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Nipah virus: A looming global health challenge

Nipah virüsü: Yaklaşan küresel sağlık sorunu

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ABSTRACT

Nipah virus (NiV) outbreaks have garnered global attention due to their potential for devastating consequences on public health. Following two recent deaths from Nipah virus infection in Kerala in 2025, and considering the overall case fatality rate (CFR) of 69.4% reported in India to date, this review article presents a comprehensive analysis of NiV outbreaks, covering their historical background, epidemiology, transmission patterns, clinical features, diagnostic approaches, treatment options, preventive strategies, and current research advancements. Nipah virus, a zoonotic pathogen primarily transmitted from fruit bats to humans, poses a persistent threat to various regions, especially in Southeast Asia. Through a critical examination of past outbreaks and the lessons learned, this review aims to contribute to a better understanding of Nipah virus and enhance preparedness and response efforts for future outbreaks.

Keywords: Nipah virus, review, epidemiology

ÖZ

Nipah virüs (NiV) salgınları, toplum sağlığı üzerine yıkıcı sonuçlara yol açma potansiyeli nedeniyle küresel ilgi toplamıştır. 2025 yılında Kerala'da Nipah virüsü enfeksiyonundan kaynaklanan iki ölümün ardından ve Hindistan'da bugüne kadar bildirilen %69,4'lük genel vaka ölüm oranını (CFR) göz önünde bulundurarak, bu derleme makalesi, tarihsel geçmişini, epidemiyolojisini, bulaşma modellerini, klinik özelliklerini, tanı yaklaşımlarını, tedavi seçeneklerini, önleyici stratejileri ve güncel araştırma gelişmelerini kapsayan NiV salgınlarının kapsamlı bir analizini sunmaktadır. Başlıca meyve yarasalarından insanlara bulaşan zoonotik bir patojen olan Nipah virüsü, özellikle Güneydoğu Asya olmak üzere çeşitli bölgelerde kalıcı bir tehdit oluşturmaktadır. Geçmişte yaşanan salgınların ve alınan derslerin eleştirel bir değerlendirmesi ile bu derleme Nipah virüsünün daha iyi anlaşılmasını ve gelecekte olası salgınlara hazır bulunuşluk ve yanıt verme çabalarına katkıda bulunmayı hedeflemektedir.

Anahtar Sözcükler: *Nipah virüsü, gözden geçirmek, epidemiyoloji*

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INTRODUCTION

Nipah virus (NiV), a highly contagious and often deadly zoonotic pathogen, belonging to Henipavirus family has emerged as a significant global health concern over the past few decades [1,2]. The case fatality rate (CFR) is estimated at 40% to 75% [1], with India having CFR 69.4% till 2025 (Table-1). This rate can vary by outbreak depending on local capabilities for epidemiological surveillance and clinical management [1].

In the year 2025, two deaths happened in the state of Kerala because of Nipah [3]. This introduction sets the stage for our comprehensive review of Nipah virus outbreaks, providing essential context and emphasizing the critical need for understanding and addressing this virus.

In the late 1990s, the world witnessed the emergence of Nipah virus during a devastating outbreak in Malaysia. This outbreak not only affected the health and livelihoods of local communities but also raised alarm bells for public health experts worldwide [4]. Since then, Nipah virus has continued to sporadically resurface in various parts of Southeast Asia, demanding a coordinated global response [5-9]. The World Health Organization (WHO) has declared in 2018 that there is an urgent need for accelerated research and development for the Nipah virus. The 2018 annual review of the WHO R&D Blueprint list of priority diseases indicates that there is an urgent need for accelerated research and development for the Nipah virus [10].

Understanding Nipah virus outbreaks requires a multifaceted approach that encompasses historical perspectives, epidemiology, transmission dynamics, clinical manifestations, diagnostic methods, treatment options, prevention strategies, and ongoing research efforts. This comprehensive review aims to consolidate this wealth of knowledge, offering readers a holistic view of Nipah virus and its impact on public health.

