

Zika Virus Outbreak: Indian Perspective

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Summary

*This review provides an overview of the Zika virus infection (ZVI) with a focus on the Indian context. The article starts by discussing the current global health scenario, where emerging and reemerging infectious diseases have become a threat to the socio-economic and political environment of the world. The review also briefly covers the history of ZVI, from its discovery in Uganda in 1947 to its recent pandemic form in different parts of the world. The article discusses the epidemiology of ZVI, including the causative agent, hosts, and transmission modes, where *Aedes aegypti* and *Aedes albopictus* mosquitoes are the primary vectors. The article also covers the history of ZVI in India, where the earliest evidence dates back to 1954, and the first pandemic was reported in 2018. The article concludes by emphasising the importance of epidemiological factors and human behaviour in containing the spread of the disease.*

Key words: Zika Virus infection, Outbreak, India

The whole world is struggling through the phase of survival against the threat inflicted by the Covid-19 pandemic. The term emerging and reemerging is not new among the health professional, but recently it was observed that the intensity and propensity of epidemics are pushing the socioeconomical and political milieu of the world into an anarchy. Integrated disease surveillance project reported the outbreaks of viral pathogen in the country during recent time including Crimean-Congo haemorrhagic fever, Kyasunar Forest disease, Nipah, Zika, Acute respiratory infection, Japanese Encephalitis, West Nile disease and variants of Dengue fever (Mourya et al 2019; Cecilia, 2014). The recent attack of ZVI on 9 June 2021, a 24-year-old pregnant lady from Thiruvananthapuram (Kerala) presenting with typical symptoms was confirmed to be affected with ZVI with CDC Trioplex RT-qPCR. The case drew the attention and highlighted the spread of the diseases beyond the borders (Yadav et al, 2022). The ubiquitous presence of its vector and the favourable climatic conditions for its growth is an alarming situation (Duffy et al, 2019). In the beginning ZVI was very rare benign human infections, but it has become a health emergency due to foetal brain damage or death in babies born to infected mothers and Guillain-Barre syndrome in adults. The lessons learned from the recent pandemic show that knowledge regarding the epidemiological factors and human behaviour is essential to contain

the diseases. This article provides an overview of ZVI with focus on Indian context.

Review of Literature

Zika virus is a mosquito-borne virus that is transmitted primarily by the *Aedes* species of mosquitoes. The emergence of ZVI as a global health threat has raised concerns among public health officials worldwide. Although the virus was first discovered in Uganda in 1947, the first large-scale outbreak of ZVI occurred in 2007 in the island of Yap in Micronesia (Duffy et al, 2009). Since then, several outbreaks have been reported in different parts of the world, including South America, Central America, the Caribbean, and Asia. The epidemiological and clinical features of the Zika virus outbreak in Gujarat found that the majority of cases were reported in young adults, and the most common symptoms were fever, rash, joint pain, and conjunctivitis. The study also highlighted the need for improved surveillance and control measures to prevent future outbreaks (Rolph & Mahalingam, 2019). Another study in Gujarat assessed the knowledge, attitude, and practices of healthcare providers regarding ZVI. The study found that there was a lack of awareness and knowledge among healthcare providers about the virus, and there was a need for more training and education to improve preparedness for future outbreaks (Sharma et al, 2018). Overall, the Zika virus outbreak in India highlights the importance of preparedness and surveillance measures to prevent the spread of emerging infectious diseases.

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More research is needed to better understand the epidemiology and clinical features of ZVI in India and to develop effective control strategies.

Concept Review of ZIV

Concept review is a useful tool that can help researchers and healthcare professionals organise and clarify complex information related to a particular topic. In the case of ZIV outbreak in India, concept mapping can be particularly helpful for nurses who are working in the field of public health and infectious disease control. Concept mapping can be used to identify and link the different aspects of the ZIV outbreak in India, including the epidemiology, clinical features, prevention and control measures, and healthcare provider knowledge and attitudes. Additionally, concept review can help nurses identify gaps in current knowledge and areas that require further research. This can help guide future studies and interventions, ultimately leading to better outcomes for patients and communities affected by the ZIV outbreak in India.

