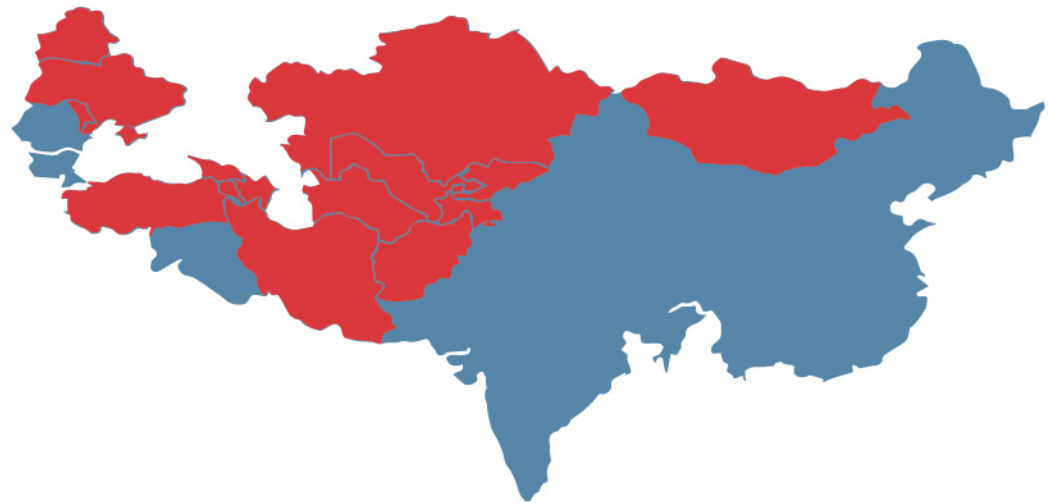


The Pan African
Medical Journal

**Learning from
Practice: Public
Health Teaching
Case Studies
from Eastern
Europe and
Central Asia**

Nipah Outbreak Investigation in One Health Approach, January 2023 in the Northern Region of Bangladesh

Dr. Abir Shaqran Mahmood, Md. Sayik Bin Alam, Md. Abu Sayeed, Nabila Nujhat Chowdhury, Wasik Rahman Akib, Dewan Imtiaz Rahman, Kamal Ibne Amin Chowdhury, Fateha Akhter Ema, Md. Zulqarnine Ibne Noman, Md. Arif Khan, Ahmad Raihan Sharif, Mohammad Ferdous Rahman Sarker, Sharmin Sultana, Mohammed Ziaur Rahman, Ariful Islam, Nazneen Akhter, Syed Moinuddin Satter, Tahmina Shirin



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Nipah Outbreak Investigation in One Health Approach, January 2023 in the Northern Region of Bangladesh

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How to Use the Case Study

General instructions: This case study should be used as adjunct training material for novice epidemiology trainees to reinforce the concepts taught in prior lectures. The case study is ideally taught by a facilitator in groups of about 20 participants. Participants are to take turns reading the case study, usually a paragraph per student. The facilitator guides the discussion on possible responses to questions. The facilitator may make use of flip charts to illustrate certain points. Additional instructor's notes for facilitation are coupled with each question in the instructor's guide to aid facilitation.

Audience: This case study was developed for novice field epidemiology students. These participants are commonly health care workers working in the county departments of health whose background may be as medical doctors, nurses, environmental health officers or laboratory

scientists who work in public health-related fields. Most have a health science or biology background.

Prerequisites: Before using this case study, participants should have received lectures on disease surveillance and outbreak investigation.

Materials needed: Flash drive, flip charts, markers, computers with MS Excel

Level of training and associated public health activity: Novice – **Outbreak investigation**

Time required: 2-3 hours

Language: English

Goal of Case Study:

- To learn how to conduct a Nipah outbreak investigation in One Health approach.
- To determine the magnitude of this outbreak through contact tracing and active case finding
- To recommend measures to control and prevent further spread of Nipah.

Learning Objectives – At the conclusion of the teaching session, participants will be able to:

1. Explain the significance of forming an outbreak investigation team in One Health approach
2. Develop a case definition on Nipah and discuss how to use it to conduct active case searches
3. Describe the role of the laboratory in Nipah surveillance and outbreak investigation for Nipah
4. Calculate the Attack rate in Nipah outbreak scenario.
5. Explain the significance of Risk Communication and Community Engagement (RCCE) in outbreak investigation scenario and recommend RCCE measures to control and prevent further spread of Nipah
6. Design action plan in One Health approach for the Nipah investigation

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Abbreviation

BIHS: Bangladesh Institute of Health Sciences Hospital, Dhaka

BSH: Bangladesh Specialized Hospital

CEPI: Coalition for Epidemic Preparedness Innovations

CS: Civil Surgeon (District Health Officer)

DMCH: Dhaka Medical College and Hospital

DPS: Date Palm Sap

ELISA: Enzyme-Linked Immunosorbent Assay

FDG: Focus group discussion

GPS: Global Positioning System

HA: Health Assistant

HI: Health Inspector

IEDCR: Institute of Epidemiology, Disease Control and Research

icddr,b: International Centre for Diarrheal Diseases Research, Bangladesh

MT Lab: Trained Medical technologist lab

NINS: National Institute Neuroscience and Hospital, Dhaka

NiV: Nipah Virus

NRRT: National Rapid Response Team

OI: Outbreak Investigation

QGIS: Quantum Geographic Information System

RCCE: Risk Communication and Community Engagement

RCMCH: Rangpur Community Medical college and Hospital, Rangpur

RDPS: Raw Date Palm Sap

RMCH: Rajshahi Medical College and Hospital

RPMCH: Rangpur Medical College and Hospital

RT PCR: Reverse Transcription Polymerase Chain Reaction

UHFPO: Upazilla (subdistrict) Health and Family Planning Officer

UHC: Upazilla Health Complex

US CDC: United States Centers for Disease Control and Prevention

WHO: World Health Organization

Abstract

Background: Nipah virus is a pandemic potential viral disease. On 13 January 2023, a confirmed case of Nipah Virus Disease (NiV) was reported through Nipah Enhanced Surveillance. We investigated to determine the scope and magnitude of the outbreak and the source of infection, also to explore the contributing perception, cultural patterns to control and prevent further spread.