Historical Overview: The emergence of Nipah virus (NiV) onto the global stage began in the late 1990s with a series of outbreaks in Southeast Asia. These events marked the first documented occurrences of the virus and drew attention to its potential as a deadly zoonotic pathogen. The Nipah virus was initially identified during an outbreak in Malaysia in 1999. The Malaysian outbreak resulted in 101 human deaths and the culling of approximately 900,000 pigs to control the epidemic [4]. The outbreak in Malaysia spilled over into Singapore, affecting several individuals who had travelled from Malaysia. Singapore's quick response helped contain the virus's spread, and the outbreak was eventually controlled [5]. After the Malaysian outbreak, Nipah virus resurfaced in Bangladesh in 2001. These outbreaks were characterized by human-to-human transmission, often within close-knit communities. Nipah outbreaks have continued to occur sporadically in Bangladesh and parts of India (details in Table-1), with varying case numbers and outcomes [6-8]. Nipah virus outbreaks have also been reported in other countries, including the Philippines, on a smaller scale [9].

Table-1. Outbreaks of Nipah in India

State	Year	Cases	Deaths	Case-fatality rate (%)
West Bengal	2001	66	45	68.2
West Bengal	2007	5	5	100.0
Kerala	2018	23	18	78.2
Kerala	2019	1	0	0.0
Kerala	2021	1	1	100.0
Kerala	2023	6	2	33.3
Kerala	2024	2	2	100.0
Kerala	2025	4	2	50.0
Total		108	75	69.4%

Epidemiology of Nipah Virus Outbreaks: Case definitions for NIPAH virus is as follows [11]:

Suspect Nipah Case

Person from an area/ locality affected by a Nipah virus disease outbreak who has:

- Acute Fever with new onset of altered mental status or seizure **and/or**
- Acute Fever with severe headache **and/or**
- Acute Fever with Cough

Probable Nipah Case

- Suspect case-patient/s who resided in the same village where suspect/confirmed case of Nipah were living during the outbreak period and who died before complete diagnostic specimens could be collected **OR**
- Suspect case-patients who came in direct contact with confirmed case-patients in a hospital setting during the outbreak period and who died before complete diagnostic specimens could be collected.

Confirmed Nipah Case

Suspected case who has laboratory confirmation of Nipah virus infection either by:

- Nipah virus RNA identified by PCR from throat swab, urine, serum or cerebrospinal fluid (optional).
- Isolation of Nipah virus from throat swab, urine, serum or cerebrospinal fluid.

Understanding the epidemiology of Nipah virus (NiV) outbreaks is essential for controlling and preventing the spread of this deadly zoonotic pathogen. This section provides an overview of the key epidemiological aspects of NiV outbreaks, including geographical distribution, affected populations, and the role of fruit bats as natural reservoirs.

Nipah virus outbreaks have primarily occurred in Southeast Asia, with Malaysia, Singapore, Bangladesh, and India being the most affected countries [4-8]. The first significant NiV epidemic, which was mostly linked to pig farming areas, occurred in Malaysia and Singapore in 1999 [4,5]. Bangladesh has witnessed recurrent outbreaks since 2001, often linked to consumption of date palm sap contaminated with bat excreta and human-to-human transmission. Outbreaks in India, particularly in the state of Kerala, have occurred sporadically, with human-to-human transmission playing a significant role [6-8]. There have been isolated instances or minor outbreaks recorded in several nations in the area, including Thailand and the Philippines. [9,10].

Fruit bats, particularly Pteropus species (flying foxes), are the natural reservoirs of Nipah virus. They can carry the virus without illness, enabling spillover to humans through contaminated fruit or date palm sap [12]. Figure-1, adapted from the World Health Organization, shows the distribution of Henipavirus outbreaks and the range of these bats, underlining the need for targeted surveillance in high-risk regions.

The case fatality rate (CFR) for NiV infections is high, frequently ranging from 40% to 75% in various outbreaks [1]. The severity of illness and CFR can vary depending on factors such as the strain of the virus and the healthcare infrastructure in affected areas [13].

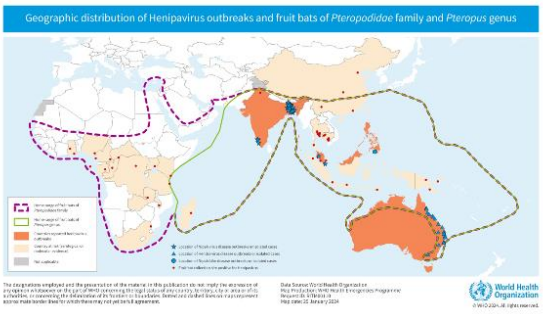

Figure-1. Geographic distribution of Henipavirus outbreaks and fruit bats of Pteropodidae family and Pteropus genus

Source: World Health Organization. © WHO 2024. Reproduced under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO licence (https://creativecommons.org/licenses/by-nc-sa/3.0/igo/). Map date: 25 January 2024.

