Abstract

Introduction: Cases of acute diarrheal disease admitted in a tertiary hospital in South India, during the post cyclone phase were confirmed as cases of cholera. An investigation was carried out in Mudaliarpet, Puducherry in January 2012, by a team of epidemiologists to conduct a rapid situation assessment of the outbreak and provide guidance for prevention and control measures. Methods: Spot map of the affected area was made. Rapid house to house survey was done using the epidemiological case sheet and cases of acute diarrheal disease were line listed. Results: Rapid survey of 968 households in the affected area was conducted covering a population of 4643. It was found that there were 566 cases of diarrhoea in the affected area with attack rate of 12.2%. The findings of the investigation and the response measures undertaken are summarized here, in addition to prevention and control measures to be considered by public health professionals. Conclusions: Provision of safe drinking water, improving sanitation and strengthening of disease surveillance is necessary for control of cholera and other diarrhoeal diseases post cyclones and other disaster situations.

Keywords: Acute diarrheal disease, outbreak investigation, post disaster, surveillance

Introduction:

The potential impact of communicable diseases is often presumed to be very high in the chaos that follows natural disasters. Infectious diseases epidemics or outbreaks may occur several days, weeks or months in the post-impact or recovery phases after major disasters strike. Increases in endemic diseases and the risk of outbreaks, however, are dependent upon many factors that must be systematically evaluated with a comprehensive risk assessment.1 There are clear research needs to improve understanding of the health risks in different settings and of the social and cultural modifiers of those risks. The public health after-effects of tropical cyclones (hurricanes and typhoons) disasters and tornadoes, especially infectious diseases outbreaks, have been less documented compared with flood disasters.2

Cyclone Thane made landfall on 30 December 2011, on the north Tamil Nadu coast, between Cuddalore and Puducherry. The cyclone Thane left at least 47 dead in Tamilnadu and Puducherry. Coastal district of Tamilnadu and Puducherry were worst affected by Thane. The storm damaged houses, communication infrastructure, agricultural land and fishing equipments.3 Following Thane, an increasing number of diarrhoea cases were reported from certain areas in Puducherry. A team of...
epidemiologists from a tertiary care hospital in Pondicherry were mobilized to conduct a rapid situation assessment of the outbreak and provide guidance for prevention and control measures. We report here the findings of the epidemiological investigation of a localized outbreak of acute diarrheal disease caused by V. cholera, which occurred amongst the residents of an urban area in Puducherry, following cyclone ‘Thane’ during January 2012.

Materials and methods:

Outbreak recognition

Fourteen patients presented to the Emergency services department of JIPMER, a tertiary care hospital in Pondicherry between 6th to 9th of January, with complaints of vomiting and diarrhea and severe dehydration, of whom five people belonged to the same area of Mudaliarpet in Puducherry. They were admitted as cases of Acute Gastroenteritis with severe dehydration and were managed as per standard protocol. Stool culture was positive for Vibrio cholera in five patients. Three of these patients were from Mudaliarpet area, with history of similar symptoms being reported in the family and neighborhood. On behalf of the Integrated Disease Surveillance Project (IDSP) of JIPMER a team was mobilized to investigate the cause of outbreak. An investigation of the outbreak was planned in coordination with government health services. The objectives of the investigation was to quantify the magnitude of outbreak, to describe the time-place distribution and persons affected, identify the source and cause of outbreak, and formulate practical recommendations for prevention and control.

Outbreak investigation

The investigation team consisted of epidemiologists, trainees in public health and sanitary inspector. Case definition for acute diarrheal disease was described as ‘acute watery diarrhea with or without vomiting in the last one week’. Forms were developed for rapid household survey and linelisting of cases of acute gastroenteritis. Spot map of the affected area was prepared by the investigators, health workers and volunteers to mark the extent of area affected by diarrheal cases. Rapid house to house survey was done using the epidemiological case sheet and cases of acute diarrheal disease were linelisted. Information on source of water, health facilities availed and treatment history was collected. Community members were also mobilized in the process, through support of local community leaders. Rapid sanitary survey of the affected area was undertaken.

