Heterogeneities in Dengue's spatial-temporal dynamics and its influence in vaccination strategy

Suani Pinho
Universidade Federal da Bahia - Salvador - Brazil

At the beginning of 21st century, Brazil was the country of the world with the most reported cases of dengue fever, occupying first place in the international ranking for total cases of the disease. The heterogeneous scenarios of dengue outbreaks arise relevant points, for instance the optimal age of vaccination. In this talk, first of all we compare different dengue outbreaks of Brazilian cities through a mathematical model in order to evaluate both the basic reproductive number as well as the effective reproductive number that may help to promote precise detection of outbreaks [1]. Additionally, we analyse those measures for dengue's epidemics in different regions of city of Rio de Janeiro, revealing different values for those measures that provide complementary information in relation to dengue incidence.

The heterogeneity was introduced through a partial differential equation model, that mimics dengue transmission taking into account age as a continuous variable, with the aim of estimating the optimal vaccination, For this purpose, the basic reproduction number of the disease was minimized assuming a single-dose vaccination strategy, equal vaccine efficacy for all circulating serotypes, and no vaccine failure. Numerical methods were used to assess the optimal vaccination age and its confidence age range of ten cities in Brazil using data from 2001 to 2014. The median value of the optimal vaccination age is around 9 years old in Belo Horizonte, Campinas, Ribeirão Preto, Campo Grande and Goiânia; their dispersion and skeewess are smaller than for the rest of the studied cities. On the other hand, the mediam value of optimal vaccination age is around 6 years old in Fortaleza, Natal, Rio de Janeiro and Cuiabá; the largest dispersion is observed in Natal; meanwhile Maceió presents the largest skeewess. The variation of the optimal age for vaccination across the country highlights the complex spatial-temporal behavior of the disease. We have recently published these results in reference [2].

Finally the heterogeneties in time series of dengue cases across the country in different scales reveal the complex behavior of Dengue's dynamics and its impact on vaccination strategy. The theoretical approach used in this work provides subsidies to catch the essential features of the complex behavior, linking data and modelling.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

[1] Pinho, S.T.R.; Ferreira, C.P. ; Esteva, L. ; Barreto, F. R. ; Morato e Silva, V.C. ; Teixeira, M.G. Phil. Trans. R. Soc. A 368 (2010) 5679-5693.
[2] Cardim, L. ; Pinho, S.T.R. ; Teixeira, M.G. ; Costa, M.C.N. ; Esteva, L. ; Ferreira, C.P. ; BMC Public Health 19 (2019) 155.