

Outbreak investigation of cholera outbreak in a slum area of urban Wardha, India: An interventional epidemiological study

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ABSTRACT

Introduction: Cholera, though a preventable and treatable disease, is still regarded as an important public health problem in developing countries including India. Migration, unhygienic living conditions, overcrowding, open field defecation, and ignorance about the spread of disease are the major reasons for the occurrence of cholera in the slum areas. Cholera was detected in the stool sample of a 3-year-old child from a slum area of urban Wardha, which demanded an urgent outbreak investigation to be carried out before it progressed into an epidemic. **Materials and Methods:** This was a cross-sectional epidemiological study, where we have used pretested, predesigned epidemiological case sheets obtained from IDSP. A case definition was proposed before beginning the investigation. Linelisting, collection of stool and water samples, immediate referral, and treatment of the patients suffering from loose stool and/or vomiting were performed. A detailed epidemiological report was made with recommendations and plan of action that was forwarded to the district health system. **Results:** In all, 28 suspected cases of cholera were line listed. Among the affected population, more than half of the suspected cases were from the age group of 0–10 years of age. Males were more affected when compared with females. The overall attack rate was 27% and case fatality rate was 0%. There was positive history of travel in the index case. Two of the water samples were found to be unsatisfactory for drinking. **Conclusion:** The investigation report was soon developed and shared with the district health authorities, and recommendations were given to prevent such outbreaks in future.

Keywords: Cholera, diarrhea, intervention epidemiology, outbreak investigation

Introduction

Cholera is an acute diarrheal disease caused by ingestion of food and water contaminated with the bacterium *Vibrio cholerae*. Access to safe water and sanitation has eliminated cholera transmission in high-income countries. However, cholera continues to be a major public health problem in many developing countries including India.^[1] Cholera occurs in sporadic, endemic, epidemic, and pandemic forms.^[2] It is estimated that every year, there are roughly 1.3–4.0 million cases and 21,000–143,000 deaths worldwide due

to cholera. According to the World Health Organization (WHO), during 2016, 132,121 cases were reported from 38 countries, including 2420 deaths. But there is a discrepancy between these figures and the estimated burden of the disease. Only 5%–10% of the cholera cases occurring annually are being officially reported. That is because of the limited capacity of epidemiological surveillance and laboratories, as well as social, political, and economic disincentives for reporting.^[3]

The bacterium secretes cholera toxin that binds to the enterocytes in the host leading to extensive loss of water and electrolytes in profuse diarrhea. Most of those infected will have no or mild

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symptoms and can be successfully treated with oral rehydration solution (ORS). If left untreated, patients with the severe form of the disease can become dehydrated and die in a matter of hours.^[4] They will need rapid treatment with intravenous fluids and antibiotics. Cholera can be diagnosed by examining stool samples or rectal swabs. But in most of the outbreak situations, because of the intense nature of the disease, we may not be able to wait. A diagnosis is often made by taking a patient history and clinical examination, with the treatment given before the laboratory confirmation of the diagnosis.^[5] In major part of the world, *V. cholerae* El Tor biotype is the main cause of the cholera cases, which causes mild and asymptomatic diarrhea.^[6] The classical type toxigenic strains of *V. cholerae*, which belong to the O1 and O139 serogroups, cause a devastating type of diarrhoea. *V. cholerae* O1 serogroup is the most common variant found in India. In India, epidemics of cholera are quite frequent, underrecognized problem, and often underreported. A population-based diarrhea surveillance in an endemic area of Kolkata, India, revealed a cholera incidence of as high as 2.2 cases per 1000 person-years.^[7]

In spite of being a predictable, preventable, and treatable disease, cholera outbreaks continue to spread across the country with a high number of mortalities even today. Similar was the incidence in a slum area of Wardha, where in mid-July there have been a number of cases reported to have loose stool, fever, and vomiting, which was acute in onset. One of the stool samples of a child from that slum tested positive for *V. cholerae*. An investigation team was formed immediately with cooperation from the district health system, and a through outbreak investigation was carried out with the sole objective of finding out more cases, source of infection of cholera, and to recommend necessary actions to control the outbreak.

Materials and Methods

A descriptive study was conducted in an area which lies in the urban area of Wardha block of Maharashtra.

The outbreak

In the mid-July, there have been cases of loose stool with/without vomiting and fever reported to get admitted in the district hospital as well as in the medical college, and one of them was reported to be positive for *V. cholerae*, diagnosed in the stool sample.

Study settings

The neighborhood consists of a slum area which is located within 3 km from the city. It comprised 35 households and had a population of about 180 individuals. We interviewed 22 households, covering a population of 104. The other houses were closed. The slum dwellers were mostly nomads by nature and hunting is their primary means of earning money. Apart from hunting, they also work as migratory laborers, working in other cities. They stay in small tents along with their livestock. Open field defecation is practiced in that slum area, which consists of two wells, which are regarded as the prime source of water for the slum dwellers.

Case definition used

According to World Health Organization (WHO), a case of cholera should be suspected when in an area where the disease is not known to be present, a patient age 5 years or more develops severe dehydration or dies from acute watery diarrhea; or, in an area where there is a cholera epidemic, a patient age 5 years or more develops acute watery diarrhea, with or without vomiting. A case of cholera is confirmed when *V. cholerae* O1 or O139 is isolated from any patient with diarrhea.^[8] We have used the same case definition for the sake of conducting this field investigation.

Investigation team

A team of 11 people including 2 faculty members, 2 postgraduate medical students, 2 interns, 2 auxiliary nurse midwives (ANMs), 2 social workers, and 1 sanitary inspector from the Department of Community Medicine visited the urban slum area on mid-May 2018. The team worked in collaboration with the ASHA, ANM, and the medical officer of the Primary Health Center (PHC), under whose jurisdiction the slum was located.