Transmission Dynamics of Nipah Virus: Understanding the transmission dynamics of Nipah virus (NiV) is critical for devising effective strategies to control and prevent its spread during outbreaks. NiV is a zoonotic virus that can be transmitted from bats to humans and between humans[14]. This section explores the key aspects of NiV transmission dynamics:

Fruit bats, particularly species of the Pteropus genus (commonly known as flying foxes), serve as the natural reservoir hosts for Nipah virus [15]. However, in many outbreaks, an intermediate host, such as pigs in the Malaysian outbreak of 1999, played a crucial role in transmitting the virus from bats to humans [16]. Bats can shed the virus in saliva, urine, and feces, contaminating the environment and food sources. Pigs can become infected by consuming contaminated materials and serve as amplification hosts, increasing the risk of human exposure [17]. Human infections often result from the consumption of fruits, date palm sap, or other food items that have been contaminated by bat excreta. This direct or indirect contact with contaminated food sources facilitates bat-to-human transmission [18].

Infected individuals can shed the virus in various bodily fluids, including saliva, respiratory secretions, urine, and feces. The extent and duration of viral shedding can vary among patients [24]. Nipah virus can also spread from person to person, primarily through close contact with bodily fluids (e.g., respiratory secretions, blood, urine) of

infected individuals. Family members who are caring for sick individuals and those working in healthcare facilities should be particularly concerned about this form of transmission [19]. NiV outbreaks can exhibit "super-spreading" events, where a single infected individual transmits the virus to a disproportionately high number of others. These events often occur in healthcare settings, highlighting the importance of infection control measures [23]. Inadequate infection control measures when providing care to Nipah virus patients makes healthcare professionals more susceptible to contracting an infection leading to nosocomial outbreaks [20].

While most human-to-human transmission of NiV occurs through direct contact with infected bodily fluids, there is some evidence to suggest limited airborne transmission in specific situations. This mode of transmission is not as common or efficient as other routes [21].

Clinical Manifestations of Nipah Virus Infection: Nipah virus (NiV) infection can lead to a wide spectrum of clinical manifestations, ranging from mild or asymptomatic cases to severe respiratory and neurological disease [26]. The clinical presentation can vary based on factors such as the virus strain, the individual's age and overall health, and the presence of underlying medical conditions. Here is an overview of the clinical manifestations of Nipah virus infection:

The incubation period for Nipah virus can vary but is generally between 4 to 14 days. This period represents the time between exposure to the virus and the onset of symptoms [22].

Some individuals infected with NiV may remain asymptomatic, meaning they show no noticeable symptoms.

Others may experience mild, flu-like symptoms, which can include fever, headache, muscle pain, and general malaise [25]. NiV infection can progress to severe respiratory illness, characterized by symptoms such as cough, sore throat, difficult breathing, respiratory distress, chest pain [26]. NiV infection can also present with atypical symptoms, making diagnosis challenging. These may include gastrointestinal symptoms like nausea, vomiting, and diarrhoea [29].

The progression of NiV infection may be rapid and severe. A characteristic of severe illness is viral encephalitis involving inflammation of the brain, developing within few days after initial symptoms. Encephalitis can lead to a wide range of neurological symptoms, including altered consciousness (confusion, disorientation), seizures, hallucinations, stiff neck, muscle weakness, coma, paralysis [27, 28]. Severe cases of NiV infection can lead to multi-organ failure and death, often within a short period [29]. Survivors of severe NiV infection may experience long-term neurological sequelae, including cognitive deficits, motor impairments, and psychological issues. Rehabilitation and supportive care are often necessary for these individuals [30, 31]

Diagnosis of Nipah Virus Infection: Timely laboratory diagnosis of Nipah virus (NiV) infection, a Henipavirus, is crucial for patient management, outbreak control, and public health interventions. NiV infection can mimic other diseases, so healthcare providers should be vigilant for patients with acute febrile encephalitis syndrome (AES) or respiratory illness in areas with known or suspected NiV activity. Several diagnostic methods are employed to identify NiV infection, ranging from clinical assessments to laboratory tests. Here are the key components of NiV diagnosis:

Initial diagnosis often begins with a clinical assessment of the patient's symptoms and medical history. Healthcare providers consider the presence of fever, respiratory symptoms, neurological signs, and potential exposure to NiV risk factors, such as contact with infected individuals, animals, or contaminated food sources.

