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Secondary Human-to-human Transmission of Nipah Virus in an Ambulance, Northwestern Bangladesh, February 2019

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Abstract

Nipah virus (NiV) infection is a zoonotic disease with epidemic potential due to its human-to-human transmission. In Bangladesh, where NiV infection is frequent, NiV spillover from fruit bats to humans usually occurs in winter. This study aimed to describe the magnitude and scope of a NiV outbreak in February 2019, identify the source of infection, and contain the spread of disease. We interviewed the cases' family members, conducted verbal autopsies, and collected samples for laboratory tests. Five family members reported died from, at the time, an unknown disease. All had fever, altered mental status, vomiting and diarrhea. Reverse transcription polymerase chain reaction confirmed NiV in one person. We suspected secondary transmission occurred when the family traveled with the primary case from their house to the hospital by ambulance. The trip took 8.5 hours and no one wore a face mask or gloves. The secondary attack rate among ambulance travelers was 67%. In this outbreak, NiV was transmitted human-to-human among riders in the ambulance. We recommend that everyone should use protective measures while traveling with suspected NiV infected patients to reduce the risk of transmission. Strengthening the existing Nipah virus surveillance system may generate earlier notification and response to contain further transmission.

Keywords: Nipah virus, outbreak, Bangladesh, zoonoses, transmission

Introduction

The World Health Organization categorizes Nipah virus (NiV) infection as an emerging infectious disease with epidemic potential.[1] Epidemics have occurred in Malaysia, India, and the Philippines.[2–4] In Bangladesh, NiV disease first appeared in 2001 and since then, 319 NiV cases and 225 deaths have been reported.[5,6] The northwestern and central parts of Bangladesh are known as the 'Nipah belt'.[7] In Thakurgaon District in Rangpur Division, a previous outbreak of NiV disease occurred in February 2007.[8]

Nipah virus is a paramyxovirus. Its most frequent transmission route in humans in Bangladesh is drinking raw date palm sap contaminated with bat excreta.[9,10] NiV spillover from bats to humans occurs mostly from December to May.[11] Human-to-human transmission among close contacts has been previously reported in two NiV disease outbreaks in Bangladesh and Kerala, India.[8,9,11–13] Approximately 3% of people exposed to NiV infected patients could develop the disease after 12–24 hours of exposure.[14] Elderly NiV infected patients with respiratory symptoms are more likely to transmit human-to-human NiV infection.[14] Adequate barrier control measures such as wearing a face mask and gloves can reduce NiV infection among close contacts and healthcare professionals.[8,9,13]

The Bangladesh Ministry of Health and Family Welfare started an Acute Meningo-Encephalitis Syndrome (AMES) surveillance system in 2007 with the objective to detect early meningo-encephalitis diseases.[15] There are sentinel sites in Rajshahi,

Rangpur, Faridpur, Chittagong and Khulna Medical College Hospitals that conduct active NiV disease surveillance. On 24 Feb 2019, the AMES surveillance system at Rangpur Medical College Hospital (RMCH) was alerted of the death of four people and one critically ill patient due to an unknown cause in a northwestern district of Bangladesh. We investigated this outbreak to describe its magnitude and scope, to identify the infection source, and to contain its spread.

Methods

A suspected case was defined as a person who lived in Thakurgaon District and had a fever and one of the following symptoms: vomiting, diarrhea, cough, respiratory distress, myalgia, severe weakness, or altered mental condition from 15 Jan to 17 Mar 2019. A probable case was a suspected case who had contact with another suspected or confirmed case. A confirmed case was a suspected or probable case with positive reverse transcription polymerase chain reaction (RT-PCR) or immunoglobulin M (IgM) for NiV. The primary case was defined as the suspected case who spread the disease to others. The index case was identified as the infected person who was first reported by the AMES surveillance authorities of RMCH.[16] A contact was a person who came into direct contact or stayed in the same room or vehicle for at least 15 minutes with a probable, suspected, or confirmed case, and who touched the body, nursed, fed, or cleaned body secretions or vomitus, or participated in funeral practices of any suspected case.[5]

We identified contacts among health workers in Baliadangi Upazila Health Complex, Thakurgaon Modern Sadar Hospital, and RMCH hospitals (Figure 1). We reviewed medical records from December 2018 to February 2019 of patients with NiV disease, Japanese encephalitis, measles, rabies, dengue encephalitis, cerebral malaria and bacterial meningitis.

