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Zika Virus: An Explosion in World

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Abstract

Zika virus is a flavivirus, in the family Flaviviridae. Although Zika virus was isolated on several occasions from Aedes africanus mosquitoes after its discovery in 1947, there initially was no indication that the virus caused human disease. Nevertheless, a serosurvey involving residents of multiple areas of Uganda revealed a 6.1% seroprevalence of antibodies against Zika virus, which suggested that human infection was frequent.Additional serosurveys indicated a much broader geographic distribution of human infection, including Egypt,East Africa, Nigeria, India ,Thailand, Vietnam, the Philippines,and Malaysia (near Kuala Lumpur and in East Malaysia [Sabah and Federal Territory of Labuan]. Zika needs a vector (a means of transportation) to infect people; generally, that vector is the mosquito. However, Zika virus has been found in semen and person-to-person sexual transmission has been documented.

Despite no incident of Zika virus infection reported in India so far, health experts in the country have sounded an alarm over the potential spread of the hazardous virus in Western Ghat and coastal areas in the coming days, unless and until the authorities take appropriate action to stop the menace. WHO also said the virus could affect 4 million people worldwide. Aedes mosquitoes, which spread Dengue virus, are also the carriers of Zika virus. As India has many unclean cities and urban enclaves, the virus could hit the country quicker, health experts warn. To date, no vaccine or specific therapy has been developed for Zika virus infection. Consequently, treatment is aimed at relieving symptoms if they occur. Many herbal medicines are used for zika virus,kwatha decoction,golden milk and madhupami,tinospora and eupatorium.

Keywords: Zika virus, Flaviviridae, Aedus mosquito.

Introduction

Zika, a flavivirus transmitted mainly by mosquitos in the genus Aedes, was discovered. In 1947 in Uganda. From the 1960s to 1980s, human infections were found across Africa and Asia, typically accompanied by mild illness. Zika virus disease is caused by an RNA virus transmitted to humans by Aedes mosquitoes, especially by the Aedes aegypti species.The first large outbreak of disease caused by Zika infection was reported from the Island of Yap (Federated States of Micronesia) in 2007, as the virus moved from south-east Asia across the Pacific. By the start of February 2016, an outbreak numbering thousands of cases was under way in Cabo Verde, western Africa. Beyond the range of mosquito vectors, Zika virus infections are expected to be carried worldwide by international travel [1].Outbreaks typically occur in tropical Africa and southeast Asia. In May 2015, Brazil reported the first outbreak of Zika in the Americas. Zika is now present in many tropical areas[2].

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Zika virus infection is generally a non-severe febrile viral illness transmitted by mosquitoes.Alarm bells started ringing in October, 2015 in Brazil, when doctors saw a huge increase in babies born with microcephaly an abnormally small head often with consequent brain damage. Zika was found in the amniotic fluid of women carrying fetuses with microcephaly.Data from some recent outbreaks in Brazil and French Polynesia and subsequent published studies appear to show that infection with Zika virus in pregnant women is associated with certain congenital abnormalities (including microcephaly). The knowledge about any causal link between Zika virus and these outcomes is evolving and further studies are required. Until more is known, specific travel precautions are recommended for pregnant women or women planning pregnancy.

History

Firstly, discovered in 1947, Zika was named after the Zika forest in Uganda. The first human cases of Zika were detected in 1952 and since then various outbreaks of Zika have been reported in tropical Africa, Southeast Asia, and the Pacific Islands.

Virus isolation in monkeys and mosquitoes, 1947

The virus was first isolated in April 1947 from a rhesus macaque monkey placed in a cage in the Ziika Forest of Uganda, near Lake Victoria, by the scientists of the Yellow Fever Research Institute [26]. A second isolation from the mosquito A. africanus followed at the same site in January 1948 [27]. When the monkey developed a fever, researchers isolated from its serum a "filterable transmissible agent" which was named Zika in 1948 [28].

First evidence of human infection, 1952

Zika was first known to infect humans from the results of a serological survey in Uganda, published in 1952 [29].

