



Research note

Zika Virus: Origin, Transmission, Risk and Prevention

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Abstract

Zika virus is an RNA virus that is normally transmitted via two species of mosquitoes, *Aedes aegypti* and *Aedes albopictus*. These mosquitoes are also responsible for transmission of the Dengue virus. A recent report has indicated that Zika is the first insect-borne disease to also be transmitted sexually. Human cases of the disease occur mostly in South and Latin America although travelers to these countries have brought the disease back to the United States. So far, Zika has not spread from person to person in the U.S., although the mosquito vector is present and many fear that it could become a potential threat in the United States. Around one in five infected humans will show symptoms for Zika and most will have a mild flu-like illness. Those at the greatest risk, are newborn children of pregnant women infected with the virus. This resulted in severe birth defects, such as microcephaly. Some infected adults have developed Guillain-Barre' syndrome but it is not clear how this occurred. At present, there is no vaccine for Zika virus and it is hoped that funding will be made available to develop effective methods to combat the disease.

Keywords: Zika virus, *Aedes aegypti*, *Aedes albopictus*, brain infection, microcephaly, hydrocephaly, Guillain-Barre' syndrome.

1.0 Introduction

Zika virus is a flavivirus, an RNA virus that uses arthropod vectors. It was discovered in Zika forest, Uganda, in 1947 (Dick, 1952; Dick *et al.*, 1952). Initially, there was no indication that this virus could cause human diseases, but in 1954, three human cases were reported in Nigeria (MacNamara, 1954). Serological test results in Uganda (Dick, 1953) and other African and Asian countries indicated a broader distribution of human infection of Zika (Smithburn, 1954; Smithburn *et al.*, 1954a; Smithburn *et al.*, 1954b; MacNamara, 1954; Hammon *et al.*, 1958; Pond, 1963; Petersen, 2016). However, this virus failed to draw adequate attention of the scientific community and remained obscure for the past six decades. In 2014, an outbreak of Zika in French Polynesia led to an evaluation of over 3000 people for possible Zika infection (Cao-Lormeau *et al.*, 1994; Petersen, 2016).

Subsequently, outbreaks were also reported in other Pacific islands (Dupont-Rouzeyrol *et al.*, 2015). In

March 2015, Zika was reported in Brazilian states and then spread rapidly throughout Latin America (Fauci, 2016). By March 2016, Zika had spread to at least 33 countries including the US (Hennessey *et al.*, 2016). In the US, 388 human infections have been reported so far (CDC, 2016a) but they were in individuals who had acquired it during travel to other countries.

Zika virus is believed to be transmitted by *Aedes* species of mosquitoes, and the two known species for Zika transmission are *Aedes aegypti* and *Aedes albopictus* (Smith, 2016). Both of these species commonly occur in tropical and subtropical climates. So far, Zika transmissions have been linked mostly to *Aedes aegypti* and to a lesser extent, to *Aedes albopictus*. *Aedes aegypti* is believed to be a more potent vector than *Aedes albopictus* (Petersen *et al.*, 2016). These mosquitoes can survive both in outdoor and indoor environments, and since they are more active during day time, barrier approaches such as mosquito nets are ineffective means of protection (Smith, 2016).

2.0 Symptoms

The incubation time for Zika virus is unknown, but it is expected to be about a week (Petersen *et al.*, 2016). According to the U.S. Center for Disease Control (CDC), the incubation period could be a few days to a week, and the most common symptoms of this virus are headache, muscle pain, joint pain, fever, rash, etc. These symptoms are mostly mild and an infected person might not be aware of the infection as they usually would not be sick enough to seek medical attention (CDC, 2016b). The virus remains in blood for about a week or longer and once infected, the person will be most likely to develop protective antibodies against future Zika infections (CDC, 2016b).

3.0 Transmission

The most common mode of Zika transmission is through mosquito bites. Pregnant women infected with Zika can spread the virus to her fetus. However, there are no reports of Zika transmission to babies through breast feeding (CDC, 2016c). This virus can also be transmitted through sexual contact which cause men to develop symptoms of infection. The virus seems to survive longer in semen than in blood (CDC, 2016c). Several cases of Zika transmission through blood transfusion have been reported in Brazil (CDC, 2016c). Zika has been implicated with microcephaly and possibly other severe brain defects. The CDC is studying potential health problems associated with Zika (CDC, 2016c).

