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An deadly outbreak of Nipah virus in India

Abstract

On May 19, 2018; first Nipah Virus (NiV) outbreak was reported from Kozhikode district of Kerala and Mallapuram district of South India. There is high risk of NiV outbreak to individual as well as community. NiV is classed across the world as a BSL-4 hazard. Emerging zoonotic risk grade–4: Hendra and Nipah viruses cause severe and often lethal respiratory illness (encephalitis particularly in sows, boars and human) and have public impact on human health [fever, aches, tiredness, chills & nervous signs (twitching, trembling, muscle fasciculation, spasms, muscle weak spot, convulsions and death)]. Zoonotic diseases transfer to human being from animals. NiV can infect a huge variety of species. Transmission of NiV from human being to human being has been observed. They are associated with high risk (group–4) of life–threatening disease in human and/or animals. Treatment is restrained to supportive care, because NiV encephalitis can be transmitted from one person to another person, standard infection control practices and proper barrier nursing techniques are important to prevent nosocomial transmission infections. For handling RG–4 Nipah virus, there is a requirement for a laboratory with extensive BSL–4 high level containment that includes practices (BSL–3 plus controlled access); safety equipment's (Biological Safety Cabinet, full–body air–supplied, positive pressure and personnel suit) and facilities (BSL–3 plus dedicated air and exhaust, decontamination procedures for exit, separate building) Biological safety cabinets use HEPA filters in their exhaust and/or supply systems. A PAPR or tight–fitting goggles and N–95 respirator should be worn for high–risk aerosol–generating procedures. The therapeutic use of a neutralizing human monoclonal antibody targeting the Nipah G glycoprotein has experimentally been evaluated in the post–exposure therapy in the ferret model and found to be of benefit. Additional efforts focused on surveillance and awareness will assist save future outbreaks.

Keywords: Pteropus bats, encephalitis, henipavirus, hazards, bsl–4, pigs, fatalities

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Abbreviations: NiV, nipah virus; RT–PCR, reverse transcription–polymerase chain reaction; BSL, bio–safety level; RG–4, risk grade–4; ELISA, enzyme–linked immunosorbent assay; HEPA, high efficiency particulate air; ICMR, international council of medical research; PAPR, power air purifying respirator

Introduction

Microorganisms that commonly cause lethal human, animal and plant diseases that can promptly be transmitted from one individual to another, directly or indirectly are considered in risk group–4. NiV in Malaysia emerged a deadly disease of respiratory infections and neurologic diseases in commercially farmed pigs, prognostically after virus spill over from Malaysian flying foxes in 1998.[1] Infection of NiV has not been detected in Malaysia or Singapore after 1999. From, 2001 to 2013 several Nipah outbreaks were reported in people of Bangladesh districts (Figure 1). There have been 17 mortalities and 18 morbidities up to 1 June 2018. This was the first NiV outbreak in Kozhikode and Mallapuram districts in South India.[2,3] However, annual cases of Nipah encephalitis (inflammation of meninges), sporadic outbreaks in human being with morbidity and mortality were recorded in India and in Bangladesh as per Table 1, Figure 2 & Figure 3. According to the United States based Centres for Disease Control and Prevention, the signs of NiV infection are encephalitis and respiratory infection especially in sows and boars. The incubation period may vary from 4 to 14 days but can be prolonged up to 45 to 60 days.[4–7]

Clinical signs and symptoms

Encephalitis and respiratory (twitching, trembling, muscle fasciculation, spasms, muscle weak spot, convulsions and death) are predominant in nerve of human beings (Figure 4). Human beings, bats, sheep and domestic pets (pigs, dogs and horses) are susceptible to NiV infection. But the observation could not be further confirmed.[8–10] There is threat to the life of human being, and experimental animals such as ferret, guinea–pig, hamster and in suckling mouse due to NiV, RG–4 virus.[11] Henipa virus and NiV genus of Paramyxoviridae family, RG–4 hazard may lead to a viral zoonotic disease which is transmitted to human being through infected fruit, animals or via near touch with infected human being (Figure 5).[12]

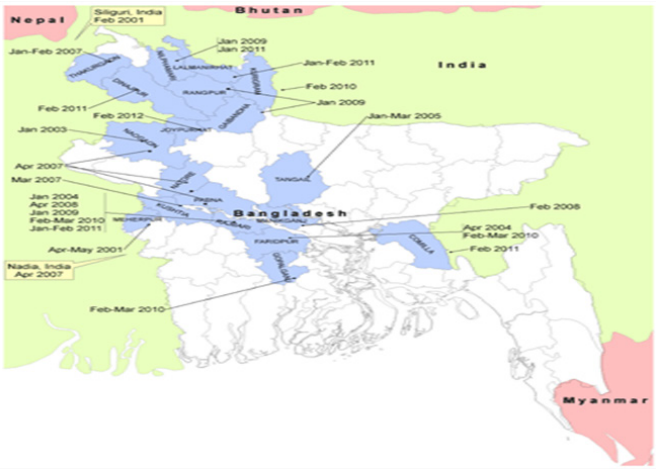

Figure 1 Chronology of NiV outbreaks in South-East Asia, 2001 to 2012.