Spread in equatorial Africa and to Asia, 1951–2016

Subsequent serological studies in several African and Asian countries indicated the virus had been widespread within human populations in these regions [28].

Micronesia, 2007

In April 2007, the first outbreak outside of Africa and Asia occurred on the island of Yap in the Federated States of Micronesia, characterized by rash, conjunctivitis, and arthralgia, which was initially thought to be dengue, chikungunya, or Ross River disease [30]. Serum samples from patients in the acute phase of illness contained RNA of Zika.

2013–2014

Between 2013 and 2014, further epidemics occurred in French Polynesia, Easter Island, the Cook Islands, and New Caledonia [31].

Americas, 2015–present

There was an epidemic in 2015 and 2016 in the Americas. The outbreak began in April 2015 in Brazil, and spread to other countries in South America, Central America, North America, and the Caribbean. In January 2016, the WHO said the virus was likely to spread throughout most of the Americas by the end of the year; [32] and in February 2016, the WHO declared the cluster of microcephaly and Guillain–Barré syndrome cases reported in Brazil – strongly suspected to be associated with the Zika outbreak – a Public Health Emergency of International Concern [33-36].

As of now, the disease has not been reported in India. However, the mosquito that transmits Zika virus, namely Aedes aegypti , that also transmits dengue virus, is widely prevalent in India. Majority of the people infected with Zika virus either remain asymptomatic (up to 80%) or show mild symptoms. Zika virus infection should be suspected in patients reporting with acute onset of fever, maculopapular rash and arthralgia, among those individuals who travelled to areas with ongoing transmission during the two weeks preceding the onset of illness.

Epidemiology

Zika virus is a flavivirus, in the family Flaviviridae. Although Zika virus was isolated on several occasions from Aedes africanus mosquitoes after its discovery in 1947, there initially was no indication that the virus caused human disease. Serosurveys indicated a much broader geographic distribution of human infection, including Egypt,East Africa, Nigeria, India ,Thailand, Vietnam, the Philippines, and Malaysia (near Kuala Lumpur

and in East Malaysia. Human illness caused by Zika virus was first recognized in Nigeria in 1953, when viral infection was confirmed in three ill persons. Despite recognition that Zika virus infection could produce a mild, febrile illness, only 13 naturally acquired cases were reported during the next 57 years[6-9]. (Table 1)(Figure 1)

ZIKA Virus outbreak in india

Despite no incident of Zika virus infection reported in India so far, health experts in the country have sounded an alarm over the potential spread of the hazardous virus in Western Ghat and coastal areas in the coming days, unless and until the authorities take appropriate action to stop the menace.The Zika virus outbreak in North and South America in recent days has posed a threat to the health sector across the world. The World Health Organization (WHO) has warned that the explosive virus can affect countries like India. WHO also said the virus could affect 4 million people worldwide.Aedes mosquitoes, which spread Dengue virus, are also the carriers of Zika virus. As India has many unclean cities and urban enclaves, the virus could hit the country quicker, health experts warn. The Indian Medical Association also asked pregnant women to refrain from visiting Latin American countries.In humans, the virus causes an illness known as Zika fever, or Zika disease, which was initially found in certain parts of Africa and Asia. Zika virus eventually spread across the Pacific Ocean to French Polynesia and later to Easter Isla.[17]

Causative agent

There are two lineages of Zika virus, the African lineage and the Asian lineage [23-25]. Phylogenetic studies indicate that the virus spreading in the Americas is most closely related to the virus from the Asian lineage isolated in French Polynesia in 2013–2014. Presently, only two full genome sequences of Zika virus from Brazil and Suriname have been published. Molecular analysis of the Zika virus isolated from the travel-related case from the Maldives and diagnosed in Finland in June 2015, showed that it too belonged to the Asian lineage [4] Recent preliminary findings from molecular investigations of 17 whole genome sequences in the public domain stressed a possible change in the fitness of the Asian lineage through an adaptation of the NS1 codon usage. The researchers suggest that these modifications may have an impact on viral replication rates and viral titres in humans. The authors also reported structural and immunological similarities in the NS1 antigen between Zika and dengue viruses. Both preliminary findings should be further studied and verified on larger whole genome panels.[5]Zika virus disease is caused by an RNA virus transmitted to humans by Aedes mosquitoes, especially by the Aedes aegypti species. Up to eighty per cent of infections are asymptomatic. Zika virus has not been noted to cause death in the past, nor has it been linked to intrauterine infections and congenital CNS anomalies. Zika virus infection can be confirmed by direct detection of Zika virus RNA or specific viral antigens in clinical specimens. [10]

