Complex spatial-temporal behavior of the vector-borne diseases transmitted by *Aedes Aegypti*

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In the last three years, intense epidemics of distinct arboviroses transmitted by *Aedes Aegypti* - Dengue, Yellow Fever, Zika and Chikungunya - have been occured in Brazilian cities. The co-circulation of different viruses reinforces the attention of the researchers how the complex spatial-temporal behavior may affect their dynamics and control. For instance, the heterogeneous scenarios of those outbreaks arise two relevant points: the coverage vaccination of Dengue in Brazil and the cross-immunity of Dengue and Zika, whose viruses belong to the same gene (flavivirus). In this talk, we present some models to measure the optimal age of vaccination for Dengue, and to investigate the co-circulating effect of Dengue and Zika viruses as well as of four heterologous viruses of Dengue. Using a PDE model and the actual series of dengue cases from 2001 to 2014 in 10 urban centers of Brazil, we estimate the optimal age of vaccination and its priority age range, based on the minimization of the basic reproduction number. Morever, the results show that the optimal age for vaccination in general does not coincide with the age of the highest number of cases or incidence. That difference is also observed by the results of an age-structured version of the model, based on the methodolgy presented in [1], for which we analyse the effect of efficacy vaccine. Using a birth-death stochastic model of co-circulating viruses, we emphasize the relevance of the stochasticity in its dynamics with the aim of analysing different scenarios that are observed in epidemics of Dengue and Zika in Brazilian cities in 2015 and 2016. As it is expected, the smaller the population and the smaller the density of initial infected individuals and vectors, the larger the fluctuations; in those cases the average epidemic curve does not reproduce the mean-field version of the model [2]. Using the stochatic model and its mean-field version, we analyse the co-circulating effect of Dengue and Zika in order to investigate the enhancement or reduction of cross-immunity against each other. Generalizing the mean-field model with n co-circulating viruses enable us to estimate the co-circulating effect of dengue data for different serotypes of some urban center in Central and South America [3]. This work has a multidisciplinary character whose team is composed by researchers and students of the Physics Institute and the Public Heath Institute of Federal University of Bahia.

References

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