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Review article

A call for proactive public health preparedness against the Zika virus in India

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ABSTRACT

Background: Arboviruses, spread by insects like mosquitoes, pose a serious threat to human and animal health worldwide. Zika virus is one of the pathogenic viruses that are spreading rapidly. In India, the virus was first reported in Ahmadabad in 2017. Zika virus was re-emerged in India, raising concerns about transmission dynamics and associated health risks. The emergence of Zika virus in India in 2024 presents a major public health challenge requiring proactive preparedness. Amidst the ongoing threat of emerging SARS-CoV-2 variants, the re-emergence of Zika depicts the complex and growing nature of global health challenges. The key driving factors include climate change and rapid urbanization that promote the proliferation of mosquito vectors. Currently the threat of Zika virus in India appears to be relatively low, however, the sustained public health vigilance and adherence to preventive measures remains priority. The implementation of improved surveillance systems, rapid diagnostic capabilities, engaging communities in prevention measures and awareness programs are essential to effectively manage the potential of virus outbreaks. This review highlights the importance of proactive responses and continuous monitoring to mitigate the re-emergence of Zika virus in India.

Introduction

Emerging and re-emerging viruses pose considerable threats to human and veterinary health due to their ability to cause a large number of diseases [1]. Arboviruses are transmitted by arthropod vectors such as mosquitoes and ticks. These viruses include pathogens like Zika virus, dengue virus, chikungunya virus, West Nile virus, and others [2,3]. Zika is an arthropod-borne virus belongs to the member of *Flaviviridae* family and genus *Flavivirus*. Zika is transmitted primarily through the bite of infected *Aedes* mosquitoes. These mosquitoes are known to cause dengue, yellow fever and chikungunya. It was first isolated in 1947 from a rhesus monkey in the Zika Forest of Uganda [4]. For many years, Zika virus outbreaks were sporadic and primarily confined to Africa and Asia. This virus is currently being reported in nearly 90 countries worldwide [5,6]. Zika virus infections typically cause mild or asymptomatic infections in adults. This virus gained much attention due to its association with severe neurological complications, including Guillain-Barre syndrome, neuropathy, myelitis, and congenital Zika syndrome. Till date, no vaccine is available for the prevention or treatment of Zika infection [5,7,8]. The World

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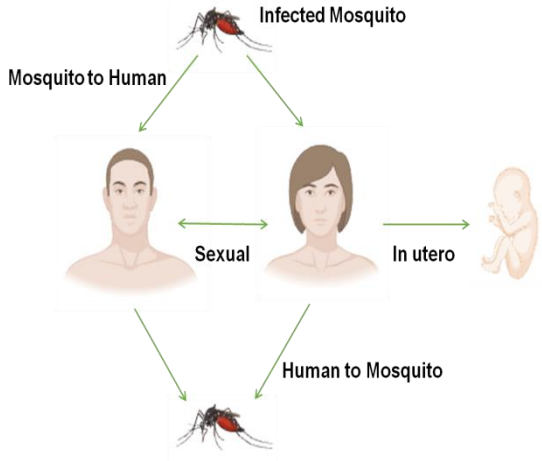
Health Organization (WHO) declared Zika virus as a Public Health Emergency of International Concern in February 2016. After which the number of Zika cases were decreased significantly and hence the emergency status was lifted on November 2016 [9]. However, Zika virus still remains a concern in the areas where the *Aedes* mosquito vectors are prevalent. Zika virus shares similarities with other arboviruses such as dengue and chikungunya, as all are being transmitted by mosquito vector; it is distinct in its association with serious congenital abnormalities and specific transmission routes. Its impact on pregnant women and newborns, as well as its unique epidemiological features, differentiate it from other arboviruses.

Zika cases in India were first reported in Ahmadabad in 2017 [10]. Zika has re-emerged in India, raising concerns about its spread and the associated health risks. About fifteen cases were detected in Pune, Maharashtra (as of July 10, 2024). The National Institute of Virology (NIV) in Pune confirmed the viral strain is of Asian genotype. NIV is screening more number of samples from different regions [11,12]. The infected case numbers are limited as of now; but it highlights the existence/circulation of the virus and the possibility of large future outbreaks, especially during the monsoon season during which the primary mosquito vector for Zika virus multiplies. The public health authorities have rapidly initiated precautionary measures such as fogging and fumigation to eradicate mosquito breeding grounds. Further, the Pune municipal corporation (PMC) has issued public advisory urging residents to maintain cleanliness in their surroundings to prevent any potential outbreak of the Zika virus. PMC officials have assured the public that they are implementing necessary measures to control and contain the spread of Zika virus within the city [12]. The state of Maharashtra in India has recently reported a significant increase in SARS-CoV-2 variants KP.2 and KP.3 cases in the country [13,14]. The recent cases of Zika virus presenting an additional public health challenge. However, further investigation and surveillance are essential to determine the full extent of virus transmission in Maharashtra and possibly in other regions of India. Although India has not yet reported a high number of Zika cases, the emergence of confirmed cases showed the potential strain on healthcare resources already stretched by the COVID-19 pandemic and its variants emergence. This situation emphasizes the need for preparedness to effectively manage both the diseases.