Transmission

Zika,being a virus, needs a vector in the form of mosquito to infect people. Although, Zika virus is also found in semen and sexual transmission between people. Travelers should take extra care to prevent mosquito bites for 3 weeks after they leave the Zika-affected area. The infection can spread to other people by:

1. Mosquito Bite from infected to uninfected humans
2. Maternal-fetal
3. Other possibilitie
    a. Sexual
    b. Blood transfusion
4. Theoretical
    a. Organ or tissue transplantation
    b. Breast milk

Pathogenesis of Zika virus infection

Following transmission by the mosquito bite, Zika virus can infect several different cell types including skin keratinocytes, dermal fibroblasts and dendritic cells (DCs) [37]. Different cell surface receptors have been proposed to me-diate Zika infection of permissive cells; including DC-SIGN, AXL and Tyro3 molecules [37] (Fig. 2).

Following cell entry, Zika virus induces strong interferon responses in infected cells.Studies on Zika virus-infected fibroblasts have revealed strong induction of RIG-I and MDA-5 transcripts. Both of these molecules are capable of initiating a signaling process following the detection of intracytoplasmic viral RNA mol-ecules. Innate immune responses are followed by adaptive

immune events including the activation of T cells; Zika virus-infected DCs migrate to regional lymph nodes where they stimulate T cell proliferation, differentiation and cytokine production [38]. While in circulation, Zika virus can infect fetal monocytes and these monocytes can carry the infection to the developing nervous system.

Symptoms

About one fifth of the symptoms are usually mild the most common of which are fever, rash, joint pain or red eyes, muscle pain and headache. Symptoms usually begin 2-7 days after being bitten by an infected mosquito and last several days to a week.Generally zika virus is not severe disease. The incubation period is typically 3–12 days. There is no specific therapy for Zika virus infection and acute symptoms typically resolve within 4-7 days.For cases with a clinical illness, symptoms may include:

• Low-grade fever
• Arthralgia
• Myalgia
• Headache
• Conjunctivitis
• Cutaneous maculopapular rash
• Post-infection fatigue[11]

Diagnosis

The diagnosis of Zika virus infection should be considered among individuals returning from South or Central America, the Caribbean, or the Pacific region who developed a fever and/or other symptoms suggestive of ZIKV while abroad or within two weeks of returning to the UK. Healthcare providers should ask all pregnant women about recent and planned travel. The maintest reverse transcription polymerase chain reaction (RT-PCR). Antibody testing is less reliable due to potential cross-reaction with antibodies against other similar viruses (e.g. dengue or yellow fever, which are often co-located), making it difficult to differentiate ZIKV infection using antibody testing alone. In the UK, samples for testing for ZIKV should be sent to Public Health England (PHE) Rare and Imported Pathogens Laboratory (RIPL). RIPL is a specialist centre for advice and diagnosis for a wide range of unusual viral and bacterial infections including ZIKV.[13-16]

1. Real-time PCR assay to detect viral RNA in serum and urine collected ≤7 days after illness onset.
2. Detection of both Zika-specific and cross-reactive antibody in serological assays to detect either IgM or IgG in serum collected from patients having > 4 days of illness.

Laboratory Diagnosis

Zika virus can be tested in a BSL-2 facility. Testing for Zika virus
should be done in pregnant women who have travelled to Zika endemic regions, or are
symptomatic patients. Tests for dengue and chikungunya should also be done in view of
similar symptoms.

