The approach of the interventional epidemiologist to vector borne viral disease

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When the etiology and the source or mode of transmission are known, epidemiologic investigation not urgent.

Source/transmission mode

Etiology	Known	Unknown
Known	Investigation + Control +++	Investigation +++ Control +
Unknown	Investigation +++ Control +++	Investigation +++ Control +

When the etiology is unknown for a disease, then can we know if it is vectorborne?

Source/transmission mode

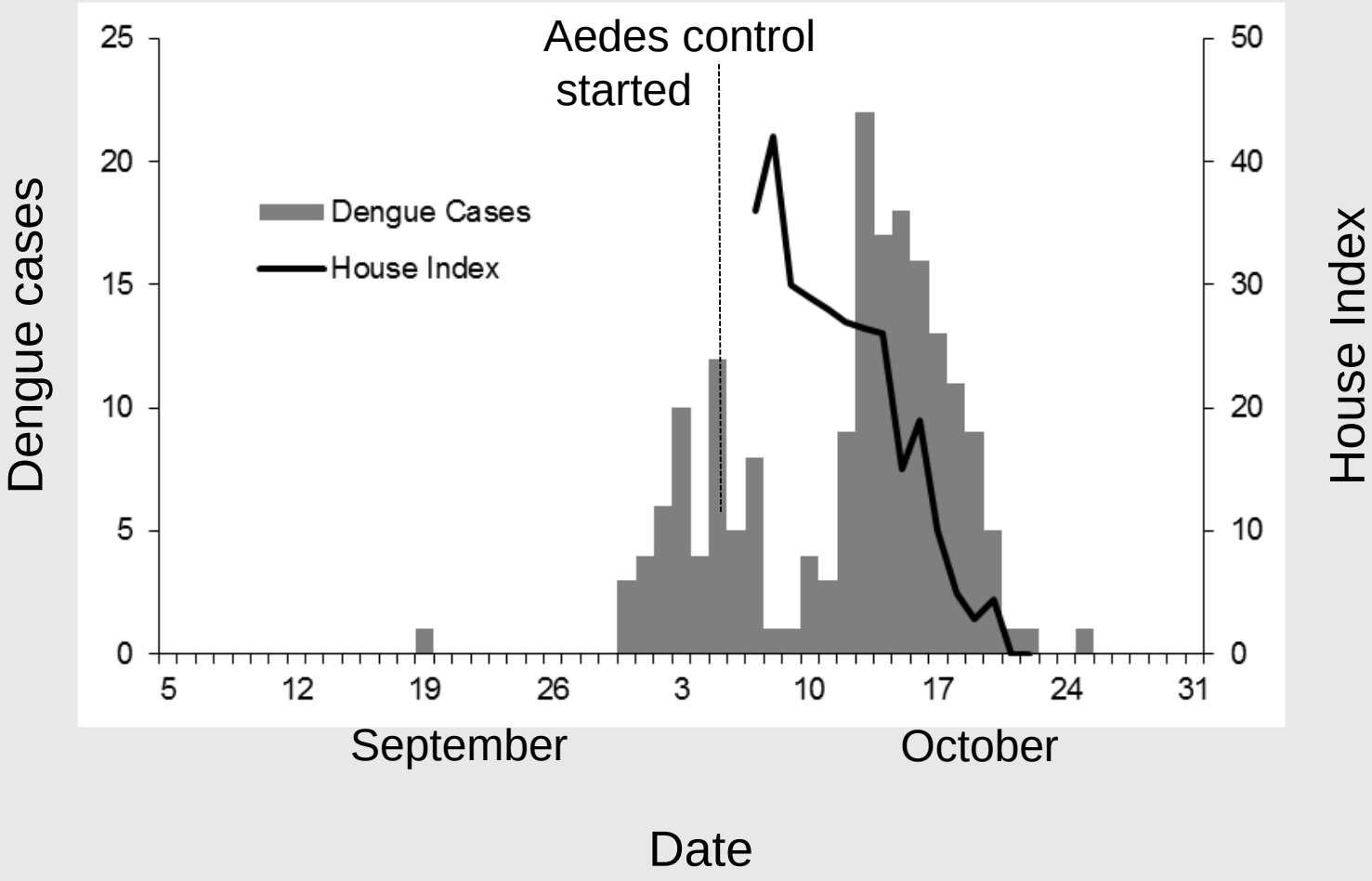
Etiology	Known	Unknown
Known	Investigation + Control +++	Investigation +++ Control +
Unknown	Investigation +++ Control +++	Investigation +++ Control +

Usually no,

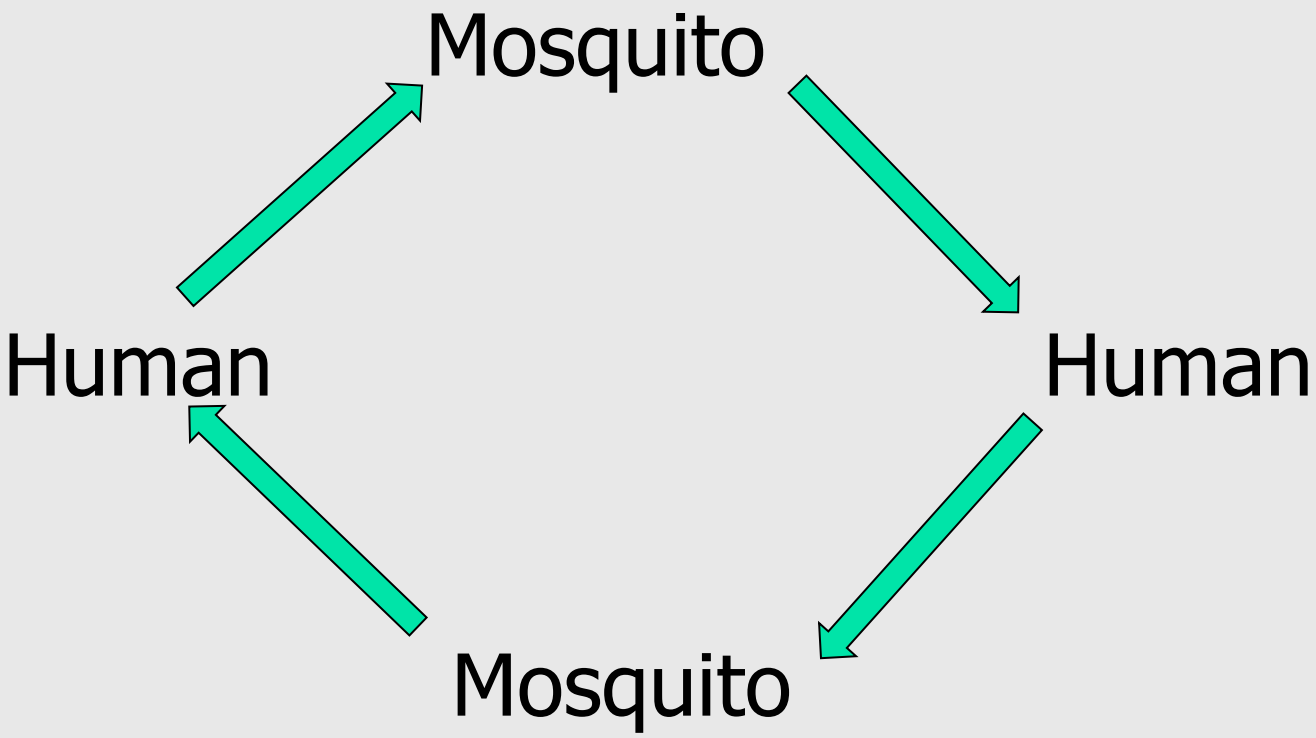
Source/transmission mode

Etiology	Known	Unknown
Known	Investigation + Control +++	Investigation +++ Control +
Unknown	Investigation +++ Control +++	Investigation +++ Control +