Methods: Face-to-face interviews of the contacts were performed between 14-28 January 2023. An operational case definition was prepared for identifying confirmed, probable cases and contacts. Data were collected by semi-structured questionnaire both prospectively (to identify other cases and line listing) and retrospectively (to obtain information on notified cases). Blood and throat swabs were collected from high risk and symptomatic contacts for detection of NiV infection by RT-PCR and ELISA.

Results: On 23 December 2022, eleven members of the same family drank Raw Date Palm Sap (RDPS) in Naogaon. Twelve days later, a 13-year-old boy and his 50-year-old aunt developed fever, diarrhoea, restlessness, incoherent speech and became unconscious. The boy was admitted into ICU later and survived, but the woman died before investigation. We identified total 107 contacts. And we tested 55 high-risk and symptomatic contacts and all were negative for NiV by RT-PCR. We maintained regular follow-ups according to protocol. Four bat roosts were found within a 10km radius (including the nearest roost which was within 2 km) from the source tree where the relative of the cases collected RDPS.

Conclusion: We identified one confirmed and one probable case of NiV infection. The outbreak was contained since there were no cases among the contacts. We suspect the source of NiV was RDPS. As there is no specific vaccine and therapeutics, community awareness and enhanced surveillance can aid early detection and control of spillover events.

Key Words

Nipah Virus, Encephalitis, Outbreaks, Zoonotic Spillover, One Health, Bangladesh;

Introduction

Nipah virus (NiV) is a zoonotic virus (one of the nine priority infectious diseases with pandemic potential) [1]. It is transmitted from animals to humans and can also be transmitted through contaminated drinks, food or directly between people. Evidence of the virus has been found in the known natural reservoir (Pteropus bat species) and several other bat species in a number of countries. According to qualitative study and epidemiological investigation it was found that, in Bangladesh and neighboring region, consumption of raw date palm sap (RDPS) contaminated with urine or saliva from infected fruit bats was the most likely source of infection [2].

Nipah virus was first recognized in 1999 during an outbreak among pig farmers in Malaysia [3]. In Bangladesh, it was first identified as the cause of an outbreak of encephalitis that happened in 2001 in Meherpur district [4]. Since then, every year cases are being reported in Bangladesh. From 2011 to March 2023, a total of 339 cases of Nipah infection were identified and among them 240 (71%) died. This indicates its high case fatality rate. Among the cases animal to human spill over is total 140 times [5].

Systematic human Nipah infection surveillance is being carried out only in Bangladesh. Surveillance and laboratory for Nipah virus detection was established in February 2006. IEDCR with the permission of Ministry of Health and Family Welfare in collaboration with icddr,b is conducting Nipah surveillance program with the technical support from US-CDC and Coalition for Epidemic Preparedness Innovations (CEPI) [6].

Nipah surveillance in Bangladesh consists of:

- **Active surveillance** at 12 Medical College and Hospitals
- **Passive surveillance** at 2 district healthcare facilities.
- **Enhanced surveillance** activity before Nipah season at around 500 health care facilities.

Human-to-human transmission of Nipah virus has been reported among family members and healthcare providers of infected patients [7]. From 2001 to 2008, around half (46%) of reported cases in Bangladesh were due to human-to-human transmission through providing care to infected patients.

Currently there is no vaccine or antiviral treatment available against Nipah virus, treatment is mostly symptomatic.

Part 1 Story (Narrative)

In Bangladesh, every Nipah case notified is to be investigated because of its high case fatality rate and reporting of new cases every year. On 13 January, 2023, IEDCR was notified of a suspected Nipah case hailing from the northern part of Bangladesh through National Nipah Enhanced Surveillance. The case tested positive by RT-PCR for Nipah and got admitted into ICU of Bangladesh Institute of Health Sciences General Hospital, Dhaka.

On 23 December 2022, a 13-year-old boy (later diagnosed as the confirmed case) consumed RDPS along with his 11 family members in Naogaon. Then he developed diarrhea on the 12th day after consumption of Raw Date Palm Sap (RDPS). Then gradually he developed fever along with restlessness, incoherent speech, unconsciousness. The probable case was identified by retrospective investigation, the aunt of the confirmed case- a 50-year-old female (same source exposure, but died earlier as she hid the RDPS history while seeking treatment).

A team was formed in One Health approach consisting of public health physicians, veterinarians and anthropologists to conduct investigation with epidemiological, ecological and anthropological assessment. The team investigated this outbreak to determine the magnitude, to identify the source of infection and also to explore the contributing perception and cultural patterns in order to control and prevent further spread.

