with clinical rabies? ^b	Correct	20 (21.5)	20 (21.5)
	Incorrect	73 (78.5)	73 (78.5)

Values are *n* (%). Blank cells indicate that an item was not applicable to that professional group.

^a For knowledge and practice items, responses were categorized as correct or incorrect according to the scoring key based on the national rabies surveillance guidelines; some practice items were originally yes/no questions.

^b The denominator is the number of respondents in the applicable professional group, rather than the total number of professionals.

For practices, strong crude associations were observed for training in the past 12 months (OR: 5.09, 95% CI: 2.86–9.05; $P < 0.001$) and workplace level: compared with commune-level staff, the crude odds of adequate practices were higher among district/provincial-level staff (OR: 4.27, 95% CI: 2.17–8.43; $P < 0.001$) and private-facility staff (OR: 10.71, 95% CI: 4.48–25.61; $P < 0.001$). After adjustment, adequate practices were independently associated with training in the past 12 months (aOR: 3.27, 95% CI: 1.46–7.34; $P = 0.004$), district/provincial-level work (aOR: 3.16, 95% CI: 1.26–7.90; $P = 0.014$), working at a private facility (aOR: 7.86, 95% CI: 1.98–31.24; $P = 0.003$) and bachelor's-level or higher education (aOR: 2.29, 95% CI: 1.02–5.14; $P = 0.045$). Sex was retained in the model as an adjustment variable. Age group was not independently associated with adequate practices (Table 5).

DISCUSSION

This study identified important areas for capacity-strengthening in human rabies surveillance among health-care workers in Nghe An province, Viet Nam. Although agreement was generally high with statements that measured attitude, surveillance-specific knowledge and practices varied by professional role and health system level. Preventive medicine staff and commune-level staff showed the greatest need for support. Comparable patterns have been documented in other studies in rabies-endemic areas such as Bangladesh, Ethiopia and Senegal.^{10–12} These findings indicated the need to strengthen practical surveillance capacity among professionals across endemic low- and middle-income countries.

These results also highlighted important weaknesses in core surveillance activities that are less often described in KAP studies. Most preventive medicine staff did not

share information about bite-victims with veterinary authorities and did not use data-analysis tools; fewer than half of clinical staff correctly answered the item about the signs and symptoms used to suspect rabies; and a large majority of vaccination staff incorrectly managed bites from clinically rabid animals. Similar operational problems have been reported in human rabies surveillance in southern Viet Nam¹⁴ in a study that documented delayed reporting, incomplete specimen collection and limited use of data for decision-making, and in Senegal¹² and Mozambique,¹³ where poor notification procedures and weak collaboration between human and animal health sectors were noted. Taken together, these findings suggest that surveillance performance is influenced not only by individual KAP, but also by limitations in surveillance procedures, data systems and intersectoral coordination – key challenges for implementing a One Health approach. Sharing information on animal-bite victims with the veterinary sector is consistent with Viet Nam's regulatory framework for zoonotic disease prevention and control. The national interministerial circular on coordination for zoonotic disease prevention and control requires the health and agriculture sectors to coordinate in surveillance, outbreak investigation, response and communication for zoonotic diseases.²⁰ The national guideline for surveillance and prevention of rabies in humans also specifies that preventive medicine centres should coordinate with veterinary authorities when multiple people in the same locality seek rabies vaccination after animal bites, when a suspected human rabies case is clinically diagnosed or when a confirmed human rabies death occurs.⁴ In this context, sharing bite-victim information can support tracing and assessment of biting animals, identification of high-risk locations, timely veterinary investigation and coordinated outbreak response. The low level of reported data-sharing observed in our study therefore reflects an important gap at the human–animal health interface.

Table 4. Association between knowledge, attitudes and practices ($\geq 70\%$ vs $< 70\%$) and demographic characteristics among human rabies surveillance professionals, Nghe An, Viet Nam, 2025 (N = 236)