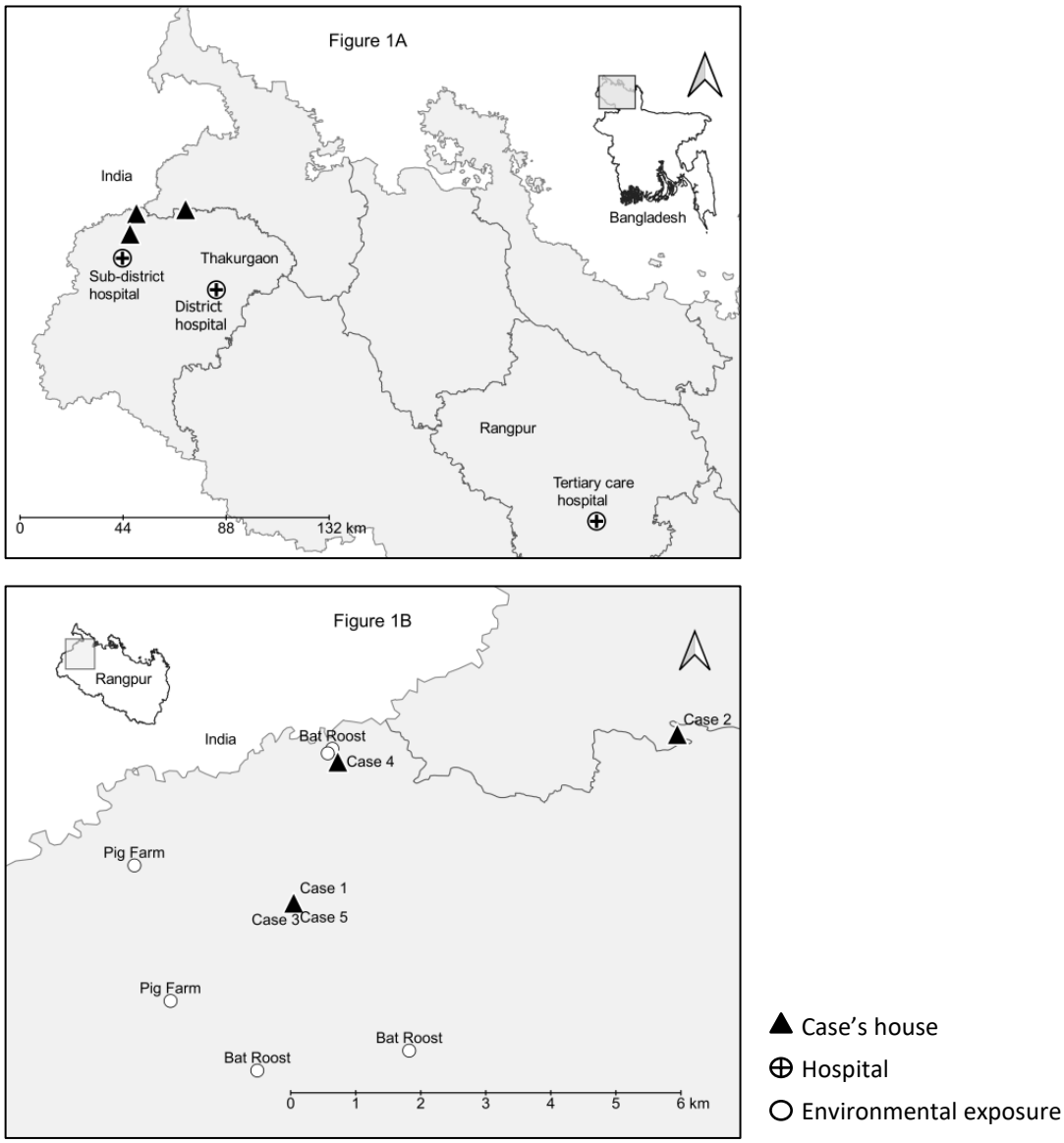

Figure 1. Map of NiV outbreak, showing residences of the cases, hospitals where patients were taken (A), and nearby environmental exposure from the case's houses (B) in a northwestern district of Bangladesh, 2019

The investigation team traveled to the cases' homes to identify contacts among family members, relatives, neighbors, friends, transporters, and people who participated in the funeral practice. We went door-to-door to the neighboring homes of cases with local health authorities and community members to identify other cases. Contacts were identified by snowball sampling. We continued active surveillance for two incubation periods (42 days) of NiV disease.

