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Nipah Virus Infection in Asia Region: A Review Update

Poly Akhter

Learning Mentor (Abbey School, Chester, England), Chester, Cheshire, England

Abstract

The Nipah virus is extremely virulent and has been linked to neurological and respiratory diseases in both humans and animals. Fruit bats, virus-containing fruit and date juice consumed by animals, as well as airborne droplets, are the main sources of the virus's dissemination. Over the previous decades, Asian countries have experienced several epidemics and significant fatality rates. Additionally, the Nipah virus infection disrupted the socio-economic progress of the affected nations, which hinders the achievement of the SDGs. [*Bangladesh Journal of Infectious Diseases, June 2022;9(1):31-37*]

Keywords: Nipah virus; NiV infection; Asia; SDGs; Socio-economy

Correspondence: Dr. Poly Akhter, Learning Mentor, Abbey School, Chester, England; Former Medical Officer, Indira Gandhi Memorial Hospital, Maldives; Former Graduate Teaching Assistant, University of Chester, 36 Cornwall Street, CH13JF, Chester, Cheshire, England; **Email:** poly.vnsc07@gmail.com; **Cell No.:** +447592235865; **ORCID iD :** https://orcid.org/0000-0002-1198-0492

Introduction

Ten major outbreaks occurred by various virus types that were highly infectious and deadly from 1967 to 2020[1]. Marburg had the highest fatality rate of 80.0% among these ten outbreaks, which caused an outbreak[2]. The novel Coronavirus infected around 270.2 million people until December 2021, and more than 5.3 million deaths occurred, which had a fatality rate of 2.2% in January 2020[3]. The second-highest fatality rate was 77.6 % for the Nipah virus in 1998[4]. Nipah virus (NiV) causes Nipah virus infection, a zoonotic disease transmitted by an animal to humans through contaminated food and human to human through direct transmission[5]. Nipah virus is a profoundly virulent, bat-borne virus widespread throughout tropical climates[6]. *Nipah henipavirus* belongs to the Mononegavirales order, the Paramyxoviridae family and several species of Pteropus fruit bats are the natural sources of infection[7]. It can be asymptomatic and infectious, which causes respiratory illness, seizures, and fatal severe encephalitis[8]. This study demonstrates Nipah virus infection as a public health issue by knowing theories, models, strategies, and ethical aspects. This assignment critically explains the importance of the Nipah virus as a health-related problem by using epidemiological data and principles of population health that relate to socio-economic development. It also addresses the ethical issues and implications done for this highly infectious disease and critically discusses the different measures taken by the community to control the disease in Asian countries.

Critically Examines Nipah Virus Infection as a Contemporary Public Health Issue

A total of 700 instances of Nipah virus infection have been detected from 1998 to 2018 worldwide, and among them, 50.0 to 75.0% died after being

infected with the Nipah virus[9]. Due to NiV infection, 17 deaths were reported in India in May 2018[10]. Even though only a few cases have been detected so far in several Asian nations, because of the virus's highly infectious features, it has the potential to infect many animals and humans, posing a threat to public health[11]. Symptoms and further laboratory investigation can diagnose the disease[12]. There is no specific treatment for NiV infection; only symptomatic management can be given. Up until this point, no vaccine has been developed[13]. The Nipah virus is classified as a priority disease on the World Health Organization's research and development roadmap list[14]. The organization is worried that NiV infection is a public health issue that requires close monitoring, research, and development[15].

Historical Perspective of the Nipah Virus

The virus was officially titled "Nipah" after the name of the Nipah river village (Kampung Sungai Nipah)[16]. Nipah Virus was first discovered in a pig farm around September 1998 in Ipoh, the northern side of Peninsular, Malaysia. Moreover, some farmers of Ipoh sold the pigs in a cut-rate sale, and some pigs crossed the border, including some areas of the South such as Sikamat, Kampung Sungai Nipah, Kampung Sawah, and Bukit pelanduk[17]. The third severe outbreak occurred in Bukit Pelanduk in December 1998[18]. However, the cases were initially diagnosed as Japanese B encephalitis (JE) with previous outbreak history in Malaysia, and treatments and prevention measurements were taken accordingly. Later, it revealed that most cases had a contact history with pigs and members of the same household, which was not like Japanese B encephalitis[19]. The rate of infectivity was more than Japanese B encephalitis which was 1:300[20]. Additionally, the affected persons were adult males and held an immunization history against JE and anti-JE. Furthermore, it was reported that pigs had severe coughs and fatality[17]. Meanwhile, The University of Malaya Hospital discovered the Nipah virus from the Paramyxoviridae family, which reacted with the Hendra virus antibody in March 1999[21].