Results of the epidemiological investigation:

Mudaliarpet covers a total population of 56,000 with 13,400 households and referral centre being General hospital, Puducherry. Most cases of diarrheal disease were reported from area adjoining Rodiar Mill Street in Mudaliarpet. A total of 968 households were surveyed in the affected area. Out of 4643 individuals enumerated, 566 cases of Acute diarrheal disease (ADD) were linelisted, giving an attack rate of 12.2%.

Fig. 1. Distribution of cases of Acute Diarrheal Diseases in Mudaliarpet by time of onset

Fig. 1 shows the distribution of diarrhoea cases in the locality throughout the surveillance period. The index case that presented to the
health facility and confirmed as a case of cholera was on 6th January 2012. An epidemic curve was plotted, and it was observed that there was a rise in ADD cases starting from the fourth day of the outbreak, peaking around seventh day. Reported ADD cases reached a plateau around the tenth day. The area wise attack rates are given in figure 2. The attack rates of ADD ranged from 20% in Pattamal Nagar first and second cross streets. Makali Amman Koil Street and Swaminathanpillai street had attack rates of 14% each.

Table 1: Age gender distribution of cases of Acute Diarrheal diseases in Rodiar Mill street area of Mudaliarpet, Pondicherry

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Male</th>
<th>Female</th>
<th>Total (n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤5</td>
<td>31</td>
<td>30</td>
<td>61</td>
<td>10.8</td>
</tr>
<tr>
<td>6-10</td>
<td>31</td>
<td>24</td>
<td>55</td>
<td>9.7</td>
</tr>
<tr>
<td>11 to 20</td>
<td>56</td>
<td>51</td>
<td>107</td>
<td>18.9</td>
</tr>
<tr>
<td>21 - 30</td>
<td>38</td>
<td>65</td>
<td>103</td>
<td>18.2</td>
</tr>
<tr>
<td>31 - 40</td>
<td>36</td>
<td>47</td>
<td>83</td>
<td>14.6</td>
</tr>
<tr>
<td>41 - 50</td>
<td>26</td>
<td>41</td>
<td>67</td>
<td>11.8</td>
</tr>
<tr>
<td>51 - 60</td>
<td>22</td>
<td>38</td>
<td>60</td>
<td>10.6</td>
</tr>
<tr>
<td>&gt;60</td>
<td>11</td>
<td>19</td>
<td>30</td>
<td>5.4</td>
</tr>
<tr>
<td>Total</td>
<td>251</td>
<td>315</td>
<td>566</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 1 shows the proportion of affected people in different age groups in the affected area. Out of a total of 566 cases around 10.8% belonged to the under-five age group. People in the age group of 11 to 30 years constituted around 37% of the total cases of ADD. Majority (51%) of ADD cases presented with diarrhea as the only symptom, while 36% of them presented with diarrhea and vomiting. Majority (90%) of the population used Municipality water as the source of water before the outbreak. Only 0.8% of the households used boiled water or water purifier. Following the outbreak almost all the households used water cans or used boiling method for purification of water. One third of ADD cases availed treatment at the health camp, while another third approached various private health care facilities. Almost two thirds of ADD cases received Oral rehydration, while 3% were admitted in various hospitals. Less than 5% of cases with ADD did not take any form of treatment.

Figure 2: Comparison of cases of Acute Diarrheal Disease enlisted during the survey and patients presenting to Mudaliarpet Primary Health Centre

Course of the outbreak

In order to determine the course of the outbreak, data on ADD cases from the Mudaliarpet PHC was considered as proxy to complete the epidemic curve (Fig. 2). The peak occurrence of ADD cases roughly corresponds in both the cases (data from the field survey and from ADD cases reported from PHC and camp site). The course of the ADD cases is in the downward trend since 12th January, the outbreak has almost reached the baseline occurrence by 15th January. Comparison with frequency of ADD cases during the same time period of last year for Mudaliarpet area (weekly 25 cases on an
average during January 2011) showed that the outbreak had reached the baseline. Surveillance for ADD in that area was continued for a few more weeks after the outbreak.

