



Mini-Review

Interventions for prevention of Nipah virus transmission and infection in Bangladesh

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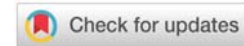
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Abstract

Nipah virus (NiV) infections have been prevalent in Bangladesh since 2001. This virus is usually transmitted from infected bats to humans, and from humans to humans in Bangladesh. The most common source of transmission of Nipah virus in Bangladesh is through the consumption of a drink made from raw date palm sap that has been contaminated by infected bats' saliva or urine. This paper describes several interventions to prevent the transmission of Nipah virus, namely, behavior change interventions, surveillance of cases, and quarantine of infected individuals. This paper also briefly touches upon the recent advancements in the development of vaccines against Nipah virus. Behavior change interventions, namely educating individuals at risk, either in person or through mass media, is an effective way of spreading awareness about and preventing the transmission of NiV. Surveillance systems can help early case detection; however, this might yield misleading numbers if there is underreporting of cases. Quarantine of infected persons is likely to be expensive and would require the presence of extensively trained personnel. Vaccines against NiV are currently being developed and the results from animal tests have been promising. In Bangladesh, given the lack of resources, behavior change intervention would be the most cost-effective way of preventing the spread of NiV, compared to routine surveillance and/or quarantine of cases. Therefore, in order to prevent NiV infections, focus should be geared towards behavior change communication through education about the transmission of NiV, provided to those living in high-risk areas of Bangladesh.

Introduction

Nipah virus (NiV) is a paramyxovirus, that was first discovered during an outbreak involving pigs and people in Malaysia and Singapore in 1998–1999. Outbreaks of Nipah virus infection have been observed in Bangladesh since 2001 [1]. The two main modes of transmission of Nipah virus are from bats to humans and from person-to-person. Transmission of the virus from bats to humans occurs as people drink the juice from raw date palm sap that has been contaminated by Pteropus fruits bats' saliva or urine [2]. Human to human transmissions occur through patients' respiratory secretions and are particularly seen in health care providers working at homes or hospitals. A case of corpse-to-human transmission of Nipah infection was also reported in Bangladesh during an outbreak in March 2010. During this outbreak, cases mostly occurred in winter (from December to May), in a geographically limited area in the northwestern and central parts of Bangladesh [2]. People with NiV infections present with cough, respiratory distress and more than 70% of patients suffer from permanent neurological deficits [1,3]. Some patients also develop Nipah

virus encephalitis [2,4]. Nipah virus infections are becoming increasingly virulent in Bangladesh, with a case-fatality rate of >70% [2]. NiV infection is, therefore, an important public health problem in Bangladesh.

Transmission of NiV is preventable. The major interventions that have been implemented for prevention of NiV transmission in Bangladesh are behavior change interventions, setting up surveillance systems, efforts to produce vaccines and quarantine of infected persons. However, several studies conclude that there are limitations pertaining to each of these interventions, that need to be explored and minimized for effective control of transmission of NiV [5–8]. This paper aims to describe the intervention strategies undertaken in Bangladesh namely, behavior change interventions, surveillance systems and quarantine of infected persons, the merits and demerits of each intervention and the progress of vaccine production.

Methods

The database used for this literature synthesis was PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>), Pub Med (Advanced),



with the following key terms – “Prevention”, “Nipah”, “Bangladesh”. The search results showed 42 articles, out of which 34 were selected based on the timeframe chosen for this paper. Out of 34 articles 13 were relevant and were included in this paper. A timeframe of 10 years was selected.

Results

Several studies have explored the strength of behavior change communication as a strategy to raise awareness among people and thus prevent the transmission of NiV. Researchers have attempted to convey the message about transmission in lay language, with informative photos to aid their description of the biomedical model of transmission of NiV from bats to humans [6]. Attempts have been made to communicate with people directly as well as, via television media to spread knowledge about transmission of NiV [9]. Some studies have compared the results of giving out two different messages of “no raw sap” and “only safe sap” in two different localities [5,9]. The post-intervention results were found to be similar in most studies, with more people reporting that they learned about an infection that is transmitted through the consumption of a drink made from date palm sap contaminated with bats’ saliva or urine [5].

The government recommended key prevention methods in Bangladesh were to either refrain from consuming raw date palm sap during the months of outbreak unless the date palm saps were covered with bamboo-skirts, or to boil the drink for 10 minutes before consumption [7].

The different forms of surveillance deployed by researchers include cluster surveillance which aimed to capture the cases of encephalitis due to NiV infection, and case-based surveillance which looked at all NiV cases presenting in hospitals [10]. Some other options for surveillance include the identification of hotspots with a risk of NiV infection, by mapping the distribution of fruit bat habitats and date palm harvesting locations. Surveillance would allow early case detection and thereby reduce case fatalities [7]. In Malaysia, surveillance involved identifying high risk populations- people who handled pigs, pork sellers, pig cullers, based on the knowledge that transmission of NiV occurred from infected pigs to humans in that country [11]. In Bangladesh, however, NiV is primarily transmitted from bats to humans.

No licensed vaccines against NiV currently exist [3]. A single administration of recombinant vesicular stomatitis virus-based vaccine could be protective; however, this is still under study [12].