Confirmation of NiV infection relies on laboratory testing. Several diagnostic methods are available:

a. Polymerase Chain Reaction (PCR): PCR is a molecular technique used to detect NiV genetic material (RNA) in patient samples, such as blood, serum, cerebrospinal fluid, throat swabs, or urine. Reverse transcription polymerase chain reaction (RT-PCR) is commonly employed for NiV detection [32].

b. Serologic Testing: Enzyme-linked immunosorbent assay (ELISA) and Indirect ELISA are other serological tests that can detect antibodies produced by the immune system in response to NiV infection. These tests are particularly useful for retrospective diagnosis and surveillance [33,34].

c. Virus Isolation: Virus isolation involves attempting to grow the live virus from patient

samples in a laboratory setting. It is a time-consuming and high-containment process typically performed in specialized facilities [35].

d. Immunohistochemistry (IHC): IHC can be used to detect NiV antigens in tissue samples, particularly in post-mortem examinations [32].

e. Next-Generation Sequencing (NGS): NGS technologies can be employed for NiV detection, sequencing, and characterization, providing valuable information about virus strains and mutations.

Proper collection, transportation, and handling of clinical specimens are essential to maintain sample integrity and minimize the risk of laboratory-acquired infections. Specimens should be collected under appropriate biosafety measures, as NiV is a high-containment pathogen. Diagnostic laboratories handling NiV samples must adhere to stringent biosafety and biosecurity protocols to prevent accidental exposure and transmission.

In many cases, especially during outbreaks, diagnostic testing for NiV may be conducted in reference laboratories with the expertise and infrastructure to handle high-risk pathogens.

NiV infection can resemble other infectious diseases, including other viral encephalitides or respiratory infections. Therefore, healthcare providers should also consider differential diagnoses when evaluating patients.

Treatment and Management of Nipah Virus Infection: There was no specific antiviral medication approved for the treatment of Nipah virus (NiV) infection. Therefore, the management of NiV infection primarily involves supportive care and infection control measures. It's important to note that research into potential treatments may have progressed since then, so healthcare professionals should consult the latest guidelines and developments. Here is an overview of the general treatment and management principles:

Supportive care is the cornerstone of NiV infection management. It aims to alleviate symptoms, maintain vital functions, and provide comfort to patients. Some specific supportive measures may include mechanical ventilation or oxygen therapy for patients with respiratory distress, anticonvulsant medications to control seizures in patients with encephalitis, intravenous fluids and electrolyte management to address dehydration and maintain fluid balance and nutritional support for patients who have difficulty eating or drinking. Patients who survive severe NiV infection may experience long-term physical, cognitive, and psychological effects. Psychological support and rehabilitation services may be needed to assist with recovery.

Patients with suspected or confirmed NiV infection should be placed in isolation under strict infection control measures. Healthcare providers and caregivers should use appropriate personal protective equipment (PPE) to prevent transmission. Hand hygiene and proper disposal of contaminated materials are crucial to minimize the risk of nosocomial infections.

Post-exposure prophylaxis (PEP), which prevents infection, may occasionally be given to those who have been in close contact with a confirmed NiV case. PEP could involve the use of monoclonal antibodies or other experimental treatments. PEP should be administered under the guidance of public health authorities.

Prevention Strategies for Nipah Virus Infection:

- ***Avoid exposure to bats*** (*Pteropus* spp. are reservoirs)
  - No direct contact with bats, excreta, or roosting/foraging areas [36].
- ***Safe food practices***
  - Do not drink raw date palm sap; always boil before use [37].
  - Avoid sap collection in bat-infested areas.
  - Wash/peel fruits thoroughly; discard bitten or damaged fruits.
- ***Personal protection***
  - Wear gloves/masks when handling animals or contaminated materials.
  - Wash hands with soap after contact; avoid touching face/eyes/mouth.
- ***Close contact precautions***
  - Isolate/quarantine those exposed to confirmed NiV cases.
  - Travelers to affected regions: avoid bats, raw sap, and contaminated foods.
- ***Community measures***
  - Raise awareness in endemic areas.