Sanitary survey

Water supply for the entire area is by two overhead tanks. Regular daily chlorination and monthly cleaning of the tank by Pump operator was being performed and supervised by health inspector. Water supply in this area was intermittent, twice a day through individual household pipes as well as street pipes. Construction of new water pipelines left them exposed in many places. Water stagnation was also seen following the rains. Old pipelines with blind ends were accessible to the households. Almost all the houses had household toilets. At the household level, water was boiled before consumption only in a few households. Majority of them used water from Municipality supply. Few houses in the affected area had water purifiers installed in their houses or used canned water for drinking water purposes.

On personal interviews the people described their water shortage problems in their areas post Thane cyclone. After the cyclone, there was disruption in electricity supply in these areas leading to water shortage. As no alternate arrangements were made of provision of water in the community, the people resorted to unauthorized water connections from old pipelines following interruption in water supply. However, after the outbreak of diarrheal disease was reported, purified water cans was supplied through Lorries, by organized community efforts.

Generation of hypothesis

This outbreak of ADD/ Cholera was probably due to mixing of sewage with drinking water supply caused by unauthorized water connections drawn by the people post “Thane cyclone”.

Discussion

Cholera outbreaks that occur worldwide are associated with certain facilitating factors. In many countries cholera transmission is primarily associated with poor sanitation. In sub-Saharan Africa, cholera outbreaks are often associated with flood events and faecal contamination of the water supplies. The marked seasonality of cholera outbreaks in the Amazon is associated with low river flow in the dry season, probably due to pathogen concentrations in pools. The effect of sea-surface temperatures in cholera transmission has been most studied in the Bay of Bengal. Here, we describe an outbreak of cholera that occurred post cyclone in Pondicherry, South India.

Communication of results and Recommendations by the investigating team

This outbreak investigation in Pondicherry showed a high attack rate of ADD in the community as compared to that which was being reported to the health system. Further the factors that probably led to this situation have also been highlighted by this study. The investigating team put forth a set of recommendations to the state government, based upon the results of the investigation.

- Water and electricity are seen as intertwined. Electricity has to be restored at the earliest, so that water can be pumped to overhead tanks for supplying to people. Provision of protected water source to the community during and after disasters may avoid such outbreak situations in future. Unauthorized connections for water during periods of water scarcity need to be discouraged.
- At the community level, better awareness regarding the outbreak has to be ensured to improve care seeking behavior.
- Hygienic practices like purification of water at the household level (by boiling or filtration) and hand washing need to be promoted. Chlorine is widely available,
inexpensive, easily used and effective against nearly all waterborne pathogens.

- Repair of old water pipelines by the Public Works Department, training and supervision of the pump operator to ensure regular chlorination of drinking water source and regular checking of water from the tank and pipelines for bacteriological quality were other recommendations put forth.

- Communication of disaster preparedness plans to all health facilities in the region and mechanisms for surveillance for communicable diseases post disasters is vital.

- Public health issues like disease surveillance, Rapid Response Teams for outbreak management are essential in post-disaster situations. At the administrative level reporting of ADD cases at the PHCs and General Hospital need to be stressed so that Early Warning Signals of an outbreak can be picked up and early action can be initiated.

Control measures initiated by the State Health department

Following the outbreak, the Health department of the Government of Pondicherry initiated prompt control measures. The local PHC was put on high alert state with drugs and stocks to manage the outbreak. A medical team consisting of Medical Officer, Health Inspector & Staff Nurses, was mobilized to the affected site to set up a camp for five days. Adequate chlorination of the tanks in the region by the Pump operator was ensured. The Public Health Division of the Public Works Department was alerted and repair works on replacing and strengthening the pipeline was commenced. Bacteriological water analysis was conducted in the affected area after the control measures were initiated. It showed satisfactory quality of water tested at four sites from the affected areas. Information education and communication activities to create awareness among people regarding sanitation and hygienic practices (safe drinking water) were carried out by means of pamphlets and media.