Quarantine of infected individuals can help control the person-to-person transmission of infection. It requires the use of appropriate protocols, procedures, and equipment [7].

Discussion

Behavior change communication is the only intervention which can clarify doubts about the transmission of NiV among people living in rural areas of Bangladesh, where consuming raw date palm sap is a winter ritual. Researchers found that

behavior change communication regarding the transmission of NiV helped gain people’s trust and enabled better understanding about the epidemiology of the disease. The trust built was demonstrated as people actively participating in community meetings. An interactive strategy was maintained throughout this intervention [6]. However, this intervention has been found to be quite costly, when a direct communication is attempted in the form of meetings. Behavior change interventions are resource and labor intensive. The problem with high costs associated with behavior change interventions can be solved using television media to broadcast information about the transmission of NiV, instead of direct contact with people. Depending on high-risk and low-risk zones, the method of communication can be differentiated in to two appropriate forms- television announcements in local channels, for low-risk areas, and direct communication strategies, such as health workers visiting communities to spread messages, in high risk areas [9]. For high risk areas, where more people tend to consume raw date palm sap, it is reasonable to directly contact people and try to motivate them to refrain from consuming raw date palm sap during outbreak seasons or, to start using bamboo-skirts to prevent bats from gaining access to the date palm saps. In low risk areas, where fewer people are at risk, spreading information about transmission of NiV through television, radio broadcast etc. would suffice. Behavior change interventions do not require the use of any advanced technology, unlike surveillance systems for which advanced lab tests are necessary. Overall, the use of behavior change communication to prevent the transmission of NiV would be cost-effective.

Surveillance can be a good way to identify cases and can allow us to prevent the onset of new cases. However, we might miss cases, if, for example, a patient got admitted to a government hospital, which was not selected as a surveillance hospital [10]. Similarly, patients suffering from NiV infection or NiV encephalitis may not get admitted to a hospital in the first place, which is a common scenario in Bangladesh, owing to low healthcare utilization [10]. Therefore, the chance of missing cases is quite high and the penalty for missing a case in an endemic zone could be huge, as this will lead to an increase in person- to- person transmission of NiV, increase in the number of cases as well as case fatality. Setting up and monitoring surveillance systems may also be time-consuming. In low resource settings like Bangladesh, where access to modern lab technologies is scarce, it may not be feasible enough to rely on surveillance alone to prevent the transmission of NiV. Studies have mentioned that integrating public education with surveillance programs would be more effective, especially in high-risk areas [7].

The average incubation period for NiV is about 5-7 days which suggests that there is a strong potential for the development of vaccines against it. All successful viral vaccines target an incubation period of about 5-7 days and vaccines have been proven unsuccessful when used for viruses with shorter incubation periods [3]. Several attempts have been made to test the feasibility of using viral outer membrane proteins, glycoproteins, fusion proteins and antigens on animal models



like ferrets, hamsters, cats etc., which resulted in effective immune responses in them [3]. Another vaccine under development is a recombinant vesicular stomatitis virus-based vaccine which is being tested in animals [12]. However, the affordability of such vaccines by low- and middle-income countries like Bangladesh, remains an issue [3]. Since these vaccines are still under animal testing, it would require more time for vaccines to be fully prepared for administration. Before being administered, the efficacy and safety of these vaccines would also need to be tested. This would delay the process of prevention of transmission of NiV. The cost of purchasing such vaccines would be high and countries like Bangladesh would need external funding to purchase these vaccines. Thus, vaccination against NiV is a potential intervention to prevent viral transmission and subsequent infection, but it is not an intervention that can be implemented immediately.

Quarantine of infected individuals requires funding from government as well as external funding, and needs extensively trained personnel for monitoring of the whole process, thus making this intervention for prevention of transmission of NiV, the least feasible.⁷ It would be difficult to control or restrict the movement of people living in rural Bangladesh, who are poorly educated and are not likely to be cooperative if they have no prior knowledge about the virus. This again points to the importance of education about NiV and how it is transmitted before the implementation of any other intervention. Studies have suggested that coupling efforts for quarantine with behavior change communication strategies for public education will be more effective in controlling the spread of NiV, compared to interventions like surveillance programs [13].

Keeping all the different prevention strategies in mind, it can be predicted that a combination of different strategies would be the best option to explore, however, the single most important method for prevention would be 'education' about the transmission of NiV infection, among populations at risk, although there is a limitation of high costs associated with dissemination of information [7].

Conclusion

Preventing the transmission of Nipah virus can be a complex problem to deal with. Nevertheless, it is possible to control its spread through a combination of interventions. It is important to note that vaccines against NiV are still under development and no known antiviral drugs have been used to control the infection or prevent its transmission. Under such circumstances, and in settings like Bangladesh, where setting up surveillance systems to detect cases and quarantine of infected persons are not as feasible, due to lack of resources, manpower and lack of knowledge among lay persons about NiV, the most ideal option is to increase awareness among people (especially those living in high-risk areas) about the

transmission of disease through education. If we weigh the merits and demerits of the different interventions in practice, behavior change communication strikes out as the intervention that is likely to spread awareness fast, bringing the biomedical model of transmission of NiV to people's knowledge, thereby playing a vital role in preventing transmission of NiV.

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