Chronological Sequence of Events on Notified Cases:

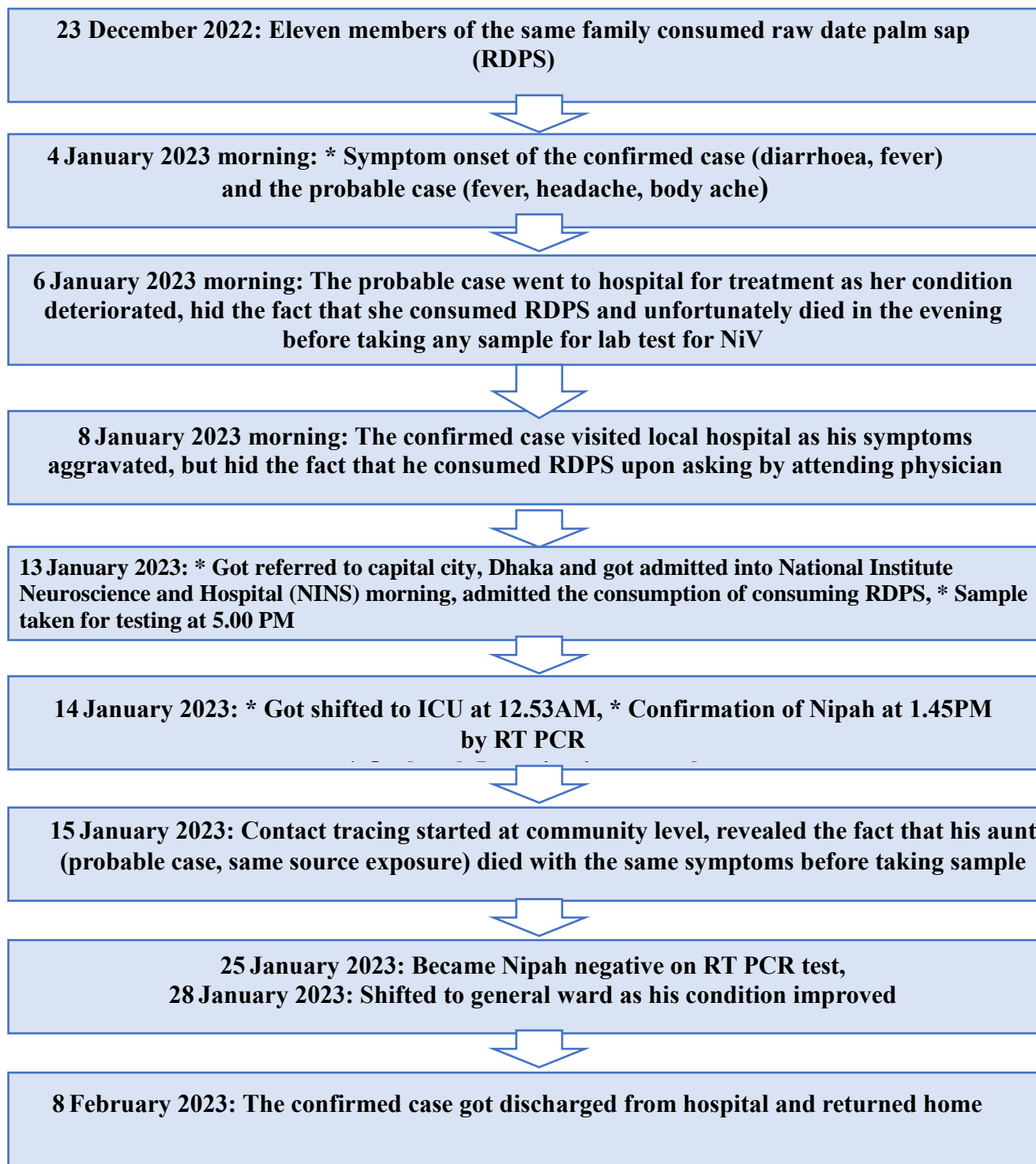


Figure 1: Chronological Sequence of Events on Notified Cases

Part 1 questions

Question 1. What is a zoonotic disease?

Question 2. What likely act as source of Nipah infection and Nipah spillover to humans?

Question 3. How Bangladesh is conducting Nipah surveillance?

Question 4. What was the objective of this outbreak investigation?

Question 5. What are the signs-symptoms of Nipah?

Part 2 Methods (Narrative)

Outbreak investigation was done by mixed method approach. Descriptive study- both prospective (to identify other cases and line listing) and retrospective (to obtain information on notified case) outbreak investigation was followed.

1. **Case investigation** (review of medical records of the deceased patient, interview with healthcare providers who treated the patient, interviews with family members of the patient); An operational case definition was prepared for identifying suspected, probable and confirmed cases and contacts.
2. **Contact tracing** (identification and interviews): Face to face interviews with the identified hospital and community level contacts were performed between 14-28 January 2023 by semi-structured questionnaire to explore the exposure history and clinical features. The questionnaire focused on detailed contact history, nature of contact, demographics, in-depth exposure history (RDPS, zoonotic and other exposure history), symptoms relevant to the case under investigation and knowledge on Nipah virus infection etc. Detailed history of the case was taken including clinical features, exposure history and behavioral pattern, and clinical records of the case (doctor's prescription and documents) were also reviewed.
3. **Active case finding** (focus group discussion to identify others in the community with potential symptoms): Informal focus group discussion was conducted to identify suspected Nipah cases in the community and among contacts of confirmed case. A line list was prepared. Investigation was conducted with open discussion among relatives, neighbors of the deceased and the local community people.
4. **Anthropological investigation** (to understand cultural practices that might contribute): For anthropological investigation, the team explored the common source of infection, behavioral factors and sociocultural contexts from observation and group discussions with community people. Preliminary information was collected from the corresponding Nipah surveillance site's Field assistant and from the local Health Inspector in charge (HI) of Sadar Upazilla Health Complex, Naogaon.
5. **Wildlife investigation:**
 - Environmental/ ecological investigation and
 - Animal lab investigation
6. **Spatial Analysis:** Using GPS locations and by QGIS (Quantum Geographic Information System), Google earth software etc.