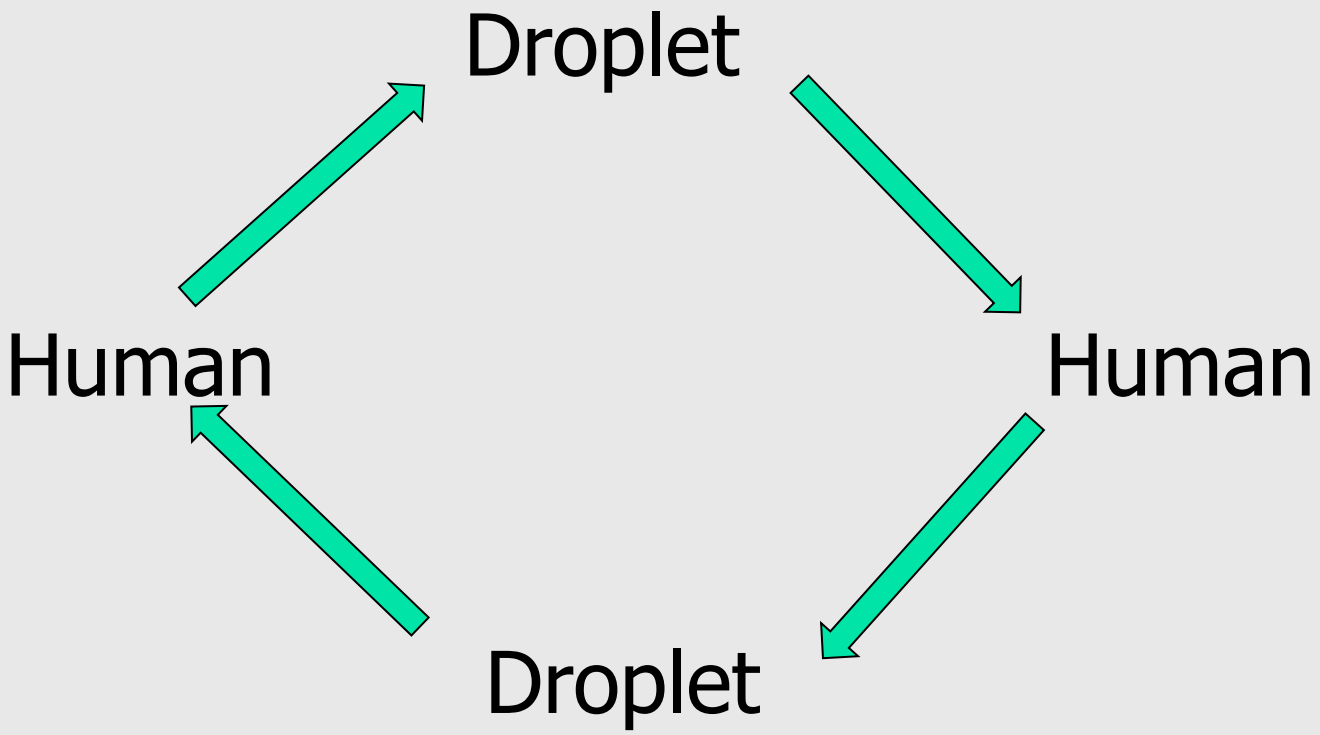
Dengue cases by date of onset in a town in south China



