

Review Article

Kampung Sungai to Kerala: A Deadly Zoonotic Trail Encroaching Diverse Geography

S. M. Rashed Ul Islam^{*}, Munira Jahan

Department of Virology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh

Email address:

smrashed@bsmmu.edu.bd (S. M. R. Ul Islam), mjahan1970@yahoo.com (M. Jahan)

^{*}Corresponding author

To cite this article:

S. M. Rashed Ul Islam, Munira Jahan. Kampung Sungai to Kerala: A Deadly Zoonotic Trail Encroaching Diverse Geography. *Science Journal of Public Health*. Vol. 9, No. 2, 2021, pp. 43-48. doi: 10.11648/j.sjph.20210902.12

Received: December 31, 2020; **Accepted:** January 11, 2021; **Published:** March 26, 2021

Abstract: Nipah virus is an emerging zoonotic virus which causes fatal encephalitis in the South-East Asia region since 1999. Thereafter, it is prevalent almost every year in the different parts of Bangladesh and India. The aims of this analysis is to describe the epidemiological patterns of the Nipah infection and also to highlight the factors for the recurrent outbreak in this region. Intensive web searching was done for documents and journals on Nipah Virus infection and Nipah outbreak from 1999 to 2019. A total of 279 research documents were found and about 40 papers, especially the PubMed indexed sources and newsletters distributed by different public health agencies were selected for the meta-analysis. Information gathered from the selected journals and documents were described in text and figures. The analysis revealed that fruit bats of the Pteropus genus are the natural hosts of the virus. After documentation of the only outbreak in Malaysia in 1999, Nipah virus struck in 2001 for the first time in Meherpur of Bangladesh and thereby, creating a public health issue for every year. In 2018, this deadly zoonotic virus caused a fatality in Kerala, India which is far away from its usual prevalent region. This infection starts with the ingestion of Nipah infected raw date palm sap and direct contact with the infected person. Early diagnosis and strict isolation of the infected persons are the mainstays to prevent an outbreak. Presently, Nipah virus infection is now one of the ten priority diseases listed by the World Health Organization considering its high fatality rate. However, effective health education and infection control practice is still considered as the mainstay of prevention of future Nipah outbreak.

Keywords: Nipah Virus, Fruit Bats, Human to Human Transmission, Encephalitis, Health Education, Infection Control

1. Introduction

Nipah virus is one of the two members of genus Henipa which belong to the family *Paramyxoviridae*. Flying fruit bats or flying fox harbouring the Nipah virus is responsible for transmitting the virus to a wide host range causing illness and death of animals and humans [1]. It was first reported in 1998-1999 with 283 cases of febrile encephalitis including 109 deaths in Malaysia [2]. In it was detected from Meherpur in 2001. After that, the Nipah outbreak has occurred in every year mainly in the northern part of Bangladesh and also the adjoining parts of India [3]. Recently, Nipah infection has struck the Kozhikode district, Kerala of India (Figure 1) which is considered to be an outskirts from the usual Nipah prevalent regions. Considering a new outbreak in that part of

India, early laboratory confirmation and infection containment has limited the spread and successfully contained the disease [4]. The aim of this article to elucidate the current situation analysis of the Nipah outbreaks of South East Asia regions and identifying the factors to combat such fatal infections.

2. Methods

A systematic review was conducted from various journals and articles from 1999 to 2019. Information was retrieved from documents available mainly in the electronic database and on the websites, using the terms Nipah Virus infection and Nipah outbreak etc. Results and comment from other researcher's work were also evaluated. Around 279 research

papers were retrieved from several national and international publications and among them, about 40 research papers were reviewed for preparation of this article. Most of the selected articles were from PubMed indexed and various online collection on Nipah virus related issues, reports on

quantitative and qualitative studies, estimates of Nipah cases, the source of infection, policy analysis, and government strategies. Data gleaned from the research papers were analyzed and results were presented in texts and chart/graph as per the requirements.