We collected blood and nasal and throat swabs from three people that rode in the ambulance and from some of the contacts. Nasal and throat swabs samples were tested for NiV by RT-PCR. Serum samples were tested for anti-NiV IgM antibodies by enzyme-linked immunosorbent assay (ELISA) following the NiV detection protocol of the U.S. Centers for Disease Control and Prevention. All samples were tested at the Virology Laboratory at Institute of Epidemiology, Disease Control and Research (IEDCR).

An anthropologist conducted interviews and held discussions with family members, relatives, friends, neighbors, and community members to identify the source of the outbreak.

We collected clinical and demographic information from hospital records. We interviewed contacts and conducted informal group discussions with healthcare professionals regarding personal protection. Data were collected through electronic forms on tablets and forms built using Epi-Info7 software (version 7.2.3.1). Descriptive data were analyzed in Epi-Info7 and Microsoft Excel to calculate frequencies and percentages. We used QGIS (version 3.12.1) to create a map of the cases and environmental links.

Ethics Considerations

This outbreak was investigated under the directive and approval from the Office of the Director of the IEDCR. Activities of this outbreak investigation were in response to a public health emergency. All respondents were older than 18 years of age. We took verbal informed consent from all respondents who were older than 18 years of age. We maintained confidentiality of the information obtained from this outbreak investigation.

Results

Descriptive Data and Clinical Features

We identified five cases; one suspected case, three probable cases and one confirmed case from 5 to 24 Feb 2019. The median age of the cases was 38 years and four were male. The median incubation period was 10 days (range 8–13 days). All suspected, probable and confirmed cases died and all had a history of fever, altered mental status, headache, vomiting, diarrhea, respiratory distress, and severe weakness, while four cases developed cough and two myalgia (Table 1).

Table 1. Demographic and clinical findings of cases during a Nipah virus outbreak in a northwestern district of Bangladesh, February 2019

Case number	Age (years)	Gender	Date of exposure	Date of onset of symptoms	Date of sample collection	Date of death	Incubation period (days)	Duration of illness (days)	Clinical symptoms
1	55	Male	Not applicable	5 February	Not done	9 February	Not applicable	4	F, A, M, H, C, V, D, R, S
2	35	Male	9 February	17 February	Not done	21 February	8	4	F, A, H, C, V, D, R, S
3	50	Female	9 February	20 February	Not done	21 February	11	1	F, A, H, V, D, R, S
4	28	Male	9 February	22 February	Not done	24 February	13	2	F, A, H, C, V, D, R, S
5	26	Male	9 February	18 February	24 February	24 February	9	6	F, A, M, H, C, V, D, R, S

Note: Clinical symptoms; F: Fever, A: Altered mental status, M: Myalgia, H: Headache, C: Cough, V: Vomiting, D: Diarrhea, R: Respiratory syndrome, S: Severe weakness

The primary case (case-1) was a 55-year-old male who died 15 days before the outbreak was reported. On 5 February, he developed a low-grade fever. On 8 February, he visited a village doctor, complaining of fever, myalgia, headache, and cough and was treated with anxiolytic and antibiotics. His condition deteriorated and he died in the hospital the next day (Figure 2).

At 8:00 AM on 9 February, six persons (case-2, -3, -4, -5, the daughter of case-1, and an ambulance driver) traveled with case-1 to hospital-2 and then hospital-3.

The ambulance took 8.5 hours to reach hospital-3. During that time, none of them wore face masks or gloves. Later, all passengers became infected except the daughter of case-1 and the ambulance driver. Case-2 became ill on 17 February, case-5 on 18 February, case-3 on 20 February and case-4 on 22 February. Case-2 and -3 died on 21 February and cases-4 and -5 died on 24 February. The mortality rate was 67% (4/6) among those who traveled with case-1 in the ambulance.

