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ORIGINAL ARTICLE

Study on Entomological Surveillance and its Significance during a Dengue Outbreak in the District of Tirunelveli in Tamil Nadu, India

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Abstract
Objectives: To study the significance of entomological surveillance, the house index (HI), container index (CI), and Breteau index (BI) were determined to estimate the degree of a major dengue outbreak in Tirunelveli, Tamil Nadu, India (Latitude: 8°42′N; Longitude: 77°42′E) in May 2012.
Methods: The HI, CI, and BI were determined in a primary health center (PHC) in the village of Maruthamputhur (Pappakudi taluk, Tirunelveli) by carrying out an antilarval (AL) work that involved door-to-door search for immature stages of *Aedes* spp. mosquitoes by trained field workers and volunteers. The work of field workers was evaluated by a junior and senior entomologist the following day.
Results: Before the AL work, the reported numbers of fever cases from Week 1 to 5 in Maruthamputhur were 211, 394, 244, 222, and 144 with two deaths. By contrast, after the AL work, these numbers were considerably reduced and there was no fever-related death (the HI was reduced from 48.2% to 1.6%, the CI from 28.6% to 0.4%, and the BI from 48.2 to 1.6).
Conclusion: Because no specific medicine and vaccines are available to treat dengue fever and dengue hemorrhagic fever, entomological surveillance and its significance can be used to halt the outbreak of dengue as shown in this study.

1. Introduction

Dengue is an acute febrile illness caused by *Flavivirus*, which exists in four different serotypes, namely, DEN-1, DEN-2, DEN-3, and DEN-4. Its transmission is effected through female *Aedes aegypti* and *Aedes albopictus* mosquitoes (vectors). Dengue fever (DF) may transform into dengue hemorrhagic fever (DHF) and

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dengue shock syndrome (DSS) and these conditions are fatal causing hemorrhages and leakage of plasma, respectively [1]. This mosquito-borne disease not only causes high levels of morbidity and mortality, but also has a great economic impact, including loss in commercial and labor output, particularly, in tropical and subtropical countries. However, no part of the world is free from these diseases [2]. To prevent and control the spread of dengue, various approaches have been attempted and most of them yielded fruitful results, with vector control proving to be the best approach until dengue-specific drugs and vaccines are developed [3]. There are three major components of dengue surveillance, namely, disease surveillance, vector surveillance, and monitoring of environmental and social risks. Among these components, entomological surveillance is used to determine changes in the geographical distribution and density of the vector, evaluate control programs, obtain relative measurements of the vector population over time, and facilitate appropriate and timely decisions regarding interventions [4]. A number of methods are available for detecting or monitoring immature and adult populations. Selection of appropriate sampling methods depends on the surveillance objectives, levels of infestation, available funding, and skills of personnel [5]. The objectives of *A. aegypti* surveillance methods are baseline infestation survey, control program monitoring low infestation levels [$<$5% house index (HI)], control program monitoring with $\geq$5% HI level, surveillance against reinfestation, verification of eradication, and evaluation of control methods. These objectives have been accomplished with larval survey, collecting data on mosquito landing on humans or biting them, collection of resting mosquitoes, ovitrap, tire larvitraps, and insecticide susceptibility based on their suitability [6].

Several indices have been used to monitor *A. aegypti* populations for dengue virus transmission. Those related to immature populations are the HI, i.e., the percentage of house infested with larvae or pupae; the container index (CI), i.e., the percentage of water-holding containers infested with larvae or pupae; and Breteau index (BI), i.e., the number of positive containers per 100 houses inspected. When using the HI or the BI, the definition of a house should be one unit of accommodation and the surrounding premises, irrespective of the number of people residing therein [7,8].

In this study, efforts have been made to understand the significance of entomological surveillance using the HI, CI, and BI during a dengue outbreak (May 2012) in Tirunelveli district of Tamil Nadu, India, and to incorporate the study findings in the dengue-control measure protocols.

2. Materials and Methods

2.1. Active fever surveillance

Information on fever was collected with the resources available by active (door-to-door search) and passive surveillance (institutional surveillance), as fever is the prime sign and symptom for DF. A door-to-door search (active surveillance) was performed by field staffs, health inspectors, and village health nurses during their field visits. Based on the data collected, malaria form 2 was filled in and a blood smear test was conducted to rule out malarial fever. The form along with the test results were sent to the medical officer at the primary health center (PHC). In addition, the S form of the Integrated Disease Surveillance Project (IDSP) was also filled out in order to understand the clinical syndromes of diseases such as malaria, dengue, leptospirosis, and acute diarrheal diseases in the community, with the case definition defined in the IDSP Manual [9]. A copy of the S form was also sent to the medical officer at the PHC. It would also be helpful to identify (using event-based surveillance) whether disease clusters are present in a place. Based on the reports submitted and laboratory test results, decisions can be made for implementing specific disease-control measures.

2.2. Case definition of dengue

According to the IDSP manual, dengue is defined as an acute febrile illness of 2−7-day duration with two or more of the following symptoms: head ache, retro-orbital pain, myalgia, arthralgia, rash, hemorrhagic manifestations, and leucopenia.

2.3. Passive surveillance

Passive surveillance is an institutional surveillance using which information about the spectrum of diseases can be obtained. For the present study, passive surveillance was used to collect daily information on fever from the outpatients of the PHCs and inpatients of government hospitals, private nursing homes, and sentinel surveillance hospitals (tertiary care hospitals such as medical college hospitals) in the district. Based on this information, the entomological surveillance was prioritized.

2.4. Entomological surveillance

Entomological surveillance was used for the anti-larval (AL) and antiadult measures. The AL work was performed by skilled field workers and trained volunteers by identifying immature stages of *Aedes* spp. in common mosquito habitats near the premises of human dwellings such as tires, coconut shells, cement cisterns, overhead tanks. These sources were removed with all possible efforts and in cases where removal was not possible larvicide [50% temephos (Abate) emulsified concentration at the dosage of 1 ppm] was used to kill the mosquito larvae.

To manage manpower, the AL work was performed in a village by dividing it into six-day blocks from Monday to Saturday. All dwellings of each block were thoroughly checked by workers on the specified day. One worker was allotted for every 60 houses, so that