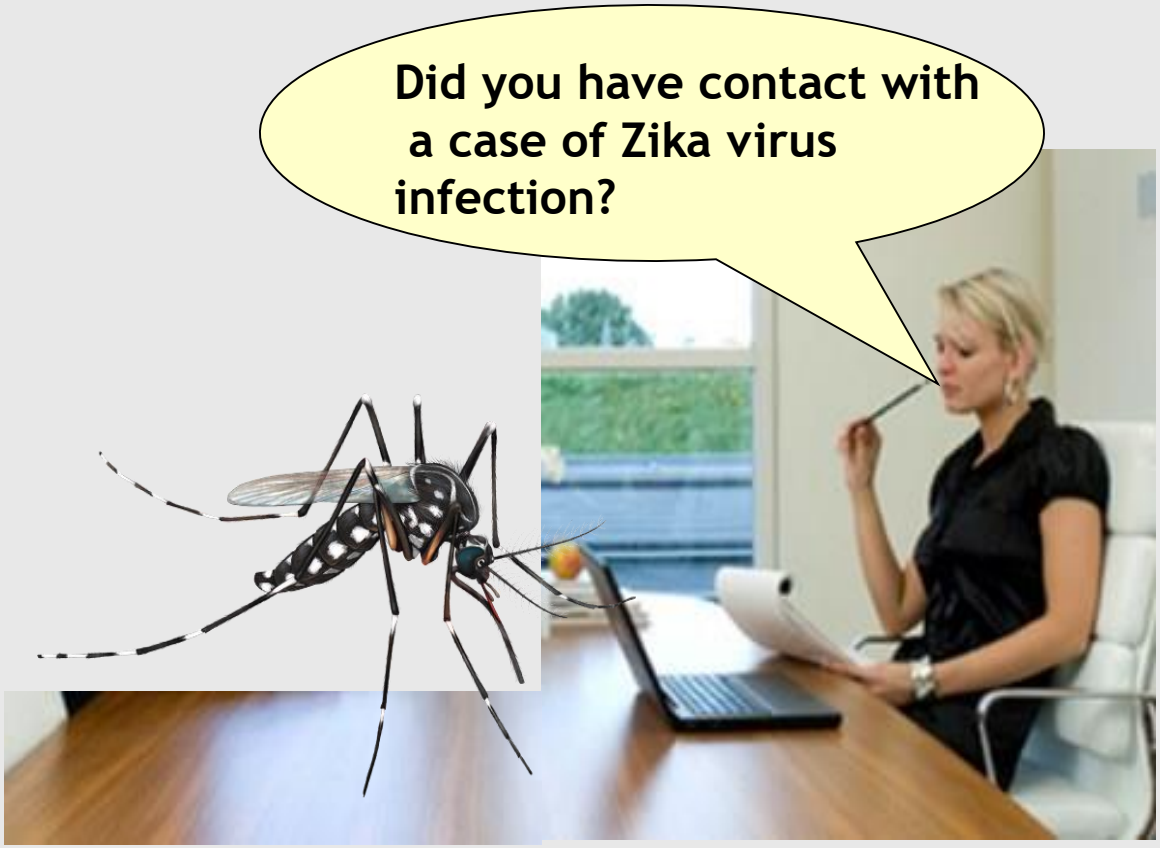
Simple human-mosquito cycle



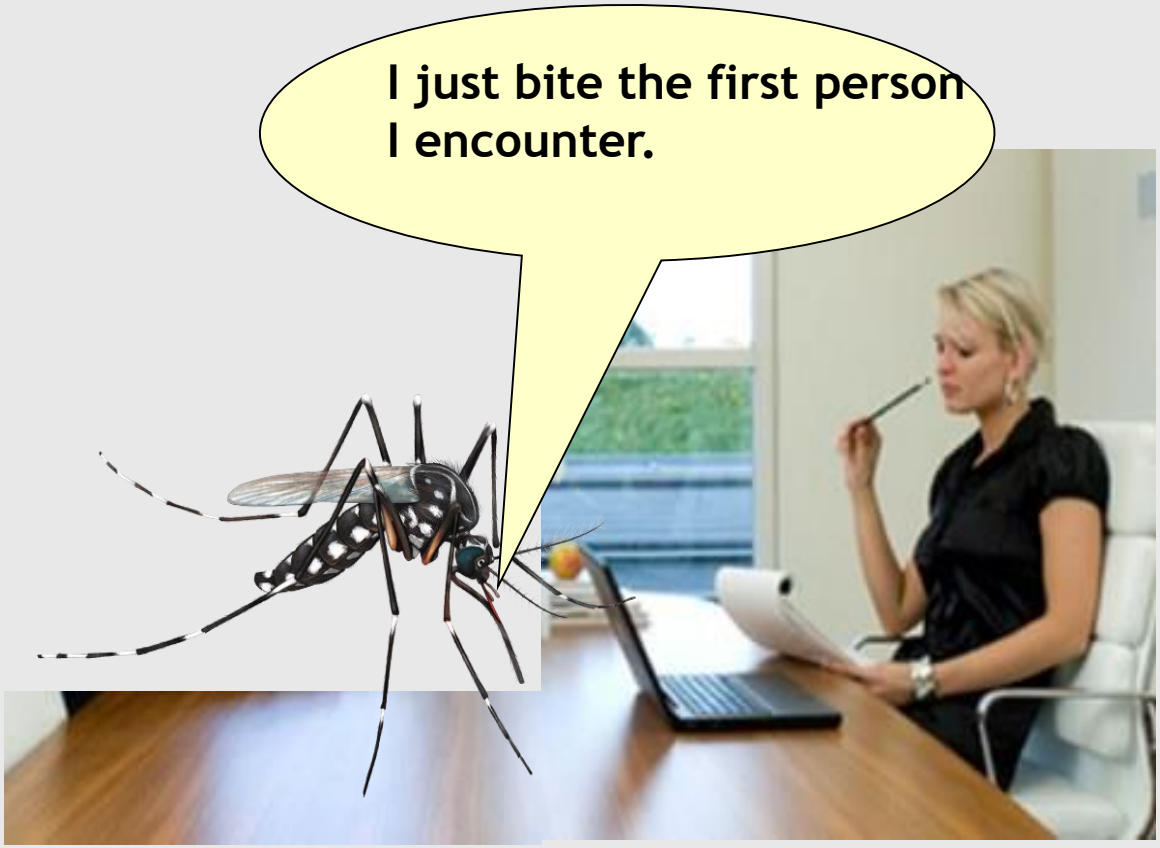
This is very similar to person to person droplet transmission



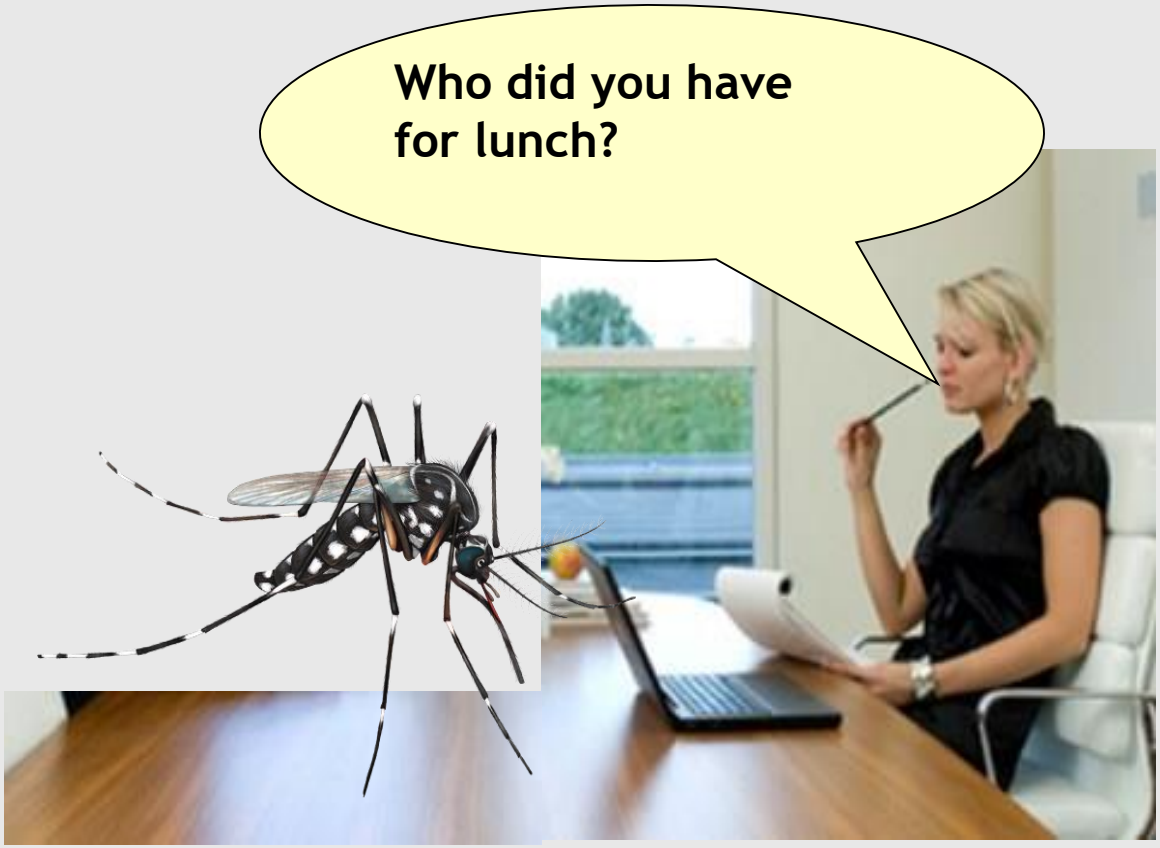
But our usual approach of questioning subjects does not work for vector borne diseases



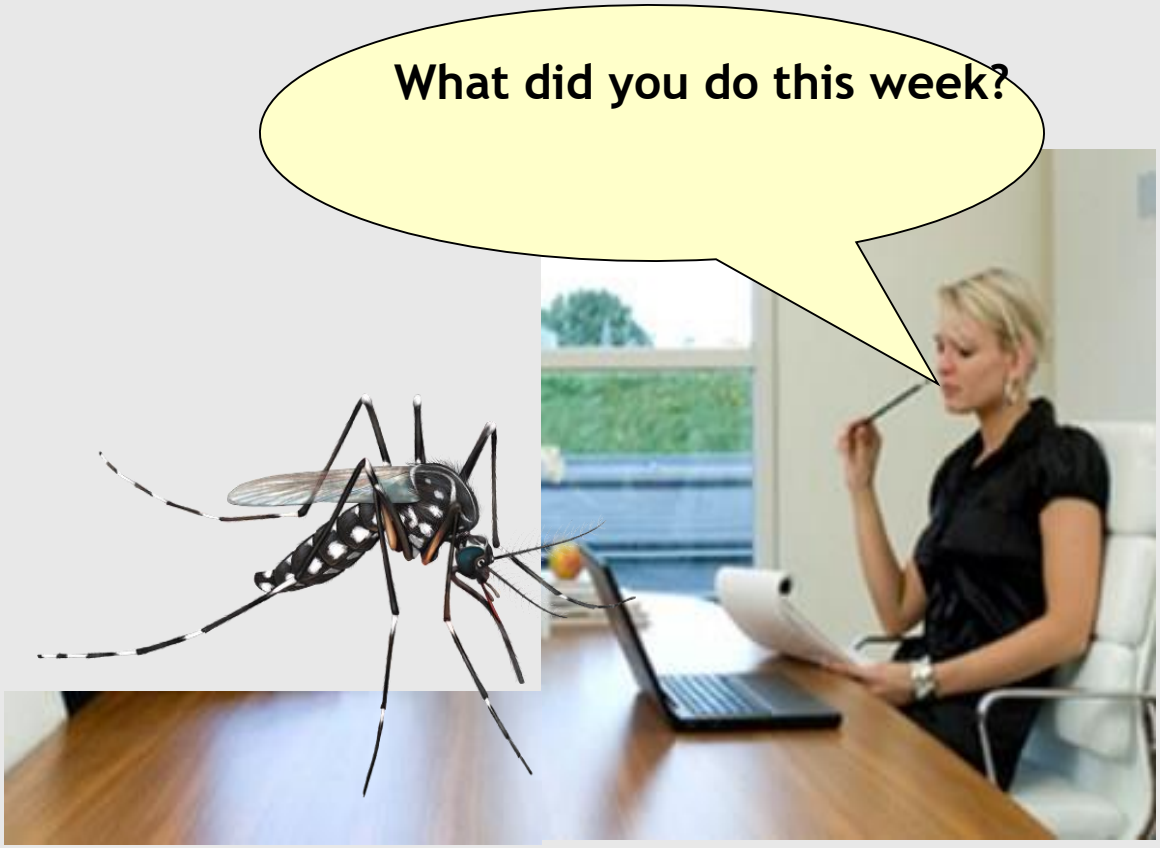
Mosquitos have little selectivity on who they bite. Unlike person to person transmission



