RESEARCH ARTICLE AGROBIOLOGICAL RECORDS
ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
Open Access Journal

KAP SURVEY TO ASSESS PREPAREDNESS AND KNOWLEDGE REGARDING NIPAH VIRUS AMONG VETERINARY STUDENTS AND PRACTITIONERS

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ABSTRACT

Nipah virus is an important zoonotic disease transmitted primarily by *Pteropus* bats, the primary reservoirs for this virus. Seasonal outbreaks of Nipah virus infection have been observed in Malaysia, Singapore, Bangladesh, and India. Infection causes respiratory signs like coughing, sore throat, and difficulty in breathing as well as nervous signs like drowsiness, disorientation, and mental confusion in humans and various animals. Currently, no vaccine is available for this disease, and a One Health approach, including appropriate surveillance and adequate preventive measures, is necessary to prevent the future emergence of this disease in high-risk areas. Although no cases of Nipah virus infection have been reported in Pakistan, outbreaks can occur in Pakistan in the future, due to the presence of the *Pteropus* bat population and recently recorded outbreaks in neighboring countries. Due to the future potential of Nipah virus infection outbreaks in Pakistan, a KAP survey was conducted, encompassing a large variety of veterinary students and practitioners from all over Punjab, Pakistan, to evaluate their knowledge, attitudes, and practices regarding Nipah virus. The information regarding associated risk factors was collected on a pre-designed questionnaire. The chi-square test was used to identify significant differences in veterinary students' and practitioners' knowledge, attitudes, and practices. None of the chi-square values were statistically significant (P>0.05). The survey results also indicated a lack of knowledge and preparedness among veterinarians for future Nipah virus infection outbreaks, with little concern towards its prevention and control.

***Keywords*:** Nipah virus, Zoonosis, *Pteropus* bats, One Health, Surveillance, Knowledge, Prevention and control.

Article History (ABR-25-007) || Received: 27 Jan 2025 || Revised: 19 Mar 2025 || Accepted: 21 Mar 2025 || Published Online: 25 Mar 2025
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1. INTRODUCTION

Nipah virus infection is a zoonotic disease caused by Nipah virus, a member of the genus Henipavirus and family Paramyxoviridae. Nipah virus is an enveloped, non-segmented, single-stranded, negative-sense RNA virus with helical symmetry (Talukdar et al. 2023). The viral RNA encodes six structural proteins i.e., nucleocapsid (N), phosphoprotein (P), matrix protein (M), fusion protein (F), glycoprotein (G), and RNA polymerase (L). Of these, fusion (F) and glycoprotein (G) are critical for viral attachment and entry into host cells, and drive infection and pathogenesis (Soman Pillai et al. 2020; Nikolay et al. 2020).

For the first time, Nipah virus appeared during a massive outbreak in Malaysia in 1998–1999 involving pig farmers who came in close contact with pigs (Ang et al. 2018). Afterwards, there have been outbreaks in Bangladesh, India, and Singapore, with recurrent epidemics in Bangladesh pointing out its long-standing public health threat (Epstein et al. 2020; Soman Pillai et al. 2020). Humans-to-humans transmission has also been seen in these outbreaks, particularly in health care settings, and therefore, these strains are of epidemic potential (Chadha et al. 2006).

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ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
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Nipah virus is normally carried by *Pteropus* bats (also known as flying foxes or fruit bats) which play a central role in the ecological cycle in spreading the virus. Nonetheless, bats other than *Pteropus* bats and other animals like dogs, horses, cattle, goats, pigs, cats, and ferrets can serve as intermediate hosts that assist zoonotic spillover to humans (Ramphul et al. 2018; Aditi and Shariff, 2019; Singh et al. 2019; Rathish and Vaishnani, 2023). Though the route of transmission is unclear, transmission is likely through direct exposure to infected animals or humans, exposure to bodily fluid, or through ingestion of virus contaminated food products for example, raw date palm sap contaminated with bat saliva or urine of bats (Aditi and Shariff 2019; Singh et al. 2019).