Variable	Knowledge			Attitudes			Practices		
	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> ^a	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> ^a	<i>n</i> (%)	<i>n</i> (%)	<i>P</i> ^a
	<70%	≥70%		<70%	≥70%		<70%	≥70%	
Sex									
Female	40 (25.5)	117 (74.5)	0.073	8 (5.1)	149 (94.9)	1.000	62 (39.5)	95 (60.5)	0.050
Male	29 (36.7)	50 (63.3)		4 (5.1)	75 (94.9)		21 (26.6)	58 (73.4)	
Age group, years									
<30	4 (19.0)	17 (81.0)	0.747	0 (0.0)	21 (100.0)	0.165	7 (33.3)	14 (66.7)	0.251
30–39	33 (29.2)	80 (70.8)		8 (7.1)	105 (92.9)		33 (29.2)	80 (70.8)	
40–49	18 (32.1)	38 (67.9)		4 (7.1)	52 (92.9)		23 (41.1)	33 (58.9)	
≥50	14 (30.4)	32 (69.6)		0 (0.0)	46 (100.0)		20 (43.5)	26 (56.5)	
Work experience, years									
<1	8 (40.0)	12 (60.0)	0.021	1 (5.0)	19 (95.0)	0.442	10 (50.0)	10 (50.0)	0.485
1–5	30 (25.9)	86 (74.1)		6 (5.2)	110 (94.8)		43 (37.1)	73 (62.9)	
6–10	13 (24.5)	40 (75.5)		1 (1.9)	52 (98.1)		15 (28.3)	38 (71.7)	
11–15	7 (24.1)	22 (75.9)		2 (6.9)	27 (93.1)		9 (31.0)	20 (69.0)	
>15	11 (61.1)	7 (38.9)		2 (11.1)	16 (88.9)		6 (33.3)	12 (66.7)	
Education									
High school	1 (33.3)	2 (66.7)	0.600	0 (0.0)	3 (100.0)	0.658	2 (66.7)	1 (33.3)	0.103
College/associate's degree	29 (25.9)	83 (74.1)		5 (4.5)	107 (95.5)		46 (41.1)	66 (58.9)	
Bachelor's degree	34 (33.7)	67 (66.3)		7 (6.9)	94 (93.1)		31 (30.7)	70 (69.3)	
Postgraduate	5 (25.0)	15 (75.0)		0 (0.0)	20 (100.0)		4 (20.0)	16 (80.0)	
Workplace level									
Provincial	2 (40.0)	3 (60.0)	0.001	0 (0.0)	5 (100.0)	0.802	0 (0.0)	5 (100.0)	<0.001
District	25 (22.7)	85 (77.3)		5 (4.5)	105 (95.5)		36 (32.7)	74 (67.3)	
Commune	28 (50.0)	28 (50.0)		4 (7.1)	52 (92.9)		37 (66.1)	19 (33.9)	
Private facility	14 (21.5)	51 (78.5)		3 (4.6)	62 (95.4)		10 (15.4)	55 (84.6)	

^a Fisher's exact test or Fisher–Freeman–Halton exact test, as appropriate.

This study identified marked differences in rabies surveillance performance by workplace level. Adequate knowledge was significantly more common among professionals working at district/provincial and private facilities than at the commune level, suggesting that access to guidance, supervision and routine exposure to bite management may be stronger in these settings. The lack of predictors for attitudes may be explained partly by the limited variability in attitude scores, as only 12 respondents had scores below 70%. Practices were most strongly associated with training in the past 12 months and workplace level, indicating that operational competencies may depend on opportunities to apply surveillance procedures in routine work,

refresher training and supportive supervision. However, some adjusted estimates, particularly for private-facility work, had wide CIs, suggesting statistical imprecision that may reflect the small numbers in some subgroups. These associations should, therefore, be interpreted cautiously. The association between sex and adequate practices in the adjusted model should also be interpreted cautiously, as it may reflect differences in task allocation, training opportunities or supervisory support. Overall, the findings suggest that surveillance gaps are driven not only by individual capacity but also by system-level differences across facility tiers, consistent with One Health implementation challenges in endemic settings.

Table 5. Multivariate analysis of factors associated with adequate knowledge and practices among human rabies surveillance professionals, Nghe An, Viet Nam, 2025 (N = 236)