• Acute phase (3 – 5 days): Detection of viral genome by RT-PCR in maternal serum
and amniotic fluid.
• Convalescent phase (≥5 days):
− Serology by testing IgM antibodies in blood. This is not the mainstay of diagnosis
as cross reactivity with other flaviviruses is very high.
− Plaque Reduction Neutralization Test (PRNT): this is a confirmatory diagnosis.

General care and symptomatic treatment

A commonly used approach for antiviral drug development involves targeting specific vulnerable stages of the pathogen's life cycle in order to disrupt its propagation within cells, effectively protecting cells and their neighbors from viral spreading To date, no vaccine or specific therapy has been developed for Zika virus infection.In 2017, an inactivated virus vaccine Provisional 15 against ZIKV (African strain MR 766) provided full protection against the homotypic and heterotypic ZIKV strains in vitro Consequently, treatment is aimed at relieving symptoms if they occur.

Rest and use of personal protection measures:

Symptomatic pregnant women with Zika virus infection should be advised to take rest and use the personal protection measures described as above to reduce the chances of viral transmission to other people, especially during the first week of the disease.

Fever: Fever should be managed with physical cooling measures like using damp clothes, baths or showers) and acetaminophen (paracetamol).

The use of aspirin or other NSAID agents should be avoided.

Headache: Headache should also be treated with acetaminophen at the dosages prescribed for fever management.

Itching: Although there is no research either supporting or refuting the safety of topical products for itchy rash during pregnancy, there is clinical experience suggesting their safety. The safety profile of systemic treatment with antihistaminic agents is also high. Topical applications of calamine lotion or menthol-based aqueous agents or oral loratadin may be used.

Hydration: Affected pregnant women should drink plenty of fluid to avoid volume depletions through sweat, vomiting, and other insensible losses that can accompany the viraemic phase.

Herbal Medication For Zika Virus

KWATHA (DECOCTION):

5 Tulsi leaves, 4 black pepper, 3 cloves, and 1 teaspoonful grated ginger. Mix them in a glass of water and boil till quantity is half. Filter and add a teaspoonful honey. Decoction is ready. Take it twice daily.

HERBS:

Sitopaladi Churna, one teaspoonful along with a teaspoonful of honey taken twice daily.

GOLDEN MILK:

Add a teaspoonful turmeric powder in a glass of warm milk. To prevent viral infection.

MADHUPARNI TABLET:

Enhance cidal ability of macrophages. Treat fever caused due to unknown reason. Immunity booster , anti-inflammatory , antiviral , antibacterial , antiallergic , antirheumatic , diuretic , reduce urea from blood , remove renal stones, jaundice , in hepatic fibrosis , promote liver regeneration .

TINOSPORA CORDIFOLIA (stem):

Bitter property helpful in preventing infections like dengue, swine flu, malaria, and other viral infections. Used in swine flu, in fever of unknown reason, in UTI.

EUPATORIUM PERFOLIATUM (boneset):

It is also known as “ague weed”, “fever wort”, or “sweating plant”. Used as prophylactic in zika infection. Most preferably used in homeopathy medicine. [20]

Prevention and control of Zika virus disease

The mainstay of prevention and control is avoiding mosquito bites by adopting the following measures:

• Personal protective measures including use of protective clothing, mosquito repellents, eliminating household aedes mosquito breeding sites

• Integrated Vector Management (IVM) including chemical, biological and environmental vector control.

• Improving community awareness by effective IEC.

Preventive Medication

1. DEET(Insect Repellent):

It is also called as DECT or DI ETHYL TOLBUTAMIDE. It was originally tested as pesticide on farm fields by US dept. of agriculture.

Deet blocks insect biting / feeding senses.