Nipah virus displays a highly characteristic seasonal periodicity of infection that is essential to understanding the pathogen's epidemiology and to controlling its outbreak. Nipah virus infections' strong seasonal features are closely related to reservoir hosts, environmental factors, and human activities. Nipah virus outbreak in South Asia (mainly in Bangladesh and India) typically happens between December and May (winter to early spring). This corresponds with the date palm sap collection season, a significant source of human Nipah virus exposure, due to fruit bats contaminating the sap (Rahman et al. 2012). In Malaysia, outbreaks are frequently associated with seasonal bat migration patterns in relation to fruiting seasons and climatic conditions (Chua et al. 2002; Epstein et al. 2006). The ecological behavior of fruit bats significantly influences the seasonality of outbreaks. Viral shedding in bats increases during the reproductive cycles of bats, increasing spillover risk during the reproductive cycle (Field et al. 2001; Epstein et al. 2020). Moreover, bats migrating to areas closer to human settlements during food scarcity periods raise the chances of human contact with bats (Daszak et al. 2001; Field et al. 2001).

The incubation period of Nipah virus is 4 to 14 days followed by signs and symptoms ranging from mild to serious. The disease can be asymptomatic in humans or can present as fever, headache, and myalgia with respiratory and neurologic signs (Ramphul et al. 2018; Rathish and Vaishnani 2023). Accurate diagnosis is important because of the need for timely intervention. Detection is commonly done with the use of laboratory techniques such as antigen capture ELISA, reverse transcription polymerase chain reaction (RT-PCR), real-time RT-PCR (RT-Real Time PCR) and duplex nested RT-PCR (RT-Duplex Nested PCR) (Singh et al. 2019). There is no specific antiviral therapy for Nipah virus at this time. The treatment is mainly supportive, emphasizing the treatment of symptoms. However, experimental trials have shown some promise in monoclonal antibodies and ribavirin (Escaffre et al. 2013; Moore et al. 2024).

To date, there have been no cases of Nipah virus infection in Pakistan. However, the country is at considerable risk for an outbreak of the virus because Pteropus bats are present there, and it is close to outbreak-prone regions, such as India and Bangladesh. Spillover events are likely to occur in large numbers, especially in rural areas where the human-to-animal interface is good and biosecurity is poor (Talukdar et al. 2023). In order to avoid this, improvement in public awareness about Nipah virus infection with proactive measures is necessary. To fill this gap, a Knowledge, Attitude and Practices (KAP) survey was conducted among veterinary students and practitioners of Punjab, Pakistan.

2. MATERIALS AND METHODS

2.1. Ethical Approval

The study was conducted according to ethical standards. Participation in the survey was voluntary, and informed consent was obtained from all participants before data collection. The identity of respondents was kept confidential.

2.2. Study area

A comprehensive survey was conducted in which veterinarians were included from multiple districts of Punjab, i.e., Lahore, Multan, Faisalabad, Bahawalpur, and Rawalpindi. An effort was made to include veterinary students and animal' practitioners from as many universities as possible. The survey encompassed 161 veterinary students and practitioners. This inclusion was based on the fact that veterinarians are the most exposed group to any new zoonotic disease, and they are more likely to come in contact with such diseases, so their awareness about Nipah virus infection is necessary to limit its spread. The survey was conducted during the period of November and December 2023.

2.3. Sampling technique and sample size

For the purpose of data collection, a fully designed structural questionnaire on Google Forms was created with four sections. In the first section, demographics were included to identify the university and area of residence of respondents. The second section focused on knowledge-related questions and included 8 questions designed to assess veterinarians' knowledge of Nipah virus. The questions were carefully crafted to evaluate the depth of

ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
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understanding of respondents easily. The third section addressed attitudes and included 7 questions to assess veterinarians' attitudes toward Nipah virus. The final section was related to veterinarians' practices that can be important in preventing Nipah virus infection and contained 5 questions to gauge veterinarians' practices regarding safety measures (Fig. 1). Convenience sampling was used to collect online data regarding knowledge, attitude, and practices. This survey included veterinarians of both genders. The online survey was shared with approximately 250 individuals, out of which 160 completed the survey. This implies that the survey achieved a response rate of 64%, while the rejection rate was 36%. Only surveys complete in all respects were included in the study.

2.4. Data analysis

All questions in the questionnaire were the ordinal type and had five options. The data was analyzed in three sections of knowledge, attitude and practice. Respondents' scores were categorized into two groups based on whether they were above or below the average score. These categories were labeled as high (above average) and low (below average). Subsequently, the number of individuals falling into each category for all three sections was tallied. For statistical analysis, R studio was used. The chi-square statistical test was applied to compare knowledge, attitude, and practices of veterinary students and practitioners. Chi-square tests with $P \leq 0.05$ were considered statistically significant.

