INTRODUCTION

Dengue fever occurs worldwide, in nearly all tropical and subtropical countries (1). The global incidence of dengue fever (DF) and dengue haemorrhagic fever (DHF) has increased dramatically in recent decades (1,2). More than half the world's population are threatened with widespread infection because of migration and industrialization (3). It has emerged as an important public health problem due to its potential to cause large scale outbreaks(3,4).

Dengue virus was first isolated in India in 1945 (4). It has now reached endemic proportion in few districts ( 5). Outbreaks have been reported at regular intervals from different parts of India (5-12). The risk of dengue has shown an increase in recent years due to rapid urbanization, life style changes and deficient water management. Dengue is a self limiting disease characterized by fever, headache, muscle, joint pains, rash, nausea and vomiting(6). The initial symptoms of dengue mimic the clinical symptoms of malaria, typhoid and leptospirosis(7). Therefore a differential diagnosis of infection at an early stage helps in patient care which is the essential component of management of dengue virus infection in the absence of suitable therapeutic and prophylactic measures(8). Over the last two decades there is a resurgence of dengue haemorrhagic fever (DHF) and dengue shock syndrome (DSS) (10-13). All four virus types of dengue virus can cause epidemic (14).

In south India, dengue virus were first isolated from febrile patients in Vellore, Tamil Nadu between 1956 and 1966(15). During the same period dengue virus isolations were made in wild Aedes aegypti mosquitoes (16-20).
During the month of September 2012 an increase in the number of dengue cases was reported from a few districts of Tamil Nadu. In this regard a team was sent to Mellur Block of Madurai District to conduct fever surveillance and an outbreak investigation. Epidemiological and entomological studies were carried out during the investigation and the results are given in the present communication.

METHODS

Descriptive epidemiology

To confirm the outbreak, we reviewed the monthly surveillance data for the period between January 2009 and January 2012. Further, we ascertained information regarding any recent population migration or changes in the surveillance system and found to be none. There was unprecedented rainfall during the period of June-July and followed by period of monsoon failure. The water supply in the study area was erratic and low pressure. This made the people the supplied water in containers for longperiods facilitating the breeding of vectors and transmission.

We defined a case of Dengue fever (DF) according to the standard case definitions provided by the National Vector Borne Disease Control Programme (NVBDCP). We included all the confirmed Dengue fever cases from Melur Block, admitted to Govt. Rajaji Medical College Hospital, Madurai and District Health Centres between 25th Sept. and 25th Nov. 2012. The investigation team conducted active door-to-door fever survey in the affected localities and also stimulated passive surveillance in health facilities to identify new cases. We collected personal histories, including symptoms, from case-patients and established a line-listing. An epidemic curve was constructed to describe the development of the outbreak over time. We calculated the attack rate (AR) by age and gender, using population census available at the health centre as denominator. The cases were plotted on a map to understand the spatial distribution. To aid in generating hypotheses, we gathered information from case-patients, health workers, and local leaders, using an unstructured trawling questionnaire to determine the possible source of exposure and about the possible sources of the outbreak.

Laboratory procedure

For the identification of serotype, virus isolation followed by indirect fluorescent antibody assay (IFA) was done. Acute phase serum samples within six days of infection were collected from 55 suspected patients. Samples were transported to the virology laboratory under cold chain. Dengue specific IgM antibodies were detected by NS1-ELISA.

Environmental Survey

Information on source, frequency of water supply, water collection, storage practices (details of containers, type) and number of waste containers with and without larvae was carried out.

Entomology Survey & Larval survey

Entomological surveys were also carried out in areas of the district from where confirmed cases of dengue fever were reported. These surveys resulted in the calculation of Aedes larval breeding indices such as house index (HI), container index (CI) and breetau index (BI). Larval survey was carried out in the study area. Identification of species of emerging mosquitoes done by a team of entomologist from Centre for Research in Medical Entomology (CRME) team along with the District Entomology unit from the department of public health and cross verification done at NIE Malaria reference laboratory.

Virus isolation was carried out in the C6/36 clone of Aedes albopictus cell lines as described earlier. IFA was performed using specific monoclonal antibodies to dengue virus types 1-4 (provided by Dr. D.J. Gubler, then at CDC, Atlanta, during the 1996 outbreak). 

Descriptive epidemiology

We collected information on various potential exposures, using standardized, closed-ended questionnaire. For all the exposures, we used a reference period of three days preceding the illness. Calculation of attack rate for blocks, age & gender specific attack rates and case fatality ratio

Confidentiality

We protected the confidentiality of participants through the use of codes. However, review of ethical committee did not apply as this was a public-health emergency response to an outbreak and was covered by normal practice.

RESULTS

On the basis of surveillance data for the previous year, available with the primary health facilities and the health office of the district, we confirmed that the an unusual increase in the incidence of fever cases for September 2012 in the affected localities and the entire district Fig 1. Further, we identified that there was neither any influx of population nor any changes in the surveillance system in any of these localities during that period. Hence, the increase in number of cases was considered an outbreak.