Similarly, the foodborne approach does not work?

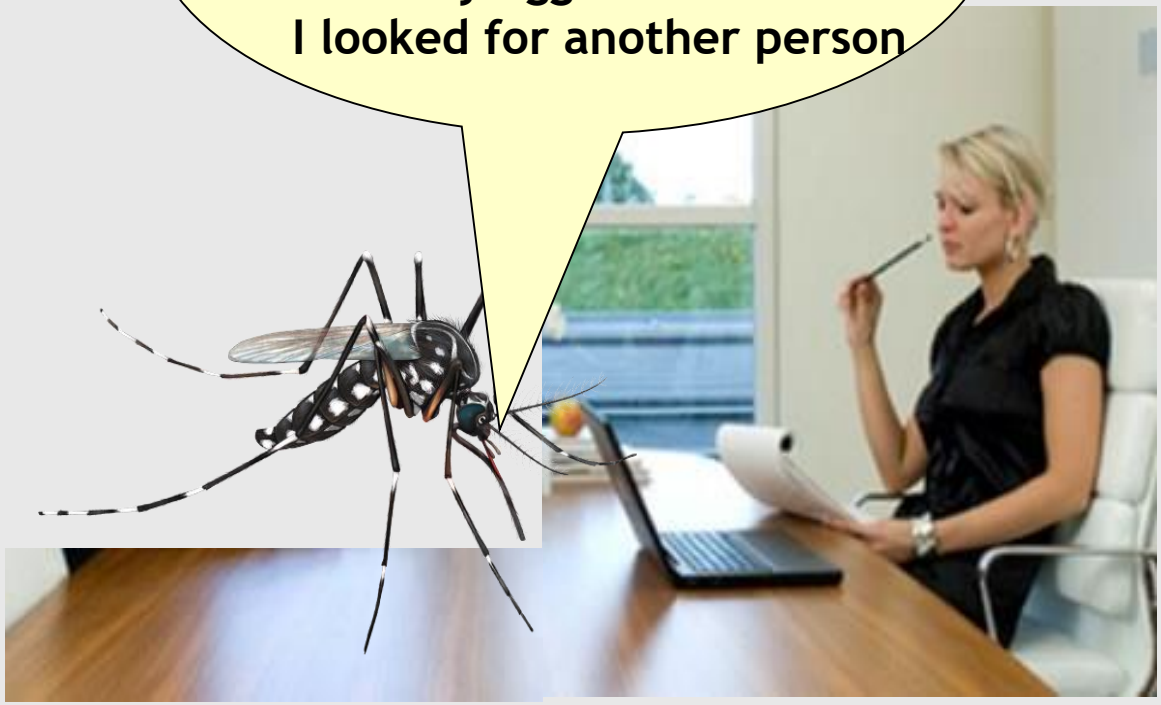


Activities of the mosquito are very simple.

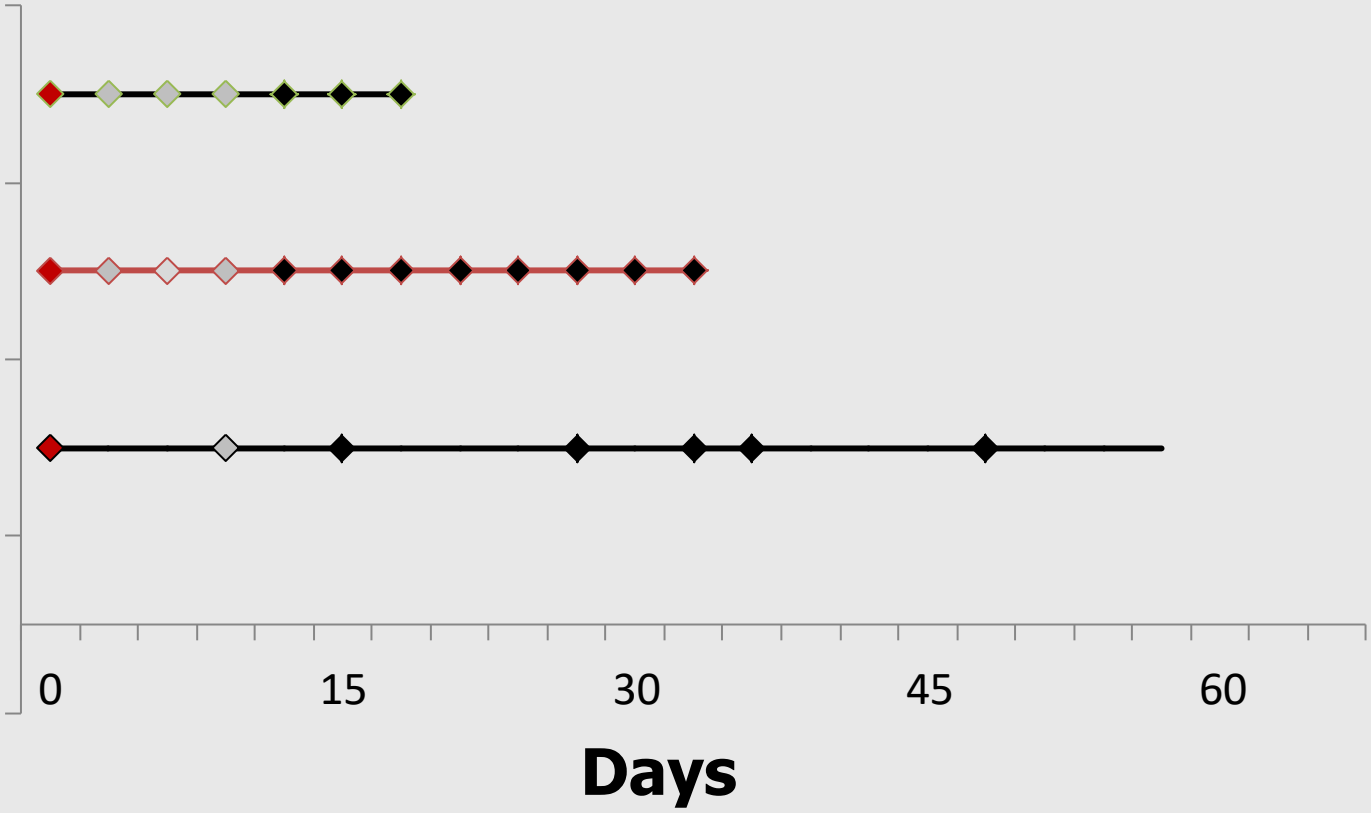


Mosquitos have two simple demands find blood and then find water.