Health problems post - cyclones could be due to defective functioning of available facilities i.e. Water supply, power supply and sanitation facilities, forcing the community to consume unsafe water and stay in unsanitary conditions, leading to water borne diseases. Power cuts related to disasters may disrupt water treatment and supply plants, thereby increasing the risk of water-borne diseases. Cyclone AILA hit Indian States on eastern coast on May 25, 2009. An investigation was conducted to examine if AILA was responsible for increased reporting of diarrhoea cases from the district of East-Medinipur in West Bengal. Post-AILA risk of diarrhoea in June, 2009 compared to June 2007 (baseline) was estimated to be 1.6 (95% CI 1.52 to 1.65) and 1.3 (95% CI 1.21 to 1.32) times higher in two sub-divisions.

With the scientific development of forecasting system advance forecasting of flood and heavy rains for precise area has become possible. Public Health measures can be planned well in advance, in the systematic and scientific manner based on forecast. There is much that can be done to reduce health and other impacts through public education, emergency service planning, and the implementation of early warning systems. Objectives of any disaster management plan would be immediate provision of essential medical care, epidemiological surveillance of selected epidemic prone communicable diseases to generate early warning signals of potential outbreaks, to undertake epidemiological investigation of potential outbreak, if any, and to take rapid appropriate action for the containment of impending outbreak.

The state of Gujarat in India has its action plan in place for floods, cyclones and heavy rains. Public health interventions to prevent disease outbreaks after disaster should focus on post disaster sanitation measures for safe water supply, food hygiene, proper sewage
systems/disposal of excreta, public health education. Strengthening epidemiological surveillance system for early detection of outbreak is vital. Protocols for identification of source of contamination of water and remedial measures, chlorination of water and case management of ADD should be communicated to medical officers, as part of disaster management and preparedness. Similar guidelines for control of epidemic-prone diseases in disaster settings need to be formulated as per the state’s feasibility and available resources. It is important to ensure an open flow of information from the beginning of the outbreak, to prevent the spread of misleading rumours. In this case, involvement of the media (radio, press, television) was optimal in providing the right type of information to people within and outside the affected area. A single spokesperson was the focal point for dealing with the media through regular press releases and conferences.

The local community must be encouraged to participate in activities for the prevention and control of outbreaks including taking appropriate action for storage of water at household level and personal hygiene. Engagement of the local stakeholders including district administration and key public health officials at every stage of investigation starting from planning through execution may play a pivotal role.

**Additional benefits of field epidemiology activities**

Apart from benefiting the community and the State Health department, this outbreak investigation was an exercise of academic interest as well. This field activity served as an opportunity for training public health specialists (postgraduates) in the field. It helped in planning and reviewing the steps of an outbreak investigation. It also enables understanding the principles of descriptive epidemiology in terms of time, place and person during an outbreak investigation. It helps in improving advocacy and communicating recommendations to the relevant target groups. This experience was again shared with the undergraduate students through Problem based learning in order to make them understand the principles of descriptive epidemiology, role of medical officer in outbreak investigation and the role of inter-sectoral coordination in health.

**Conclusion:**

Ensuring uninterrupted provision of safe drinking-water is one of the most important preventive measures to be implemented following a natural disaster. Improved detection and response to communicable diseases is important in order to monitor the incidence of diseases, to document their impact and to help to better quantify the risk of outbreaks following natural disasters.

**Acknowledgement:** We sincerely acknowledge the Director of Medical Services, Pondicherry, for his permission to conduct the investigation. We also wish to thank the Residents of the Dept. of PSM, JIPMER and Interns who helped in conducting the field work. We sincerely thank Mrs. Kritika for her help in compiling the data collected in the field.

**Conflict of Interest:** nil

**Source of funding:** nil

**References:**