Figure 1. Trail of Nipah virus infection in South East Asia Region.

3. Results

3.1. National Host and Outbreak Detection

Large fruit bats of the genus *Pteropus* appear to be the natural reservoir of Nipah virus [5]. In Bangladesh, the only *Pteropus* species "*Pteropus giganteus*" are the reservoirs of Nipah virus which are widely distributed across the country and also in India [6]. Usually, Nipah virus infection has a short incubation period of 4 days to 2 weeks but may extend up to 45 to 60 days [2]. Clinical features range for asymptomatic influenza-like symptoms e.g. fever, vomiting, sore throat headaches and myalgia to fatal encephalitis. Nipah cases are confirmed by various laboratory tests like neutralization test, enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR) assay, immune-fluorescence assay and virus isolation by cell culture technique [7].

3.2. The Situation in Malaysia and Singapore

The majority of the Nipah Virus infection cases in Malaysia [8] and Singapore [9] were acquired from infected pigs. Clinical features of this new infection being similar to Japanese encephalitis (JE) misled the investigator at that time. But later, it was confirmed to be a new zoonotic disease and was named as per the village "Sangai Nipah" [10]. At that time, an association of this new infection with Pig were anticipated as many of the victims were from pig farm who had direct physical contact with sick Pig [11]. A retrospective study revealed that, during that outbreak, pigs were sick having a barking cough and dying from an unknown disease [12]. After the Nipah outbreak confirmation, all the infected pigs were culled within the area of the outbreak [13]. After an in-depth scientific evaluation, Nipah virus was internationally classified as Biosafety Level (BSL) – 4 agent [14].

3.3. Situation in Bangladesh

Nipah virus was first detected as a cause of an outbreak of encephalitis in 2001 in Meherpur district. Since then, outbreaks of Nipah virus encephalitis have been reported almost annually till 2015 in selected districts of Bangladesh causing high case fatality [4] (Figure 2). So far, about 28 districts have been known for Nipah occurrence. Among them, outbreak from this virus has been reported 7 times in Rajbari,

5 times in Naogaon & Faridpur, 4 times in Nilphamari & Natore and 3 times in Kustia, Magura, Manikong & Rangpur [15, 16]. Consumption of raw date palm juice contaminated with urine or saliva from Nipah infected fruit bats was the most likely source of infection in Bangladesh. But human to human transmission among the family members from close contact was also documented in the year of 2004 and 2007 where respiratory secretion was reported to be the most likely source of infection [17].