KAP Survey of Nipah Virus among Veterinary Students and Practitioners

Rate Your Knowledge, Attitude, and Practices relative to each of the following questions on a scale of 1 to 5 (1 means negligible, 2 means low, 3 means moderate, 4 means high, and 5 means very high).

PERSONAL INFORMATION						
1.	Name:					
2.	Email address:					
3.	University:					
4.	Profession:					
5.	City:					
6.	Student of Veterinary Practitioner:					
KNOWLEDGE						
1.	How much are you familiar with Nipah virus?	1	2	3	4	5
2.	How often do you think respiratory signs are observed in Nipah virus infection?	1	2	3	4	5
3.	How often do you think encephalitis is observed in Nipah virus infection?	1	2	3	4	5
4.	How often do you think direct contact with animals is main source of spread of Nipah virus?	1	2	3	4	5
5.	How much is media involved in disseminating information about Nipah virus infection?	1	2	3	4	5
6.	Rate your awareness regarding clinical signs of Nipah virus infection.	1	2	3	4	5
7.	Rank your knowledge regarding the vaccine against the Nipah virus.	1	2	3	4	5
8.	What is the severity of Nipah virus infection?	1	2	3	4	5
ATTITUDE						
1.	What is your level of concern about the Nipah virus outbreak in your area?	1	2	3	4	5
2.	How much do you consider Nipah virus as a serious health threat?	1	2	3	4	5
3.	How confident are you in your community's ability to cope with Nipah virus outbreak?	1	2	3	4	5
4.	What do you think is the rate at which the Nipah virus can affect the social and economic conditions of Pakistan?	1	2	3	4	5
5.	How confident are you in the authorities to handle the Nipah virus outbreak?	1	2	3	4	5
6.	How significant do you think it is to create public awareness about Nipah virus infection?	1	2	3	4	5
7.	How willing are you to follow restrictions and public health guidelines for protection against Nipah virus?	1	2	3	4	5
PRACTICE						
1.	How often do you wear a mask while handling animals?	1	2	3	4	5
2.	How frequently do you wash your hands after dealing with animals?	1	2	3	4	5
3.	How much have you educated your family and clients about preventive measures of Nipah virus infection?	1	2	3	4	5
4.	How well do you practice sanitization protocols at your work place?	1	2	3	4	5
5.	How much considerate are you in reporting cases with similar signs to Nipah virus?	1	2	3	4	5

Fig. 1: Questionnaire for KAP survey of veterinary students and practitioners.

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3. RESULTS

3.1. Knowledge about Nipah virus

According to the data in Table 1, the level of knowledge among veterinary students and practitioners regarding the Nipah virus. According to the above data, 30.2% (29) of veterinary students have high knowledge of the Nipah virus, and 68.8% (67) have little knowledge. Meanwhile, 35.9% (23) of veterinary practitioners have high knowledge of the Nipah virus, and 64.1% (41) have little knowledge. Fig. 2 indicates a graph for several veterinary students and practitioners with high and low knowledge about Nipah virus infection.

3.2. Attitude section

According to the data in Table 2, the attitude among veterinary students and practitioners regarding the Nipah virus. According to the above data, 48.4% (31) of veterinary practitioners had a positive attitude towards the importance of Nipah virus infection, and 51.6% (33) were less concerned about it. Meanwhile, 41.7% (40) of veterinary students were highly concerned, and 58.3% (56) demonstrated little concern about it. Fig. 3 indicates graph for number of veterinary students and practitioners with positive and negative attitude regarding Nipah virus infection.

3.3. Practice section

Table 3 demonstrates the practices among veterinary students and practitioners regarding the Nipah virus. According to the above data, 43.8% (28) of veterinary practitioners were practicing the preventive measures and protocols to avoid contact with Nipah virus infection, and 56.2% (36) were not practicing any preventive measures. Meanwhile, 48% (46) of veterinary students were practicing the preventive measures and protocols, and 52% (50) were not practicing any preventive measures. Fig. 4 indicates a graph for several veterinary students and practitioners with high and low practice scores for the prevention of Nipah virus infection.