- Encourage early reporting of sick individuals.

- ***Healthcare settings***
  - Follow strict infection control; use PPE and dispose of waste safely.
  - Ensure availability of PPE, isolation wards, and containment measures [38].

- ***Public health response***
  - Strengthen labs, healthcare readiness, and emergency response.
  - Active surveillance for NiV cases or unusual illness clusters.
  - Rapid reporting to authorities; public awareness campaigns.

- ***Overall***
  - NiV prevention needs combined individual, community, and public health efforts [40].
  - Continuous vigilance and swift outbreak response are essential.

Future Directions and Research in Nipah Virus (NiV): Continued research and development efforts are essential for better understanding, preventing, and managing Nipah virus infections. Research involving NiV should consider ethical considerations, including the informed consent of study participants, especially in clinical trials and experimental treatments. Here are some key areas of future research and directions in NiV:

Developing safe and effective NiV vaccines is a top priority. Research should focus on advancing vaccine candidates to provide protection against various NiV strains and facilitating vaccination of at-risk populations [41]. Vaccination of at-risk populations, such as individuals in close contact with confirmed cases or in areas with recurrent outbreaks, may be considered if effective vaccines become available.

The development of rapid and reliable diagnostic tests for NiV is essential for early case detection and outbreak management. Research should aim to enhance diagnostic accuracy and accessibility. Diagnostic tests should become available at least in the reference laboratories of countries in the range of the fruit bats, thus under risk, like Turkey and some African countries, where cases have not yet been reported.

Research into specific antiviral drugs for NiV is crucial. Identifying compounds with therapeutic potential and evaluating their safety and efficacy in clinical trials is a priority.

Support and participation of community in research efforts to develop NiV vaccines and antiviral treatments is essential.

Further research should embrace the One Health approach, fostering interdisciplinary collaboration among human health, animal health, and environmental health experts. This approach is critical for understanding the complex interplay of NiV across species [42].

NiV research should contribute to global health security efforts, emphasizing the importance of preventing and responding to emerging infectious diseases. Conducting comprehensive epidemiological studies can provide insights into NiV transmission dynamics, host reservoirs, and factors influencing outbreak emergence. This research informs prevention strategies. In-depth studies of NiV's natural reservoir hosts, such as fruit bats, can shed light on the biology of the virus in its natural environment and inform strategies to reduce spillover events. Research should continue to investigate the role of intermediate hosts in NiV transmission, identifying potential amplification hosts and understanding the mechanisms of transmission. Genomic surveillance can help monitor the evolution of NiV strains and detect potential genetic changes that may impact virulence, transmission, or drug resistance. Conducting research on effective community engagement strategies is crucial for building trust, disseminating accurate information, and encouraging reporting during NiV outbreaks. Mathematical modelling can aid in predicting NiV outbreak patterns, assessing the impact of interventions, and guiding public health decision-making.

Building research capacity in countries at risk of NiV outbreaks is crucial. Training local scientists and healthcare workers in diagnostics, research, and outbreak response enhances preparedness. Collaborative research efforts across countries and regions with a history of NiV outbreaks can help share knowledge, resources, and expertise, facilitating a coordinated response to future outbreaks.

Ongoing research into Nipah virus and related areas will advance our ability to combat this deadly pathogen and enhance preparedness for future

outbreaks. International collaboration, funding support, and interdisciplinary approaches are vital to the success of these research endeavours.

CONCLUSION

Nipah virus (NiV) remains a formidable global health threat, emphasizing the need for ongoing vigilance, research, and preparedness. This comprehensive review has explored the multifaceted aspects of NiV, including its historical emergence, epidemiology, clinical manifestations, diagnosis, treatment, prevention strategies, lessons learned, and future directions in research. Lessons from past NiV outbreaks have underscored the importance of early detection, interdisciplinary collaboration, and community engagement. These lessons have informed strategies for prevention and outbreak response, which are critical given the absence of specific antiviral treatments and the high case fatality rate associated with NiV infections.