History of Zika Virus

The Zika virus was discovered from the Zika Forest in Uganda in 1947 during the investigations of yellow fever, and named after the place from which the virus was discovered. The virus was isolated from the Rhesus monkey and later from a mosquito *Aedes africanus* in 1948. First human infection of Zika virus was identified through the serological survey in 1952 from a patient in Eastern Nigeria (Macnamara, 1954). Since then, outbreaks have been reported in tropical Africa, Asia and Pacific islands. During 1969 to 1983, ZVI extended to different parts of India, Indonesia, Malaysia and Pakistan, but the infections were mild and there were only 14 cases of human infection worldwide. First large-scale outbreak of Human Island occurred in Pacific Island of Yap in 2007. The disease spread to other parts of the Pacific Islands during 2013-2014. On 1 February 2016, World Health Organisation declares the association between clusters of microcephaly and other neurological disorders and declared ZVI as a public health emergency of international concern and informed the member states to set up surveillance for ZVI (Gupta et al, 2019; The History of Zika Virus, 2021).

Zika Virus Infection in India

Though the disease outbreak was reported in recent years, the earliest evidence of ZVI is dates back to 1954. During the active surveillance for the identification of viruses of public health significance in India, the blood samples collected from healthy individuals and neutralising antibodies against Zika virus were detected in 16.8 percent of

serum samples tested. The highest test positivity rate was reported from Gujarat (Smithburn et al, 1950; Gupta et al, 2020; Khailboullina et al, 2018). National Institute of Virology, Pune and network of Virus Research and Diagnostics Laboratories (VRDL) was set up for Zika surveillance in India. A linkage is established between the Medical Colleges and the VRDLs for referring samples of suspect/proven cases of microcephaly for testing of Zika virus.

In India, during 2016-17 four cases of Zika cases were reported from Gujarat and Tamil Nadu states. In 2018, India faced the first pandemic with an index case of 85-year old female from Rajasthan admitted with one episode of generalised convulsions with the semi-unconscious state. There were no other symptoms like fever, rash, myalgia or arthralgia nor travel history and Zika was confirmed serologically. This was the fifth Zika confirmed case in India and there were 159 confirmed cases including 63 pregnant women in Rajasthan followed by 127 positive cases with 42 infected pregnant women in Madhya Pradesh in 2018 (Yadav et al, 2019).

Epidemiology

Agent: The causative agent is Zika virus, which belongs to the family Flaviviridae and the genus Flavivirus. The virion is about 40 nm in diameter, having 5-10 nm surface projections. The ZIKV contains a nucleocapsid surrounded by a lipid bilayer with envelope proteins. It is an enveloped single stranded, icosahedral virus with a non-segmented, single-stranded, positive-sense RNA genome. The attachment of the virus to receptors on the host membrane is facilitated by the E proteins. Subsequently, the virus gets internalised via endocytosis. Replication takes place on the endoplasmic reticular surface. Zika virus can be of African or Asian lineage (Gregory et al, 2019).

Host

The host of Zika virus are humans and non-human primates such as apes, chimpanzees, baboons, monkeys and orang-utans. Literature suggests that anti-zika antibodies have also been detected in domestic animals such as goats, sheep, horses and ducks.

Transmission

Vector transmission

Zika is an arboviral disease like dengue, chikungunya and yellow fever. It develops after a bite of an infected mosquito from the *Aedes* genus, mainly *Aedes aegypti* and *Aedes albopictus*. *Aedes* is a daytime biter, peak on early morning and late afternoon or evening. The virus originates in

non-human primates like chimpanzees, monkeys and baboons from tropical rainforests, but can infect humans. The cycle in non-human primates is called the sylvatic cycle and human cycle is called urban cycle. The disease is a zoonosis of non-human primates that spread through the forests of the Brazilian countryside, killing many animals and eventually infecting man. All these arboviruses have urban maintenance cycles and spread throughout tropical areas of the world causing large epidemics. Zika virus is unusual among the arbovirus in its capacity for sustained transmission in a human-endemic cycle.

Non-vector transmission

The non-vector transmission can be from infected mother to foetus during intrauterine or perinatal. The virus is isolated from the in saliva, breastmilk, urine, and serum of two mothers and their new-born babies within 4 days of delivery. It can also transmit through sexual contact, transfusion of blood and blood products, and organ transplantation. The virus remains in semen longer than in blood (CDC).

Incubation period

The incubation period is between 3-14 days (CDC).