Demography and Epidemiology of Nipah Virus

Malaysia/Singapore: During the first outbreak of Nipah in Malaysia, in 1998, among five hundred thousand population, NiV infected 27 people and 15 people died. After the post-mortem, it was confirmed that 9 of the people died because of NiV infection[22]. The following outbreaks occurred in South and Bukit Pelanduk, where more than 180 people were infected[22]. Serum was collected from 28 patients, where Japanese encephalitis (JE) specific IgM and JE nucleic acids were found in 4 serums[23]. Hence, to prevent the occurrence of Japanese encephalitis, the government took measures such as JE immunization and killing mosquitoes[24]. Meanwhile, 500 cases were detected in Singapore who worked in a slaughterhouse with symptoms of fever and respiratory illness or neurological disease[25]. The Ministry of Health tracked down the cause of the outbreak that revealed pigs imported from a Malaysia farmhouse spreading the infection and slaying 2 to 3 weeks prior to the spread of the disease[26]. However, it was revealed by University Hospital, Kuala Lumpur, that the cause of outbreaks was Nipah virus infection[27]. Malaysia was a predominantly Muslim country that was unlikely to have a contact history with pig and pig-containing food. After thorough investigations, a natural reservoir for the virus was found: Pteropodid fruit bats[28]. Bats usually eat fruits. Partially eaten fruits may be dropped down into pigsties, and pigs can be infected by eating contaminated food[29].

Bangladesh: In 2001, the outbreaks occurred in 20 districts of Bangladesh located in the central and north-western regions during the winter season. Drinking date juice is the primary derivation of spreading the virus[27]. Date juice is ubiquitous and famous in the winter season in Bangladesh. The date juice is collected by snipping the husk of the date palm tree at the top, and then a pot attached to the tree collects drip of the nectar overnight[30]. Pteropus species bat consumes the nectar and infects it with saliva, urine, and excreta. At the same time, a human consumes the same nectar the virus transmits from bat to human[31]. Moreover, the virus can be transmitted by people climbing the poisonous date tree, eating contaminated fruits, and contacting sick animals and humans[32]. Domestic animals are being infected by eating contaminated saliva and mixing fruits[33]. A retrospective investigation was done in two villages in Bangladesh to identify clinical features, causative agents, risk factors, and natural and animal reservoirs. Immunoglobulin M for IgM antibodies and indirect EIA for IgG antibodies were tested in the Centers for Disease Control and Prevention (CDC) to affirm the diagnosis. Samples were taken from severely ill patients having encephalitis and identified Nipah virus[34]. The critical source of spreading the disease in Bangladesh is man-to-man transmission[35]. The largest outbreak occurred in 2004 by droplet infection and was identified in saliva[36]. The Nipah virus has been a flare up in Bangladesh since 2001. In 2009 another outbreak

occurred in Rajbari and Manikganj, and cases were reported of encephalitis and severe respiratory illness[37]. Between 2010 to 2012, multiple outbursts occurred in different places in northern Bangladesh, such as Faridpur and Lalmonirhat. The experts could not control the death from the disease; hence the fatality rate was high[38]. About 24 patients were detected having Nipah virus infection in 2013 and 21 of them died where male and female patients were 16 and 8 respectively, and the age was between 8 months to 60 years[39].

Table 1: Outbreaks of Nipah Virus[40] from 1998-2013

Year	Country	State or District	Cases	Deaths	Case fatality
1998-1999	Malaysia	Perak, Selangor, Negeri Sembilan states	265	105	40%
1999	Singapore	Singapore	11	1	9%
2001	India	Siliguri district, West Bengal	66	49	74%
2001	Bangladesh	Meherpur district	13	9	69%
2003	Bangladesh	Naogaon district	12	8	67%
2004	Bangladesh	Faridpur and Rajbari districts	67	50	75%
2005	Bangladesh	Tangail dstrict	12	11	92%
2007	Bangladesh	Thakurgaon, Naoga and Kushtia districts	18	9	50%
2007	India	Nadia district, West Bengal	5	5	100%
2008	Bangladesh	Manikgonj, Rajbari and Faridpur district	11	9	82%
2009	Bangladesh	Rajbari, Gaibandha, Rangpur and Nilphamari districts	4	1	25%
2010	Bangladesh	Faridpur, Rajbari, Gopalganj and Madaripur districts	16	14	88%
2011	Bangladesh	Lalmonirhat, Dinajpur, Comilla, Nilphamari and Rangpur districts	44	40	91%
2012	Bangladesh	Joypurhat Rajshahi, Natore, Rajbari and Gopalganj districts	12	10	83%
2013	Bangladesh	Gaibandha, Jhinaidaha, Kurigram, Kushtia, Magura, Manikgonj, Mymenshingh, Naogaon, Natore, Nilphamari, Pabna, Rajbari and Rajshahi districts	24	21	87%