4.0 Risks

Since the first case of Zika infection in Brazil, the virus has moved into over 20 Latin American countries (Tavernise and McDonald, 2016). The CDC has reported that as of April 20, 2016, there have been 388 travel-associated Zika cases detected in the U.S. The CDC also has confirmed the suspicion that Zika is associated with microcephaly in newborns (CDC, 2016a). Along with microcephaly, hydrocephaly and calcification of cerebral cortex and sub-cortical white matter in fetal brain have also been reported (Mlakar *et al.*, 2016). Zika also has being suspected for brain infection in adults (Ryan, 2016) and swelling of brain and spinal cord tissue (Parry, 2016). Recent reports

have indicated that adults infected with Zika have developed Guillan-Barre' syndrome, although, it was not clear why or how this may have occurred (Thiery, 2016).

Zika is an RNA virus and studies indicate that structurally this virus is similar to other flaviviruses such as West Nile and Dengue viruses (Kostyuchenko *et al.*, 2016). However, unlike other known flaviviruses, Zika is very stable at 40 degrees Celsius; mimicking the body temperature of an extremely feverish, virus-infected patient (Kostyuchenko *et al.*, 2016).

RNA of Zika virus has been found in amniotic fluid of pregnant women where fetal cerebral abnormalities were detected by ultrasonography (Oliveira-Melo *et al.*, 2016). Therefore, pregnant women who have visited or lived in Zika infected areas, and develop Zika infection symptoms, should check with their health care providers (CDC, 2016b). The World Health Organization (WHO) has declared that Zika's involvement in birth defects is an international Public Health Emergency (Gulland, 2016).

5.0 Prevention

Like most other mosquito species, *Aedes aegypti* and *Aedes albopictus* mosquitoes lay their eggs in standing water in discarded tires, buckets, bowls, pots, planters, etc. People should be vigilant and remove such possible mosquito breeding vessels. Since Zika transmitting mosquitoes are more active during daytime, both indoor and outdoor, mosquito nets are not effective measures against them. Wearing long-sleeved shirts and pants may provide some protection (Smith, 2016). Currently, no vaccine is available for protection against Zika.

6.0 Discussion and Conclusion

Zika virus is an arbovirus (i.e. arthropod-borne) and is transmitted via the bite of an infected mosquito. Recent evidence indicates that sexual contact can also be involved in person to person transmission, making it the first insect-borne disease of any sort to be transmitted sexually (CDC, 2016c). Mosquitoes become carriers when they bite someone infected with the virus. This follows typical

“biological transmission” in that the virus must replicate inside the mosquito to become infectious. One in five individuals infected with the virus develops symptoms. When symptoms occur, most cases of the disease are mild and include fever, rash and conjunctivitis. However, severe neurological conditions such as Guillan-Barre’ syndrome have occurred in adults (Thiery, 2016). The major problem is birth defects, such as microcephaly and the danger for pregnant women remain extreme (Gulland, 2016).

At present, the only confirmed cases in the U.S. were from travelers who were infected in Latin America. Although the United States does have *Aedes* mosquitoes, most of the infected travelers were thought to have eliminated the virus before they returned to the U.S. The virus typically is cleared in humans in less than a week and a mosquito must bite someone during that time frame to initiate biological transmission. So far, health officials have not seen any outbreaks in the continental U.S. The *Aedes* mosquitoes are also present in Puerto Rico and the Virgin Islands, which are U.S. territories, and several cases have occurred, particularly in Puerto Rico that were not due to someone traveling to Latin America (Dasgupta, 2016).

The question remains whether or not the virus could be established in the United States and become a potential threat (Szabo, 2016). As noted earlier, *Aedes* mosquitoes are present in the U.S., especially in the southeast. As temperatures rise, this could also cause an increase in mosquito populations throughout the country and some have predicted that limited outbreaks may occur in the U.S. once mosquito season begins. Since the consequences of infection are potentially devastating to developing fetuses, pregnant women would be most at risk. Currently, the CDC is studying various health problems associated with the disease and the United States Congress is discussing funding to combat Zika (CDC, 2016c; Fox, 2016). Hopefully, funding for prevention, treatment and vaccines will become available so that any potential threat may be halted.

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