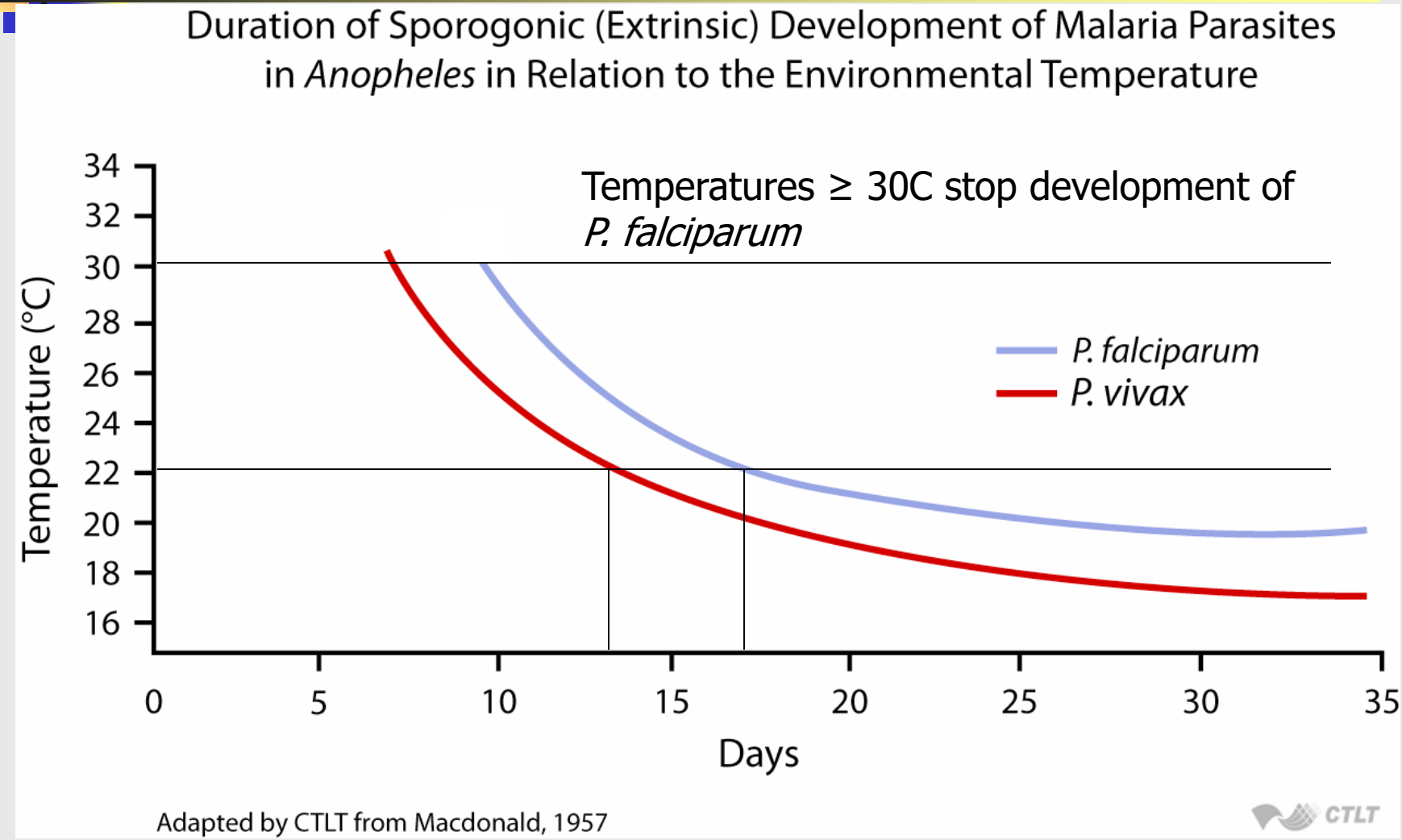
I found a person to bite
I drank blood
3 days later I found some water
I laid my eggs
I looked for another person



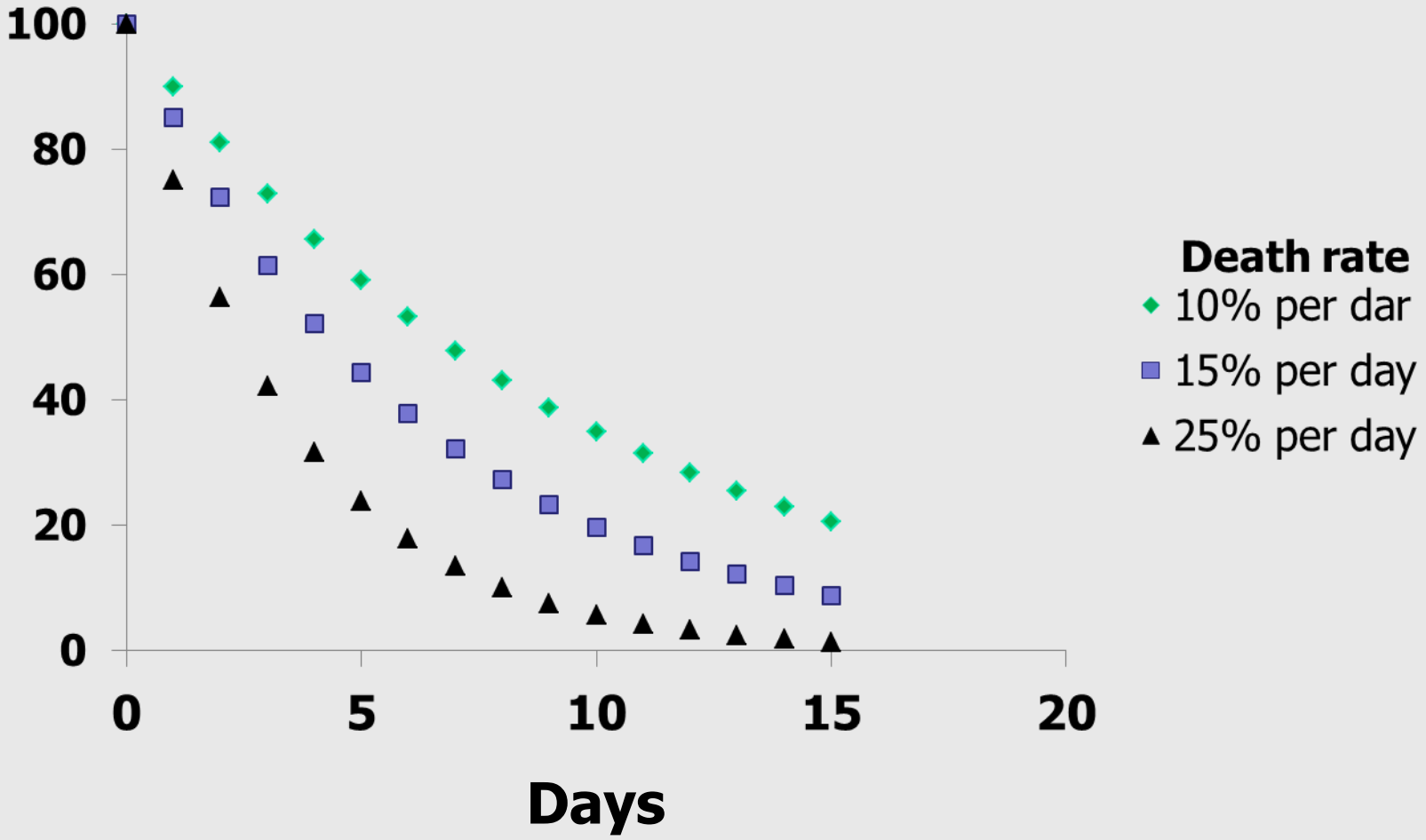
Transmission to secondary cases in time for 3 mosquitos



