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Predict dengue epidemics with entomological and virological surveillance by xenomonitoring

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ABSTRACT

Dengue is the most important arboviral disease with 50-100 million dengue virus (DENV) infections estimated to occur annually (WHO). The entomological and virological surveillance by xenomonitoring, i. e., the detection of DENV in mosquito vectors by continuous real time observation can be an important tool for preventing dengue epidemics. The detection of DENV in Aedes aegypti and Aedes albopictus captured in dengue-risk epidemic areas can reveal the circulating virus before reaching the human population. The main objective of this study was to verify the DENV flow in field-captured vectors in Belo Horizonte, State of Minas Gerais in Brazil. The mosquitoes were captured weekly with "BG-Sentinel Traps" during 3 years from 2011 to 2013. A real-time PCR procedure was used every week to analyze these mosquitoes for the detection and quantification of DENV. The total amount of A. aegypti captured in the 3 following years was 7.748 mosquitoes being 1.504 in 2011, 2.516 in 2012 and 3.728 in 2013. The comparative analyze of infected Ae. aegypti mosquitoes with human cases showed: (a) 2011 = 53 mosquito positive pools and 1,977 human cases; (b) 2012 = 86 mosquito positive pools and 879 human cases and 2013 = 164 mosquito positive pools and 71.892 humans cases. We found similar infection rates in Ae. albopictus. DENV virus circulates in the mosquito vectors weeks before the rise of human cases. Our project also developed a study of the vector competence of the all Ae. aegypti populations. Mosquito samples from all the district

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regions were "in vitro" infected with DENV-2 and their dissected heads and bodies analyzed by real-time PCR. The vector competence of these vectors to transmit dengue varied according to the year of the collection, however, the highest percentage of infected mosquitoes remained in the traditional areas of the dengue outbreaks. Finally, we developed experiments to follow the transovarian DENV transmission in Ae. aegypti females. Vertical transmission was observed during 8 generations suggesting that the DENV adopts a survival strategy and can be maintained in nature before the dengue disease outbreak in humans. These results demonstrate the importance of exploring and understanding vector dynamics, which may help develop mathematical models in an attempt to predict future dengue outbreaks.

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