7. **Laboratory investigation** (lab confirmation results for deceased patient, lab testing of contacts): Throat swabs and blood were collected from high-risk and symptomatic human contacts for laboratory investigation of NiV infection by detection of NiV-RNA by real time one step RT-PCR and detection of antibodies against NiV by ELISA.

The wildlife team collected environmental/roost urine from the identified bat roosts and captured bats for individual sampling. At midnight the team members set down the multiple polyethylene under the roost tree covering all branches. In the early morning when bats were back to roost, they collected the dropped urine from the polythene by using the pipette. Roost urine samples were collected in individual cryovials and placed in the cool box. For individual bat sampling, bats were captured by using the mist net, setting on the flying zone of bats at midnight. Oropharyngeal swabs and urine swabs were collected from each captured bat following the appropriate restraining and handling protocol.

After collection, the vials were transferred into liquid nitrogen and shipped to the laboratory for laboratory diagnosis. The team also investigated the distribution and density of the bat roost, roosting, and feeding ecology of bats.

Table 1: Types of specimens collected for Laboratory investigation during this Nipah outbreak

Specimen	Host	Sent to	Type of Lab test
Throat swab	Case and contacts	icddr,b (virology laboratory)	RT-PCR
Blood (serum)	Case and contacts	IEDCR	ELISA
Urine	Bat (Animal)	icddr,b (one health laboratory)	RT-PCR

The outbreak investigation team was formed in One Health approach for the inclusion of human health, animal health, and environmental factors. It consisted of public health physicians, wildlife experts, anthropologists, laboratory technologists and supporting staff. Their roles were as follows:

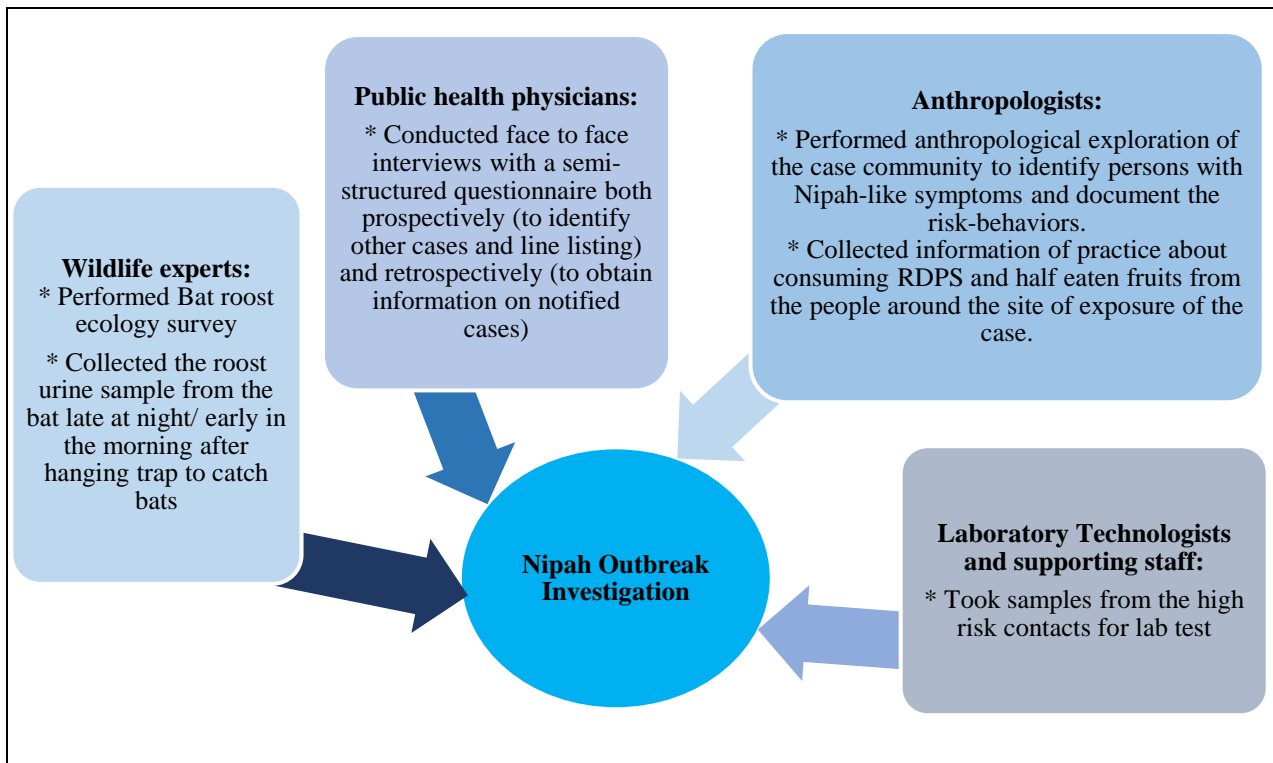


Fig 2: Contribution of the outbreak investigation team members

Operational definitions:

- **Suspected case:** Any person, Fever with- new onset of altered mental status or seizure and/or headache and/or vomiting and/or cough or breathlessness- with/without history of contact and common exposure with notified Nipah patient prior to 21 days of onset of symptoms (4th January, 2023) in the areas where RDPS was consumed (Naogaon) is suspected case of Nipah virus infection till to date.
- **Probable case:** Any patient with history of possible Nipah encephalitis, who has died before sample collection but, has an epidemiological link with at least one confirmed Nipah patient prior to his/her symptom onset.
- **Confirmed case:** A suspected Nipah case with laboratory confirmation of Nipah virus infection either by- IgM antibody against Nipah virus by ELISA in serum or Nipah virus RNA identified by PCR from respiratory secretions (throat swab).
- **Contact:** For this investigation, any person who came in direct contact (touching patient, stay with patient within 1 meter distance for 15 minutes or more, sleep together, using common towel, caregiver) and indirect contact (not touching, stay within 1 meter distance less than 15 minutes) with notified confirmed Nipah patient after onset of symptoms.

- **High risk contact:** Following symptom onset of the confirmed Nipah case, any person who reports direct exposure to bodily fluid with a confirmed Nipah case or close proximity (within 1 meter distance) that may lead to exposure with cough or sneeze of the Nipah case, is a high-risk contact.
- **Exposure:** Any person who had a history of taking raw date palm sap from the common source of confirmed Nipah case on 23rd December, 2022 will be considered as exposed.

Participant Consent and Ethical Considerations:

Informed consents were obtained from contacts and the respondents and assent were taken from children. This field investigation was exempted from review by an independent human subjects committee since it was an emergency investigation. It was conducted in response to an outbreak and was approved by Director, IEDCR with the DGHS, Ministry of Health and Family Welfare (MOHFW), Government of the People’s Republic of Bangladesh.

Part 2 Questions

Question 1. What is the case definition of Nipah- suspected, probable, and confirmed case in case of this outbreak investigation?

Question 2. What is the case definition of contact, high risk contact and exposure in this scenario?

Question 3. What is the role of different members of the outbreak investigation team formed in One health approach such as public health physicians, wildlife experts, anthropologists etc.?

Question 4. Which samples should be collected for which laboratory testing here?

Question 5. What role do you think the laboratory plays in this scenario?

Part 3: Results (Narrative, figures, tables)

According to the case definition, one confirmed case and one probable case were found. No other cases were found.

Contact tracing: We collected information about contacts from patients’ relatives at Dhaka, Naogaon and Saidpur and healthcare providers from BIHS, BSH, NINS, Rangpur Community Medical College hospital and Saidpur Railway hospital. We found total 107 contacts- 16 contacts in Naogaon, 25 contacts in Nilphamari, 33 contacts in Rangpur and 33 contacts in Dhaka were identified. Out of them, 33 were household contacts and 76 were hospital contacts. Two were both household and hospital contacts (as they directly provided medical care to the cases) and same source exposure. We interviewed them individually.

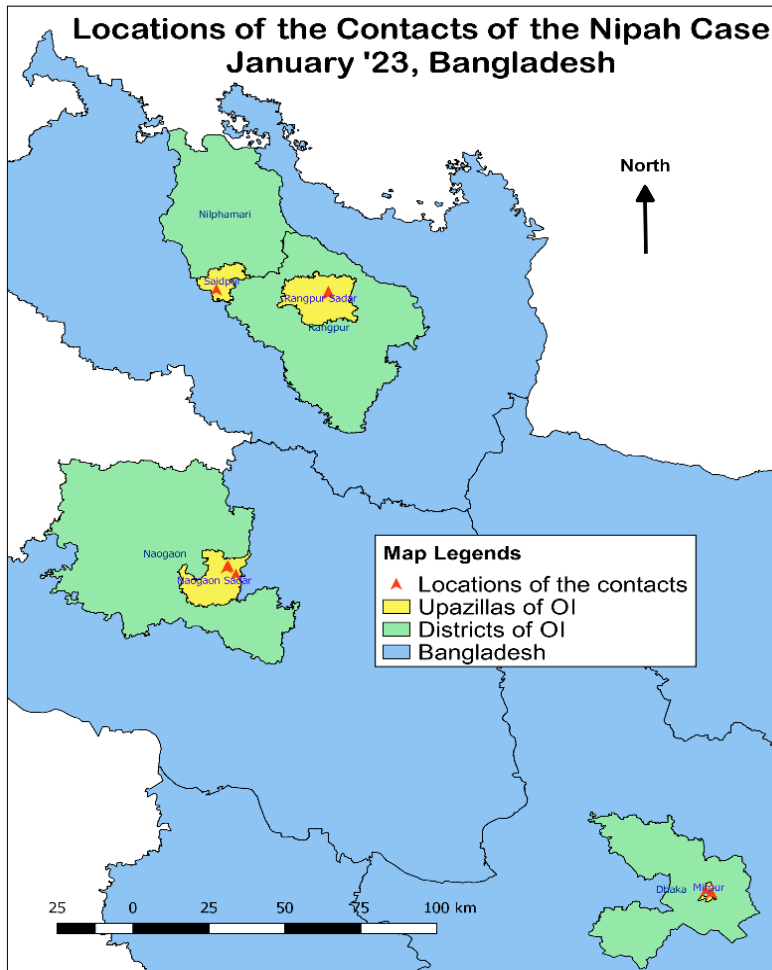


Figure 3: Location of the contacts of the Nipah cases

Exposure history: We collected exposure history of taking RDPS among the household contacts. We found 11 people consumed raw date palm sap from the same source/ clay pot on 23rd December 2022 at 10AM. We found 2 of the exposures who developed symptoms, 1 was probable case who died afterwards, 1 was the confirmed case and others were healthy. We took sample (serum and throat swab) from the nine of the same source exposure. We couldn't collect sample from the probable case who died before taking the sample and one was a 6-year-old child who was non-co-operative.