Clinical manifestations

Most of the patients infected with Zika virus may be asymptomatic or present with minor symptoms such as mild fever, macular or popular rash, arthralgia, particularly in the hands or feet and conjunctivitis. They may complain muscle pain, headache, retro-orbital pain, fatigue or a general feeling of discomfort and abdominal pain.

Infants with confirmed or possible Zika infection may present with microcephaly, miscarriage, still-birth, absent or poorly developed brain structures, defects of the eye, hearing deficits and impaired growth. Children born with Congenital Zika syndrome will be present with limb contractures, high muscle tone, hearing loss, and eye abnormalities. The risk of congenital malformations following infection in pregnancy remains unknown; an estimated 5-15 percent of infants born to women infected with Zika virus during pregnancy have evidence of Zika-related complications. The maternal infection may be symptomatic or a symptomatic infection. There is no evidence of infants getting Zika through breastfeeding.

Diagnosis

- The diagnosis of Zika can be done with clinical and laboratory evaluation. The differential diagnosis of Zika is broad and considerations include, Dengue, Chikungunya, Leptospirosis, Malaria, Rickettsia, Group A Streptococcus, Rubella and Measles.
- Person showing the signs and symptoms of live

Zika or having history of recent travel to an endemic area may be suspected for the ZVI. It can be confirmed by the laboratory tests of blood or other body fluids, such as urine or semen.

- Real time reverse transcriptase-polymerase chain reaction (rRT-PCR) for viral RNA in clinical specimens collected < 7 days (serum) or < 14 days (urine) after illness onset.
- Serology for IgM and neutralising antibodies in serum collected up to 12 weeks after illness onset.
- Plaque reduction neutralisation test (PRNT) for presence of virus-specific neutralising antibodies in paired serum samples.
- Immunohistochemical (IHC) staining for viral antigens or RT-PCR on fixed tissues (clinicalpptpdf-2021).

Treatment & Prevention

There are no vaccines or medicine for Zika. So, the management of Zika is symptomatic. Antipyretics, rest, maintaining hydration are the usual course of management.

Prevention

The vector of Zika is widely prevalent in India. In urban areas it is seen in non-degradable tyres. Long-lasting plastic containers, overhead tanks, ground water storage tanks and septic tanks are usually the primary habitats. The natural larval habitats include tree holes, leaf axles and coconut shells. The preventive and control strategies are described below.

Vector surveillance is the initial step to identify the density of the vector. It can be larval survey include house index, Breteau index and pupae index and container index. Adult survey include landing and biting collection, resting collection, oviposition traps

Vector Management

At Household Level

- *Aedes aegypti* mosquito bites during daytime. Adult mosquitoes should be killed by using of commercially available pyrethroid-based safe aerosols.
- Rooms including closets, bathrooms and kitchens should be sprayed for a few minutes and closing the room for 15-20 minutes during the peak biting time of the mosquito like early morning or late afternoon.
- Personal protection measures like wearing protective clothing such as full sleeved shirts & full pants during day time and using mosquito nets, preferably insecticide treated ones, while sleeping, even during day time.

- Using commercially available repellents during day time. Using mosquito repellents or burning neem leaves, coconut shells and husk to kill or repel the mosquitoes.
- Using tight-fitting screens/wire mesh on doors and windows.
- Covering all water containers in the house to prevent fresh egg laying by the vector. Emptying and drying water tanks, containers, coolers, bird baths, pets' water bowls, plant pots, drip trays at least once each week. Regularly checking for clogged gutters and flat roofs that may have poor drainage.
- Introducing larvivorous fishes (like Gambusia/ Guppy) in ornamental water tanks/garden. These small fishes eat mosquito larvae.

At Community Level

Community groups should reinforce efforts through awareness campaigns on Zika Virus disease and seek cooperation for prevention of mosquito breeding and protection from mosquito bites. Community activities against larvae and adult mosquitoes can include:

- Cleaning and covering water storage containers.
- Burning mosquito coils to kill or repel the mosquitoes/burning neem leaves, coconut shells and husk to repel mosquitoes and eliminating outdoor breeding sites.
- Cleaning weeds and tall grass to reduce available outdoor resting places for adult mosquitoes near houses.
- Organising camps for insecticide treatment of community-owned mosquito nets/curtains.