Treatment

According to the U.S. Centres for Disease Control and Prevention, supportive care is the only current treatment for this viral infection.

There is no vaccine specifically available to protect humans.[13] The primary treatment for human cases is intensive prophylaxes, because NiV encephalitis may be transmitted one person to another, standard infection control practices and proper barrier nursing techniques are important to prevent hospital–acquired infections (nosocomial transmission). Prophylactic treatment of the infection with ribavirin, antiviral drug is effective against the viruses *in vitro*, but usefulness of ribavirin remains clinically uncertain. However, some researchers suggest that the antiviral drug ribavirin may be useful, but there is little or no data to support this. A human monoclonal antibody that targets the G glycoprotein of NiV has shown benefit in a ferret animal model of this disease, but researchers have not studied the effects of the antibody in humans. Vaccination programs would also have to cover livestock animals, too, e.g., pigs, and perhaps horses in certain areas where NiV is endemic.[13–16] While WHO has declared NiV to be a priority pathogen, pharmaceutical companies may be reluctant to fund trials in underdeveloped countries that can ill afford medications or vaccines. Fortunately, a new international coalition of governments and pharmaceutical companies called the Coalition for Epidemic Preparedness Innovations was formed in January 2017 to develop safe, effective, and affordable vaccines for diseases with pandemic potential, such as NiV.[17]

Table 1 Morbidity and mortality in human due to *Nipah virus*

Month /year	Place	Cases	Deaths
INDIA			
Jan–Feb /2001	Siliguri	66	45
Apr–07	Nadia	5	5
May–June /2018	Kerala	18	17
BANGLADESH			
Apr–May /2001	Meherpur	13	9
Jan-03	Naogaon	12	8
Jan-04	Rajbari	31	23
Apr-04	Faridpur	36	27
Jan–Mar /2005	Tangail	12	11
Jan–Feb /2007	Thakurgaon	7	3
Mar-07	Kushtia, Pabna, and Natore	8	5
Apr-07	Naogaon	3	1
Feb-08	Manikgonj	4	4
Apr-08	Rajbari and Faridpur	7	5
Jan-09	Gaibandha, Rangpur, and Nilphamari	3	0
Feb–Mar /2010	Faridpur, Rajbari,Gopalganj, and Madaripur	16	14
Jan–Feb /2011	Lalmohirhat, Dinajpur, Comilla, Nilphamari, and Rangpur	44	40
Feb-12	Joypurhat, Rajshahi, Natore, Rajbari, and Gopalganj	12	10
Jan–Feb /2013	Gaibandha, Natore, Rajshahi, Naogaon, Rajbari, Pabna, Jhenaidah, and Mymensingh	12	10

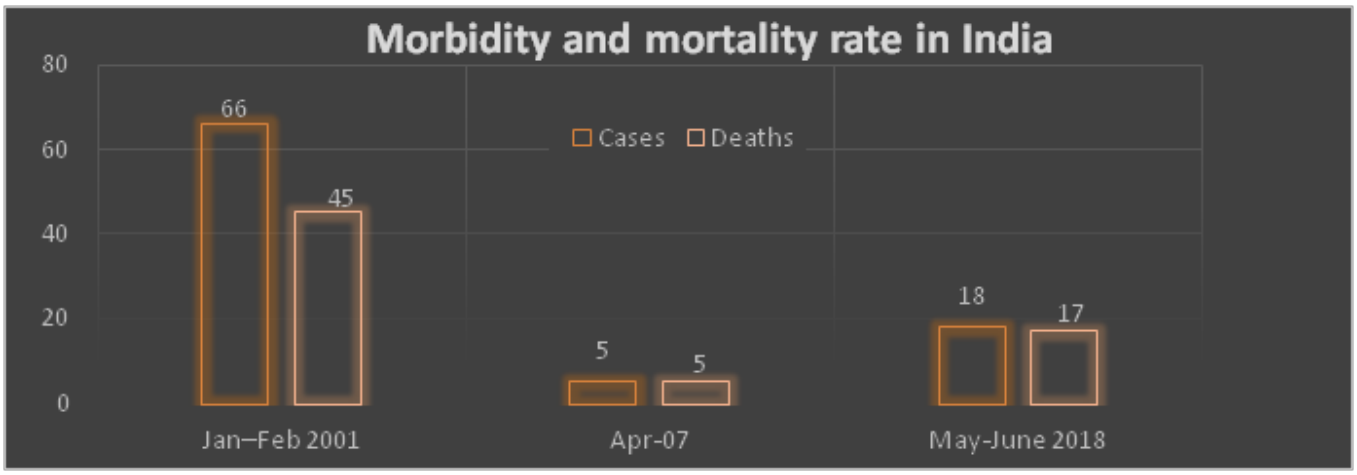

Figure 2 The graphical representation in morbidity and mortality rate in India.

