

Epidemiological investigation and containment measures of a dengue fever outbreak in an institutional set up in South India

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Abstract

Background: Dengue viruses of the family flaviviridae are the most common cause of arboviral disease in the world. During September–October 2012, there was a sudden spurt in the number of dengue fever cases in a training facility of security forces located in Ranga Reddy district of Andhra Pradesh, India.

Objective: To describe the distribution and determinants of the sudden surge of dengue fever cases and undertake measures to prevent further spread.

Materials and Methods: The clinical features; distribution of dengue fever cases in terms of time, place, and person; prevailing ecological conditions; entomological survey findings; and results of the biological specimens collected from the cases were studied.

Result: There were a total of 46 dengue fever cases, all male subjects, undergoing training, except one person who was a permanent staff. All of them provided history of fever of acute onset and associated with a varying combination of headache, retro-orbital pain, myalgia, arthralgia, rash, and hemorrhagic manifestations. Serological investigation revealed 26 (56.52%) and 11 (23.91%) cases positive for NS1 antigen and IgM, respectively, while nine (19.57%) cases were positive for both NS1 antigen and IgM. Leukopenia was observed among 39 (84.78%) cases. No fatality was reported. Intermittent rains coupled with favorable ambient temperature and humidity conditions and availability of breeding places helped in maintaining vector population.

Conclusion: Favorable climatological conditions, availability of hidden breeding sites of *Aedes* mosquitoes, and congregation of susceptible persons in large numbers at one place over a number of days led to the sudden surge in the number of dengue fever cases.

KEY WORDS: Dengue fever, NS1 antigen, IgM, *Aedes* mosquito

Introduction

Dengue fever is the most common and widespread arboviral infection in the world today. It is an increasingly prevalent tropical arbovirus infection with significant morbidity

and mortality.^[1] In recent years, the disease has changed its course manifesting in the severe form as DHF and with increasing frequency of outbreaks.^[2] Dengue fever and DHF are evolving chief public health issues in India and are reported from over 19 states.^[3,4] In southern India, the disease has been reported in Tamil Nadu,^[5] Karnataka,^[6] Andhra Pradesh,^[7] and Kerala.^[8] *Aedes aegypti* (Diptera: Culicidae) is the principal vector of dengue fever and is widely prevalent in India.^[9] *A. aegypti* is the commonest vector of dengue fever in India, followed by *Aedes albopictus*. Larval indices show that *A. aegypti* is well established in peri-urban areas and is beginning to displace *A. albopictus*.^[10,11]

An outbreak of dengue fever among the inmates of a training academy of security forces located in Ranga Reddy (RR)

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district of Andhra Pradesh (now Telangana), South India, occurred between 26 September 2012 and October 12, 2012. The author being in charge of the health matters of the forces investigated the outbreak. The investigation was undertaken with the objective of identifying the cause of the outbreak, adopting quick control measures, and recommending remedial measures so as to prevent similar outbreaks in future.

Materials and Methods

Background Information

The training academy of security forces is located in RR district of Andhra Pradesh (now Telangana), South India. The terrain is undulated, and the area receives rainfall owing to the southwest monsoon between mid-July and October. The usual pattern of rainfall is intermittent, mild to moderate, with occasional heavy spells. Stagnation of runoff water after rains in small to large pools owing to uneven terrain is common, favoring breeding of mosquitoes. The academy is spread over a huge area covering several hundreds of acres in which various administrative units (also called battalions) are well dispersed. The young trainees belonging to any particular battalion are housed and trained for a specified discipline separately, and they do not generally intermingle with the trainees or training staff of other battalions. The entire academy is fenced, and the accommodations are located far off from the areas inhabited by the general population. However, at places, habitations of general population are located close by (100–200 m). The trainees of different disciplines undergo indoor and outdoor training at different training areas, depending upon their respective trade and stage of training. However, there are certain places where training is imparted on common topics or skills to trainees of diverse trades. The entire training academy had own Medical Officers and paramedical personnel. The security forces hospital was within 4 km from the affected battalion where all cases of dengue fever were admitted and treated.