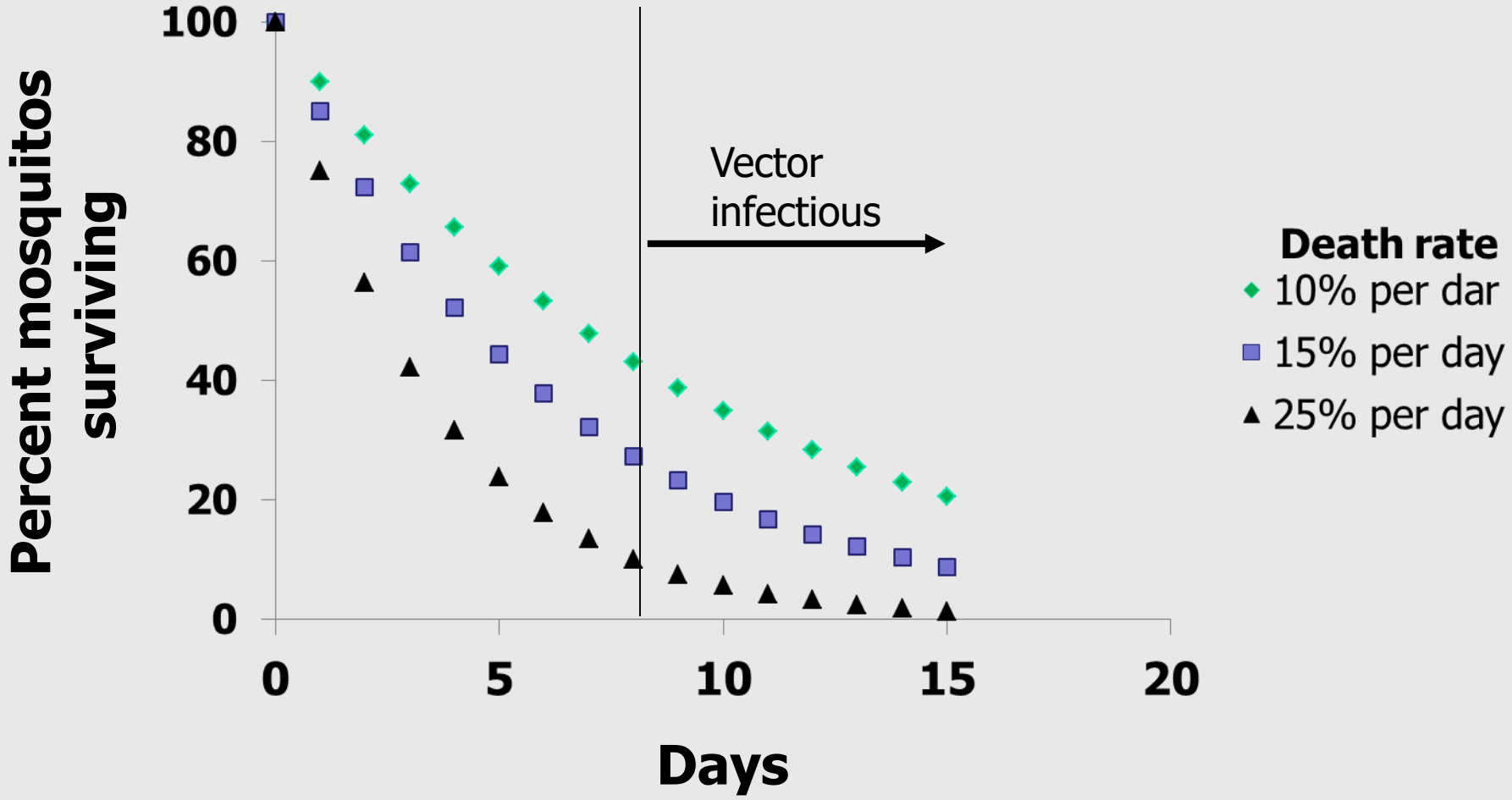
Environmental temperature determine the incubation in the mosquito



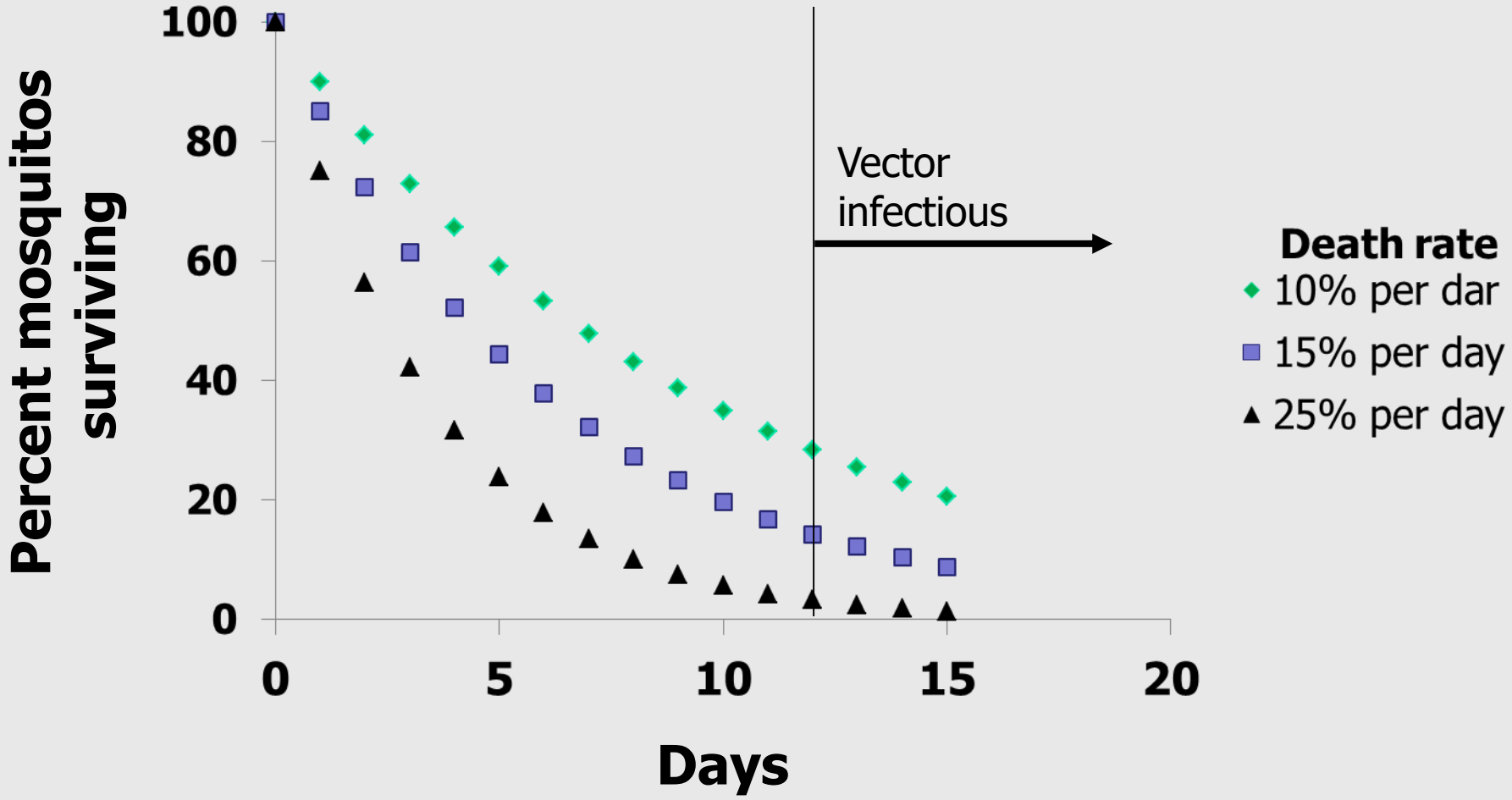
Vector population remaining under different death rates