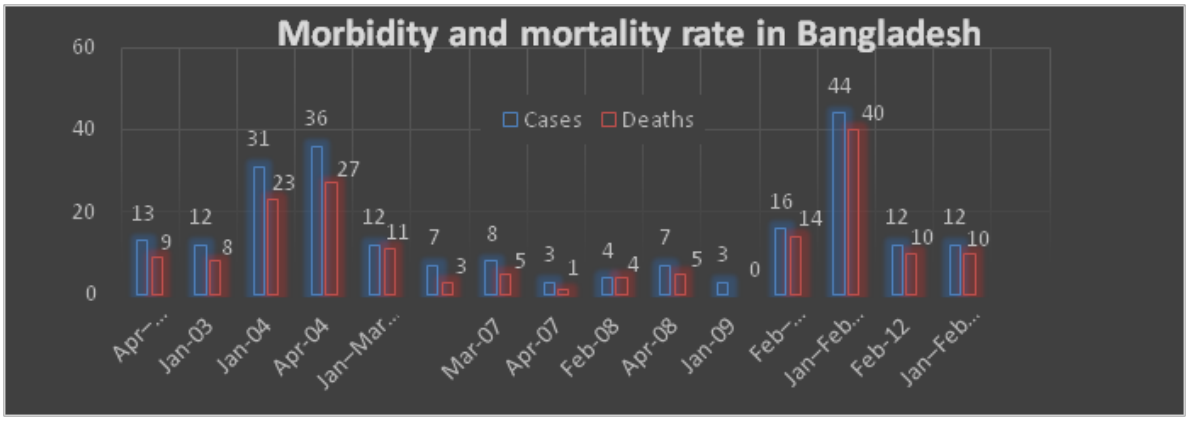

Figure 3 The graphical representation in morbidity and mortality rate in Bangladesh.

Figure 4 Symptoms in patient suffering from Nipah virus infection.

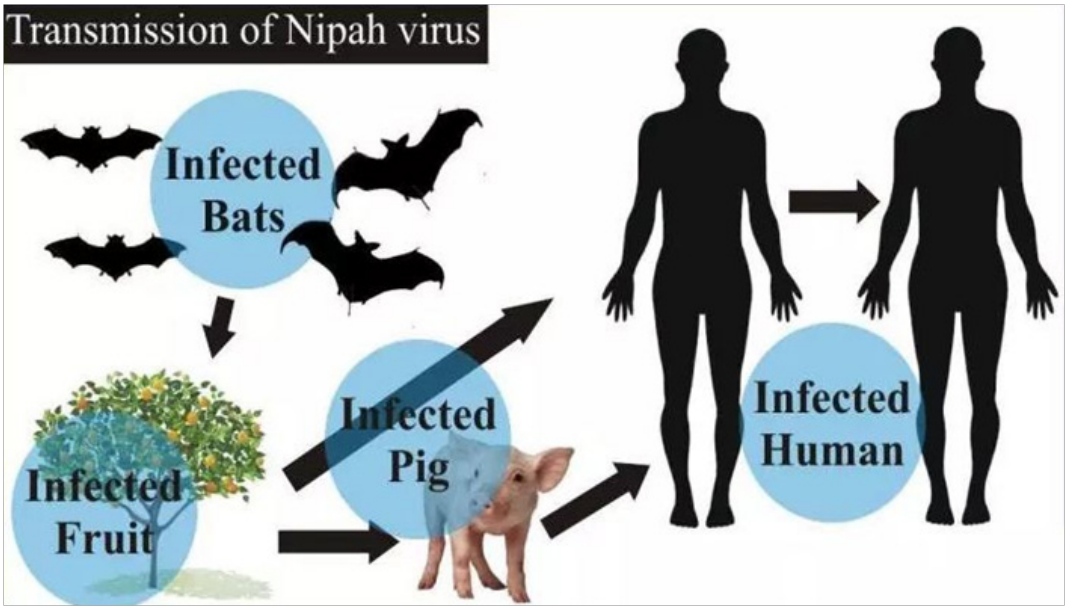

Figure 5 Transmission of Nipah virus.