We searched for other sources as exposure of the confirmed case. We interviewed the respondents about history of taking half eaten fruit, movement of pig herd, migratory bird visits, unnatural death of domestic animal etc.

Sample collection for laboratory testing: A total of 55 samples (Blood- serum and throat swab) from high- risk contacts were collected, among them 10 were household contacts and 45 were hospital contacts. IgM antibody against Nipah virus by ELISA in serum was tested in Virology laboratory of IEDCR and Nipah virus RNA identified by real time RT-PCR from throat swab was done in icddr,b lab.

- All samples tested negative.

Anthropological exploration: We pinpointed the source tree at their house premise in Naogaon which was cultivated by his relative. Our anthropologist team members also interviewed the gachi (RDPS collector) in the community about trade areas, sap collection procedures, protective measure knowledge, etc. We also collected information about the specific DPS collection and distribution history of 23rd December, 2022.



Figure 4: The date palm tree identified by the team

Common practice in the community about RDPS and half eaten fruits:

Anthropological team did extensive community search for persons with Nipah like symptoms and identified the risk behaviors. They did not find any active cases and also did not find history of any unusual death in the community within the last 30 days.

We collected information of practice about consuming raw DPS, boiled DPS, molasses and half eaten fruits from the people of 132 households around the site of exposure of the case in Boalia, Naogaon. We have asked the households in that area and found none who drink raw DPS within the last 30 days.

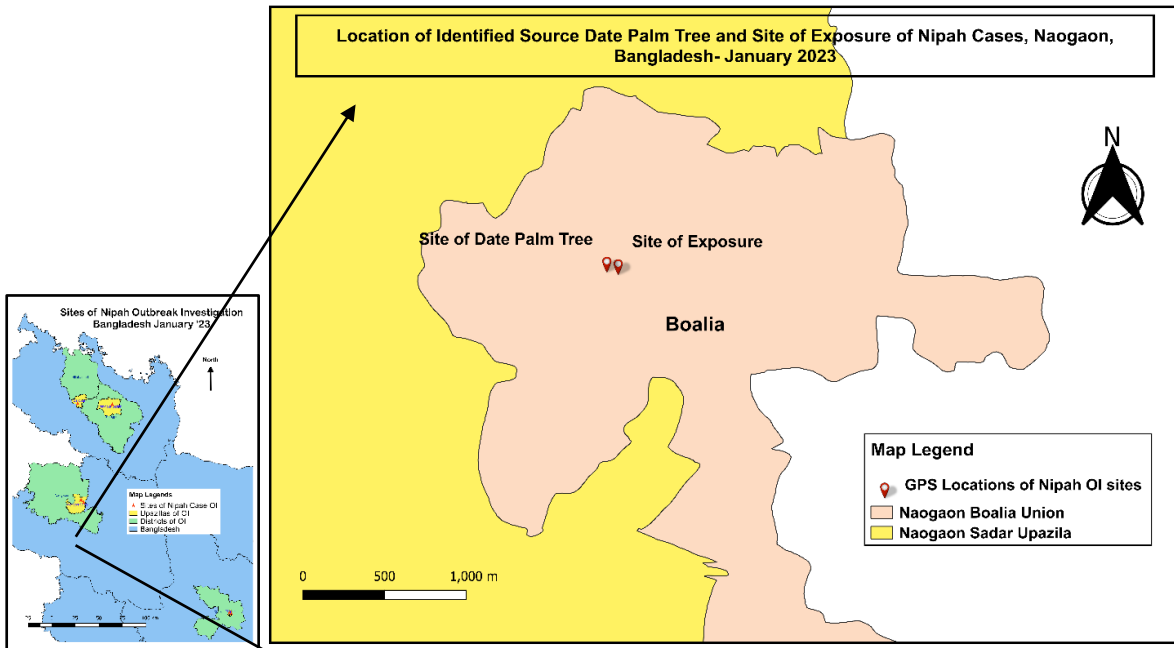


Figure 5: Locations of date palm tree and site of exposure of Nipah Cases in Naogaon Sadar, Bangladesh, Jan 2023 (prepared by QGIS 3.34 version)

Wildlife Team: Environmental investigation/Ecological investigation: Our wildlife expert team performed the ecological survey to find out the available bat roost within the 10 km aerial distance from the source tree. They found 4 active bat roosts within 10km of the source tree exposure house (Figure 6 and Table 2)