Table 1: Respondents with high and low knowledge scores among veterinary students and practitioners

Category	High Knowledge Score	Low Knowledge Score
Veterinary Students	29	67
Veterinary Practitioners	23	41
Chi-square Value	0.343	
P-value	0.5581	

Table 2: Number of respondents with high and low attitude scores among veterinary students and practitioners

Category	High Attitude Score	Low Attitude Score
Veterinary Students	40	56
Veterinary Practitioners	31	33
Chi-square Value	0.465	
P-value	0.4952	

Table 3: Number of respondents with high and low practice scores among veterinary students and practitioners

Category	High Practice Score	Low Practice Score
Veterinary Students	46	50
Veterinary Practitioners	28	36
Chi-square Value	0.127	
P-value	0.7218	

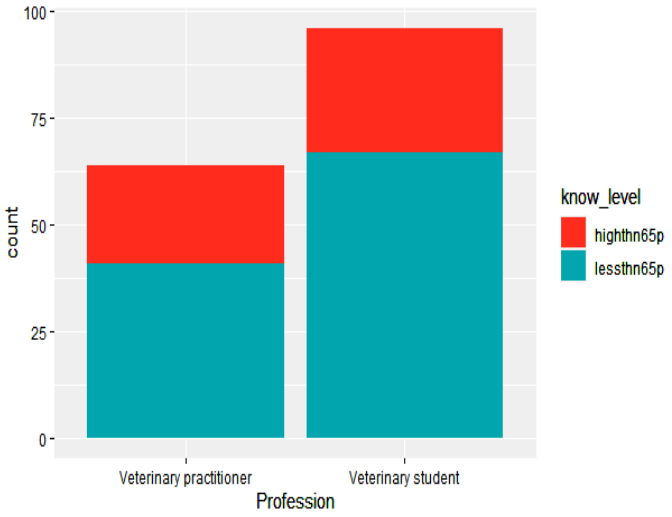

Fig. 2: Level of knowledge among veterinary students and practitioners about Nipah virus, with most having a low level of knowledge about Nipah virus. i) know_level is knowledge level, ii) highthn65p indicates respondents with a higher than 65% score; such respondents are considered to have high knowledge, and iii) lessthn65p indicates respondents with a score of less than 65%; such respondents are considered to have low knowledge. Chi-square was used to analyze data relative to the knowledge section, which gave a P=0.5581, indicating no significant difference in the level of knowledge regarding Nipah virus among veterinary students and practitioners.

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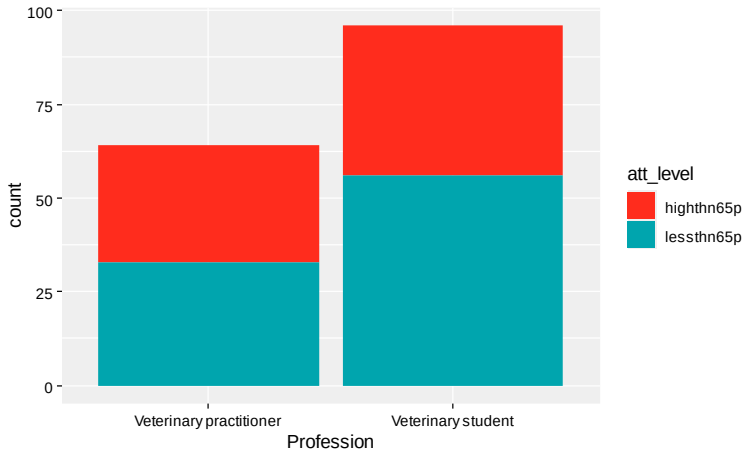

Fig. 3: Attitude among veterinary students and practitioners about Nipah virus. i) Att_level is attitude level, ii) highthn65p indicates respondents with a higher than 65% score; such respondents are considered to have a positive attitude, and iii) lessthn65p indicates respondents with a score of less than 65%; such respondents are considered to have a negative attitude. Chi-square was used to analyze data relative to the attitude section, which gave a P=0.4952, indicating no significant difference in the attitude towards Nipah virus among veterinary students and practitioners.

