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Dengue surveillance using gravid oviposition sticky (GOS) trap and dengue non-structural 1 (NS1) antigen test in Malaysia: randomized controlled trial

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Dengue remains a major public threat and existing dengue control/surveillance programs lack sensitivity and proactivity. More efficient methods are needed. A cluster randomized controlled trial was conducted for 18 months to determine the efficacy of using a combination of gravid oviposition sticky (GOS) traps and dengue non-structural 1 (NS1) antigen for early surveillance of dengue among *Aedes* mosquito. Eight residential apartments were randomly assigned into intervention and control groups. GOS traps were placed at the intervention apartments weekly to trap *Aedes* mosquitoes and these tested for dengue NS1 antigen. When dengue-positive pool was detected, the community were notified and advised to execute protective measures. Fewer dengue cases were recorded in the intervention group than the control. Detection of NS1-positive mosquitoes was significantly associated with GOS *Aedes* index ($r_s = 0.68$, $P < 0.01$) and occurrence of dengue cases ($r_s = 0.31$, $P < 0.01$). Participants' knowledge, attitude, and practice (KAP) toward dengue control indicated significant improvement for knowledge ($P < 0.01$), practice ($P < 0.01$) and total scores ($P < 0.01$). Most respondents thought this surveillance method is good (81.2%) and supported its use nationwide. Thus, GOS trap and dengue NS1 antigen test can supplement the current dengue surveillance/control, in alignment with the advocated integrated vector management for reducing *Aedes*-borne diseases.

Dengue is an important arthropod-borne viral infection that has rapidly spread globally in recent years. About three billion people live in dengue-prone areas with an estimated 100–400 million dengue cases occurring annually on a global scale[1]. An estimated 390 million dengue infections occur per year with only 96 million being clinically apparent[2], of which more than half the cases are reported in Southeast Asia[3]. In Malaysia, there was a four-fold increase in national dengue cases in the year 2014 due to environmental factors, rapid urbanization, and serotypes switch[4]. Since then, all four serotypes are circulating in Malaysia and dengue disease remains a significant public health threat[5,6]. Female *Aedes aegypti* and *Aedes albopictus* mosquitoes are primary and secondary vectors in Malaysia. The primary vector *Ae. aegypti* is very anthropophilic[7], day-biting and feeds on several humans during one blood meal if disturbed during feeding[8]. An infected *Ae. aegypti* remains infected for life and can easily cause an epidemic, especially at places where people live in close proximity[9].

A licensed dengue vaccine, Dengvaxia[10], has recently become available in the absence of an antiviral cure, but still, it falls short in protection due to its partial efficacy and safety issues[11]. Therefore, vector surveillance remains the critical core of the dengue control program in many Southeast Asian countries including Malaysia[12–14]. This involves source reduction, house to house larval surveys, larviciding and fogging which are reactive and

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