Concentration:

1. 100% deet often protects for 12 hours.
2. 20% - 30% deet protects for 3-6 hours.
3. CDCP recommends 30%- 50% deet for preventing pathogens carried by insects [21] (Figure 3)

Queries About Donating Blood, Tissues Or Semen

Individuals who have been diagnosed with Zika virus infection, or who report having experienced symptoms consistent with Zika virus infection, should not donate blood, tissues, or semen for six months following resolution of symptoms. The individuals arriving from an area with active Zika virus transmission should try not to donate blood, tissues or semen. Further information is available from the Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee.[19]

Recent developments in Zika antiviral treatments

At the present time, no effective antiviral treat-ments are available for Zika virus infection [39].However, considering rapid geographic expan-sion of Zika virus, its severe neurological compli-cations and devastating effects on the fetus, in-vestigations are underway to find safe and potent drugs and therapies. These approaches range from repurposing earlier approved drugs to the screening and testing of in silico designed

drugs [40]. The antiviral candidates comprise agents targeting cellular components in addition to viral ones [39]. All of the steps of Zika virus life cycle in the host cell from entry to release can be tar-geted by antiviral agents. In order to block the viral entry into the cell, var-ious strategies have been used. On one hand, blocking the entry by receptor binding agents such as nanchangmycin (previously used as anti-bacterial and insecticidal agent), ZINC33683341 and ZINC49605556 (both in silico designed) has been proposed. The other approaches include the inhibition of endosomal fusion using com-pounds that reduce the acidity of endolysosomal vesicles like chloroquine (an anti-malaria drug) and disrupting the electrostatic interaction be-tween cell and virus membrane using squalamine (a cationic chemical) [40]. RdRP activity of NS5 is an outstanding target for antiviral drugs. Therefore, several nucleoside analogues are investigated for their ability to in-hibit Zika virus replication.Sofosbuvir (a nucleotide analog inhibitor) is a RdRP inhibitor approved by FDA for chronic HCV treatment. It also inhibits Zika virus replication (15-17). Zika virus N2B-NS3 protease and NS3 helicase, which play essential roles in virus replication, constitute potential tar-gets for antiviral drugs [39].

WHO Guidelines for Zika virus

World Health Organisation declared on 1st February 2016 that Zika virus is a Public Health Emergency of International Concern. Due to its close association with pregnancy, the Directorate General of Health Services, Ministry of Health and Family Welfare has advised the following:

1. Enhanced Surveillance:

1.1. Community based Surveillance: The Integrated Disease Surveillance Programme (IDSP) by gathering data through its community and hospital would track down the acute febrile illness. The State and District level units would also be advised for the clustering of cases. The Maternal and Child Health Division (under NHM) would also advise its field units to look for clustering of cases of microcephaly among new born

1.2. International Airports/ Ports: All international airports would display signs that would provide information regarding Zika virus disease and its possible transmission. The Airport Health Organization (APHO) would have quarantine facility in identified Airports. Appropriate aircraft disinfection guidelines should be followed.

1.3. Rapid Response Teams: Rapid Response Teams (RRTs) should get activated at Central and State surveillance units. Each team would consist of an epidemiologist, microbiologist and a medical / paediatric specialist and other experts (entomologist etc) who would be ready to travel at short notice to investigate suspected outbreak. For India, the National Centre for Disease Control (NCDC), Delhi would be the nodal agency for investigation of any kind of Zika virus outbreak in any part of the country.

1.4. Laboratory Diagnosis: NCDC, Delhi and National Institute of Virology (NIV), Pune, have the capacity to provide laboratory diagnosis of Zika virus disease in acute febrile stage. This lab would support the outbreak investigation and for confirmation of laboratory diagnosis. RT- PCR test would remain the standard test. Serological tests are not recommended.

2. Risk Communication: The States/ UT Administrations would create increased awareness among clinicians including obstetricians, paediatricians and neurologists about Zika virus disease and its possible link with adverse pregnancy outcome (foetal loss, microcephaly etc). The authorities should be vigilant enough to take note of travel history to the affected countries in the preceding two weeks.

3. Vector Control:There would be enhanced integrated vector management. States where dengue transmission is going on currently due to conducive weather conditions (Kerala, Tamil Nadu etc) should ensure extra vigil.

5. Non-Governmental Organizations: MHFW would work closely with Non-Governmental organizations such as Indian Medical Associations, Professional bodies etc to sensitize clinicians both in Government and private sector about Zika virus disease.

6. Co-ordination with International Agencies:National Centre for Disease Control, Delhi, woyuld touch with World Health Organization for updates on the evolving epidemic.

