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ZIKA: THE FORMIDABLE SPEED OF VIRAL SPREAD

BY MICHELLE VERGHESE

In 1947, deep inside the Zika Forest of Uganda, a group of scientists studying yellow fever happened upon something unexpected. A Rhesus monkey they were studying had developed a fever. However, the disease ultimately isolated from the monkey's serum was certainly not yellow fever: it was an undocumented virus that had been transmitted by a mosquito bite. A few years later, 12 unique strains of this virus were isolated in mosquitos in the tree canopy of the forest, and the virus was named after the forest in which it was discovered.

Fifty years went by, and few cases of Zika in humans were reported. Then suddenly in 2007, Yap Island in Micronesia was struck by an outbreak that ultimately affected 75% of its residents. The perpetrator was identified as the same virus that had been discovered in the Ugandan forest. It proved to be acute and non-deadly in humans, causing only mild illness and no deaths or hospitalizations.[3] In 2015 during its Summer Olympics, Zika had reached Brazil.

By 2016, Zika was identified in the United States and the World Health Organization officially declared a Global Health Emergency over what had become a worldwide viral epidemic. But how did Zika get here? How did a seemingly docile virus in the depths of an African Forest circle the globe in a matter of nine years? At the same time, why would an outbreak of a virus that is non-deadly prompt a global health warning?

HOW DID A SEEMLINGLY DOCILE VIRUS IN THE DEPTHS OF AN AFRICAN FOREST CIRCLE THE GLOBE IN NINE YEARS?

Zika is indeed both a non-deadly and acute virus; for the most part, the symptoms are not severe. Once infected, a patient will experience 3-12 days of fever, red eyes, joint pain, headache, and a rash. In some cases, depending on the patient, the virus may even present asymptomatically. The Zika virus does not appear to be very threatening, but the same cannot be said for the complications that can result post-recovery: microcephaly and Guillain Barre's syndrome.

Microcephaly is a neurological condition and birth defect in which an infant's brain is significantly underdeveloped, resulting in a head size that is smaller than normal. The first suggestion that microcephaly may be linked to Zika occurred in Slovenia when a woman suspected of having Zika gave birth to a child with intrauterine growth retardation and a reduced head circumference. A brain sample from the infant showed traces of Zika virus. Since then, the sudden increase of microcephaly cases in Brazil, in conjunction with its outbreak of Zika, has lead scientists to believe that the virus can damage the developing neurons of the fetus, which could lead

to microcephaly.[7] On the other hand, Guillain Barre's Syndrome is an illness with underlying autoimmune mechanism in which the immune system attacks the peripheral nervous system, resulting in muscle weakness and in some cases, paralysis. Twenty percent of patients are left with a severe disability from GBS, but most will experience symptoms from a few weeks to months. Only a small percent of those infected actually experience GBS; at the same time, countries such as Brazil, El Salvador, Colombia, and Venezuela have all seen increases in the number of GB patients during the Zika epidemic.[8] These complications are quite dangerous; their association with Zika, though not officially confirmed, is strong. Furthermore, Zika's life-changing complications coupled with its rapid and sudden emergence is concerning to scientists. Even more concerning is the adaptability of both the virus and its vector. The Zika virus falls under the umbrella term "arbovirus": an RNA virus that is transmitted by arthropods, namely mosquitos and ticks. In fact, Zika's path toward the Western Hemisphere mimics the arrival of three other arboviruses: dengue, West Nile virus, and Chikungunya. In general, arboviruses are quick to adapt, but their adaption is accelerated by human travel and urban crowding. This way, viruses that seem contained to one region, such as a forest, can quickly emerge unexpectedly. It is suspected that viruses get from the forest to the city due to encroachment of forested habitats by people looking for either housing or adventure, as well as increased amount of air travel.[5]

Additionally, Zika is spread by a mosquito genus known as Aedes, and more specifically by the species Aedes aegypti and Aedes albopictus. The Aedes mosquito is notoriously adaptable and able to spread not only Zika, but also dengue, chikungunya, and yellow fever. In fact, it is suspected that the Zika initially reached the Americas because the Aedes mosquito traveled on a sailing ship from Africa and was able to adapt to the tropical climates of South and Central America.[6] The possibility certainly exists that the Aedes species could adapt to colder temperatures, or could spread other arboviruses to the Western Hemisphere.