India: Two separate incidents of the Nipah virus were reported from 2001-2009 and occurred across the demarcation line from Bangladesh's Nipah zone[41]. Initially, in 2001, 11 infected patients were admitted into the hospital; for further treatment, the patient got transferred to another hospital, which caused the further infection, and 25 hospital staff and 8 visitors got infected[42]. During the first outbreak, 45 cases died among 66 patients, and during the subsequent outbreak, 4 cases were infected in 2007, with a 100.0% fatality rate[43]. In 2007, the first case had a history of taking alcohol made of date palm, and other subjects were infected by the first case[38]. The recent outbreak happened in 2018 in districts of Kerala named Kozhikode and Malappuram;17 people dead among 18 affected people[10]. There was no history of Nipah virus infection in this area before and separate from the areas previously affected by the virus. The date juice was not typical in that area, and the spread of the infection was by a contacted health care professional[44]. The affected groups mainly were from economic aged and different age groups. Moreover, all the outbreaks that occurred in India were human-to-human transmission[45].

Philippines: Seventeen persons were identified for NiV infection in an island of the Philippines named Mindanao in 2014, where two deaths, eleven cases of encephalitis, five influenza-like illnesses, and one meningitis were recorded[46]. The Philippines National Epidemiology centre confirmed the testing for henipavirus, where antibodies against NiV and IgM against NiV were confirmed. The fatality rate was 53.0%, the rate was high (82.0%) in patients with acute encephalitis[47]. Around 10 cases had contact history with horses or meat of horses. At the same time, ten horses died having neurological symptoms; however, the horses were not tested for NiV infection. Five cases were infected through man-to-man transmission; among them, 2 cases were health care professionals[48]. Later, it revealed that the strain was like the Malaysian strain, either a mutation strain or collaboration or multiple strains[49].

Achieving Goal of SDGs

The United Nations agreed on an agenda 2030, Sustainable Development Goals (SDGs), consisting of 17 goals that focus on peace and prosperity in developing and developed countries[50]. SDGs aim to end poverty, inequality, and deprivation and improve the education system and economy. All the members will conserve the forest and ocean along with lives under oceans and intercept climate change[51]. Most of the emerging infectious diseases are arisen from wild animals and become infectious due to intermingling with domestic birds or animals. The occurrence of infectious diseases depends on the population size and wildlife varieties[52]. Nowadays, due to the destruction of forests and the growth of industries and agricultural land, the build-up of the animal firm hampering the climate and wildlife. Wild animals and birds are traveling to the urban area, searching for food, and transmitting the disease to local animals, birds, and humans[53]. For example, the beginning of the Nipah virus occurrence in 1998 happened in a pig farm located in the countryside area, near to tropical rainforest where the fruit bats (reservoir of Nipah virus) resided[54]. The bats are the reason for the emergence of the Nipah virus, Ebola virus, SARS, and areas affected by those viruses were the place for haunting wildlife and living place of wild animals[55]. Humans are being infected due to contact with wildlife or infected domestic animals. Multiple socioeconomic developments must be required,

including the strategy of SDGs need to imply, to minimize this problem[56].

The goal 3 implies to confirm healthy lives and promoting health and well beings[57]. Infectious diseases like the Nipah virus increase the rate of hospital admission, morbidity, and mortality that impairs the goal three strategies[58]. Hence, to achieve goal three, infectious diseases need to be controlled. Moreover, there is a strong relation between infectious disease with environmental policy[59]. The destruction of forest and the extermination of wild animals from their inhabited region increases the chance of transmitting the virus and hamper the achievement of SDGs goal 15 that focuses on the existence of living species on land[60]. The main aim of this goal is to conserve and re-establish the forest that encourages earth ecologies[61].

