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

Héléna Ladreyt[1], Véronique Chevalier[1, 2, 3, 4], Benoit Durand[5]

[1] *CIRAD, UMR ASTRE, Montpellier, France*
[2] *CIRAD, UMR ASTRE, Antanarivo, Madagascar*
[3] *Epidemiology and Public Health Unit, Institut Pasteur du Cambodge, Phnom Penh 12201, Cambodia*
[4] *Epidemiology and Clinical Research Unit, Institut Pasteur de Madagascar, Antanarivo, Madagascar*
[5] *Epidemiology Unit, Laboratory for Animal Health, ANSES, Maisons-Alfort, France.*

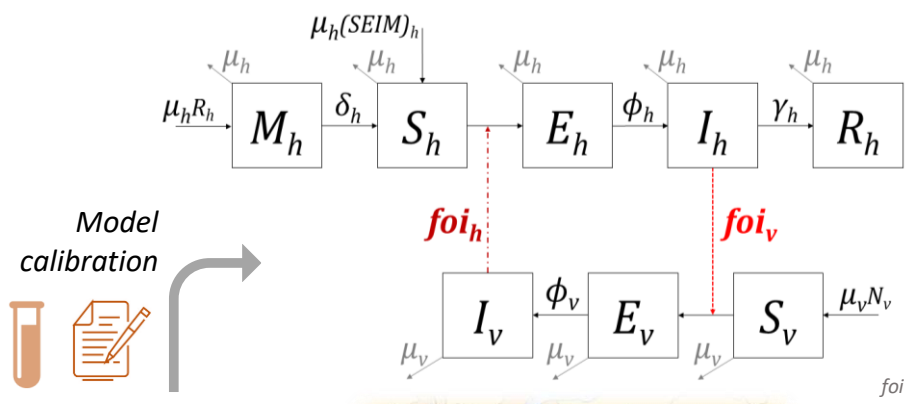
BACKGROUND

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 and *Culex spp* mosquitoes as vectors. JE is endemic in Cambodia, where it circulates in areas with low pig densities, 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.

→Capacity of the epidemiological system to be invaded by JEV and sustain virus transmission in villages (R0)?
→Quantification of human exposure in Kandal villages?
→How host community composition affects R0 and human exposure?
→Could dog JE seroprevalence be used as an indicator of human exposure to JEV?

Culex tritaeniorhynchus

MATERIALS AND METHODS

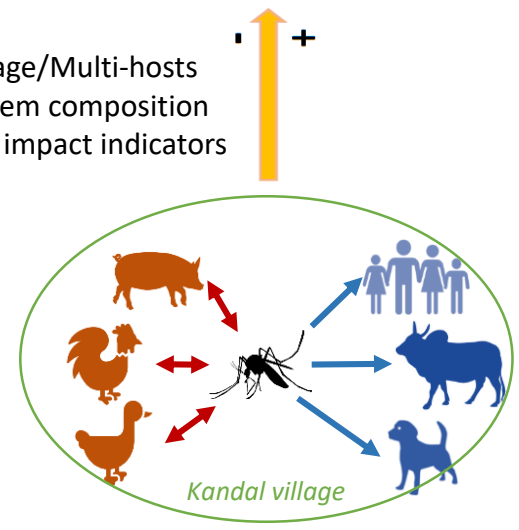


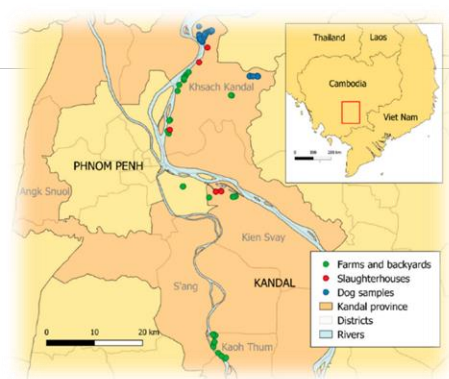
foi : force of infection
v : vector
h : host

Indicators estimation

R0
Probability of human exposure
Incidence rate of human infections
Average age at infection

Village/Multi-hosts system composition can impact indicators





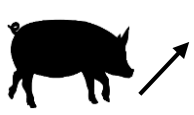
Dogs as a proxy for human exposure? :
Dog seroprevalence
X
Probability of human exposure

RESULTS

In a traditional village of Kandal province:

R_0	1.1-1.4
Exposure probability	9-47 %
Incidence	**24-56** people/village/year
Age at infection	**2-11** years old