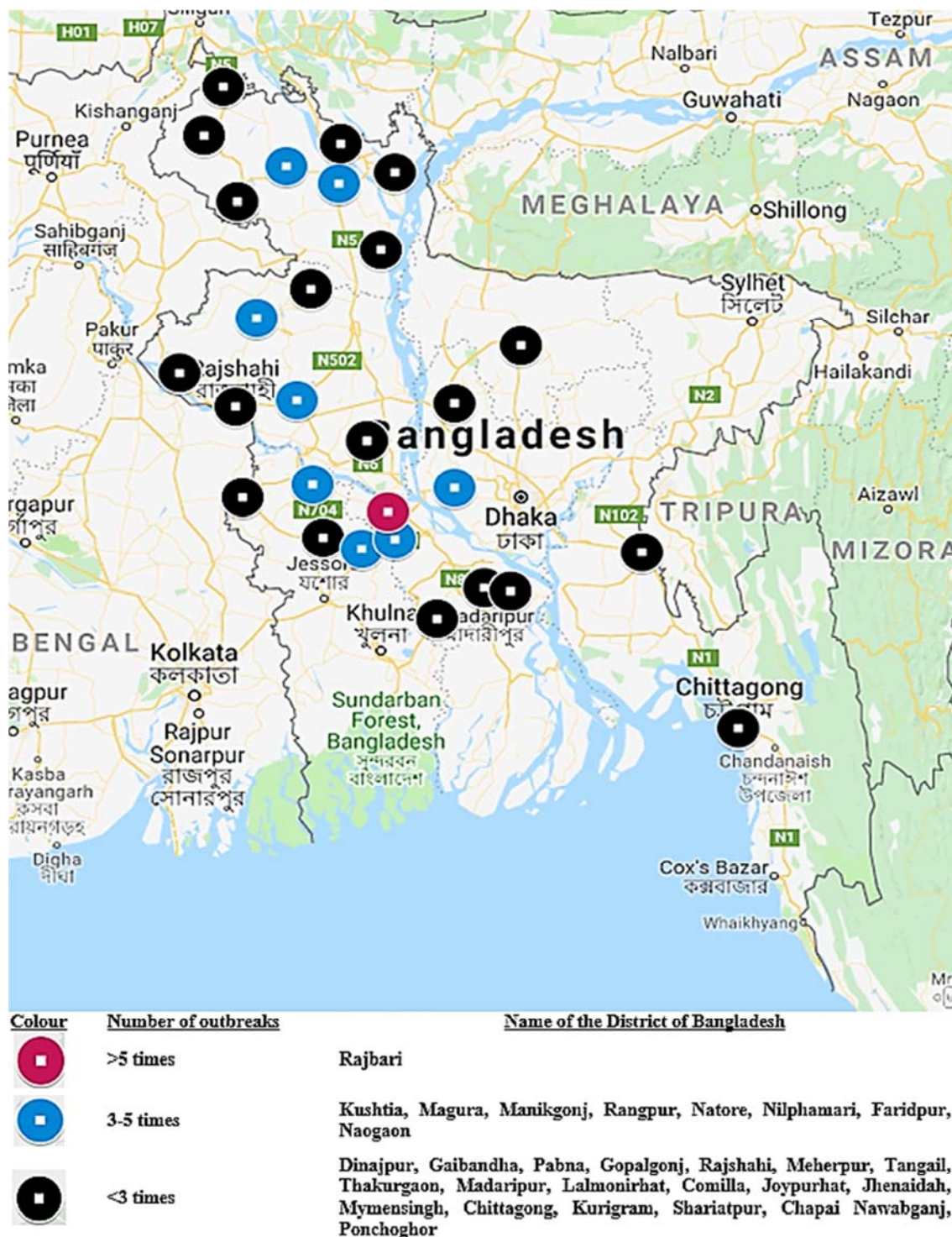


Figure 2. Nipah virus affected region in Bangladesh 2001-2019.

3.4. Situation in India

Apart from the recurrent outbreaks in Bangladesh, Nipah virus infections are also reported from the adjoining border area of India, namely Siliguri (2001) and Nadia (2007) of West Bengal [3]. The mode of transmission of these outbreaks was human to human source following nosocomial infection [18]. In the year of 2018, the outbreak in Kerala has cost 21 lives out of 23 laboratory-confirmed cases and all the cases except the index case were transmitted through human to human transmission. However, how the index case got infected is still unknown. 97% Nipah virus genome sequence were found similar to previous Nipah-Bangladesh genetic lineage [4]. Currently, Nipah virus infection is now considered as one of the ten priority infection by World Health Organization in terms of its fatal nature [19].

3.5. Credible Factors Causing Episodic Outbreaks of Nipah Virus Infection in South East Asia Region

Since the first case in Bangladesh, almost every year mainly in the winter season, the virus flares up around cluster districts near the Padma River flowing through the western side of the country [20]. In this region, people are getting infection directly by consuming date palm sap contaminated by infected fruit bats. But, human to human transmissions are becoming prevalent which was not previously observed in Malaysian settings [8].

Some common associations have been observed in the transmission of Nipah virus infection to human. It seems to occur only between December to April coinciding with the time of collecting palm sap and infected from drinking contaminated palm sap. Another hypothesis linked with the bat's breeding cycle's time. A large number of newborns pups carrying Nipah viruses are available, at that time might shed virus in urine and contaminating a large number of the date palm sap [21].

