

The recent arbovirus disease epidemic in Brazil

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In 2015, at least 9 pathogenic arboviruses that cause disease in humans have been circulating in Brazil. The Saint Louis encephalitis virus (SLEV; a flavivirus), which is transmitted from birds to humans by *Culex* mosquitoes, causes sporadic cases and small outbreaks of acute febrile illness and meningoencephalitis. The Mayaro virus (MAYV; an alphavirus), which is transmitted from monkeys to humans by *Haemagogus* mosquitoes and has a similar maintenance cycle as the sylvatic yellow fever virus is highly endemic in the Amazon region and causes sporadic cases or outbreaks of acute febrile illness with arthropathy.

The Oropouche Orthobunyavirus (OROV; a bunyavirus) has an urban maintenance cycle in the Northern and Midwestern regions of Brazil and is transmitted human-to-human by the midge *Culicoides paraensis*. It has been associated with outbreaks of acute febrile illness, including some cases of meningitis. MAYV and OROV outbreaks have been recently reported in Manaus City. The majority of human cases of illness associated with these 3 arboviruses likely remain undiagnosed. In the last 3 decades, new arbovirus types have been introduced to Brazil. Dengue virus (DENV; a flavivirus) serotypes 1, 2, 3, and 4 were introduced between 1986 and 2007, mostly from Caribbean countries but in at least one case from Asia. The number of DENV outbreaks has been increasing due to the alternating predominance of the different serotypes that have been spreading across the country. During these outbreaks, approximately 10 million cases of acute febrile illness have been reported. These include dozens of thousands of patients suffering from toxic shock syndrome, meningitis, or other severe forms of the disease, resulting in thousands of deaths. The West Nile virus (WNV; another flavivirus) has likely been introduced to Brazil from North America in the past decade. West Nile virus, which is transmitted from birds to humans by *Culex* mosquitoes, has caused many infections in horses. The first human case of meningoencephalitis associated with WNV was reported in Northeastern Brazil (State of Piauí) in 2014. In the past

2 years, the introduction of 2 genotypes of the Chikungunya virus (CHIKV; an alphavirus), likely from the Caribbean and Asia, to different regions of the country has significantly worsened the situation. Chikungunya virus has rapidly spread through the Northern (State of Amapá), Northeastern (State of Bahia), Midwestern, and Southeastern (City of São Paulo) regions of Brazil, and outbreaks are predicted to increase in the next years. In 2015, the Zika virus (ZIKV; a flavivirus) was introduced to Brazil, likely from Asia, producing outbreaks of acute febrile illness in Northeastern Brazil (State of Bahia) and spreading to other Brazilian regions. ZIKV is transmitted to humans by *Aedes* spp. mosquitoes. It has recently been suggested that the virus can also be transmitted through sexual contact. Considering the recent increase in the introduction of new arbovirus types to Brazil, the question why Brazil has been experiencing this recent epidemic arises. We hypothesize that it is likely the result of a combination of factors. Infected migratory birds can travel from North to South America and thereby introduce WNV to Brazil where many *Culex* mosquito species, which are known to transmit the virus, are found.

The introduction of CHIKV and ZIKV is likely related to the movements of humans, in particular those associated with tourism and immigration. CHIKV would have been introduced by infected immigrants who crossed the Northern border of Brazil (State of Amapá and French Guyana). In the Northeast (State of Bahia), CHIKV might have been introduced from Asia by tourists or immigrants. The Football World Cup is an example of a large event that resulted in an increased influx of tourists from all over the world, some of whom might have been infected with an arbovirus. Finally, as has been previously reported for DENV, CHIKV and ZIKV were introduced to Brazilian urban areas through colonizing their main vector, the *Aedes aegypti* mosquito. This imported highly anthropophilic vector for DENV, CHIKV, and ZIKV likely allowed the fast adaptation of these viruses to our environment and resulted in the transmission to humans. We hope to have an efficient vaccine to control dengue fever in the upcoming years. For CHIKV and ZIKV, however, infection control programs rely almost exclusively on vector control due to the lack of an effective vaccine^{(1) (2) (3) (4) (5) (6)}.

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CONFLICT OF INTEREST

The author declare that there is no conflict of interest.

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