Table 2 List of Bio safety level-4 facilities

S No.	Name	Location
1	High Security Animal Disease Laboratory	Bhopal Madhya Pradesh, India
2	Centre for Cellular and Molecular Biology	Hyderabad, Telangana, India
3	Microbial Containment Complex	Pune, Maharashtra, India
4	Instituto Nazionale per Le Malattie Infettive	Rome, Lazio, Italy

Prevention

As treatment options are limited, focus on NiV management should be on prevention. Preventive strategies include interventions to prevent farm animals from acquiring NiV by eating fruit contaminated by bats. Farms should be designed to reduce overcrowding to avoid rapid spread of disease between animals and should not be near fruit trees that attract bats. Consumption of contaminated sap should be avoided.[18–20] However, efforts to reduce fresh sap consumption in general would be unpopular, as they go against social and cultural norms. Other, more acceptable methods would include physical barriers to prevent bats from accessing and contaminating sap.[21]

Possible causes of re-emergence of NiV in India

South–East Asia host wide variety of bats and is habitat for 30% of the known global bat fauna. Anthropogenic and environmental changes may impact the dynamic of virus transmission and public health.[22] India is facing rapid growth, economic development, speedy urbanization associated with massive deforestation, overcrowding of cities, movement of migrant workers. Political instability is associated with decrease in nations output, Economic crisis, currency devaluation, and inflation leading to decrease in funding for health care infrastructure.[23] Existing weak surveillance, lack of awareness, lack of facilities for early diagnosis. Facilities if available are restricted to one place alone. Expanding population and diversity and poor infrastructure are possible causes of re-emergence of the NiV in India.[24]

Biosafety issues

Bio safety 3 or 4 level biological safety cabinet. The construction of class-III biological safety cabinet available in India provides utmost personnel and environmental protection against infectious aerosols and new drug derived from biotechnology–pharmacy invention.[25] Full body air–supplied (PAPR and N–95 respirator) or, gas–tight construction; Positive pressure: HEPA filters in exhaust and supply systems. Personnel suit: tight–fitting goggles and N–95 respirator. There are two BSL-3 facilities for Microbiology laboratory and one for the animal experimentation in National JALMA Institute for Leprosy & other Micro–bacterial Diseases under ICMR Tajganj, Agra. There are four laboratories with BSL–4 facilities (Table 2) in which the virus may be studied safely without a risk of escaping and possibility of infecting a greater number of people.[26]

For those who have to work in the field or on farms where NiV is suspected, personal protection, such as masks, goggles, gloves, gowns, and boots, is advocated, together with hand washing and disinfection of equipment.[27] With its high virulence, animal to human and human to human spread, significant morbidity and mortality, and resultant fear and panic and tremendous economic losses caused, NiV fulfils some criteria to be considered a potential agent for bioterrorism. It is thus listed as a category C agent on a list of bioterrorism agents by the Centres for Disease Control and Prevention, and any handling has to be done in biosafety level-4 facilities (Figure 6).[28]

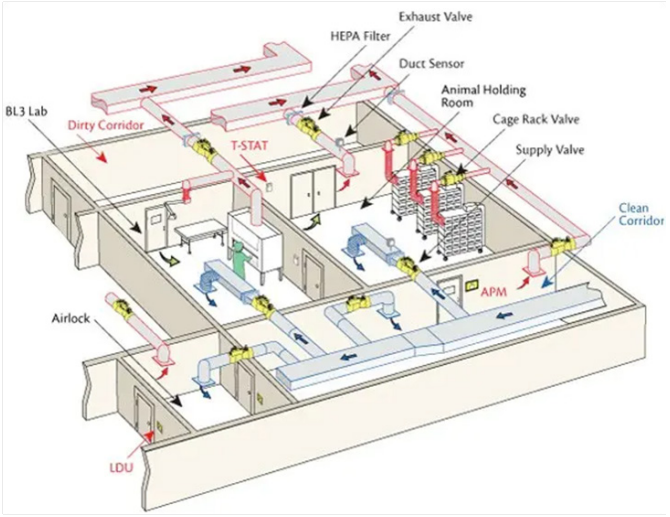

Figure 6 Lay-out of bio safety level-3 laboratory.

Conclusion

According to World Organisation for Animal Health, Nipah virus is a noticeable disease of international importance. Most risk grade–4 infectious hazard leads to life threatening disease in human being. NiV infection most RG–4 produced progressive serious or lethal human disease excessive infection which affects the central apprehensive and respiration structures. A PAPR or tight–fitting goggles and N–95 respirator should be kept in hand to avoid high-risk contaminated fine air droplets in respiratory infections in human beings. Scientific characteristics of NiV infection in Bangladesh, consisting of a severe breathing problem, seem distinct from scientific characteristics mentioned during advance outbreaks in other nations. Most countries in the South–East Asia vicinity do not have adequate facilities to diagnose and control the virus. Therapeutic interventions are not usually available. There is need for further research to understand aetiology, ecology of the disease within reproductive cycles of bats & transmission, clinical signs and symptoms of NiV infection.

Acknowledgments

None.

Conflicts of interest

Authors declare that there is no conflicts of interest.

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