The geographic information system as an epidemiological tool in the surveillance of dengue virus-infected Aedes mosquitoes

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Abstract
A Geographic Information System (GIS) was used as analysis tool to study the spatial distribution of dengue virus-infected Aedes mosquitoes in Thailand. Global Positioning System (GPS) instruments were used to map villages involved in dengue epidemiological studies in Ratchaburi Province, Thailand. Differentially processed GPS data, with a spatial resolution of approximately 1 meter, were incorporated into a GIS for analysis and mapping. Databases associated with a village GIS included village number, Aedes aegypti populations, and test results. Epidemiological surveillance for dengue infection through the detection of the dengue virus type(s) infecting Aedes mosquitoes during epidemic periods constitutes a reliable sentinel system for dengue outbreaks. Various techniques were applied including: enzyme linked immunosorbent assay (ELISA), indirect immunofluorescent assay (IFA), and reverse transcriptase - polymerase chain reaction (RT-PCR) assay for the virologic surveillance of the type-specific detection of dengue viruses in artificially infected and in field-caught adult Aedes mosquitoes. In laboratory experiments, all assays showed sufficient sensitivity to detect one virus infected mosquito and the rapid RT-PCR clearly showed serotype-specificity with very high detection sensitivity. In the field study conducted from April to September 2000, female adult Aedes mosquitoes were collected from selected dengue-sensitive areas in Chom Bung district, Ratchaburi Province and assayed by ELISA, IFA and RT-PCR with 18.3\% (44/240), 28.98\% (20/69) and 15\% (3/20) positive for dengue virus, respectively. Geographic distribution of the virus-infected Aedes mosquitoes and household locations were demonstrated by the GPS and the GIS. The development of disease mapping data coupled with RT-PCR laboratory-based surveillance of dengue virus infection can successfully serve as epidemiologic tools in an early warning system for dengue hemorrhagic fever (DHF) epidemics.