There was intermittent mild to moderate showers during the months of August and September in 2012. Cases of dengue were on the rise in the state and in the nearby city as reported by the media. Sporadic cases of dengue were also being reported among the security forces personnel, but the incidence was not higher when compared with the incidence of previous years, and there was no clustering of cases in terms of time, place, or persons before this outbreak. During the period of the outbreak, there was a daily average strength of 1,370 trainees and 230 regular staff in the battalion.

Case Definitions

The Case definition used for dengue cases was: any acute onset fever of 2–7 days duration with, two or more of the following: (i) headache; (ii) retro-orbital pain; (iii) myalgia; (iv) arthralgia; (v) rash; and (vi) hemorrhagic manifestations with two or more of the following: (a) Testing positive for NS1 antigen; (b) positive IgM antibody test for dengue;

(c) epidemiologically linked with a confirmed case of dengue fever; and (d) leukopenia.

Data Collection

All dengue cases occurring between September 26, 2012 and 12 October 12, 2012 as per the above mentioned case definition were admitted to the nearest security forces hospital, and line listing of all cases was done. All such cases were also investigated to exclude any other causes of fever. The history, clinical findings, and laboratory results were entered in an epidemiological case sheet.

Environmental data (viz. maximum and minimum temperature and relative humidity) were recorded for this period. A “container survey” as per the guidelines of National Vector Borne Disease Control Program of India^[12] was conducted in all accommodations, and a record of the same was prepared.

Management of Cases

The cases were managed symptomatically, and four cases with very low platelet count were transfused with platelet concentrate.

Result

There was a sudden explosive outbreak of dengue fever reported from a particular battalion, wherein a total of 46 dengue fever cases were admitted to the security forces Hospital between 26 September 2012 and October 12, 2012 (17 days) affecting trainees undergoing different trade training. All of these dengue fever cases were trainees, except only one permanent staff from the same battalion. The details of day and date-wise incidence of dengue cases are given in Figure 1.

Clinical Features

The affected individuals provided history of fever of acute onset of 2–7 days duration associated with a varying combination of headache; retro-orbital pain; myalgia; arthralgia; rash; and hemorrhagic manifestations. All cases were treated symptomatically, and four (8.7%) of them required platelet transfusion. No mortality was reported.

Laboratory Findings

While 26 (56.52%) cases tested positive for NS1 antigen, 11 (23.91%) cases were positive for Ig M and nine (19.57%) were positive for both NS1 antigen and Ig M. Leukopenia was observed among 39 (84.78%) cases.

Descriptive Epidemiology

Of the 46 cases, 45 (97.8%) of them were trainees of various trade groups but belonging to a particular battalion. They were aged between 18 and 20 years. Only one (2.2%) regular staff, aged 36 years, was affected with dengue fever who was also from the same battalion. All affected persons were essentially male subjects as the training academy trains

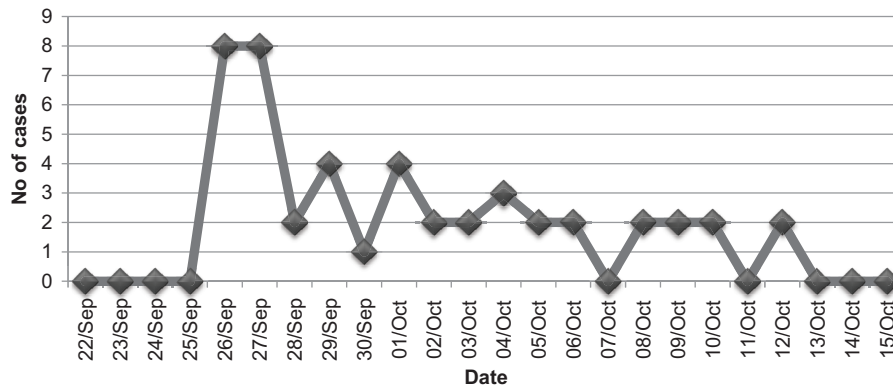


Figure 1: Day and date-wise distribution of dengue fever cases during the outbreak.

male trainees only through male instructional staff. A total of 16 cases (34.78%) developed the condition within the first 2 days, and the majority (29 cases, 63.04%) occurred within the first week [Figure 1].

