

# Nipah virus: Transmission Dynamics, Epidemiology, Clinical Features and Advances in Diagnosis and Treatment

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## ABSTRACT

Nipah virus (NiV) is the causative agent of Nipah viral disease, which belongs to the genus *Henipavirus* and is a zoonotic virus. This newly emerging Biosafety level 4 pathogen can cause fatal encephalitis and other respiratory infections. From its natural host (fruit bats), its ability to spread from animals to humans and then person to person and its high fatality rate make it a severe threat to global health. The Nipah virus has been associated with multiple outbreaks, it was named Nipah because the first case of NiV was reported in 1998 from Kampung Sungai Nipah Village of Malaysia. This article aimed to provide an overview of the transmission, epidemiology, symptoms, control strategies, advances in diagnostics and treatments from the recent investigations on NiV.

**Keywords:** Nipah virus, epidemiology, transmission, treatment, zoonotic, vaccines, control

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### Introduction

The Nipah virus (NiV) is a newly discovered zoonotic paramyxovirus and highly lethal bat-borne pathogen which is classified as Biosafety level 4 pathogen due to its high mortality rate. NiV belongs to the genus *Henipavirus* similar to Hendra virus (HiV). Initial outbreak was recorded in Malaysia from 1998 to 1999 with <40% of mortality rate, later on subsequent outbreaks were observed in Bangladesh, India and Philippines with high >70% of mortality rate [1]. NiV is an RNA virus and its genome consists of negative sense single stranded RNA and encodes six major proteins such as Glycoprotein, Fusion, Nucleocapsid, Phosphoprotein, Matrix and Large Polymerase. For viral replication all of these proteins are needed [2]. Natural reservoir host for NiV is *Pteropus* bat also known as flying foxes, from the carrier specie pigs were infected by NiV with signs of nervous system and respiratory illness [3]. NiV infections represents a serious threat to global security therefore there is a need for more investigations to stop any future outbreak.

### Transmission

The Nipah virus viral disease transmission initiates from the natural reservoir host (fruit bats), from fruit bats the NiV breaks its species-barrier and infects the pigs. Pigs were infected via ingestion of contaminated date palm sap with infected bat's saliva, feces and urine [4]. Humans can be infected while using the contaminated fruits or its derivatives in the form of juices/alcohol and can also be infected via climbing the NiV contaminated trees [5]. Furthermore, human can also be exposed with risk factor by means of intermediate hosts such as domestic animals via consumption of their meat or dealing with them. A NiV infected person can infect other people through respiratory droplets and saliva spittle [6]. By means of transportation of NiV contaminated fruits/its derivatives and infected domestic animals can escalate the NiV infections to other locations.

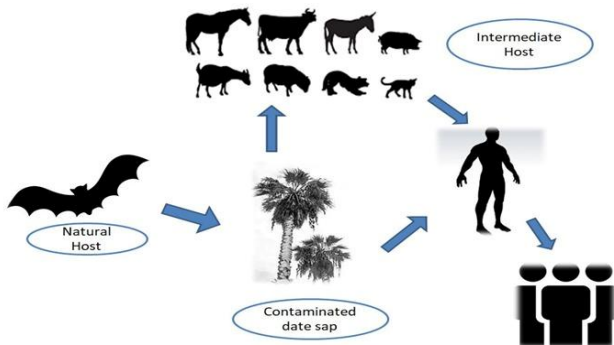


Fig. 1: Transmission

### Epidemiology

In March 1999 NiV was first identified in cerebrospinal fluid (CSF) of a patient from Malaysia. During outbreaks in Malaysia:

- 1998: 283 cases and 109 death incidents were reported
- 1999: 265 cases and 105 deaths were recorded

In the same year (1999) 11 cases and 1 death was observed in Singapore [7]. During outbreak (2001-2024) in Bangladesh the total reported cases of NiV is 341 and death toll is 242. In India the overall cases are 102 and 74 reported deaths during 2001 to 2023. In Philippines (2014) 17 cases and 9 deaths were reported [8]. In 2026, three more cases are reported 2 cases in west Bengal, district parganas, India and 1 case in Naogaon, Bangladesh [9].

### Clinical features

Nipah virus infection cause acute encephalitis by infecting the neuron and glial cells. NiV infection also leads to respiratory illness due to injury to alveolar epithelial cells [10]. Initial symptoms include headache, weakness and fever which may lead to confusion and finally coma. In some patients vomiting, cough, respiratory distress, altered mental status and convulsion are also observed [11].

### Lab diagnosis and treatment

For diagnosis of Nipah virus RT-PCR, IgM-ELISA, virus isolation, histopathology, and whole genome sequencing techniques are used [12]. PHV02 and ChAdOx1 NipahB are anti-Nipah vaccines that are under-development [13]. But these vaccines are not approved yet. Antiviral drug such as Ribavirin was used to treat NiV infections during 1998 because of its broad-spectrum activity, effective against both DNA and RNA viruses. Antimalarial drug chloroquine was also used and its effective in in-vitro but ineffective in in-vivo NiV infections [14].

### Challenges in vaccine development

Developing a vaccine for a low-incidence but high-fatality rate pathogen (NiV) poses multiple challenges. Firstly, the outbreaks of the NiV are limited and sporadic in nature, which causes difficulty in conducting large scale clinical trials. Moreover, outbreaks are recorded in developing countries which have limited facilities such as BSL-4 Laboratories. Furthermore, lack of sufficient sample size due to sporadic outbreaks and low commercial and economic incentives are the challenges for developing a vaccine for the Nipah virus.

### Prevention

According to World Health Organization (WHO):

- Minimize the risk of infection in people
- Decrease the risk of bat to human, person to person and animal to human transmission.
- Control NiV infection in animals and in healthcare settings [15].

Avoiding direct contact with NiV host, infected animals and peoples and avoiding consumption of contaminated food can reduce the NiV transmission [16].

### Conclusion

The Nipah virus is a novel pathogen responsible for zoonosis, imposing a major impact on public health as a result of its high mortality rate. There is a need to raise more awareness of risk factors and conducting more investigations to minimize the transmission and pathogenesis of Nipah virus. Furthermore, development of an approved vaccine or therapeutic drug is essential before any future re-emergence or pandemic.

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