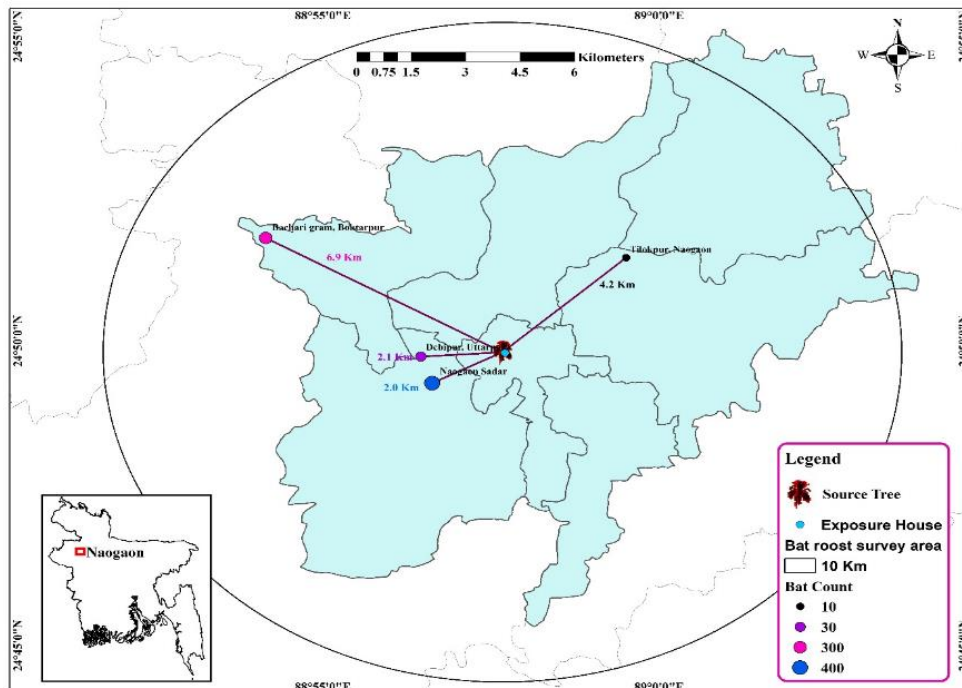


Fig 6: Location of bat roosts along with the aerial distance from the source tree

Table 2: Bat roost ecology by the wildlife team

Name	Interface	Type of roost	No. of bat	Normal mean of bat count	Location	Location type	No. of years of bat roosting in the current area	Frequency of bat roosting last 5 years	Name of roost tree
Debipur, Uttarpara	Within 10m of human residence	Active	30	Fewer than normal	Backyard/ Homestead areas	Peri-urban	>10 years	Continuous	Burflower tree
Tilokpur, Naogaon	Within 10m of human residence	Active	10	Fewer than normal	Backyard/ Homestead areas	Peri-urban	>10 years	Continuous	Pakor tree
Naogaon Sadar	Within 10m of human residence	Active	400	Normal	Backyard/ Homestead areas	Rural	>10 years	Continuous	Latim tree
Bachari gram, Boktarpur	Within 10m of human residence	Active	300	Normal	Backyard/ Homestead areas	Rural	>10 years	Continuous	Burflower tree

Follow-up of the contacts: We have collected the phone numbers and address of all the hospital contacts and most of the household contacts.

Early follow-up: Immediately after laboratory diagnosis of the case and getting contact list during investigation.

Over phone follow-up of the listed contacts at two days interval (Contacts also instructed every time to communicate if they develop any illness including fever with or without headache/ convulsion/respiratory distress/ unconsciousness etc.) If anyone would develop symptoms, FA (Field Assistant) were instructed to collect samples. This over phone follow-up was continued 21 days of the last contact with the case.

Late follow-up: 6 weeks or 42 days after the patient’s final outcome of the case. It was done physically after visiting the same locations. Re-verification of the contact list was done. Consent was taken of the contacts before interviewing them and collecting of blood samples.

A total of 29 samples were collected from enlisted contact persons and tested for IgG antibody by ELISA at IEDCR and all of them found negative for anti-Nipah IgG antibody.

RCCE (Risk communication and community engagement) measures taken:

Health message was provided to the family members about preventive measures. They were instructed to isolate the common source exposure and symptomatic patients as much as possible until the laboratory test reports came back. The investigation team members were instructed to take proper safety measures while interviewing the contacts.

The investigation team conducted a brief meeting with the field healthcare providers (doctors, nurses, HI) about control and prevention of Nipah and also instructed them to contact National (IEDCR and icddr) hotline number asap in case of any suspected cases.

Figure 7: Health Education materials distributed in the community (originally printed in local language Bangla and then translated to English version here for the readers)

Awareness program about Nipah to the local community and institutions was arranged with the help of local authority (focal person of disease control). They made a plan to arrange an awareness program there where all the govt. officials and influential media persons will attend and to use local media to spread the health message. The program included dissemination of health message about Nipah prevention, RDPS consumption method (boiling) and half eaten fruit risk.

Part 3 questions

Question 1: How many confirmed Nipah cases are required for the Country authority to classify the existence of a Nipah outbreak in this scenario?

Question 2: How Nipah transmits from one person to another?

Question 3: What is the necessity of tracing of Nipah contacts?

Question 4: Using the available data- calculate the attack rate of RDPS?

Question 5: What is the significance of follow-up of the contacts in this Nipah outbreak investigation?

Question 6: What is the significance of RCCE in this Nipah outbreak investigation?

Question 7: What do you think about the significance of printing health awareness/ education materials in local language which to be distributed in the community?

Question 8: What is the significance of qualitative method of interview of the contacts to explore the contributing perception and cultural practices? Do you think anthropologist are necessary for this? Justify your answer.