Ecological Factors

There was intermittent mild to moderate rainfall during the months of August and September of 2012. Average maximum and minimum temperature during the month of September 2012 were 31.2°C and 27.4°C, respectively. For the first 15 days of the month of October 2012, the same parameters were 31.4°C and 27.1°C, respectively. While the average humidity during September 2012 was 69.4%, it was 66.5% during the first half of October 2012.

Prevention and Control Measures

A robust control measure was launched to prevent further spread within the first 3 days of onset of this outbreak. All the individuals in the battalion were asked to put on full sleeve shirts, socks, and covered footwear during the wakeful hours and to apply mosquito repellent cream every 3 hours. They were also strictly instructed to sleep under mosquito net only.

Antilarval measures were undertaken by using Temephos 50% EC (25 ml and 500 linear meters respectively), and thermal fogging with portable fog generator was carried out using malathion 95% solution (diluted with kerosene oil at 1:19 ratio) for three consecutive days. In addition, Pyrethrum 0.1% solution was used as space spray in all accommodations, and these activities were repeated. Health education sessions were arranged for all staff. Administrative authorities were made aware about the disease and ways and means of preventing the same.

Discussion

There was a sudden spurt in the incidence of dengue fever cases in the affected battalion. The attack rate among the trainees in the said battalion was 54.74 cases per

1,000 person-months, which was far above the highest attack rate recorded in the last 3 years (0.85 cases per 1,000 person-months). Clinical features, laboratory investigation reports, and ecological parameters were all corroborative of dengue fever. Hence, existence of a dengue fever outbreak was established.

Despite a detailed search, in and around the affected battalion keeping the flight range and bionomics of aedes mosquitoes in mind, no mosquito breeding site especially favorable for breeding of Aedes mosquitoes could be found. A thorough analysis of history from the patients revealed that all of the affected trainees had attended some practical classes in a common workshop shed. On paying a visit to the aforementioned shed, it was found to be a high-roof, permanent building with steel-sheet roof and concrete floor. However, there were underground drains covered with fenestrated iron sheets for carrying runoff water, coming down through vertical pipes from the roof top. Further search revealed stagnation of rain water in small puddles within these drains, and breeding of Aedes mosquitoes were found in some of them. Presence of some big furniture and unused machinery could have provided ideal hiding as well as resting places for adult aedes mosquitoes.

Institutional outbreaks of dengue fever have been reported by some authors.^[13,14] Dengue viruses are transmitted by infected Aedes mosquitoes during feeding, which can occur several times in a day causing intense transmission of the disease.^[15] It was revealed during investigation that all the individuals who were diagnosed with dengue fever had attended classes in the identified workshop shed within the longest incubation period of dengue fever. Clustering of the cases in terms of time, place, and person and evidence of breeding of Aedes mosquitoes within the said workshop shed suggested that this was the most probable place of man-vector-pathogen contact leading to transmission of dengue fever within a closed group of individuals linked epidemiologically.

This study had certain limitations. No adult Aedes mosquito was found in the location, because fogging operation were initiated before investigations began. This was a missing link.

Blood specimens from the patients were also not subjected to serotyping of dengue viruses, owing to certain constraints, which could have further refined the investigational findings.

Conclusion

This outbreak has shown that dengue fever can present as a sudden explosive outbreak under appropriate epidemiological setting, especially at an institutional set up. Breeding places of *Aedes* mosquitoes can be missed unless looked for in a systematic way. Because dengue fever is known to exhibit severe complications, sometimes culminating in fatalities, all such outbreaks should be prevented and promptly controlled.

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