7. Research:Indian Council of Medical Research (ICMR) would identify the research priorities and take appropriate action.

8. Monitoring:

- There should be close monitoring by the Joint Monitoring group under Director General of Health Services on regular basis.

Guidelines issued by health Ministry in India

According to the Health ministry guidelines document,

1. Prevent mosquito breeding around houses.
2. Use mosquito repellents to protect yourself from mosquito bites.
3. Non-essential travel to the affected countries in the Latin American region and the Caribbean should be deferred/cancelled.
4. Pregnant women or women who are trying to become pregnant should defer/cancel their travel to the affected areas.
5. All travellers to the affected countries/areas should strictly follow individual protective measures, especially during the day, to prevent mosquito bites (use of mosquito repellant cream, electronic mosquito repellants, and use of bed nets, and dress that appropriately covers most of the body parts).
6. Persons with co-morbid conditions (diabetes, hypertension, chronic respiratory illness, immunity disorders, etc.) should seek advice from the nearest health facility, prior to travel to an affected country.
7. Travellers who complain of fever within two weeks of return from an affected country should report to the nearest health facility.
8. Pregnant women who have travelled to areas with Zika virus transmission should mention about their travel during ante-natal visits in order to be assessed and monitored appropriately.[22]

Government bodies working on Zika

1. ICMR's NIV Pune

The Indian virology research institute situated in Pune (National Institute of Virology) has been working upon Zika virus. Along with this, the Translational Science Cells a part of Indian Council of Medical Research (ICMR) is also involved.

2. DHR/ICMR

The main aim behind Department of Health Research (DHR) situated in Japan, is to bring modern health technology to people by encouraging innovations related to diagnostics, treatment methods as well as prevention-vaccines; translating the innovations into products/ processes

3. VRDLs

Viral and Rickettsial Disease Laboratory (VRDL) is providing assistance for the diagnosis, investigation, and control of viral diseases in California.

Preparedness of ICMR'S NIV, PUNE, DHR/ICMR VRDLS AND ICMR Institutes to handle zika virus outbreak in India

For testing acute phase samples:

• NIV, Pune has capacity to test the samples received during the acute phase of the disease by RT-PCR. The RT-PCR test available with NIV is standardized from published primers (Reference: Balm eta al: J Med Virol 2012; 84: 1501-5). These primers are developed from NS-5 non-structural gene of Zika virus, which is relatively conserved across the different strains. Detailed SoP for the RT-PCR test is placed at Annexure 1.

For testing convalescent phase samples:

• NIV & CDC are currently partnering on creating laboratory surveillance networks for enhancing diagnostic capabilities for high risk viral pathogens, under the Global Health Security (GHS) funds. As per this understanding, ICMR has requested CDC to provide Zika virus strains to NIV alongwith IgM ELISA diagnostic kits till in-house ELISA kits and PRNT tests are developed at NIV. WHO has also been requested separately.

Others:

• A training of DHR/ICMR VRDLs and concerned ICMR Institutes for Zika virus testing is shortly being organized by NIV, Pune. Tentative list of 20 labs have been identified for training.

• ICMR has also issued an alert to several paediatricians under various networks of ICMR as well as the Viral Research & Diagnostic Laboratories to refer suspected samples for Zika testing at NIV, Pune.

As of now, there are no diagnostic kits commercially available for testing of Zika virus inIndia.

Conclusion

Together with Severe Acute Respiratory Syn-drome (SARS) and Middle East Respiratory Syn-