Recurrent attacks of Nipah virus infection have been recognized since 2001 [6, 22, 23] and substantial heterogeneity of their nucleotide sequences was seen among the strains of Nipah isolates, causing the repeated introduction of Nipah virus from its reservoir to the human population. But all the Nipah virus strains from human cases were genetically similar to Malaysian outbreaks [24]. Nipah antibody was regularly found in blood samples collected from *Pteropus giganteus* bats of Bangladesh and neighbouring India [25] but the condition which permits recurrent Nipah virus infection to a human in Bangladesh are yet to be identified.

Another important factor contributing to the high frequency of Nipah virus infection is person-to-person transmission [23]. It was observed to spread very rapidly among the family members through the respiratory route before any kind of intervention or anticipation of an outbreak could be made.

4. Discussion

Although Nipah virus infection causes smaller outbreaks in Bangladesh and India, the case fatality rate remains higher (>75%) over the years than the outbreaks from Malaysia and

Singapore (>40%) [23, 26]. This repeated outbreak from Bangladesh has demonstrated both foodborne transmission and also human to human transmission [22, 23]. Usually, date palm sap is collected and harvested from December to April when *Pteropus giganteus* bats frequently visit and lick the sap [27]. Traditionally, people in this region are used to enjoy the delicious raw sap together in a family within a few hours of collection increasing their vulnerability to Nipah infection [28].

Most of the patients who had presented with acute meningoencephalitis had died by the time a diagnosis was made, which creates difficulty in isolating the case and build up strategies to prevent nosocomial transmission [29]. The physician and health caregiver in such settings are more vulnerable to Nipah infection as they are attending emergency outdoor patients without wearing personal protective equipment (PPE) because of their unawareness of impending outbreak [30]. But, these tendencies have been greatly reduced after a mass awareness campaign and training program run by the government.

Prevention strategies should focus on the people (Gachhis) along with their families who collect the date palm sap and also the health caregiver who will attend the Nipah cases. Various local approaches have been developed to prevent pests and bats from accessing the sap. But most efficient is the bamboo skirt method (Figure 3) which covers both the shaved part of the tree and also the mouth of the pot, making it difficult for the bat to access the sap. Other methods like using mosquito net or cloth to cover the mouth of the containers should also be employed where necessary [31]. Gachhis should take bath after collection of palm sap as the surfaces of trees are often contaminated with bats urine harbouring the Nipah virus. After collection, they should refrain from drinking it raw; instead of boiling at high temperature is the single most effective method of prevention. Family members reporting to health-care with fever or flu-like symptoms should be given special attention. Residence from Nipah belt [32] should be made aware prior to every winter season through a mass media campaign (Figure 4). More emphasis should be put on a person to person communication by health care worker through courtyard or group meetings with special emphasis on those families who live on date palm sap collection and selling trade.



Figure 3. Bamboo skirt method to block fruit bats contamination date palm sap.

