VECTOR-BORNE AND ZOONOTIC DISEASES
Volume 16, Number 2, 2016

DOI: 10.1089/vbz.2016.29001.hig

EDITORIAL

Zika Virus: Emergence and Emergency

Stephen Higgs

Since chikungunya virus (CHIKV) emerged on an epidemic scale on islands in the Indian Ocean, and subsequently invaded the Americas, *Vector-Borne and Zoonotic Diseases* has published numerous articles, including a dedicated issue in 2015 (Volume 15, Issue 4). The introduction of chikungunya virus into the Americas was preceded by West Nile virus in 1999, and an inevitable question was, ''What would be next?'' With over 500 other arthropod-borne viruses to choose from, it would be a fool or a time traveler to predict with any degree of certainty, but we now know the answer, and the answer is Zika virus (ZIKV), named after the Zika forest in Uganda from where it was originally isolated in 1947 (Dick, et al. 1952). History has shown us that when a virus is introduced into a new region and new ecosystem, one should expect the unexpected. New vectors may be involved in the transmission cycle and diseases in vertebrates with which the virus did not evolve, may be more severe than occurs in endemic regions. Yellow fever virus in the Americas is fatal to new world primates, West Nile in the Americas is fatal to many bird species, CHIKV outside of Africa and Asia seemed to be associated with some fatal infections and mutated to be transmitted more efficiently by the Asian tiger mosquito, *Aedes (Ae.) albopictus* (Tsetsarkin, et al. 2007). Despite these lessons, in the last few years researchers and physicians have reported more unusual characteristics with ZIKV than for most other emerging viruses.

Human infections of ZIKV have occurred in several African and Asian countries, but in 2007 an outbreak on the Pacific Island of Yap resulted in 185 suspected cases and 59 probable cases (Duffy, et al. 2009). This first report of ZIKV outside of Africa or Asia was followed by another novel event when a 2007 outbreak in Gabon was attributed to the Asian tiger mosquito, *Ae. albopictus*, being the primary vector. Although ZIKV can infect several different species of mosquito, prior to 2007, *Ae. aegypti* was always the vector for human epidemics. This capacity to be transmitted by two species of mosquito that preferentially feed on people exacerbates an already difficult situation. Both species thrive in close proximity to people, but while *Ae. aegypti* will use discarded containers and often breed very close to or even in the home, *Ae. albopictus* often breeds in less accessible areas such as the water-filled leaf axils of plants. This means that control methods for one species do not necessarily control the other. Furthermore, when populations of *Ae. aegypti* are reduced, the opportunistic invasive *Ae. albopictus* may rapidly move into an area.

As with any blood-borne pathogen, transmission via contaminated blood, for example by transfusion is always a possibility (Musso, et al. 2014), however, another relatively new discovery related to ZIKV is the capacity for sexual transmission (Foy, et al. 2011) probably due to survival of the virus in semen (Musso, et al. 2015). Although in 2014 Besnard (Besnard, et al. 2014) reported perinatal transmission from mothers to newborns, nobody was prepared for what is happening since ZIKV was introduced into Brazil in May of 2015. Predictably, the virus has spread to neighboring countries in the region and there have been travel-related cases in several countries including the United States and the United Kingdom. Recent new adult consequences of ZIKV infection have included Guillain-Barre syndrome (Oehler, et al. 2014), however, the tragedy of Zika in Brazil, is a hitherto unseen phenomenon of newborns being delivered with microcephaly – reduced brain size – apparently as a result of their mothers being infected during pregnancy. Almost 4000 cases have been recorded with over 40 deaths.

As with all mosquito-borne disease, people living in or visiting an area with ongoing transmission are advised to minimize the risk of exposure to infected mosquitoes, for example by using an appropriate repellant, dressing in long pants and long sleeves, and staying indoors at times when mosquitoes are most actively feeding. At a community level, reducing habitats which are conducive to mosquito breeding is important. Organized mosquito control efforts using traditional adulticides and larvicides is also important, but new approaches with genetically engineered mosquitoes for example, the release of insects with a dominant lethal gene (RIDL) is being implemented in Brazil (Alphey, et al. 2010).

What is new for ZIKV is that as a result of the growing epidemic and the severity of cases, several countries including Brazil, Columbia, Ecuador, El Salvador, and Jamaica have recommended that women avoid becoming pregnant – with El Salvador's recommendation lasting until 2018.

The US Centers for Disease Control and Prevention has recommended postponing travel to areas with ongoing transmission and is updating travel advisories as the epidemic spreads. The World Health Organization has stated that the virus will spread across the Americas except for Canada and Chile. This may be true if ZIKV continues to be transmitted only by the currently known vector species, but it is possible that as it is introduced into new areas, then new vector species may become involved. Even Canada and Chile may not be safe. New diagnostic kits are under development, and there are calls for increased research and efforts to produce new vaccines. Clearly there is much to learn and much to do, but I fear that we will still be left with the question, "What's next?"

References

Alphey L, Benedict M, Bellini R, Clark GG, et al. Sterile-insect methods for control of mosquito-borne diseases: an analysis. Vector Borne Zoonotic Dis 2010;10:295–311.

Besnard M, Lastere S, Teissier A, Cao-Lormeau V, et al. Evidence of perinatal transmission of Zika virus, French Polynesia, December 2013 and February 2014. Euro Surveill 2014;19:pii/20751.

Dick GW, Kitchen SF, Haddow AJ. Zika virus. I. Isolations and serological specificity. Trans R Soc Trop Med Hyg 1952;46: 509–520.

Duffy MR, Chen TH, Hancock WT, Powers AM, et al. Zika virus outbreak on Yap Island, Federated States of Micronesia. N Engl J Med 2009;360:2536–2543.

Foy BD, Kobylinski KC, Chilson Foy JL, Blitvich BJ, et al. Probable non-vector-borne transmission of Zika virus, Colorado, USA. Emerg Infect Dis 2011;17:880–882.

Musso D, Nhan T, Robin E, Roche C, et al. Potential for Zika virus transmission through blood transfusion demonstrated during an outbreak in French Polynesia, November 2013 to February 2014. Euro Surveill 2014;19:pii/20771.

Musso D, Roche C, Robin E, Nhan T, et al. Potential sexual transmission of Zika virus. Emerg Infect Dis 2015;21:359–361.

Oehler E, Watrin L, Larre P, Leparc-Goffart I, et al. Zika virus infection complicated by Guillain-Barre syndrome–case report, French Polynesia, December 2013. Euro Surveill 2014;19:pii/20720.

Tsetsarkin KA, Vanlandingham DL, McGee CE, Higgs S. A single mutation in chikungunya virus affects vector specificity and epidemic potential. PLoS Pathog 2007;3:e201.

Address correspondence to:
Stephen Higgs, PhD, FRES, FASTMH
Editor-in-Chief
Vector-Borne and Zoonotic Diseases

Associate Vice President for Research
Director, Biosecurity Research Institute
University Distinguished Professor,
Diagnostic Medicine and Pathobiology
Peine Professor of Biosecurity
Professor Diagnostic Medicine & Pathobiology
Kansas State University
President, American Society of Tropical Medicine & Hygiene
Manhattan, KS

Email: shiggs@bri.ksu.edu