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drome (MERS), Zika virus infection qualifies as a "newly emerging" infectious disease, with the potential to cause serious public health issues. Unlike the other "newly emerging" infections which can lead to severe morbidity and mortality in infected adults or pediatric hosts, Zika infection does not pose a significant threat to infected adults and its risk is more due to the potential to cause fetal abnormalities, provided that the infection occurs during pregnancy.There has been sudden outburst of zika virus in recent times with the virus changing its character while spreading through different geographical horizons. The possible changes in virus have been from an endemic, mosquito-borne infection causing mild illness across equatorial Africa and Asia, to an infection causingoutbreaks linked with neurological disorders including Guillain-Barre syndrome and microcephaly across the Pacific region and the Americas from 2007 till 2013. The future transmission of Zika infection is likely to coincide mainly with the distribution of Aedes mosquito vectors, although there may be rare instances of person-to-person transmission (other than mother to child, e.g. through semen). Apart from mosquitoes being the carrier, infection has been carried widely by international travelto different countries as well.The U.S. and international governments are pushing forward with programs for Zika vaccines, and at least three pharmaceutical companies are either considering or actively pursuing programs, including giants GlaxoSmithKline GSK 0.65% , and Sanofi SNY -0.11% . Inovio Pharmaceutical's INO 6.11% which entered into clinical trials with MERS vaccine holds a promise for future Zika vaccine. Indian authorities had alarmed the pregnant women not to travel to countries that are affected by Zika virus, which some doctors and health officials suspect is linked to a recent spate of babies born with small heads in Brazil where the disease has reached epidemic proportions.

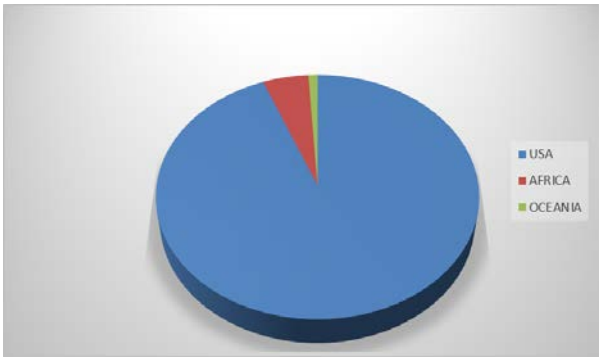

Fig. 1: A graph depicting the maximum cases of Zika virus

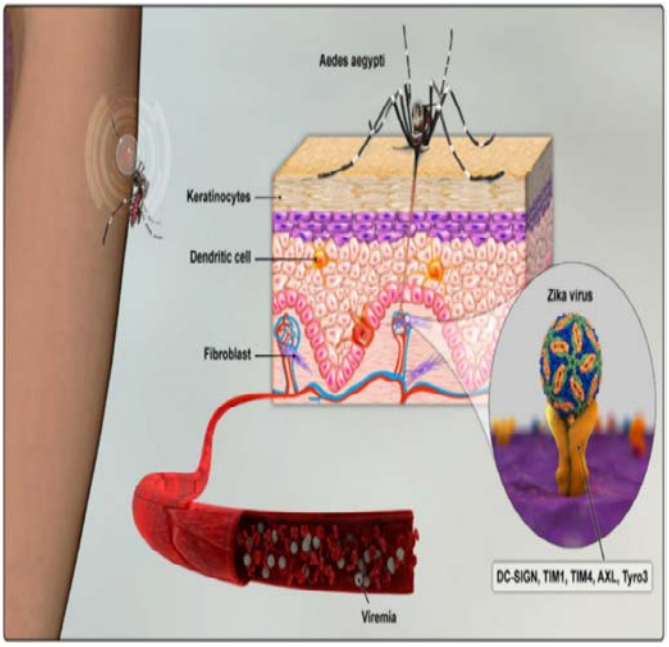

Fig. 2: Immunopathogenic pathways and virus-host cell interaction in Zika virus infection

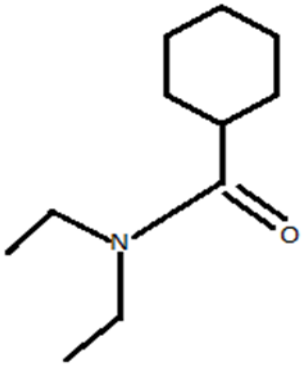

Fig. 3: DEET

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Table 1: Some data of epidemiology of zika virus cases

COUNTRY	CITIES	CONFIRMED CASES	TOTAL
	Brazil	534	
	Columbia	2361	
	El Salvador	3	
	Guadeloupe	151	
	Martinique	12	
	Venezuela	352	3401
Africa	Tonga	36	
	Solomon Island	302	368
Oceania	American Samoa	14	14

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