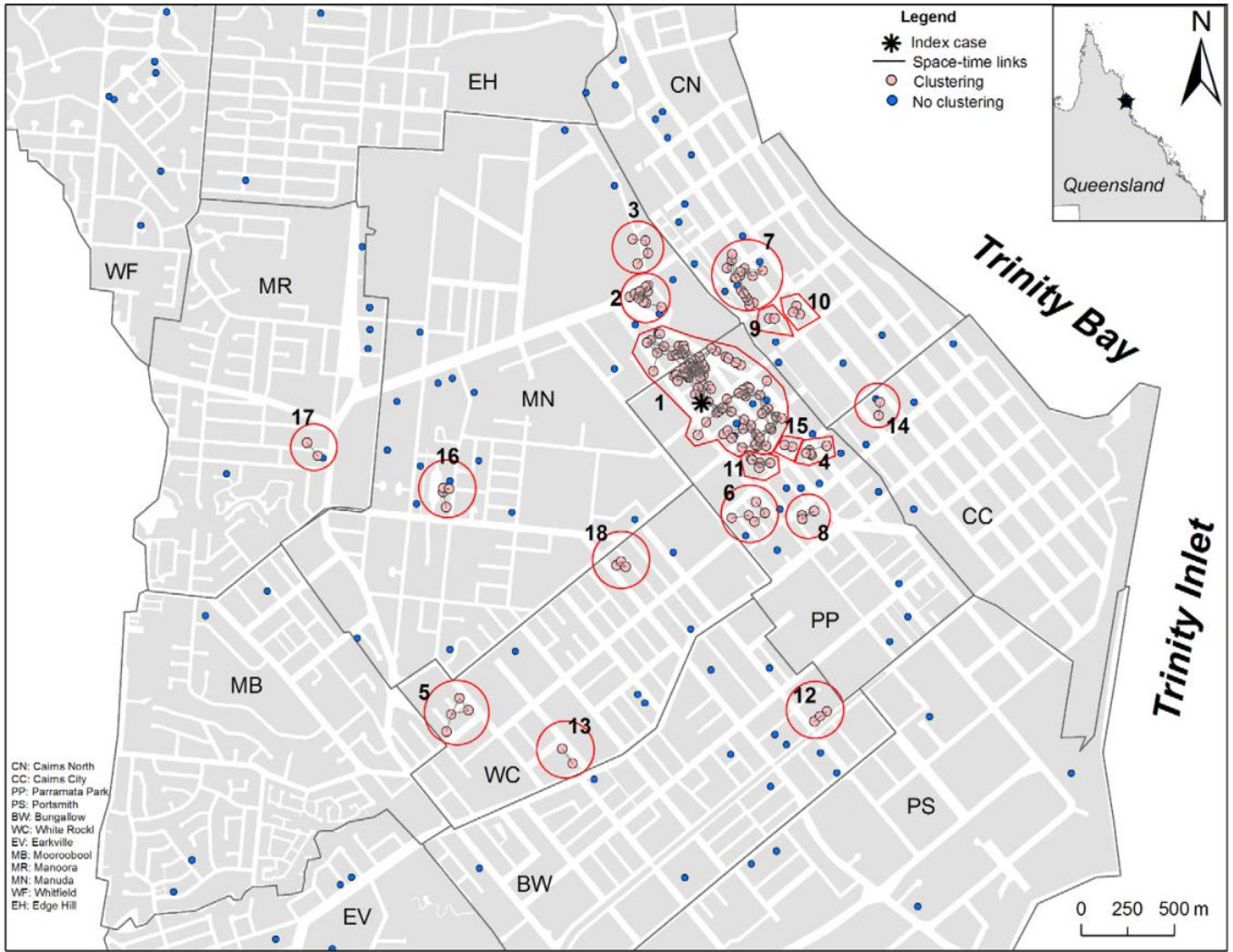
Extrinsic incubation for dengue at higher temperature can be 8 days



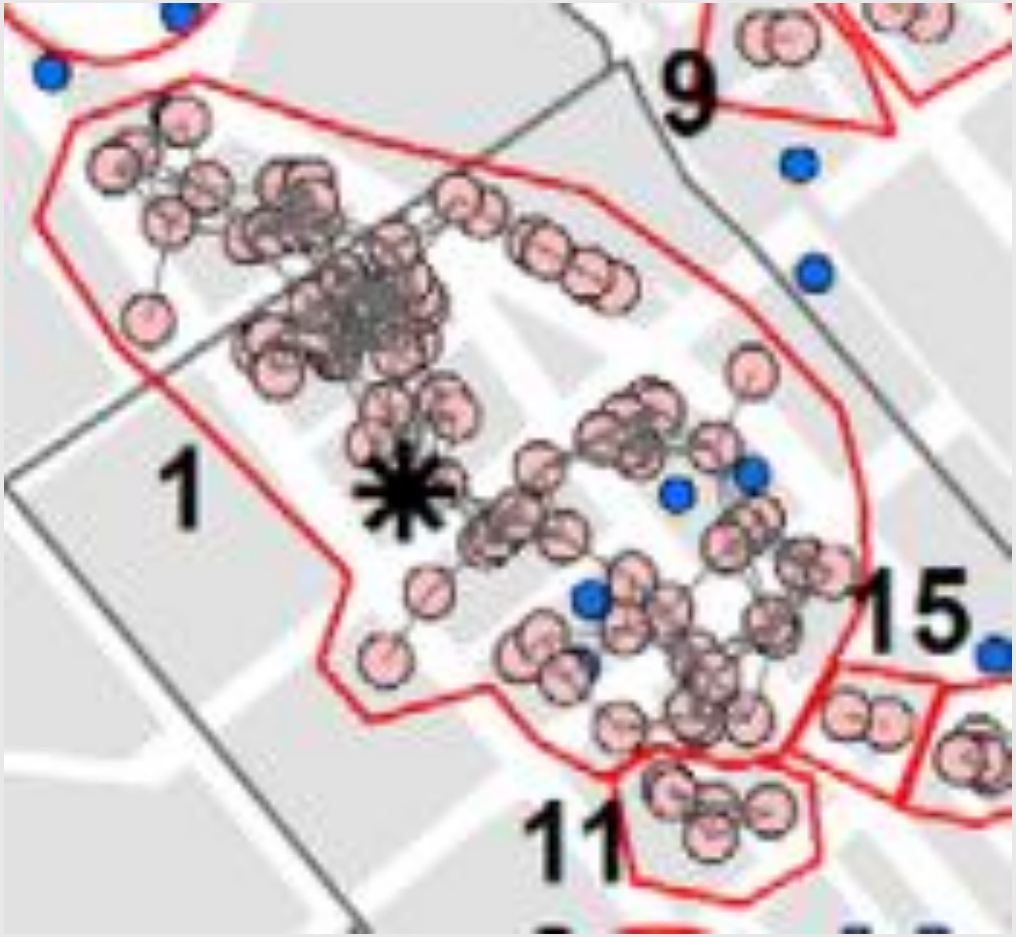
At lower temperatures the extrinsic incubation rises to 12 or more days.