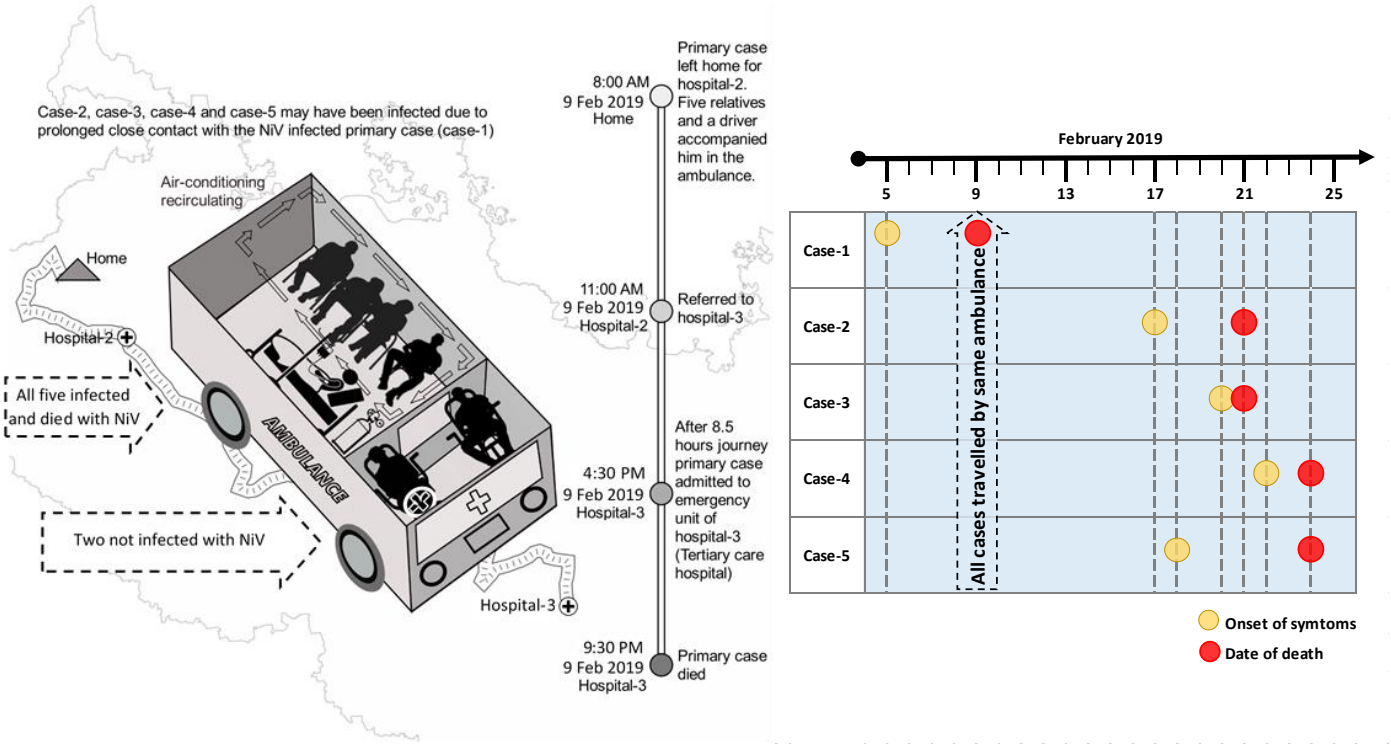

Figure 2. Human-to-human transmission of NiV in an ambulance, Nipah outbreak in a northwestern district of Bangladesh, February 2019

Identification of contacts

We identified 64 contacts; 8 from the primary case and 56 from secondary cases. Some contacts (contacts 30, 31, 37, 45, 58, 50 and 62) were exposed to more than one case. Most of the contacts were caregivers (55%) (Figure 3). The first- and second-generation attack rate was 50% (4/8) and 0% (0/56), respectively.

