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Popular Article

Zika Virus: Past, Present, and future directions in diagnosis, prevention

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Introduction:

After being discovered for the first time in Uganda in the 1940s, the Zika virus (ZIKV) eventually spread to the Americas. For over 70 years, it was largely unnoticed until it abruptly expanded throughout the Americas, raising alarm on a worldwide scale. According to studies, the ZIKV strain that originated in the Americas has moved to Angola and is linked to a rise in microcephaly occurrences. Because of its link to birth abnormalities, the World Health Organization (WHO) has declared it a public health emergency of international concern (1).

History and Epidemiology of ZIKV:

Like other arboviruses like dengue and Japanese encephalitis viruses, ZIKV is a member of the *Flaviviridae* family and is mostly spread by *Aedes* mosquitoes. Numerous animal species have been reported to have it, most notably non-human primates. *Aedes africanus*, *Aedes aegypti*, and *Aedes albopictus* are among the mosquito species from Africa and Asia from which the virus has been isolated (2).

Three primary ZIKV lineages have been found through studies; two originate in Africa and one in Asia (3). While the Asian lineage had a larger range, developing in the Pacific Ocean and South America, the African lineages separated into East and West African clusters. A strain of Asian ancestry known as the "American strain" was the cause of the 2015–2016 outbreak in the Americas.

ZIKV has been found in many countries and areas including parts of North Africa, Vietnam, Malaysia, Indonesia, the Philippines, Thailand, Pakistan, and India. The first person known to be infected was in Uganda in 1952, with occasional cases appearing before a significant outbreak in Yap, Federated States of Micronesia, in 2007. The most extensive outbreak happened in French Polynesia from 2013 to 2014, spreading to other Islands in the Pacific (4).

Zika in India:

During the second wave of the COVID-19 pandemic, outbreaks of Zika were reported from Kerala, Uttar Pradesh, and Maharashtra, India in 2021 (1).

Molecular biology:

ZIKV belongs to the family Flaviviridae, which includes arboviruses that cause diseases in humans. Its genetic material is about 10.8 kb in length and is made up of single-stranded RNA and a long open reading frame that encodes a polyprotein. This polyprotein is cleaved into smaller parts called capsid (C), envelope (E), the precursor of the membrane (prM), and seven other non-structural proteins (NS1, NS2A, NS2B, NS3, NS4A, NS4B, NS5).

ZIKV has unique glycosylation spots on its surface compared to other flaviviruses, which may affect its ability to attach to human cells and infect them (4).

Transmission:

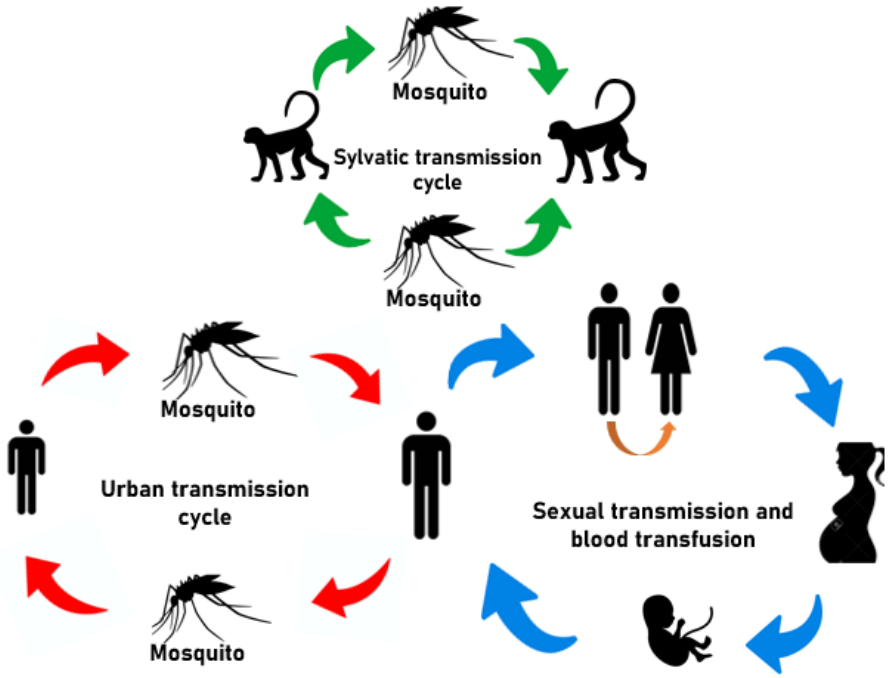

Fig 1. **Transmission cycle of ZIKV (5)**

Clinical Manifestation:

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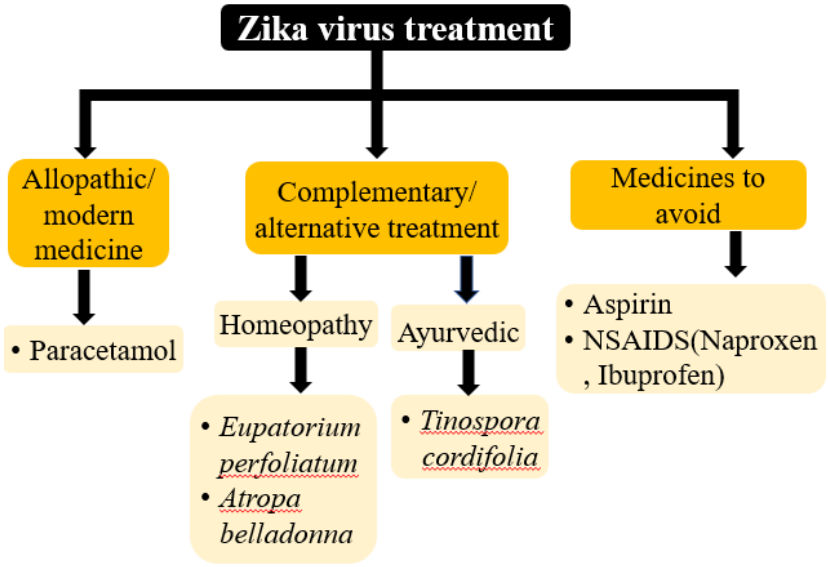
The incubation period for ZIKV disease is typically 2-7 days. Symptoms include fever, rash, headache, dizziness, stomachache, and malaise. Some people experience retro-orbital eye pain, lymphadenopathy, diarrhea, and edema. ZIKV can be mistaken for other similar viruses and bacterial infections, especially in places where it's common. During outbreaks of ZIKV, serious neurological problems, including Guillain-Barré syndrome, have been reported (4).

Diagnosis (6)**:**

- **Virus Isolation:** through cell culture.
- **Serological Methods:** detect antibodies produced by the body in response to infection.
- **Reverse Transcription PCR:** RT-PCR is a molecular method used to detect genetic material (RNA). It is rapid, specific, and sensitive, making it a valuable tool for confirming ZIKV infections in serum or cell culture.
- **ELISA for IgM Detection:** detect immunoglobulin M (IgM) antibodies against ZIKV in patient samples. This method is particularly useful for detecting recent infections.
- **Saliva as a Sample Source:** Molecular detection of ZIKV has been successful using saliva samples, especially in children and neonates where collecting blood may be challenging.
- **Diagnosis Guidelines:** The Pan American Health Organization (PAHO) provides guidelines for ZIKV fever diagnosis. These guidelines typically involve RT-PCR on blood or saliva samples, with sequencing performed if RT-PCR results are positive.

Treatment (4)**:**



Prevention and control:

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- **Mosquito Repellents:** Using mosquito repellents containing active ingredients such as picaridin, DEET, eucalyptus oil, IR3535, oil of lemon, and para-menthane-diol can help reduce mosquito bites. It's important to note the recommended repellents for pregnant and lactating mothers, as well as the ones suitable for children (9).
- **Mosquito Nets:** Employing mosquito nets, especially for babies, can protect them from mosquito bites while they sleep (7).
- **Indoor Mosquito Killing Sprays:** Using indoor mosquito-killing sprays containing active ingredients like Imidacloprid and β-Cyfuthrin can help eliminate mosquitoes indoors (7).
- **Flying Insect Fogger:** Foggers containing active ingredients such as Tetramethrin and Cypermethrin can be used to combat mosquitoes in outdoor spaces (7).

Vector Control Strategies:

- Using intracellular bacteria like *Wolbachia* as a biopesticide to control mosquito populations.
- Leveraging mosquito species like *Toxorhynchites splendens*, which feed on the larvae of other mosquito species, to reduce overall mosquito numbers.
- Employing the strategy of releasing sterile males to induce sterility in wild fertile female mosquitoes, thereby suppressing Aedes species populations (8).

- **Blood Transfusion Screening:** Conducting tests for ZIKV infection before blood transfusions can prevent transmission through this route.
- **Pregnancy Precautions:** In areas where ZIKV infection is prevalent, it's important to either avoid pregnancy until the risk is reduced or take extra precautions, as ZIKV infection during pregnancy is associated with microcephaly in infants.

Future directions:

Developing a ZIKV vaccine is crucial, drawing on successes with other flaviviruses. Reliable animal models are needed to study transmission and its impacts on immunity and reproduction. Swift and accurate diagnosis through molecular techniques is vital for timely treatment. Modern molecular biology tools can aid in designing targeted vaccines. Addressing research gaps, including understanding fetal infection consequences and improving vector control, is necessary. Global collaboration is key for effective prevention and control efforts.

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