Factors associated with emergence of Zika virus

Zika virus poses a serious threat to India due to several critical factors that contribute to its potential impact on public health. The widespread distribution of *Aedes* mosquitoes, particularly *Aedes aegypti* and *Aedes albopictus* across the country, serves as effective vectors for the transmission of Zika virus in both urban and rural environments. **Figure 1** shows the Zika virus transmission cycle. Urbanization has increased the human-mosquito interactions [15]. India has a diverse tropical to subtropical climate which supports year-round mosquito activity thereby increasing the likelihood of Zika virus transmission throughout different regions and seasons [16]. High urban population and extensive rural populations increase the potential for rapid virus spread, once it is introduced and also domestic/ international travel patterns increase the likelihood of importing Zika cases from endemic areas. In addition, challenges in India's healthcare infrastructure, particularly in rural areas, cause barriers to timely Zika virus surveillance, diagnosis, and management, potentially delaying effective public health responses [17].

Figure 1. Transmission of Zika virus.



Recommendations

In order to address and mitigate disease outbreaks, the Government of India has taken

certain steps with the National Centre for Disease Control as the nodal agency to investigate an outbreak of disease. A comprehensive, integrated approach including vector control, personal protection measures, engaging communities, and targeted interventions for high-risk groups is required for the effective prevention and control of arboviruses like Zika [18]. Similar like Zika, dengue and chikungunya are also spread by *Aedes* mosquitoes and exhibit similar symptoms which complicates the surveillance and detection efforts [19]. Therefore continued research, implementing robust, national surveillance programs, real time data analysis, enhancing diagnostic capabilities and collaborative initiatives are crucial to reduce the impact of Zika and other arboviruses on global health. The key preventive and control measures include reducing mosquito populations, protecting individuals from mosquito bites, promoting safe sexual contact and avoiding travel to regions with active Zika transmission [17,18,20]. Furthermore, it is crucial to setup robust surveillance systems to track the mosquito populations and identify early signs of virus circulation. The reduction of mosquito population by managing mosquito breeding sites is also crucial [21]. It is also essential to provide community education and awareness about virus transmission, symptoms, and the importance of seeking proper medical advice if experiencing any symptoms. This includes disseminating information through media channels, community events, and health professionals. It is vital to provide specific guidance to pregnant women about the risks of Zika infection during pregnancy, including potential birth defects, and emphasizing preventive measures. It is advisable to issue travel advisories for regions experiencing active Zika virus transmission to inform travelers about associated risks and recommended preventive measures [22,23].

It is essential to develop reliable, cost-effective, and standard diagnostic tests for accurate confirmation and timely detection of the virus. The availability of point-of-care diagnostic tests aids quick diagnosis and patient management especially in the resource-limited settings. The strengthening of laboratory infrastructure for confirmatory testing is also crucial for outbreak verification and epidemiological investigations. Further, the development of effective vaccines and targeted therapeutic interventions is necessary to address the threats of Zika virus. Many groups are working on developing safe vaccines against Zika virus. Various candidates including live attenuated, inactivated, nucleic acid, viral vector, and recombinant vaccines have showed better efficacy in preclinical testing and are currently in clinical trials [24,25]. The promising results from the ongoing trials will eventually help to select the promising candidates for further development. Overall, the implementation of the preventive and control measures can reduce the virus transmission, protecting vulnerable populations thereby promoting the safer environments in areas at risk of zika virus transmission [17].

In conclusion, Zika virus remains a major public health concern due to its potential to cause severe birth defects and neurological complications. The Zika virus resurgence in India, amidst the circulation of emerging SARS-CoV-2 variants depicts the complex and increasing nature of health challenges. While the immediate threat of a Zika in India appears low, continued public health vigilance and adherence to preventive measures are essential. The challenges due to emerging and reemerging viruses such as coronaviruses, influenza, monkeypox and Zika require sustained commitment, collaboration, and innovation across sectors. The efforts to strengthen health systems, advance scientific knowledge, and empower communities are essential for building a safer and healthier future for all.

Abbreviations

COVID-19	Coronavirus disease
NIV	National Institute of Virology
PMC	Pune Municipal Corporation
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

Conflicts of interest

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