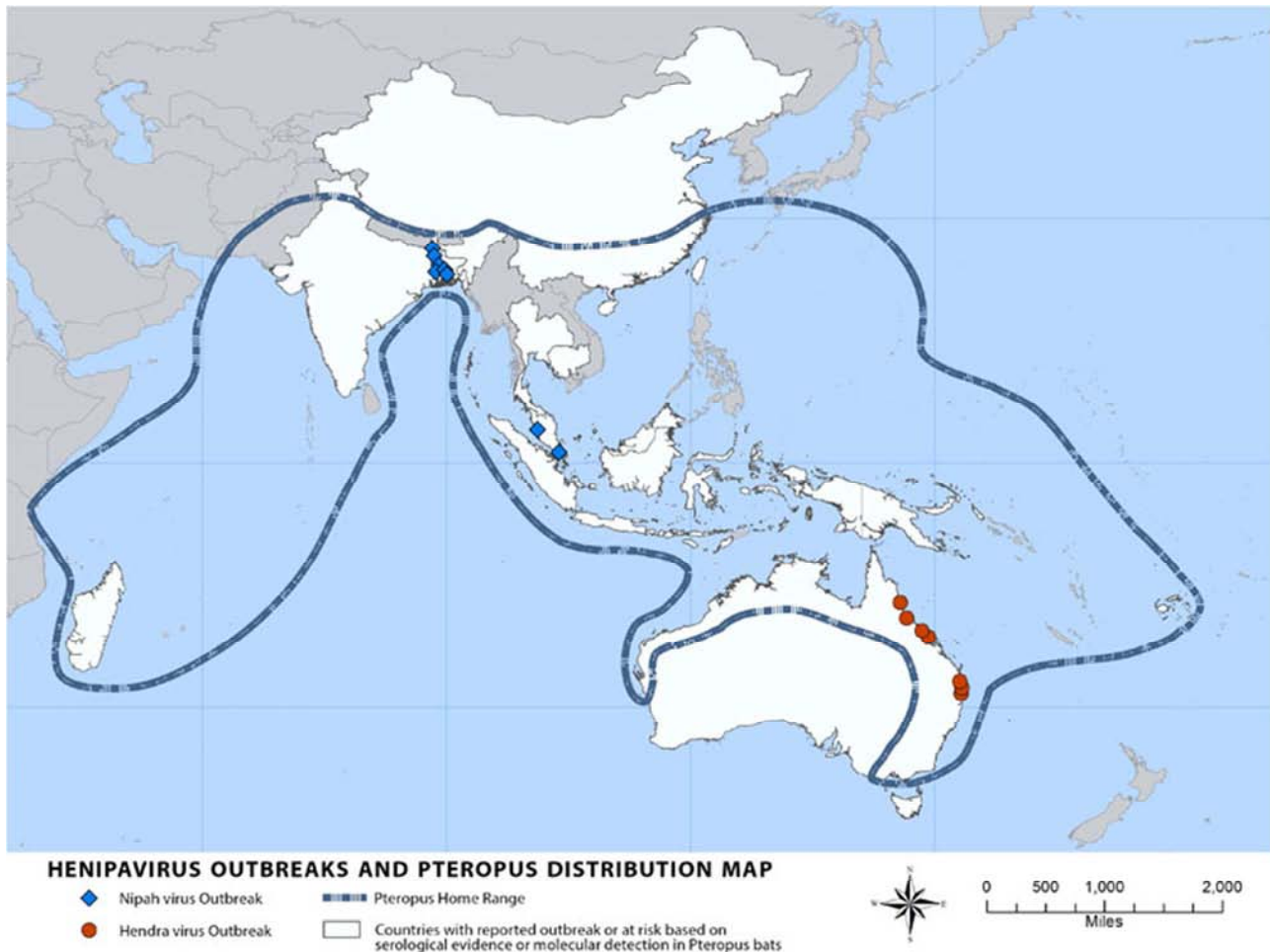


Figure 4. Risk of Nipah virus as per global distribution of Pteropus bats.

Another important mode of Nipah virus infection from the dead body handling is often ignored. During transportation and grieving situation, close contact should be avoided with a deceased's face, especially respiratory secretion. Personal protection should be taken during washing/ritual bath of a deceased body. Reusable items like clothes, utensils etc. of the identified individuals should be decontaminated with soap/detergent and beddings should be kept in sunlight for several consecutive days [33].

5. Conclusions

Clinicians in the Southeast Asia region should continue to be alert to the possibility of Nipah virus infection, before every Nipah season and gaps/drawbacks should be filled up after combating any outbreaks. Besides, continued surveillance and outbreak investigations will help to battle further Nipah occurrence.