Outcome	Predictor	Crude odds ratio (95% CI)	P	Adjusted odds ratio ^a (95% CI)	P
Knowledge ≥70%	Male vs female	0.59 (0.33–1.05)	0.075	0.75 (0.37–1.52)	0.430
	Clinical vs preventive medicine	1.11 (0.53–2.34)	0.782	0.52 (0.19–1.42)	0.200
	Vaccination vs preventive medicine	2.16 (1.13–4.15)	0.020	0.96 (0.29–3.13)	0.945
	Training in the past 12 months (yes vs no)	1.55 (0.88–2.74)	0.129	0.79 (0.36–1.72)	0.547
	Age 30–39 vs <30 years	0.57 (0.18–1.82)	0.344	0.67 (0.19–2.44)	0.546
	Age 40–49 vs <30 years	0.50 (0.15–1.69)	0.263	0.69 (0.16–2.96)	0.622
	Age ≥50 vs <30 years	0.54 (0.15–1.89)	0.334	1.11 (0.24–5.06)	0.898
	Experience (≥5 years vs <5 years)	0.67 (0.38–1.20)	0.177	0.80 (0.39–1.65)	0.544
	Education (≥Bachelor's degree vs <Bachelor's degree)	0.74 (0.42–1.30)	0.300	0.63 (0.29–1.36)	0.238
	Workplace level (district/province vs commune)	3.26 (1.65–6.42)	<0.001	5.78 (2.18–15.35)	<0.001
	Workplace level (private vs commune)	3.64 (1.65–8.03)	0.001	4.58 (1.19–17.56)	0.026
	Male vs female	1.80 (1.00–3.26)	0.051	2.38 (1.09–5.21)	0.030
	Clinical vs preventive medicine	2.17 (1.04–4.53)	0.039	0.67 (0.24–1.84)	0.433
	Vaccination vs preventive medicine	4.85 (2.51–9.37)	<0.001	1.13 (0.36–3.56)	0.837
Practices ≥70%	Training in the past 12 months (yes vs no)	5.09 (2.86–9.05)	<0.001	3.27 (1.46–7.34)	0.004
	Age 30–39 vs <30 years	1.21 (0.45–3.27)	0.704	1.19 (0.33–4.28)	0.785
	Age 40–49 vs <30 years	0.72 (0.25–2.05)	0.536	0.91 (0.22–3.85)	0.902
	Age ≥50 vs <30 years	0.65 (0.22–1.91)	0.434	0.66 (0.14–3.07)	0.596
	Experience (≥5 vs <5 years)	1.17 (0.68–2.00)	0.570	2.12 (0.97–4.64)	0.060
	Education (≥Bachelor's degree vs <Bachelor's degree)	1.76 (1.03–3.02)	0.040	2.29 (1.02–5.14)	0.045
	Workplace level (district/province vs commune)	4.27 (2.17–8.43)	<0.001	3.16 (1.26–7.90)	0.014
	Workplace level (private vs commune)	10.71 (4.48–25.61)	<0.001	7.86 (1.98–31.24)	0.003

CI: confidence interval.

^a Adjusted for sex, role in rabies surveillance, training in the past 12 months, age group, experience, education and workplace level.

Strengths of the study include comprehensive coverage of core surveillance functions across preventive medicine, clinical and vaccination units at multiple health system levels, which have been rarely achieved in previous KAP surveys. Moreover, the alignment of the questionnaire with national guidelines supports assessment of competencies relevant to the national rabies surveillance system.

This study has several important limitations. First, although it was designed from a One Health perspective, we could not survey the animal-health sector. During the study period, the veterinary system in Viet Nam was undergoing administrative reform, with changes to district and commune animal-health units and staffing. As a result, the study was unable to assess KAP among veterinary officers, which limits its ability to describe the full human–animal interface of rabies surveillance. Second, because of the cross-sectional design, the study could identify associations but could not determine causal relationships or underlying reasons for observed practices. Third, data were collected through an online self-administered questionnaire, which may have introduced selection bias related to internet access or digital literacy, recall bias and social desirability bias. Because responses were anonymous, the characteristics of respondents and non-respondents could not be compared; however, the response rate was high (96.3%), which may have reduced the potential for non-response bias. Some respondents may have over-reported desirable behaviours, such as timely reporting or correct PEP practices, and reported practices could not be independently verified. Fourth, data were collected from a single province using convenience sampling, so the results may not fully represent rabies surveillance professionals in Viet Nam. Despite these limitations, the study provides evidence that important gaps exist in both knowledge and practices related to human rabies surveillance, and its quality is strengthened by the grouping of professionals by role and health system level and by the use of a structured, guideline-based KAP assessment instrument.

In conclusion, substantial gaps in surveillance-specific knowledge and, especially, practices persist among front-line human rabies surveillance professionals in Nghe An, particularly in preventive medicine and

commune-level settings. These gaps may hinder One Health collaboration and undermine efforts to prevent human rabies deaths despite the preventive tools available. Targeted interventions are needed, especially practical, guideline-based training; simplified digital reporting and data-analysis tools; routine intersectoral information-sharing; and regular feedback on human–animal interface data. Qualitative research to elucidate barriers, and intervention studies to improve the surveillance system, are logical next steps. Strengthening surveillance capacity is essential to meeting the global 2030 target of zero dog-mediated human rabies deaths.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Ethics statement

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