The future of NiV research holds promise, with ongoing efforts in vaccine development, antiviral therapies, and improved diagnostics. The One Health approach, which recognizes the interconnectedness of human, animal, and environmental health, will continue to guide research and response efforts. As we move forward, it is crucial for the global community to remain committed to addressing emerging infectious diseases like NiV. Strengthening public health infrastructure, enhancing surveillance capabilities, and fostering international collaboration are fundamental steps in protecting global health security.

References

1. Nipah virus | WHO [Internet]. 2018 [cited 2025 Sep 07]. Available from: https://www.who.int/news-room/fact-sheets/detail/nipah-virus
2. Nipah Virus (NiV) | CDC [Internet]. 2022. [cited 2025 Sep 07]. Available from: https://www.cdc.gov/vhf/nipah/index.html
3. World Health Organization. 2025. [cited 2025 Sep 07]. Disease Outbreak News; Nipah virus infection – India. Available from: https://www.who.int/emergencies/disease-outbreak-news/item/2025-DON577
4. Uppal PK. Emergence of Nipah virus in Malaysia. Ann N Y Acad Sci. 2000;916:354-7. doi: 10.1111/j.1749-6632.2000.tb05312.x. PMID: 11193645.
5. Nipah virus infection - Bangladesh [Internet]. [cited 2025 Sep 07]. Available from: https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON442
6. Bureau TH. Suspected Nipah deaths: fever surveys under way in two places in Kozhikode. The Hindu [Internet]. 2023 Sep 12 [cited 2025 Sep 07]; Available from: https://www.thehindu.com/news/cities/kozhikode/suspected-nipah-deaths-fever-surveys-under-way-in-two-places-in-kozhikode/article67298395.ece
7. Nipah Virus Outbreak in Kerala [Internet]. [cited 2025 Sep 07]. Available from: https://www.who.int/southeastasia/outbreaks-and-emergencies/health-emergency-information-risk-assessment/surveillance-and-risk-assessment/nipah-virus-outbreak-in-kerala
8. Ching PK, de Los Reyes VC, Sucaldito MN, Tayag E, Columna-Vingno AB, Malbas Jr FF, Bolo Jr GC, Sejvar JJ, Eagles D, Playford G, Dueger E. Outbreak of henipavirus infection, Philippines, 2014. Emerging infectious diseases. 2015 Feb;21(2):328.
9. Department of Health and Family Welfare, Government of Kerala. NIPAH virus infection: guidelines for surveillance, diagnosis, treatment, prevention and control. Kerala: Department of Health and Family Welfare; 2021 Sep 5.
10. Mehand MS, Al-Shorbaji F, Millett P, Murgue B. The WHO R&D Blueprint: 2018 review of emerging infectious diseases requiring urgent research and development efforts. Antiviral Research. 2018 Nov 1;159:63–7.
11. National Centre for Disease Control (NCDC), Ministry of Health and Family Welfare, Government of India. Case definitions of Nipah virus disease. New Delhi: NCDC, MoHFW, GoI; 2024 Sep. Available from: https://ncdc.mohfw.gov.in/wp-content/uploads/2024/09/Case-Definitions-of-NIPAH-Virus-Disease.pdf
12. Yadav PD, Raut CG, Shete AM, Mishra AC, Towner JS, Nichol ST, Mourya DT. Detection of Nipah virus RNA in fruit bat (Pteropus giganteus) from India. Am J Trop Med Hyg. 2012 Sep;87(3):576-8. doi: 10.4269/ajtmh.2012.11-0416. Epub 2012 Jul 16. PMID: 22802440; PMCID: PMC3435367.