References

- [1] Centers for Disease Control and Prevention (CDC). Update: outbreak of Nipah virus--Malaysia and Singapore, 1999. *MMWR Morb Mortal Wkly Rep.* 1999 Apr 30; 48 (16): 335–7.
- [2] Chua KB, Bellini WJ, Rota PA, Harcourt BH, Tamin A, Lam SK, et al. Nipah virus: a recently emergent deadly paramyxovirus. *Science.* 2000 May 26; 288 (5470): 1432–5.
- [3] Singh G, Raksha, Urhekar AD. Nipah: A killer virus. *Int. J. Adv. Microbiol Health Res.* 2018; 2 (2): 40-55.
- [4] Arunkumar G, Chandni R, Mourya DT, Singh SK, Sadanandan R, Sudan P, et al. Outbreak investigation of Nipah Virus Disease in Kerala, India, 2018. *J Infect Dis.* 2019 May 24; 219 (12): 1867-1878.
- [5] Yob JM, Field H, Rashdi AM, Morrissy C, van der Heide B, Rota P, et al. Nipah virus infection in bats (order Chiroptera) in peninsular Malaysia. *Emerging Infect Dis.* 2001 Jun; 7 (3): 439–41.
- [6] Hsu VP, Hossain MJ, Parashar UD, Ali MM, Ksiazek TG, Kuzmin I, et al. Nipah Virus Encephalitis Reemergence, Bangladesh. *Emerg Infect Dis.* 2004 Dec; 10 (12): 2082–7.
- [7] 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.
- [8] Chua KB, Goh KJ, Wong KT, Kamarulzaman A, Tan PSK, Ksiazek TG, et al. Fatal encephalitis due to Nipah virus among pig-farmers in Malaysia. *Lancet.* 1999 Oct 9; 354 (9186): 1257–9.