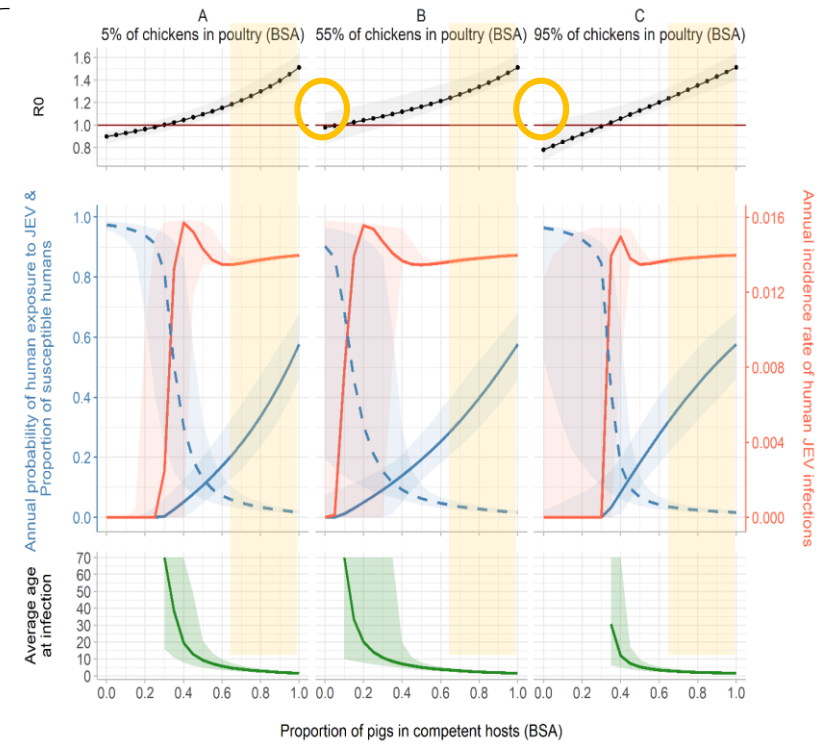
R_0 princially influenced by proportion of pigs in the system
Scenario B, **0 pigs : $IC_{95\%}$ R_0 includes 1** !



Probability of human exposure ↗
Average age at infection ↘
Incidence rate ~

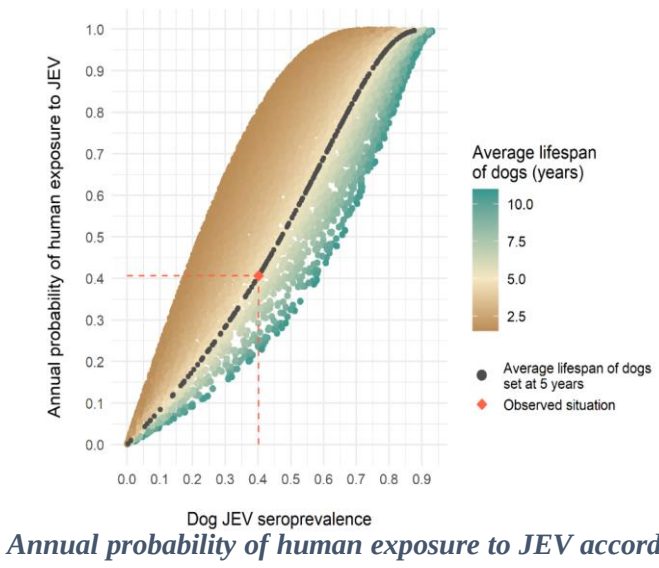
→ Infections affect young people

Village/multi-host system composition modification:



Three estimated indicators and proportion of susceptible humans (dashed blue line) at the epidemiological equilibrium, according to the proportion of pigs in competent hosts in terms of body surface area (BSA), for three fixed percentages of chickens among poultry (BSA). *Total BSA of hosts and the size of vector population (48,663 mosquitoes, 95% CI: 40,347-58,863) remain constant.*

Dog seroprevalence as a proxy for human exposure?



Annual probability of human exposure to JEV according to dog JEV seroprevalence

DISCUSSION, PERSPECTIVES

*1st JEV model calibrated on field data in Cambodia that suggest a quantification of human exposure

***Poultry potential reservoir of JEV**

*Estimated incidence of infection in Kandal: 14 infections for 1000 habitants / year
*Clinical cases incidence? : 1/500 to 1/250 of infections would be symptomatic (hospital based data)
➔ **3/100 000** to **6/100 000** clinical cases / years in Kandal
Average age at infection low → severe cases → **intensify vaccination of children in Cambodia**