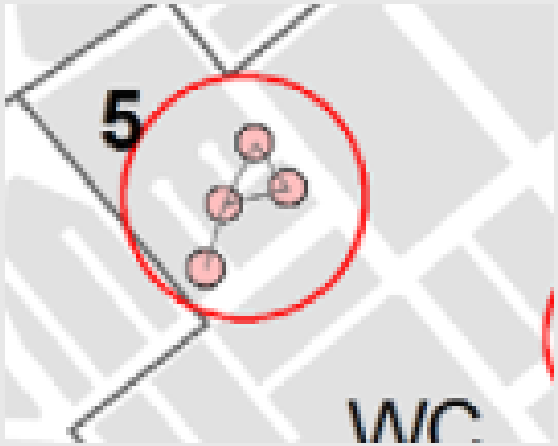
Dengue outbreak showing main focus and satellite clusters, and solitary cases, Cairns, Australia.

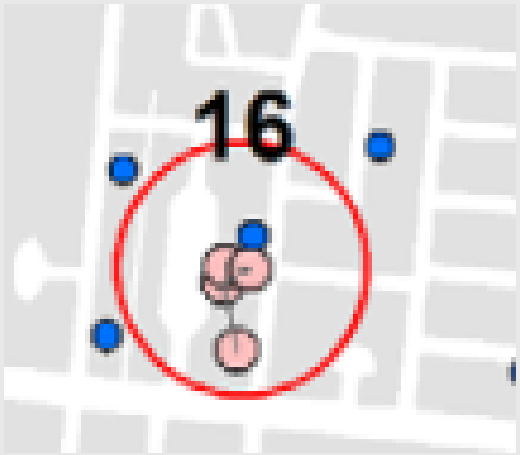


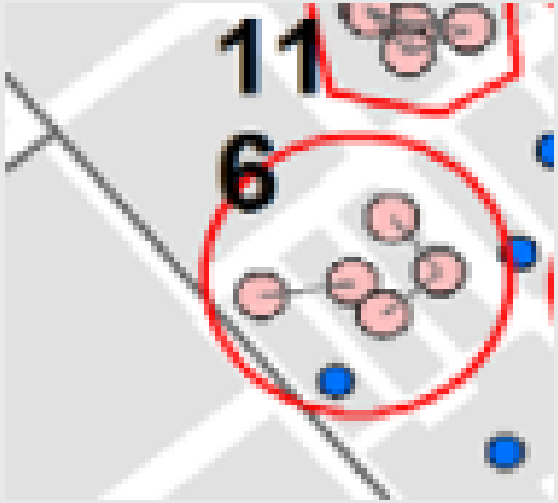
The primary cluster in Cairns shows dispersion over several city blocks over 3 months.

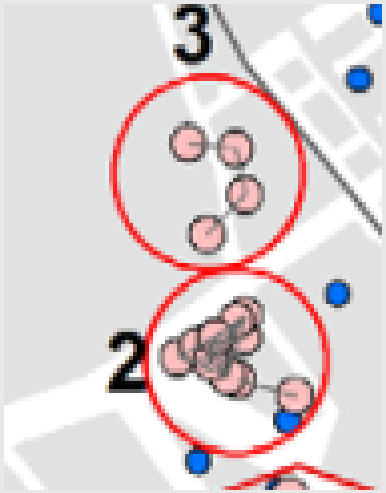


A typical clusters in the Cairns outbreak. Remains trapped between medium streets.

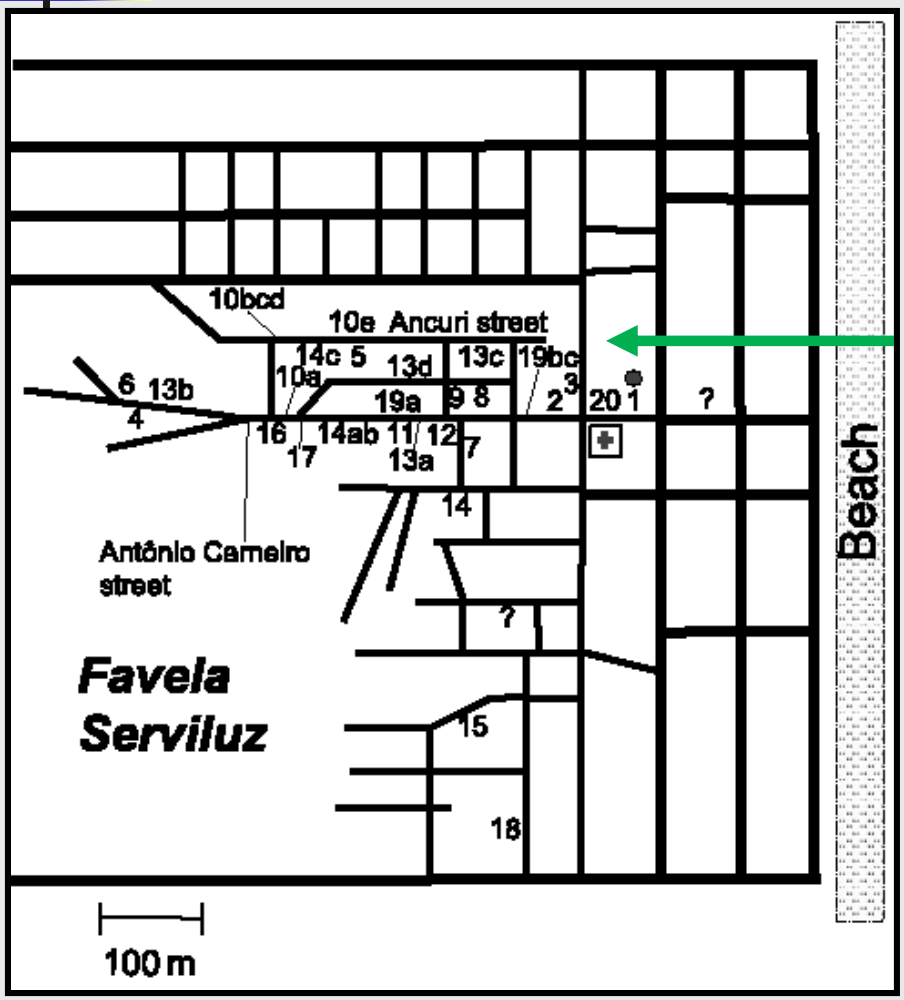








Residents of 36 cases of dengue, Favela Serviluz, Fortaleza, Brazil, June -- July, 1999*



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Wind direction

3 Cases in order of onset

? Case with unknown onset date

1 Primary case

Health-center

*J Heukelbach et.al. Trop Med Internat Health, 6:635-42, 2001

Locations of neglected swimming pools breeding the West Nile virus vector, Bakersfield CA 2009

How outbreaks of vector borne disease arise.

- Introduction of agent in a previously uninfected area with the vector
- Introduction of infected vectors
- Introduction of a more competent vector (*Anopheles gambiae* into Brazil 1930's)
- Changes in vectorial capacity in currently infected areas
  - Natural
  - Manmade
- Increased exposure of man to vectors
- Interruption of control measures

Examples of factors that influence vectorborne transmission

That produce factors

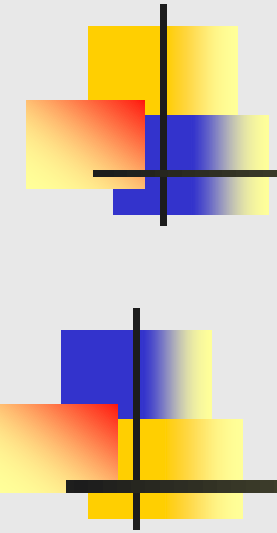
- Agriculture
- Water management
- Animal management
- Construction

That increased contact

- Concentration
- Movement
- Construction

What epidemiologic factors can we measure?

- Time of exposure, onset, and treatment
- Place
- Protection from and exposure to the vector
- Environmental factors
  - Modifications of the environment by man
  - Natural environmental factors



Questions?