Modelling the impact of a changing environment on vector-borne disease epidemic risks

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Vector-borne diseases are responsible for devastating health consequences, particularly in Low- and Middle-Income countries. Changing environmental conditions (e.g. variations in temperature or humidity) play a key role in the risk of epidemics of diseases such as dengue virus disease and Zika virus disease. This not only leads to variations in epidemic risks within each year, but it also raises an important question: how will vector-borne disease epidemic risks be altered in future under a variable and changing climate? [1–3]

In this project, the student will consider a previous study in which a model was developed for assessing the risk of Zika virus disease epidemics [4]. In that work, the epidemic risk was assessed by assuming that environmental conditions (specifically, the temperature in nine municipalities in Italy) were fixed at the conditions at the exact time that the virus entered the population. While this assumption allowed the epidemic risk to be derived straightforwardly, in reality the epidemic risk depends on changes that occur over the lifetime of the initial phase of a potential epidemic. This can be accounted for in models by estimating the "case" epidemic risk, as opposed to the "instantaneous" epidemic risk. The student will investigate the conditions under which the case epidemic risk and instantaneous epidemic risk are identical and the conditions under which they are different. By deriving the case epidemic risk for the Zika virus epidemic model, and pairing it with climate projections, they will explore precisely how epidemic risks are likely to vary under a changing and variable climate.

In this project, climate data will be provided as required by Dr Jim Hurrell – an expert in climate science at Colorado State University and the National Center for Atmospheric Research in USA.

References

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4. Guzzetta G, Poletti P, Montarsi F, Baldacchino F, Capelli G, Rizzoli A, et al. Assessing the potential risk of Zika virus epidemics in temperate areas with established Aedes albopictus populations. Eurosurveillance. 2016;21: 30199.