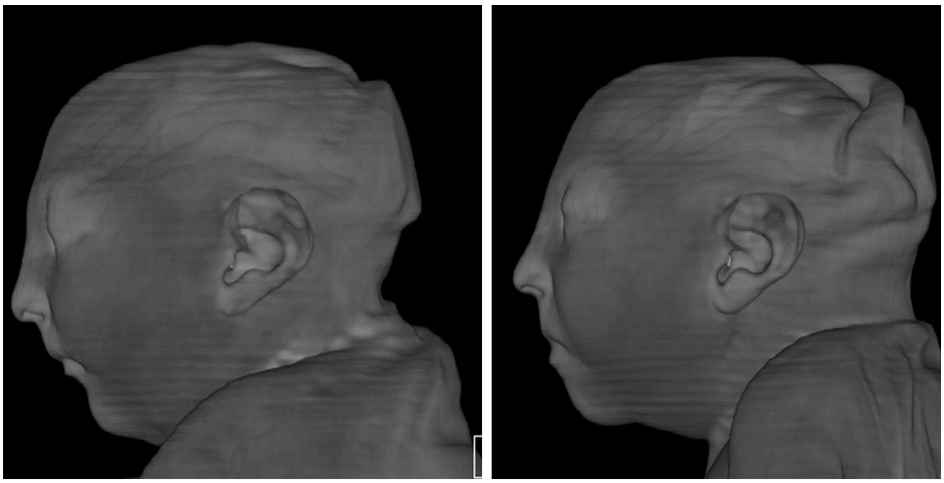
Zika is still very relevant and some even say it may become an endemic disease: a disease that is native to a certain location. In the case of Zika, it is becoming a possibility that Zika will become endemic to the United States. As of October 2016, the Center for Disease Control upgraded its health advisory for Florida, stating that there is risk of local transmission. It is also advising pregnant women to take caution when traveling to parts of the country, especially those where local transmission is taking place.[1] Another issue that has come to light specifically in the cases in Florida has been the post-virus sexual transmission that has been documented. The virus was found in a man's semen 2 weeks post his recovery, bringing up issues such as how long to wait post Zika recovery before trying to have a child.[2] Without our effort and interference, there is great potential for the virus to continue to rapidly adapt and spread. Luckily, there are already efforts underway and research that can still be done in order to control the virus.

Zika's life-changing complications coupled with its rapid and sudden emergence is concerning to scientists.

The mosquito tower in Zika Forest

Vector control is an important part of viral protection; it involves attempting to reduce our contact with the vector of a virus. Simply limiting exposure to mosquitoes by using bed nets, and eliminating standing water can greatly reduce the chances of disease introduction. More aggressive and widespread mosquito control using insecticides is underway, including aerial spraying in Miami, but it is proving to be quite challenging.[9]

A Zika vaccine is certainly on the table; the first vaccine is beginning human trials as of June 2016, and fifteen other vaccine candidates are still in development. However, the sporadic and unpredictable nature of Zika makes it inefficient and expensive to vaccinate large populations preemptively. At the same time, waiting to vaccinate patients after an outbreak has taken begun might be too late to effectively halt transmission.[4] A solution to this may lie in linking arbovirus trends. We can study these arboviruses that are following a common trend of expanding after previously being restricted to remote areas. This could lead to the development of a vaccine platform that is adaptable to work for a



Brain scans of an infant with microcephaly

range of newly emerging viruses. Some argue that a broad spectrum antiviral will be more efficient than a vaccine that is specific to one virus. However, others say that a vaccine platform has the potential to make Zika more virulent; research has shown that small numbers of antibodies to dengue, for example, can allow the Zika virus to infect macrophages in the bloodstream. It is therefore challenging to design a vaccine that is cost-effective, easy to implement, and works as intended in a variety of patients.

Apart from vector control and vaccine development, there is still more we can do to aid in the effort against Zika. It is vital that people are educated about the risks of transmission so that they know to seek medical attention when necessary. We need to improve our diagnostic testing mechanisms for Zika so that they are not only more specific but also more fit for use in rural, remote areas. In terms of epidemiology, we can study the adaptation of Zika, specifically the differences between the African strain and American strain to learn more about the ways in which Zika may continue to adapt. Medically, we can find a way to identify the Zika virus in the fetus during pregnancy. We can protect the blood supply, in order to not spread the disease unintentionally by blood transfusion. Most importantly, we should not disregard Zika simply because the infection is acute; the complications have proved to be detrimental, and the virus has proved its ability to spread rapidly and unexpectedly. We have more than enough reason to continue studying the virus and its effects, work toward a functional vaccine, protect ourselves and be prepared.

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