

The importance of schools and other non-household sites for dengue entomological risk

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Dengue entomological risk

- Dependent upon 2 key factors:
 - Vector abundance and breeding
 - Human presence and movement
- These risk factors are not limited to the household environment alone

Assessing entomological risk: Vector abundance

- Immature mosquito indices
 - ‘traditional’ indices (house, container, Breteau)
- Oviposition indices
 - Presence/absence or absolute counts of eggs in ovitraps
- Productivity measures (absolute counts of pupae or larvae)
 - Containers can vary in their epidemiological importance
- Adult mosquito indices

Adult mosquito indices

- The adult stage of the mosquito is the most epidemiologically important
- Adult *Aedes* are notoriously difficult to sample
 - But not impossible!
- A robust index of dengue entomological risk should include measures of adult mosquito density as well as human presence

Assessing entomological risk: Human presence & movement

- Where are people and host-seeking mosquitoes likely to come into contact?
- Individuals can be at risk of infection in multiple locations, not just the household
- Dengue transmission risk in individuals increases 3-fold when taking into account potential exposure at non-household locations (Stoddard *et al.* 2009; data from Iquitos, Peru)

So where are the areas of highest entomological risk?

Presumably these are primarily residential areas; but can non-household areas also significantly contribute to dengue entomological risk?

Spatial clustering

- Transmission ‘hot spots’
 - Evidence suggests that these occur primarily in residential areas
 - School-based surveillance of dengue cases can aid in the identification of these residential foci
 - Mammen *et al.* (2008): ‘... active school-based dengue case detection prompting local spraying could contain recent virus introductions and reduce the longitudinal risk of virus spread within rural areas’
 - Kittayapong *et al.* (2008); targeted interventions to foci identified using school-based surveillance

Schools as transmission foci

- Conflicting evidence regarding their importance:
 - Strickman *et al.* (2000)
 - Thailand; transmission likely occurred in residential settings rather than schools
 - Strickman & Kittayapong (2002)
 - Thailand; schools and houses adjacent to schools can be important sources of *Aedes* larvae
 - Endy *et al.* (2002)
 - Thailand; transmission likely occurred in residential settings rather than schools
 - Mammen *et al.* (2008)
 - Thailand; transmission was highly focal in residential settings; school-based case surveillance was effective but no DENV-infected mosquitoes were found in schools
 - Kittayapong *et al.* (2008)
 - Thailand; case detection in schools to identify residential transmission foci; both residences and schools were treated and vector infestations and dengue incidence were reduced
 - Garcia-Rejon *et al.* (2011)
 - Mexico; schools presented a risk environment for students, teachers, and other personnel to be exposed to DENV-infected *Ae. aegypti*

School-based interventions

- Educational
 - Many examples in the published literature of school-based education programmes on dengue prevention and control
 - Do these actually lead to long-term behaviour change?
- Breeding site control on school premises
 - Kittayapong *et al.* (2008)
 - Screen covers, Bti, *Mesocyclops* copepods
- Insecticide-treated uniforms
 - Proposed by Wilder-Smith *et al.* (2011)
- Insecticide-treated window screening
 - Currently being deployed in Merida and Acapulco, Mexico in cluster-randomized trials in both residential sites and schools (UADY, LSTM, SSM collaboration)
- Colombia HEALTHPLATFORM study

Other non-household sites

- Abe *et al.* (2005) calculated that a single cemetery in Venezuela produced a daily output of approximately 3000 *Ae. aegypti* females per day
- Morrison *et al.* (2006) reported high levels of dengue vector breeding in a variety of non-household sites in Iquitos, Peru (ports, markets, commercial sites, parks, schools, etc.)
- Arunachalam *et al.* (2010) reported more pupae per container were found in public spaces, particularly schools and religious facilities (7 SE Asian countries)
- Pilger *et al.* (2010) demonstrated the sampling bias of entomological infestation indices when only residential sites are surveyed

Conclusion:

Pay attention to the non-residential sites

- As the efficacy of control programmes targeting residential sites improves, the mosquitoes will seek alternative habitats
 - Schools, commercial sites, vacant lots, etc.
- By thinking in terms of dengue entomological risk, interventions can be targeted to maximize their impact depending on when and where people are most likely to come into contact with mosquitoes.