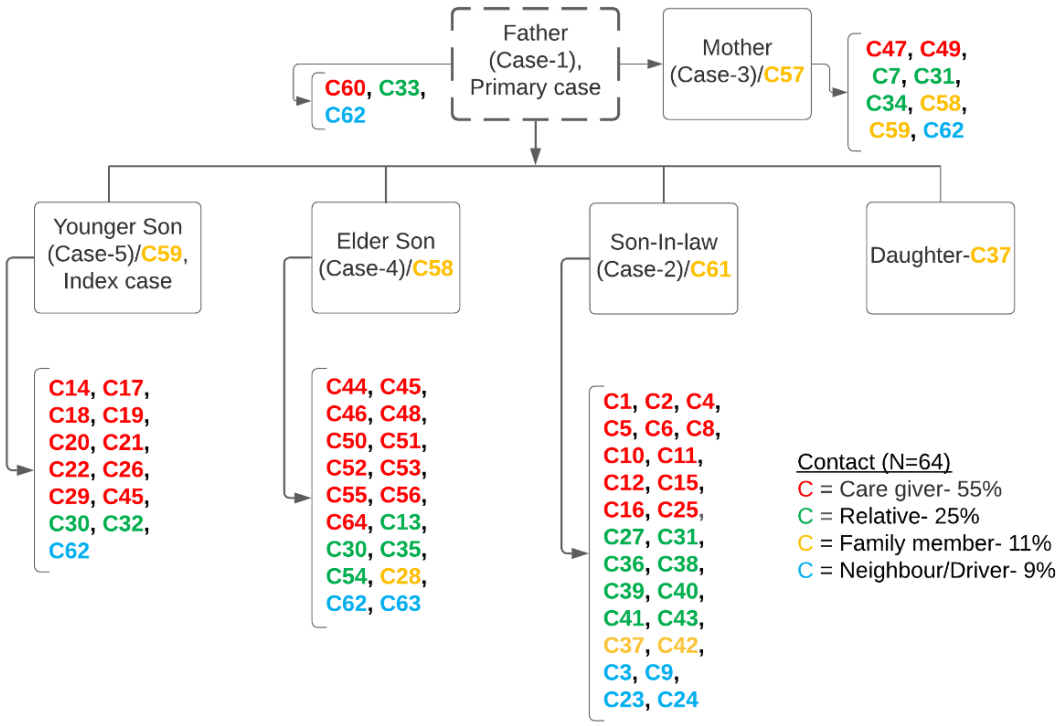

Figure 3. Sociogram of contacts in Nipah virus outbreak in a northwestern district of Bangladesh, February 2019

Laboratory Results

We collected and tested 45 blood, nasal swab, and throat swab samples from one case (case-5) and 44 contacts. They all tested negative for NiV by PCR and ELISA, except case-5 who had positive IgM and RT-PCR tests (Table 2) on 26 February. Among the 64 contacts, six were compatible with the suspected case definition. The suspected cases were three family members, one nurse, one doctor, and the ambulance driver. They were investigated and some were discarded from the list of cases.

Table 2. Contact exposures and laboratory findings of cases that traveled in an ambulance during a Nipah virus outbreak in a northwestern district of Bangladesh, February 2019

Case number	Type of contact	Nature of exposure	Epidemiological link	NiV real-time RT-PCR	NiV IgM ELISA
1	Primary case	Not applicable	Not identified	No sample collected	No sample collected
2	Companion to primary case in ambulance	Touched the patient during transportation	Contact with primary case	No sample collected	No sample collected
3	Family contact and companion to primary case in ambulance	Touched the patient at home and during transportation	Contact with primary case	No sample collected	No sample collected
4	Companion to primary case in ambulance	Touch the patient during transportation	Contact with primary case	No sample collected	No sample collected
5	Companion to primary case in ambulance	Stayed in the same room and touched the patient during transportation	Contact with primary case	Sample collected on 24 February and results were positive	Positive

Anthropological Investigation of the Primary Case

The primary case was a traditional healer and collected herbs and animals in the forest before he became ill. His neighbors reported that he used herbs and some animals to prepare medicines. Therefore, he might have used various parts of a bat's body for preparation of traditional medicine. No person who was interviewed reported that the primary case consumed raw date palm sap.