13. Bruno L, Nappo MA, Ferrari L, Di Lecce R, Guarnieri C, Cantoni AM, Corradi A. Nipah Virus Disease: Epidemiological, Clinical, Diagnostic and Legislative Aspects of This Unpredictable Emerging Zoonosis. Animals. 2022 Dec 31;13(1):159.
14. Gurley ES, Hegde ST, Hossain K, Sazzad HMS, Hossain MJ, Rahman M, Sharker MAY, Salje H, Islam MS, Epstein JH, Khan SU, Kilpatrick AM, Daszak P, Luby SP. Convergence of Humans, Bats, Trees, and Culture in Nipah Virus Transmission, Bangladesh. Emerg Infect Dis. 2017 Sep;23(9):1446-1453. doi: 10.3201/eid2309.161922. PMID: 28820130; PMCID: PMC5572889.
15. Yadav PD, Raut CG, Shete AM, Mishra AC, Towner JS, Nichol ST, Mourya DT. Detection of Nipah virus RNA in fruit bat (Pteropus giganteus) from India. Am J Trop Med Hyg. 2012 Sep;87(3):576-8. doi: 10.4269/ajtmh.2012.11-0416. Epub 2012 Jul 16. PMID: 22802440; PMCID: PMC3435367.
16. Mohd Nor MN, Gan CH, Ong BL. Nipah virus infection of pigs in peninsular Malaysia. Rev Sci Tech. 2000 Apr;19(1):160-5. doi: 10.20506/rst.19.1.1202. PMID: 11189713.
17. Pulliam JR, Epstein JH, Dushoff J, Rahman SA, Bunning M, Jamaluddin AA, Hyatt AD, Field HE, Dobson AP, Daszak P; Henipavirus Ecology Research Group (HERG). Agricultural intensification, priming for persistence and the emergence of Nipah virus: a lethal bat-borne zoonosis. J R Soc Interface. 2012 Jan 7;9(66):89-101. doi: 10.1098/rsif.2011.0223. Epub 2011 Jun 1. PMID: 21632614; PMCID: PMC3223631.
18. Gurley ES, Montgomery JM, Hossain MJ, Bell M, Azad AK, Islam MR, Molla MA, Carroll DS, Ksiazek TG, Rota PA, Lowe L, Comer JA, Rollin P, Czub M, Grolla A, Feldmann H, Luby SP, Woodward JL, Breiman RF. Person-to-person transmission of Nipah virus in a Bangladeshi community. Emerg Infect Dis. 2007 Jul;13(7):1031-7. doi: 10.3201/eid1307.061128. PMID: 18214175; PMCID: PMC2878219.
19. Homaira N, Rahman M, Hossain MJ, Epstein JH, Sultana R, Khan MS, Podder G, Nahar K, Ahmed B, Gurley ES, Daszak P, Lipkin WI, Rollin PE, Comer JA, Ksiazek TG, Luby SP. Nipah virus outbreak with person-to-person transmission in a district of Bangladesh, 2007. Epidemiol Infect. 2010 Nov;138(11):1630-6. doi: 10.1017/S0950268810000695. Epub 2010 Apr 12. PMID: 20380769; PMCID: PMC10071638.
20. Luby SP, Gurley ES, Hossain MJ. TRANSMISSION OF HUMAN INFECTION WITH NIPAH VIRUS. In: Institute of Medicine (US). Improving Food Safety Through a One Health Approach: Workshop Summary. Washington (DC): National Academies Press (US); 2012. A11. Available from: https://www.ncbi.nlm.nih.gov/books/NBK114486/
21. Transmission | Nipah Virus (NiV) | CDC [Internet]. 2020 [cited 2025 Sep 07]. Available from: https://www.cdc.gov/vhf/nipah/transmission/index.html
22. Signs and Symptoms | Nipah Virus (NiV) | CDC [Internet]. 2020 [cited 2025 Sep 07]. Available from: https://www.cdc.gov/vhf/nipah/symptoms/index.html
23. Nikolay B, Salje H, Hossain MJ, Khan AD, Sazzad HM, Rahman M, Daszak P, Ströher U, Pulliam JR, Kilpatrick AM, Nichol ST. Transmission of Nipah virus—14 years of investigations in Bangladesh. New England Journal of Medicine. 2019 May 9;380(19):1804-14.
24. Banerjee S, Gupta N, Kodan P, et al. Nipah virus disease: A rare and intractable disease. Intractable & rare diseases research. 2019 Feb 28;8(1):1-8.
25. Kumar CG, Sugunan AP, Yadav P, et al. Infections among contacts of patients with Nipah virus, India. Emerging Infectious Diseases. 2019 May;25(5):1007.
26. Hossain MJ, Gurley ES, Montgomery JM, et al. Clinical presentation of nipah virus infection in Bangladesh. Clin Infect Dis. 2008 Apr 1;46(7):977-84. doi: 10.1086/529147. PMID: 18444812.
27. Abdullah S, Tan CT. Henipavirus encephalitis. Handb Clin Neurol. 2014;123:663-70. doi: 10.1016/B978-0-444-53488-0.00032-8. PMID: 25015510.
28. Parashar UD, Sunn LM, Ong F, et al. Case-control study of risk factors for human infection with a new zoonotic paramyxovirus, Nipah virus, during a 1998-1999 outbreak of severe encephalitis in Malaysia. J Infect Dis. 2000 May;181(5):1755-9. doi: 10.1086/315457. Epub 2000 May 15. PMID: 10823779.
29. Alam AM. Nipah virus, an emerging zoonotic disease causing fatal encephalitis. Clinical Medicine. 2022 Jul;22(4):348.
30. Siva SR, Chong HT, Tan CT. Ten year clinical and serological outcomes of Nipah virus infection. Neurol Asia. 2009 Jun 1;14(1):53-58.
31. Sejvar JJ, Hossain J, Saha SK, et al. Long-term neurological and functional outcome in Nipah virus infection. Ann Neurol. 2007 Sep;62(3):235-42. doi: 10.1002/ana.21178. PMID: 17696217.
32. Guillaume V, Lefeuvre A, Faure C, et al. Specific detection of Nipah virus using real-time RT-PCR (TaqMan). J Virol Methods. 2004 Sep 15;120(2):229-37. doi: 10.1016/j.jviromet.2004.05.018. PMID: 15288966