The purpose of SDGs 2 is to increase the productivity of crops and livestock that will improve the agricultural system, reduce food hunger, and increase food security among the people[62]. Around 2.37 billion people cannot have a healthy diet in the world[63]. During any pandemic, the rate of impoverished people increases; as a result, it is challenging for people to meet their basic needs[64]. Hence, a vast number of people encounter hunger. In 2020, almost 70 to 161 million had experienced starvation during the pandemic. The most vulnerable groups were the reproductive age group and children. One-third of total reproductive age women had anaemia due to having less nutritious food[65]. Additionally, some pig farms were destroyed previously due to the transmission of the Nipah virus from bat to pig and other domestic animals, which affected livestock productivity[66]. Hence, it can be said that infectious disease can obstruct achieving goal 2. However, to increase the productivity of crops and livestock, it may need to destroy the forest, wildlife life may be curtailed, and the risk of infectious diseases like the Nipah virus may increase[67].

Socio Economic Determinants of Nipah virus Infection

Workers from China and other Asian countries ran the farm in Peninsular Malaysia in 1998 and 1999. Farmers lived in the farmhouse, passed down through the family[68]. They sold the meat and food from the pigs in the local market and shipped them overseas to Singapore and other Asian countries. They also supplied the local markets[69]. This is on top of them lending a helping hand to the neighbourhood's bank and shops. Young adults began to work in banks, shops, and farmhouses due to increased employment options[70]. The outbreak of the Nipah virus infection, on the other hand, had destroyed the company. Eight thousand five hundred direct pig farm workers, 9400 supported workers in pig farm industries, and 3,00,000 workers from other industries were affected during the Nipah Virus outbreak in Malaysia[71]. The pigs were infected and died because of the infection. It was recommended that the pigs be slaughtered, and the export of pigs to other countries was put on hold[72]. The virus had the most significant impact on farmers, who were either admitted to the hospital or died due to the infection. The death of the farmers had an impact on the family member who died and influenced the economy of the region[73]. The government encouraged to start off another agricultural and animal farmhouse and provided free medical services. The government offered a donation of 32 USD to the families of the pig farm; however, the amount was insufficient to stock up the pig farm business. Hence, the pig farm business and other local businesses were closed[74]. Local authorities collected funds from the public to help the devastated family. Around 91.0% of patients had received USD 6950, while half of the dead patients received 1400 USD for their funeral[11].

The drink of date juice is popular among children and adults in Bangladesh during the winter season. Date juice is commonly used to make date jaggery and pithas a type of pancakes or fritters[75]. Local markets and other districts in Bangladesh used to be flooded with date juice, date jaggery, and pithas, which were sold by locals[76]. People became ill due to the Nipah virus outbreak and were admitted to hospitals, placing a significant financial strain on their families. The Nipah virus was also extremely contagious, as previously stated[35]. It had an impact on other family members and healthcare workers, which resulted in an increase in hospital admissions and a burden on hospitals due to the limited number of beds available[77]. Bangladesh is a country with a population that is moderately educated[78]. People began to isolate themselves, which had a negative impact on their families. Rather than assisting, they began to avoid family members, which had a negative impact on their social and psychological well-being[38].

Domestic animals (cows and goats) were also affected and died due to the effects of the Nipah virus, which had an adverse economic impact on the local market[15]. Bats are known to consume fruits from the surrounding area[79]. Children in Bangladesh died after consuming bat fruit that had been partially digested[80]. Farmers and vendors at

the fruit market have also reported a low selling rate for their products[81].

Conclusion

According to aetiology and demography, it implies that, Nipah virus infection is a highly contagious zoonotic disease circulating for the past two decades. After thorough analysis it is discovered that, even though bats spread the initial outbreak to pigs, it later spread from bats to humans and from humans to humans. Epidemiological data shows that, many pig farms were destroyed due to NiV because of the high mortality and morbidity rates among animals and humans. Acute encephalitis and respiratory illness necessitate hospitalization and treatment on an emergency basis. To reduce the frequency of Nipah virus infection outbreaks, WHO, government agencies, and various social work organizations collaborate. However, outbreaks persist due to inadequate awareness about the spread of infection, poor education, a shortage of surveillance, an inappropriate isolation strategy, and poor hygiene maintenance.

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Conflict of Interest
We declare that we have no conflict of interest.

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Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
None

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