Public Health Response

The investigation team quarantined four of the six suspected cases in RMCH but were unable to quarantine the other two. We continued active monitoring of all contacts up to 17 Mar 2019. We contacted several government stakeholders about the current situation and requested them to prepare for an emergency. IEDCR distributed NiV disease prevention-related messages and guidelines through person-to-person contacts, official letters, and print and electronic media. The local health authority disseminated NiV disease prevention and control-related messages to the community. All members of our team used personal protective equipment (PPE) during the investigation and incinerated all used PPE and equipment used for sample collection.

Discussion

We verified this episode as a NiV disease outbreak based on the laboratory findings, clinical information, and epidemiological data. Of the five cases, one had a positive laboratory test and all had clinical signs and symptoms consistent with NiV disease. The outbreak area was located in the 'Nipah belt' where NiV spillovers frequently occur.[7] The primary case infected four other people in the back of the ambulance; all were symptomatic and all died. We identified sixty more contacts who were all asymptomatic and there were no new NiV cases until 17 Mar 2019.

The evidence for human-to-human transmission of NiV in this outbreak consists of an incubation period compatible with secondary spread. In the ambulance, people were in close contact in a confined and poorly ventilated space, did not wear PPE, and traveled for eight and a half hours.[3,8,13,17] Lastly, older adults can transmit NiV person-to-person, and coughing at the terminal stage of life can increase the infection rate.[8,9,12,14] The primary case was 55 years old and experienced respiratory distress while in the ambulance.

A few outbreak investigations have reported human-to-human transmission from close contact, such as caregivers of NiV disease patients.[3,8,12,13] NiV can also be transmitted from human-to-human contact during burial practices, by contact with the bodily secretion of deceased persons infected with NiV.[9] In this outbreak, we suspected that the enclosed environment of an air-conditioned ambulance was a risk factor for human-to-human transmission of NiV.

The source of this outbreak was not identified because the primary case died on 9 February, before the notification of this event to public health authorities on

24 February, thus he was not interviewed. A verbal autopsy on the primary case could also not identify the source of this outbreak because the case was an introverted person who isolated himself and his family from his neighbors and relatives. The most likely source of NiV infection for the primary case was direct contact with bats or bat excreta when he harvested herbs in the forest.

Surveillance is an essential tool to prevent future NiV disease outbreaks. In this outbreak, over half of the NiV infected patient contacts were healthcare professionals and family members. This outbreak is similar to other NiV disease outbreaks in Bangladesh and India.[8,9,18,19] Early detection is crucial to the early isolation of cases and quarantining of contacts to prevent secondary spread. In this incident, the AMES surveillance of RMCH did not capture the two earlier cases, including the primary case, that had been admitted to RMCH. Although this active surveillance system did capture the third admitted cases, it might not have been able to detect the outbreak earlier due to the large spillover event distance from the surveillance hospital (132 kilometers). A previous study found a 0.78 reduction in the odds of NiV spillover event detection by a surveillance hospital with every increase in 10 kilometers.[20] Tracing of contacts is essential because there are no vaccines and specific treatments to prevent NiV infection.

Public Health Action and Recommendations

The source of NiV infection for the primary case was likely from contact with bat excreta during forest visits or from making traditional medicine. The investigation found evidence of human-to-human transmission of NiV in the enclosed environment of an ambulance. We recommend that visiting forests, especially around bat habitats, should be discouraged to prevent further NiV spillover from bats to humans. All ambulance attendees should use protective measures while transporting suspected NiV infected patients, and other patients with infectious diseases, to prevent human-to-human transmission. To promote this behavior, an informatic should be developed and displayed in a prominent position in the ambulance office or garage. Increasing the number of sentinel sites in the Nipah belt of Bangladesh may increase the chance of detecting NiV spillover events. Increased surveillance could prevent future NiV disease outbreaks.