International Regulations by World Health Organisation

- Advancing research of Zika virus infection and associated complications.
- Developing, strengthening and implementing integrated surveillance systems for Zika and associated complications.
- Strengthening the capacity of laboratories and supporting global efforts to monitor vector control strategies aimed at reducing Aedes mosquito populations.
- Strengthening care and support of affected children and families affected by complications of Zika infection.

References

1. Mourya DT, Yadav PD, Ullas PT, Bhardwaj SD, Sahay RR, Chadha MS, et al. Emerging/re-emerging viral diseases & new viruses on the Indian horizon. *Indian J Med Res* 2019 Apr; 149(4): 447-67
2. Cecilia D. Current status of dengue and chikungunya in India. *WHO South-East Asia J Public Health* 2014 Mar; 3(1): 22-26
3. Yadav PD, Niyas VKM, Arjun R, Sahay RR, Shete AM, Sapkal GN, et al. Detection of Zika virus disease in Thiruvananthapuram, Kerala, India 2021 during the second wave of COVID-19 pandemic. *J Med Virol* 2022 Jun; 94(6): 2346-49
4. Gupta N, Kodan P, Baruah K, Soneja M, Biswas A. Zika virus in India: Past, present and future. *QJM Mon J Assoc Physicians* 2019 Oct 23; hcz273
5. Duffy MR, Chen TH, Hancock WT, Powers AM, Kool JL, Lanciotti RS, et al. Zika virus outbreak on Yap Island, Federated States of Micronesia. *N Engl J Med* 2009 Jun 11; 360(24): 2536-43
6. Rolph MS, Mahalingam S. Zika's passage to India. *Lancet Infect Dis* 2019 May 1; 19(5): 469-70
7. Sharma S, Tyagi A, Ramachandra S, Bhuyan L, Dash KC, Raghuvanshi M. Knowledge, attitudes, and practices among health-care providers regarding Zika virus infection. *J Int Soc Prev Community Dent* 2018; 8(1): 41-47
8. Macnamara FN. Zika virus: A report on three cases of human infection during an epidemic of jaundice in Nigeria. *Trans R Soc Trop Med Hyg* 1954 Mar; 48(2): 139-45
9. The history of zika virus [Internet] [cited 2021 Jul 20]. Available from: <https://www.who.int/news-room/feature-stories/detail/the-history-of-zika-virus>
10. Smithburn KC, Kerr JA, Gatne PB. Neutralizing antibodies against certain viruses in the sera of residents of India. *J Immunol Baltim Md* 1950. 1954 Apr; 72(4): 248-57
11. Gupta N, Yadav PD, Patil DY, Sapkal G. Preparedness of public health-care system for Zika virus outbreak: An Indian perspective. *J Infect Public Health* 2020 Jul; 13(7): 949-55
12. Khaiboullina S, Uppal T, Martynova E, Rizvanov A, Baranwal M, Verma SC. History of ZIKV infections in india and management of disease outbreaks. *Front Microbiol* 2018 Sep 12; 9: 2126
13. Yadav PD, Malhotra B, Sapkal G, Nyayanit DA, Deshpande G, Gupta N, et al. Zika virus outbreak in Rajasthan, India in 2018 was caused by a virus endemic to Asia. *Infect Genet Evol* 2019 Apr; 69:199-202
14. Gregory CJ, Oduyebo T, Brault AC, Brooks JT, Chung KW, Hills S, et al. Modes of transmission of Zika virus. *J Infect Dis* 2017 Dec 16; 216(suppl_10): S875-83
15. Zika virus - Symptoms and causes [Internet]. Mayo Clinic. [cited 2021 Jul 23]. Available from: <https://www.mayoclinic.org/diseases-conditions/zika-virus/symptoms-causes/syc-20353639>
16. clinicianppt.pdf [Internet]. [cited 2021 Jul 24]. Available from: <https://www.cdc.gov/zika/pdfs/clinicianppt.pdf>
17. File568.pdf [Internet] [cited 2021 Jul 21]. Available from: <https://ncdc.gov.in/WriteReadData/1892s/File568.pdf>
18. Zika Strategic Response Framework: Google Search [Internet]. [cited 2021 Jul 24]. Available from: <https://www.google.co.in/search?q=outlined+in+Zika+Strategic+Response+Framework>