We identified 260 case-patients of Dengue among the 127492 residents [Attack rate 1.5%], there were seven deaths reported [case fatality 2.8%]. The attack rate was...
higher among females and in the age-group of 50 years and above (Table 1). We also identified 2330 suspected fever cases among 127492 residents [Attack Rate 18%] The attack rate for these fever cases was higher among females and in the age-group of 6-14 years and. Nearly 70% of the case-patients had fever and headache. The cases began appearing during the first week of September 2012, followed by a rapid increase to peak on 1 week of October and, thereafter, declined from 24 October with the (Figure 1). Cases were spread out in a wide area in five affected blocks Therukuthur ,Vellalapatti , Vellalore Keelavalavoo ,Thiruvathavoor (Figure 2) .There were some clustering of cases around six major streets of Therukuthur area on either side of Melur High Road (Figure 3).

**Laboratory Investigation**

A total of 600 hospitalised cases of clinically sus-
expected dengue fever were identified for the period of 1st September to 7th November 2012. Department of Microbiology, tested & reported positive for 260/600 (16%) serum samples of suspected Dengue patients from Melur block, Madurai district) with NS1 antigen capture ELISA. Out of the above 96 cases were positive by rapid card kits and later on confirmed by NS1 antigen capture ELISA.

Larval Investigation

Larval indices for PHC area of Therkutheru, Vellalapatti, Vellalore Keelavalavoo, Thiruvathavoor were found to have high larval indices with co-related increase in area wise attack rates. The correlation coefficient of cases of dengue is 0.67 with House Index, 0.65 with container index and was 0.68 with Breatheau index (Table 3) (Figure3).

Entomology Survey

The vector in causation of this outbreak is Aedes Aegypti mosquito identified and the Viruses identified: Dengue virus type 2 and 3

DISCUSSION

Dengue affects humans of all age-groups. Usually maximum number of cases was in the 5-20 year group. (21-23) Where dengue is endemic, only a few individuals exhibit severe disease (11,14,18). But even mild dengue infection is important since studies suggest that sequential infection with different serotypes of dengue virus may increase the risk of Dengue Hemorrhagic Fever and Dengue Shock Syndrome (17,18). In our study, maximum dengue cases were from adults more than 50 years of age though the fever survey showed paediatric and adolescent age group. The shift from paediatric/adolescent population to adults getting affected reflects the presence of non-immune adult population falling prey to the circulating serotype of dengue virus.

The role of environmental factors in infectious diseases is well-known. Most dengue outbreaks in India have been reported to occur during the post monsoon period (23-25). The present outbreak occurred during September to November 2012, immediately after an unusually heavy rainy season during which favourable conditions. The epidemics are reported to occur, during temperature (25-35°C) and humidity (60-70%) for breeding which favor abundant mosquito growth and shorten the extrinsic incubation period as well. High mosquito density with high larval indices of the main vector Aedes were noted before and during the outbreak (26).
portion of serologically positive cases was recorded after unprecedented rains period, which is in agreement with previous studies.(25,26).

Immediate control measure were taken to control the epidemic was done by the Inter-sectoral coordination committee to mobilize resources from non-health sectors, namely Urban Development, Ministry of Education, Water Supply Department and Waste Disposal Department. Daily indoor and outdoor fogging was undertaken early morning and late evening. Malathion was used for outdoor fogging and Pyrethrum extract 2 percent was used for indoor fogging. Cleaning of all overhead tanks, desilting and cleaning of all open drains. Removal of garbage’s and discarded tyres was done by the Village sanitary department. Water storage containers were covered with cloth to prevent mosquito breeding. Heath education sessions stressing the importance on Personal protective measures and general sanitation were conducted by health inspectors for the residents of the effected area. Micro plan for weekly antilarval activity in outbreak areas were carried out. Intensive IEC Activities were carried out in the form of Pamphlets, sticking posters at household’s radio and television news in the effected areas. Vaccines or antiviral drugs are not available for dengue viruses; the only effective way to prevent epidemic dengue fever/dengue haemorrhagic fever (DF/DHF) is to control the mosquito vector, Aedes aegypti and prevent its bite. Activities like source reduction measures for mosquito breeding sites, fogging, and residual spraying should be enhanced to prevent dengue transmission. These should be taken up routinely not only during epidemics or under pressure. Anti larval measures and source reduction are the main strategy to reduce adult mosquito load and transmission. This activity should be undertaken in all seasons as the mosquito breeds in clean water stored in containers and non degradable sources. Increasing community awareness will surely result in increased responsibility by the individual and community participation. Improved surveillance both passive and active surveillance for early detection of suspected dengue cases and confirmation for effective action and control measures to prevent transmission. Enhanced activity in this regard will help to identify the outbreak at the beginning and contain the epidemic effectively.

REFERENCE
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CONFLICT OF INTEREST:

Authors report no conflicts of interest.