- [9] Paton NI, Leo YS, Zaki SR, Auchus AP, Lee KE, Ling AE, et al. Outbreak of Nipah-virus infection among abattoir workers in Singapore. *Lancet*. 1999 Oct 9; 354 (9186): 1253–6.
- [10] Chua KB. Nipah virus outbreak in Malaysia. *J Clin Virol*. 2003 Apr; 26 (3): 265–75.
- [11] Tan KS, Tan CT, Goh KJ. Epidemiological aspects of Nipah virus infection. *Neurol J South East Asia*. 1999 4: 77–81.
- [12] Looi LM, Chua KB. Lessons from the Nipah virus outbreak in Malaysia. *Malays J Pathol*. 2007 Dec; 29 (2): 63–7.
- [13] Lam SK, Chua KB. Nipah virus encephalitis outbreak in Malaysia. *Clin Infect Dis*. 2002 May 1; 34 Suppl 2: S48–51.
- [14] Daniels P, Ksiazek T, Eaton BT. Laboratory diagnosis of Nipah and Hendra virus infections. *Microbes Infect*. 2001 Apr; 3 (4): 289–95.
- [15] Ang BSP, Lim TCC, Wang L. Nipah Virus Infection. *J Clin Microbiol*. 2018 May 25; 56 (6): e01875-17.
- [16] Institute of Epidemiology, Disease Control and Research (IEDCR). Nipah situation. Available online: https://www.iedcr.org/index.php?option=com_content&view=article&id=146&Itemid=177 (accessed on 26 December 2019).
- [17] Hossain MJ, Gurley ES, Montgomery JM, Bell M, Carroll DS, Hsu VP, et al. Clinical presentation of nipah virus infection in Bangladesh. *Clin Infect Dis*. 2008 Apr 1; 46 (7): 977–84.
- [18] Chadha MS, Comer JA, Lowe L, Rota PA, Rollin PE, Bellini WJ, et al. Nipah Virus-associated Encephalitis Outbreak, Siliguri, India. *Emerg Infect Dis*. 2006 Feb; 12 (2): 235–40.
- [19] World Health Organization (WHO). World Health Organization Research and Development Blueprint of 2018 (6 to 7 February 2018, Geneva, Switzerland). 2018prioritization-Report.Pdf. Available online: <http://www.who.int/emergencies/diseases/2018/prioritization-report.pdf?ua=1> (accessed 20 December 2018).
- [20] Rahman M, Chakraborty A. Nipah virus outbreaks in Bangladesh: a deadly infectious disease. *WHO South East Asia J Public Health*. 2012 Jun; 1 (2): 208–12.
- [21] Stone R. Breaking the Chain in Bangladesh. *Science*. 2011 Mar 4; 331 (6021): 1128–31.
- [22] Luby SP, Rahman M, Hossain MJ, Blum LS, Husain MM, Gurley E, et al. Foodborne transmission of Nipah virus, Bangladesh. *Emerging Infect Dis*. 2006 Dec; 12 (12): 1888–94.
- [23] Gurley ES, Montgomery JM, Hossain MJ, Bell M, Azad AK, Islam MR, et al. Person-to-person transmission of Nipah virus in a Bangladeshi community. *Emerging Infect Dis*. 2007 Jul; 13 (7): 1031–7.
- [24] Harcourt BH, Lowe L, Tamin A, Liu X, Bankamp B, Bowden N, et al. Genetic Characterization of Nipah Virus, Bangladesh, 2004. *Emerg Infect Dis*. 2005 Oct; 11 (10): 1594–7.
- [25] Epstein JH, Prakash V, Smith CS, Daszak P, McLaughlin AB, Meehan G, et al. Henipavirus Infection in Fruit Bats (*Pteropus giganteus*), India. *Emerg Infect Dis*. 2008 Aug; 14 (8): 1309–11.
- [26] Lo MK, Rota PA. The emergence of Nipah virus, a highly pathogenic paramyxovirus. *J Clin Virol*. 2008 Dec; 43 (4): 396–400.
- [27] Khan MSU, Hossain J, Gurley ES, Nahar N, Sultana R, Luby SP. Use of infrared camera to understand bats' access to date palm sap: implications for preventing Nipah virus transmission. *Ecohealth*. 2010 Dec; 7 (4): 517–25.
- [28] Luby SP, Hossain MJ, Gurley ES, Ahmed B-N, Banu S, Khan SU, et al. Recurrent Zoonotic Transmission of Nipah Virus into Humans, Bangladesh, 2001–2007. *Emerg Infect Dis*. 2009 Aug; 15 (8): 1229–35.
- [29] Sazzad HMS, Hossain MJ, Gurley ES, Ameen KMH, Parveen S, Islam MS, et al. Nipah virus infection outbreak with nosocomial and corpse-to-human transmission, Bangladesh. *Emerging Infect Dis*. 2013 Feb; 19 (2): 210–7.
- [30] Nahar N, Paul RC, Sultana R, Sumon SA, Banik KC, Abedin J, Asaduzzaman M, Garcia F, Zimicki S, Rahman M, Gurley ES, Luby SP. A Controlled Trial to Reduce the Risk of Human Nipah Virus Exposure in Bangladesh. *Ecohealth*. 2017 Sep; 14 (3): 501–517.
- [31] Nahar N, Sultana R, Gurley ES, Hossain MJ, Luby SP. Date palm sap collection: exploring opportunities to prevent Nipah transmission. *Ecohealth*. 2010 Jun; 7 (2): 196–203.
- [32] Nipah Virus Distribution Map | Nipah Virus (NiV) | CDC. Available from: <https://www.cdc.gov/vhf/nipah/outbreaks/distribution-map.html>. (accessed on 26 December 2019).
- [33] Institute of Epidemiology, Disease Control and Research (IEDCR). National Guideline for Management, Prevention and control of Nipah Virus infection including encephalitis. December 2011. Available online: https://www.iedcr.org/pdf/files/nipah/National_Nipah.pdf. (accessed on 28 December 2018).