33. Daniels P, Ksiazek T, Eaton BT. Laboratory diagnosis of Nipah and Hendra virus infections. Microbes Infect. 2001 Apr;3(4):289-95. doi: 10.1016/s1286-4579(01)01382-x. PMID: 11334746.
34. Fischer K, Diederich S, Smith G, et al. Indirect ELISA based on Hendra and Nipah virus proteins for the detection of henipavirus specific antibodies in pigs. PLoS One. 2018 Apr 30;13(4):e0194385. doi: 10.1371/journal.pone.0194385. PMID: 29708971; PMCID: PMC5927399.
35. AbuBakar S, Chang LY, Ali AM, Sharifah SH, Yusoff K, Zamrod Z. Isolation and molecular identification of Nipah virus from pigs. Emerging infectious diseases. 2004 Dec;10(12):2228.
36. Satterfield BA. 2017. The future of preventing and treating Nipah virus infection. Future Sci. OA. 3(4):FSO220. doi: 10.4155/fsoa-2017-0056
37. Nahar N, Paul RC, Sultana R, et al. A Controlled Trial to Reduce the Risk of Human Nipah Virus Exposure in Bangladesh. Ecohealth. 2017 Sep;14(3):501-517. doi: 10.1007/s10393-017-1267-4. Epub 2017 Sep 13. PMID: 28905152.
38. Ramphul K, Mejias SG, Agumadu VC, Sombans S, Sonaye R, Lohana P. The Killer Virus Called Nipah: A Review. Cureus. 2018 Aug 21;10(8):e3168. doi: 10.7759/cureus.3168. PMID: 30416895; PMCID: PMC6223664.
39. Glennon EE, Restif O, Sbarbaro SR, et al. Domesticated animals as hosts of henipaviruses and filoviruses: A systematic review. Vet J. 2018 Mar;233:25-34. doi: 10.1016/j.tvjl.2017.12.024. Epub 2017 Dec 30. PMID: 29486875.
40. Chua KB. Epidemiology, surveillance and control of Nipah virus infections in Malaysia. Malays J Pathol. 2010 Dec;32(2):69-73. PMID: 21329176
41. Satterfield BA, Dawes BE, Milligan GN. Status of vaccine research and development of vaccines for Nipah virus. Vaccine. 2016 Jun 3;34(26):2971-2975. doi: 10.1016/j.vaccine.2015.12.075. Epub 2016 Mar 11. PMID: 26973068
42. Zumla A, Dar O, Kock R, et al. Taking forward a 'One Health' approach for turning the tide against the Middle East respiratory syndrome coronavirus and other zoonotic pathogens with epidemic potential. Int J Infect Dis. 2016 Jun;47:5-9. doi: 10.1016/j.ijid.2016.06.012. Epub 2016 Jun 15. PMID: 27321961; PMCID: PMC7128966.