Implications of vector surveillance for arbovirus epidemiology in Miami-Dade County, Florida

Fabio M. Gomes,[a] and Ana C. Bahia [b]*

[a]Laboratório de Ultraestrutura Celular Hertha Meyer, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil
[b]Laboratório de Bioquímica de Insetos e Parasitos, Instituto de Biofísica Carlos Chagas Filho, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil

The Lancet Regional Health - Americas 2022;11: 100310
Published online 22 June 2022
https://doi.org/10.1016/j.lana.2022.100310

Dengue (DENV) is the best-studied and most prevalent mosquito-borne virus, causing an estimated number of 390 million worldwide infections per year.[1] While there are no specific treatments for dengue fever, most infections are subclinical or result in mild symptoms. Nevertheless, a smaller percentage of cases can develop into potentially lethal manifestations, such as dengue hemorrhagic fever and dengue shock syndrome. While dengue fever epidemics used to occur in southern areas of the continental United States of America (USA), vector control eradication programs implemented in the second half of the 20th century succeeded in limiting autochthonous transmission cases.[2] Presently, rare outbreaks are still reported in limited geographic areas of the country, such as regions in Florida and Texas.[3] In these areas, limited vector circulation can still allow for local transmission of viruses imported due to global travelling and trade.

In 2020, the Center for Disease Control (CDC) reported the existence of 71 locally transmitted cases of dengue fever (86% of the total number of cases in the USA) in Florida. This was a major increase from the 18 cases reported in 2019. This challenge was aggravated by a concurrent outbreak of West Nile virus (WNV) and SARS-COV-2 in the state. In this current publication,[4] Coatsworth H. et al. analyzed whether mosquito collection data would fit a model of increased virus positivity rates in arboviral diseases hotspots. For that, they analyzed collection data from trap collected DENV (*Aedes aegypti* and *Ae. albopictus*) and WNV (*Anopheles crucians*, *Culex coronator*, *Cx nigripalpus*, *Cx quinquefasciatus*) vectors in the Miami-Dade County (MDC) in Florida. They observed an increased prevalence of *Aedes* in urban environments and areas of higher total precipitation. Oppositely, *Culex* mosquitoes were more predominantly encountered in rural settings and areas of lower total precipitation. While all 71 detected cases in 2020 were from DENV serotype 1 (DENV-1), the authors identified DENV-2 and DENV-4 infected circulating mosquitoes. Overall, this suggests the existence of silent DENV circulation in MDC. There is not a single good explanation for why only DENV-1 cases have been detected in MDC. One possibility is that circulating DENV-2 and DENV-4 strains have reduced virulence or pathogenicity in the human host, which would prevent patients to look for medical care. On top of that, the ongoing COVID-19 epidemics during the period of the collection could have prevented patients to seek a clinician due to self-isolation on the first signs of symptoms. Other possible scenarios are low virulence in the human host and maintenance of the DENV-2 and DENV-4 only in invertebrate host populations sustained by vertical transmission and differences in vector competence for DENV serotypes that increase the efficiency of DENV-1 transmission to humans. Differences in vector-virus strain compatibility could also help explain why only *Cx. nigripalpus* (and not *Cx. quinquefasciatus*) have been found infected with WNV, and deserve further analysis.

Overall, their results point to the importance of vector surveillance to identify potential arbovirus transmission hotspots. While vector control programs in the USA benefited from a relatively less favourable climate for vector reproduction in the continental USA (compared to tropical Latin America), climate change models predict an expansion of the suitability of mosquito reproduction.[5,6] Recent outbreaks in subtropical and temperate areas of the world have been associated with climate change.[7] These models unanimously pose a major public health challenge, imposing the implementation of vector surveillance-guided vector control programs, and the training of medical professionals.

The potential existence of a pool of subclinical or unreported dengue cases is also a matter of importance. While acquired immunity against DENV is thought to be lifelong, infection against one DENV strain does not confer full protection against other DENV strains. More importantly, aggravations such as hemorrhagic fever are more likely to occur during subsequent DENV infections.[8] Recently, the Dengvaxia vaccine was approved by the USDA for children and adolescents 9-16 years old who had at least 1 episode of

DOI of original article: http://dx.doi.org/10.1016/j.lana.2022.100231

*Corresponding author at: Laboratório de Ultraestrutura Celular Hertha Meyer, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.
E-mail address: fabiomg@biof.ufrj.br (F.M. Gomes).

dengue fever in the past. Nevertheless, case-control or serological screenings to identify such candidates in areas where dengue fever is endemic but underreported might be essential to minimize the rates of dengue fatality.[9] Also, the genetic background and the pathogenicity of circulating DENV strains to mammals' hosts should be investigated.

Contributors

Fabio M. Gomes: Formal analysis, Conceptualization, Writing – review & editing.
Ana Bahia: Formal analysis, Conceptualization, Writing – review & editing.

Declaration of interests

The authors declare no conflict of interest.

References

1 Bhatt S, Gething PW, Brady OJ, et al. The global distribution and burden of dengue. *Nature*. 2013;496:504–507.
2 Brathwaite Dick O, San Martín JL, Montoya RH, del Diego J, Zambrano B, Dayan GH. The history of dengue outbreaks in the Americas. *Am J Trop Med Hyg*. 2012;87:584–593.
3 Bouri N, Sell TK, Franco C, Adalja AA, Henderson DA, Hynes NA. Return of epidemic dengue in the United States: implications for the public health practitioner. *Public Health Rep*. 2012;127:259–266.
4 Coatsworth H, Lippi CA, Vasquez C, et al. A molecular surveillance-guided vector control response to concurrent dengue and West Nile virus outbreaks in a COVID-19 hotspot of Florida. *Lancet Reg Health Ame*. 2022;11:100231.
5 Ryan SJ, Carlson CJ, Mordecai EA, Johnson LR. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. *PLoS Negl Trop Dis*. 2019;13:e0007213.
6 Iwamura T, Guzman-Holst A, Murray KA. Accelerating invasion potential of disease vector Aedes aegypti under climate change. *Nat Commun*. 2020;11:2130.
7 Robert MA, Stewart-Ibarra AM, Estallo EL. Climate change and viral emergence: evidence from Aedes-borne arboviruses. *Curr Opin Virol*. 2020;40:41–47.
8 Grange L, Simon-Loriere E, Sakuntabhai A, Gresh L, Paul R, Harris E. Epidemiological risk factors associated with high global frequency of inapparent dengue virus infections. *Front Immunol*. 2014;5:280.
9 Aguiar M, Stollenwerk N, Halstead SB. The risks behind Dengvaxia recommendation. *Lancet Infect Dis*. 2016;16:882–883.