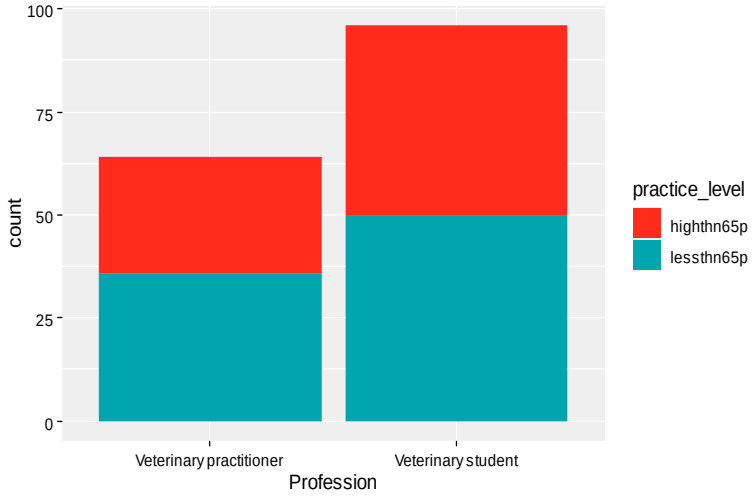

Fig. 4: Practices among veterinary students and practitioners for protection from Nipah virus. i) practice_level is level of practices for prevention from Nipah virus infection, ii) highthn65p indicates respondents with higher than 65% score; such respondents are considered to have good practices, and iii) lessthn65p indicates respondents with less than 65% score; such respondents are considered to lack good practices to prevent Nipah virus infection. Chi-square was used to analyze data relative to the practice section, which gave a P=0.7218, indicating no significant difference in the practices to prevent Nipah virus infection among veterinary students and practitioners.

4. DISCUSSION

The results of this Knowledge, Attitude, and Practice (KAP) survey are very useful to identify veterinary students' and practitioners' preparedness and awareness about the Nipah virus. Results from the survey indicated that respondents appeared to have less knowledge about the Nipah virus, despite increasing zoonotic threats from the virus. Only 32.5% of the participants had high knowledge regarding Nipah virus. This resonates with a study conducted in Bangladesh and India where KAP survey indicated high knowledge in only 46.15 and 43.5% of health care workers and medical students respectively (George et al. 2020; Islam et al. 2024). Poor knowledge among public regarding Nipah virus infection has also been observed in studies conducted in other regions of the world. For instance, results of studies conducted on the general population and farmers in Thailand and Bangladesh indicated poor knowledge and attitude towards Nipah virus disease, with most of Thailand's study population having no idea of bats being potential transmitters of diseases (Agari, 2017; Ahmed et al., 2025). These findings can be correlated to low knowledge among veterinarians and healthcare providers. As a lack of knowledge among these people corresponds to their inability to educate the public, which subsequently results in lack of knowledge in the general public as well.

Concern is raised about the ability of veterinary professionals to function as first-line responders in zoonotic disease outbreaks due to the low knowledge levels observed in this study. One Health approach, which concerns human, animal, and environmental health, adopts an integrative approach to combat zoonotic diseases, crucially involving veterinarians as important stakeholders (Gibbs et al. 2013; Mackenzie et al. 2019; Van Herten and Meijboom 2019; Cersosimo 2024; Safdar et al. 2024). Nonetheless, gaps in knowledge and preparedness at the community level suggest the need for more targeted educational interventions to bridge existing knowledge gaps. This is consistent with the views from studies suggesting that there is a need for continuous education and training programs on Nipah virus among veterinary and healthcare workers in endemic regions (Arunkumar et al. 2019; Yadav and Singh 2024).

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The attitude and willingness of respondents to learn about the Nipah virus were positive among 44.375% of respondents, indicating relatively greater willingness to learn about the virus. However, most lacked significant knowledge on the topic. Other studies on a similar topic made similar conclusions regarding knowledge gaps associated with positive attitudes toward better disease preventive measures (Mohamed et al. 2019; Islam et al. 2024). The positive attitude of respondents can be linked to their science-related educational background. This has been demonstrated in a KAP survey conducted on Nipah virus infection in Bangladesh, where the majority of respondents having a science-based background demonstrated significantly positive attitudes towards prevention from Nipah virus infection and other zoonotic diseases compared to respondents not having a science-based background (Ahmed et al. 2025).

Contrary to the relatively positive attitude among veterinarians and veterinary students regarding Nipah virus infection in our study. Studies conducted on farmers and general population reveal a poor attitude towards Nipah virus disease. This highlights the significance of good knowledge and practices among veterinarians and health care providers to play their role in educating the general public (Agari 2017).