Part 4: Discussion (Narrative, Drawings)

In Bangladesh, every Nipah case notified is to be investigated because of its high case fatality rate and reporting of new cases every year. On 13 January, 2023, IEDCR was notified of a suspected Nipah case hailing from the northern part of Bangladesh through National Nipah Enhanced Surveillance. A team was formed in one health approach consisting of public health physicians, veterinarians and anthropologists to conduct investigation with epidemiological, ecological and anthropological assessment. The investigation at hospital and community level contacts were performed between 14 to 28 January 2023 which included contact tracing from 4 districts of Bangladesh- as the cases travelled those area after onset of symptoms. Public health physicians conducted face to face interviews of the contacts with a semi-structured questionnaire both prospectively (to identify other cases and line listing) and retrospectively (to obtain information on notified cases). An operational case definition was prepared for identifying suspected, probable and confirmed cases and contacts. Wildlife experts performed bat roost ecology survey and collected the roost urine sample from the bat late at night/ early in the morning after hanging trap to catch bats. Anthropologists performed anthropological exploration of the case community to identify persons with Nipah-like symptoms and document the risk-behaviors and collected information of practice about consuming RDPS and half eaten fruits from the people around the site of exposure of the case. Laboratory Technologists and supporting staff collected throat swabs and blood from high-risk and symptomatic contacts for laboratory investigation of NiV infection by detection of NiV-RNA by real time one step RT-PCR and detection of antibodies against NiV by ELISA. On 23 December 2022, a 13-year-old boy (later diagnosed as the confirmed case) consumed RDPS along with his 11 family members in Naogaon. Then he developed diarrhea on the 12th day after consumption of Raw Date Palm Sap (RDPS). Then gradually he developed fever along with restlessness, incoherent speech,

unconsciousness. The probable case was identified by retrospective investigation, the aunt of the confirmed case- a 50-year-old female (same source exposure, but died earlier as she hid the RDPS consumption history while seeking treatment). Attack rate of the RDPS was 18.2%. Total 107 contacts- 16 contacts in Naogaon, 25 contacts in Nilphamari, 33 contacts in Rangpur and 33 contacts in Dhaka were identified. 55 high-risk and symptomatic contacts were tested and all were found Nipah negative by RT-PCR. The source tree was pinpointed at their house premise in Naogaon which was cultivated by his relative. Four bat roosts were found within 10km radius (including the nearest roost which was within 2 km) from the source tree. The anthropologist team members saw a few date palm trees being harvested within a 500-meter radius area around the source of exposure and also came to know that, the local collectors sold the RDPS without boiling due to reduced demand of boiled sap. During the visit in the community, health messages were provided to the people about Nipah prevention, RDPS consumption method (boiling) and half eaten fruit risk. The regular follow-up protocol up to 42 days was maintained and no contacts developed any sign-symptoms at that time period. We suspect the source of Nipah virus was RDPS. As there were no cases among the contacts, the outbreak was successfully contained.

Part 4 Questions

Question 1: What is the significance of One health approach in Nipah outbreak investigation?

Question 2: Summarize the steps of an outbreak investigation.

Question 3: What type of surveillance would be most appropriate for use during the Nipah outbreak? Why?

Part 5: Case study conclusion

The confirmed case has survived by our timely investigation in One Health approach and clinical intervention. The One Health approach, which emphasizes the interconnectedness between human, animal, and environmental health, is essential for controlling the Nipah virus in Bangladesh. This method integrates fruit bat, habitat, and human health surveillance to improve early identification, prevention, and control. Coordinated responses to outbreaks are made possible by the established links between the environmental, wildlife, and animal sectors and the National Rapid Response Team (RRT). In the end, this collaboration results in more effective mitigation of the impacts of the Nipah virus by strengthening the public health infrastructure, encouraging interdisciplinary research, and ensuring sustainable health systems capable of tackling complex zoonotic threats.

Recommendations:

Community-focused One Health surveillance should be strengthened to prevent disease spillover drawing from outbreak lessons and fostering interdisciplinary collaboration among health, wildlife and anthropology sectors for effective preparedness to tackle future epidemic and pandemic threats. The FETP, V vet fellows should be included in the outbreak investigation as part of Animal health team. Community based awareness program about Nipah virus and social stigma regarding RDPS consumption need to be conducted in a large scale to combat Nipah. It may include the local people, the RDPS collectors, the local influential or media persons etc. The authority should make this program sustainable to raise awareness every year. As Nipah has a very case fatality rate, physicians should consider taking RDPS consumption history rigorously. Regular upgradation of treatment protocol with periodic arrangement of Continuing Medical Education program in health facilities of the area can be organized.

Part 5 Questions:

Question 1. Based on the findings above, what control and prevention measures do you think the investigating team should recommend?

Question 2. What actions would you take to engage the community while implementing prevention and control measures?

Question 3. What is your opinion on necessity of one health approach in tackling battle against Nipah?

Question 4: Why do you think wildlife expert and anthropologists should be included in the team in Nipah outbreak investigation? Can FETP Vet fellows can be included here? Justify your answer.

Question 5: As a public health professional and field epidemiologist what more steps can be recommended to prevent further Nipah-associated death?

Acknowledgements

We wish to acknowledge Institute of Epidemiology, Disease Control and Research (IEDCR), MoHFW, US-CDC Bangladesh country office, all the members of icddr,b and EcoHealth Alliance Nipah Surveillance and outbreak investigation team, other partners, FETP,B team, Dr. Gretchen Cowman, Prof. Dr. Mahmudur Rahman and the Eastern Mediterranean Public Health Network (EMPHNET) for their support to develop this case study. Artificial Intelligence (AI) like chatgpt was used to facilitate some answers of the questions prepared for the facilitator's guide of this case study.

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