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Conflict of Interest

There are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Footnotes

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References

1. World Health Organization. WHO publishes list of top emerging diseases likely to cause major epidemics [Internet]. Geneva: World Health Organization; 2015 Dec 10 [cited 2020 Aug 16]. <https://www.who.int/news/item/10-12-2015-who-publishes-list-of-top-emerging-diseases-likely-to-cause-major-epidemics>
2. Lam SK, Chua KB. Nipah virus encephalitis outbreak in Malaysia. Clin Infect Dis. 2002 May 1;34 Suppl 2:S48–51.
3. 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.
4. Ching PKG, de los Reyes VC, Sucaldito MN, Tayag E, Columna-Vingno AB, Malbas FF, et al. Outbreak of Henipavirus Infection, Philippines, 2014. Emerg Infect Dis. 2015 Feb;21(2):328–31.
5. Flora MS, Salimuzzaman M, Alamgir ASM, Sultana S, Muraduzzaman AKM, editors. National guideline for management, prevention and control of Nipah virus infection including encephalitis [Internet]. 2nd ed. Dhaka (BD): Institute of Epidemiology, Disease Control and Research; 2016 Nov [cited 2020 Nov 13]. <https://iedcr.gov.bd/publication/guidelines/10adb7d5-b36b-4e87-a37c-7fc981f4f888>

6. Institute of Epidemiology, Disease Control and Research. Nipah virus transmission in Bangladesh [Internet]. Dhaka: Institute of Epidemiology, Disease Control and Research; [cited 2020 Nov 14]. <https://iedcr.gov.bd/surveillances/93c87e70-9c22-4f21-9506-a1161ecf404f>

7. Luby SP, Hossain MJ, Gurley ES, Ahmed BN, 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.

8. Homaira N, Rahman M, Hossain MJ, Epstein JH, Sultana R, Khan MSU, et al. Nipah virus outbreak with person-to-person transmission in a district of Bangladesh, 2007. Epidemiol Infect. 2010 Nov;138(11):1630–6.

9. 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. Emerg Infect Dis. 2013 Feb;19(2):210–7.

10. Islam M, Sazzad H, Satter S, Sultana S, Hossain M, Hasan M, et al. Nipah virus transmission from bats to humans associated with drinking traditional liquor made from date palm sap, Bangladesh, 2011–2014. Emerg Infect Dis. 2016 Apr [cited 2018 Mar 21];22(4):664–70. <https://wwwnc.cdc.gov/eid/article/22/4/15-1747_article>

11. Rahman M, Chakraborty A. Nipah virus outbreaks in Bangladesh: a deadly infectious disease. WHO South East Asia J Public Health. 2012 Apr–Jun;1(2):208–12.

12. 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. Emerg Infect Dis. 2007 Jul;13(7):1031–7.

13. 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 [Internet]. 2019 Jun 15 [cited 2019 Feb 17];219(12):1867–78. <https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiy612/5144922>

14. Nikolay B, Salje H, Hossain MJ, Khan AKMD, Sazzad HMS, Rahman M, et al. Transmission of Nipah virus — 14 years of investigations in Bangladesh. N Engl J Med. 2019 May 9;380(19):1804–14.

15. Institute of Epidemiology, Disease Control and Research. Surveillance [Internet]. Dhaka: Institute of Epidemiology, Disease Control and Research; [cited 2020 Sep 21]. Available from: <https://www.iedcr.org/index.php?option=com_content&view=article&id=42&Itemid=99>

16. Giesecke J. Primary and index cases. Lancet. 2014 Dec 6;384(9959):2024.

17. Homaira N, Rahman M, Hossain MJ, Nahar N, Khan R, Rahman M, et al. Cluster of Nipah Virus Infection, Kushtia District, Bangladesh, 2007. PLoS ONE [Internet]. 2010 Oct 21 [cited 2020 Jan 26];5(10):e13570. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2958840/>

18. Lo MK, Lowe L, Hummel KB, Sazzad HMS, Gurley ES, Hossain MJ, et al. Characterization of Nipah virus from outbreaks in Bangladesh, 2008–2010. Emerg Infect Dis. 2012 Feb;18(2):248–55.

19. Thomas B, Chandran P, Lilabi MP, George B, Sivakumar CP, Jayadev VK, et al. Nipah virus infection in Kozhikode, Kerala, South India, in 2018: epidemiology of an outbreak of an emerging disease. Indian J Community Med. 2019 Oct–Dec;44(4):383–7.

20. Cortes MC, Cauchemez S, Lefrancq N, Luby SP, Jahangir Hossain M, Sazzad HMS, et al. Characterization of the Spatial and Temporal Distribution of Nipah Virus Spillover Events in Bangladesh, 2007–2013. J Infect Dis. 2018 May 1;217(9):1390–4.