Another significant finding is that personal protective equipment (PPE) usage, plus biosecurity measures, all important in preventing the spread of zoonotic disease to humans, were practiced only by 46.25% of respondents. This finding is consistent with studies conducted on healthcare workers, poultry farmers, and livestock farmers in Bangladesh, where most exhibited inadequate preventive practices to prevent the spread of zoonotic diseases (Islam et al. 2024; Ahmed et al. 2025). A general lack of practices ensuring biosafety and biosecurity is present in Pakistan (Qasmi and Khan 2019). This can be attributed to insufficient training of healthcare professionals and a lack of resources to practice adequate biosecurity, along with a lack of awareness and a sound regulatory framework in developing countries, as shown in studies conducted on underdeveloped countries. Therefore, boosting institutional assistance for veterinarians (for example, by providing access to PPE) and observing strict rules for following biosecurity measures is fundamental to ensure better preventive practices against disease spread (Heckert et al. 2011; Pavithra et al. 2019).

These findings have broader implications for individuals' preparedness than just reducing the Nipah virus infection cycling in animals. Veterinarians play a vital role in the early identification and control of zoonotic diseases, including Nipah virus. However, a lack of knowledge and preparedness regarding Nipah virus infection can greatly reduce their ability to contribute effectively to broader public health responses during outbreaks. Due to their close contact with livestock and frequent interactions with animals, veterinarians are in a prime location to identify early warning signals of possible future outbreaks. However, a lack of awareness and inadequate training in identifying and responding to Nipah virus infections can delay disease detection. This delays the timely implementation of effective control strategies and increases the chances of disease transmission from animals to human populations. The insufficient preparedness among veterinarians could further aggravate the spread of the virus, increasing the possibility of larger future outbreaks with severe public health consequences. Reinforcing veterinary training programs and incorporating them more effectively into One Health frameworks is necessary to fill in this knowledge gap. A well-educated and well-trained veterinary workforce can tremendously help in early disease surveillance, risk assessment, and outbreak mitigation. Therefore, addressing these knowledge and preparedness gaps is crucial in reducing the effect of the Nipah virus outbreak and reducing the chances of future zoonotic transmission events (Sharma et al. 2019; Singhai et al. 2021; Bruno et al. 2022; Gulzar et al. 2023).

This research signals a considerable knowledge and preparedness gap among veterinary students and practitioners. Although no case of Nipah virus infection has been reported to date in Pakistan, there is a huge risk of Nipah virus disease outbreak in Pakistan as it harbors a population of Pteropus bats. So there is a need to fill in the knowledge and preparedness gap through curricular enhancements, ongoing changes in professional development, and public health campaigns. While these interventions will improve individual competencies, they will also reinforce "One Health" thinking in zoonotic disease management. Further studies should be conducted among veterinary professionals, healthcare workers, and the general public to determine the effectiveness of these interventions in improving KAP survey outcomes and reducing the likelihood of zoonotic outbreaks.

5. CONCLUSION

This study identifies a large gap in the awareness of veterinary students and practitioners about the Nipah virus. As they are likely to come into contact with zoonotic diseases, the role of veterinarians becomes crucial in the early detection, prevention, and control. However, their probable contribution is compromised by their lack of awareness about the virus. To fill this gap, focused awareness programs and training sessions must be conducted. These sessions should highlight transmission routes, clinical presentations, preventive measures, and response procedures. More awareness will help veterinarians protect themselves and enable them to advise farmers, animal handlers, and other stakeholders at risk. *Pteropus* bats, the natural reservoir of Nipah virus, in Pakistan can potentially lead to future outbreaks among humans and animals. Preemptive action in the form of government-sponsored awareness

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Open Access Journal

programs, surveillance, and training of veterinarians and healthcare professionals is needed to neutralize this threat. In conclusion, veterinarians must have better information on the Nipah virus to ensure effective disease surveillance and prevention. There is an excellent chance of undetected outbreaks without proper knowledge and preparedness. Hence, veterinarians must be provided with the necessary information and training to protect public and animal health.

DECLARATIONS

Conflict of Interest: The author declares they have no relevant conflicts of interest to disclose.

Funding: This study received no financial support from national or international funding agencies.

Acknowledgment: We acknowledge the technical support of the University of Veterinary and Animal Sciences for the publication of this article.

Author's Contribution: Riaz F conceptualized the study. Riaz F, Ashraf M, and Usman M wrote the manuscript. Bashir M, Ahmed W, and Suleman M performed data analysis. Mughal MAS and Maroof S added tables and figures. All authors contributed to data collection, reading, and the correction of the manuscript.

Generative AI Statement: The authors declare that no Gen AI/DeepSeek was used in the writing/creation of this manuscript.

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ISSN: 2708-7182 (Print); ISSN: 2708-7190 (Online)
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