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Modelling Japanese encephalitis virus transmission dynamics and human exposure in a Cambodian rural multi-host system

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Japanese encephalitis (JE) is a vector-borne zoonosis and the leading cause of human acute encephalitis in Asia. Its epidemiological cycle is usually described as involving wild birds as reservoirs and pigs as amplifying hosts. JE is endemic in Cambodia, where it circulates in areas with low pig densities (<70 pigs per km²), and could be maintained in a multi-host system composed of pigs, but also poultry as competent hosts, and dogs, cattle and humans as non-competent hosts. We built and used a mathematical model representing Japanese Encephalitis virus (JEV) transmission in a traditional Cambodian village (calibrated with field data collected in 3 districts of Kandal province), to assess the capacity of the epidemiological system to sustain JEV transmission in villages in the 3 districts (based on R0), and to quantify human exposure. Changes in farm density and agricultural practices, or epizootics (e.g., African swine fever), can profoundly alter the composition of host communities, which could affect JEV transmission and its impact on human health: we used the model to analyze how host community composition affected R0 and human exposure. Lastly, we evaluated the potential use of dog JE seroprevalence as an indicator of human exposure to JEV. In the modeled villages, the calculated R0 ranged from 1.07 to 1.38. Predicted annual probability of human exposure ranged from 9% to 47%, and predicted average age at infection was low, between 2 and 11 years old, highlighting the risk of severe forms of JEV infection and the need to implement vaccination of children. According to the model, increasing the proportion of competent hosts induced a decrease in age at infection. Finally, the annual human exposure probability appeared linearly correlated with dog seroprevalence, suggesting that in our specific study area, dog seroprevalence would be a good proxy for human exposure.

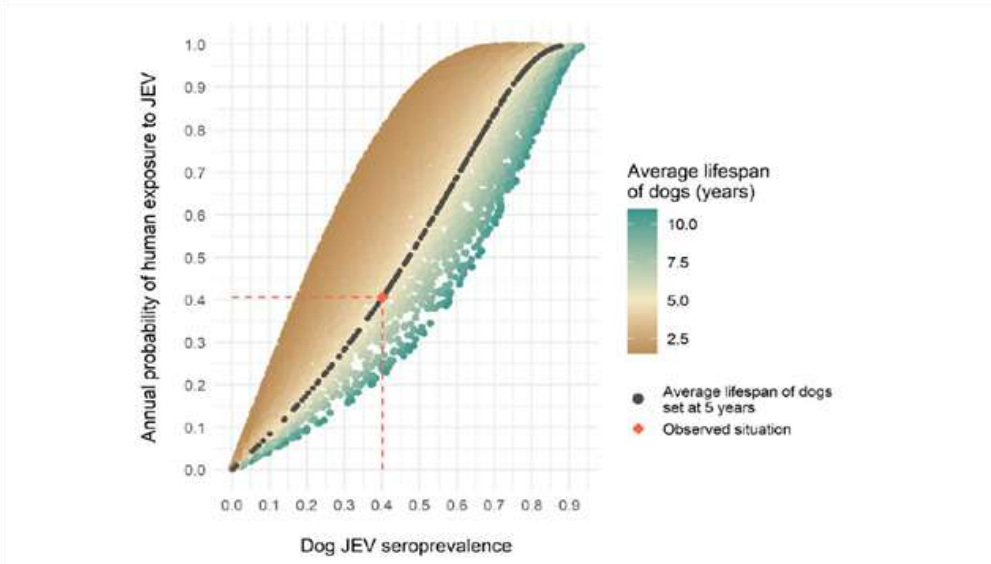

Fig 5. Annual probability of human exposure to JEV according to dog JEV seroprevalence.