Activities carried out

The team visited each and every house for doing the linelisting. The linelisting was done using a pretested schedule containing information of demography, socioeconomic status, and environment. Physical examination was carried out with proper history taking of all the probable cases. Stool samples were collected from all the probable cases of diarrhea, and ORS packets were distributed with demonstration of how to use that. Treatment was started using antibiotics, and few of the patients were also referred to district hospital and medical colleges.

Sanitary survey

The sanitary inspector visited all the water sources that are being used for collecting drinking water. He examined the wells and took water samples under utmost aseptic condition. Both were dug wells. The diameter of one of the well was about 25 feet. The second well was also of similar dimension. The water in both of them was turbid with lots of suspended particulate matter. According to the slum dwellers and Accredited Social Health Activist (ASHA), the wells were never chlorinated. They were filled with water. Water samples were also collected from the pipe water, which was circulated in the neighboring residential area, and also from few of the households where the family members suffered from the same symptoms. Chlorine demand was also estimated in the field itself and chlorination of the wells was performed.

Few members of the team did a transect walk and tried to understand the environmental hygiene and sanitation of that area. The slum spread around an area of around 1 km². The surrounding area was barren and there is a railway track passing in the vicinity of the slum. In-depth interviews of the slum dwellers, the people residing outside the slums, and key informant interviews of the ASHA and Auxiliary Nurse Midwife (ANM) were also carried out to triangulate the data.

Spot map was made using GPRS, where all the houses of the cases were marked along with the sources of water. The samples of stool and water were sent to the Department of Microbiology in reverse cold chain for confirmation of the causative agent.

Health education using Information Education Communication (IEC) materials were used to create general awareness of sanitation and hygiene. Demonstration of hand washing was carried out in different occasions involving the children, adolescent, and the housewives. Demonstration of ORS was done by the ASHA under the supervision of the social workers. All the collected data were entered and analyzed using Microsoft Excel.

Results

Of a total of 104 cases, 28 suspected cases of cholera were listed. The age ranged from 3 to 65 years. Among the affected population, more than half of the suspected cases were from the age group of 0–10 years of age [Table 1]. Of 28 cases, 18 (64%) were male [Table 2]. The overall attack rate was 27%. The age-specific attack rate was highest (80%) in the age group of 0–10 years. The case fatality rate was 0.

The epidemic curve [Figure 1] depicts that the first case occurred on 12th July 2018 and gradually the curve took a peak on 17th July 2018, following which there was a gradual descent of the occurrence of new cases of loose stool.

Table 1: Age-wise distribution of slum dwellers and suspected cases with age specific attack -rates

| Age in years | Population | No. of suspected cases (Percentage) | Attack rate (%) |
|--------------|------------|--|-----------------|
| 0-10 | 20 | 16 (57) | 80 |
| 11-20 | 16 | 2 (7) | 12.5 |
| 21-30 | 16 | 3 (11) | 18.7 |
| 31-40 | 32 | 5 (17) | 15.6 |
| 41-50 | 13 | 1 (4) | 7.6 |
| 51 + | 7 | 1 (4) | 14.3 |
| Total | 104 | 28 | |

Table 2: Sex wise distribution of suspected cases

| Sex | No. of suspected cases | Percentage |
|--------|------------------------|------------|
| Male | 18 | 64% |
| Female | 10 | 36% |
| Total | 28 | |

Table 3: Microbiological and Ortho-Toluidine test results of collected drinking water samples

| Sample no. | Lab no. | Source of drinking water | OT test result | Report for <i>Vibrio cholerae</i> | Presumptive coliform count based on multiple tubes method |
|------------|---------|--------------------------|----------------|-----------------------------------|---|
| 1 | 16950 | House of patient 1 | Negative | Negative | Unsatisfactory |
| 2 | 16951 | Handpump 1 | Negative | Negative | Unsatisfactory |
| 3 | 16952 | House of patient 2 | Negative | Negative | Unsatisfactory |
| 4 | 16953 | Pipe water, | Negative | Negative | Satisfactory |
| 5 | 16954 | Handpump 2, | Negative | Negative | Unsatisfactory |

There was no history suggestive of food poisoning as there was not any large gathering within the past 1 week of occurrence of the symptoms. The majority of the slum dwellers practice open field defecation. There are two wells, the water of which was used for drinking purpose. Pipe water is also supplied in the area surrounding the slum, where there were few cases of loose stools, but cholera was not diagnosed in their stools. Pipe water is not established in the slum area.

The water sample [Table 3] of both the wells and those taken from the households were found to be negative for *V. cholerae* though the presumptive *Coliform* count based on multiple tubes method was found to be unsatisfactory. Ortho toluidine test was found to be negative for all the water samples collected.

Two stool samples were reported to be positive for *V. cholerae* O1 biotype El Tor serotype Ogawa. On in-depth enquiry, it was found that the one of the patients suffering from diagnosed cholera gave a history of travel within the past 1 week of onset of the symptoms.

In the spot map [Figure 2], the suspected households were marked along with the two wells that are the prime source of potable water in the slum area. The spot map shows clustering of cases around hand pump 1, that is, in the southern part of the area. The outbreak was managed in a coordinated fashion with the help of the PHC, district hospital, and the medical college.

Discussion

Cholera outbreaks are not a problem in the developed Western world, but it still remains a major cause of mortality in the developing countries. In the present outbreak investigation, bacteriological examination of the stool sample revealed *V. cholerae* O1 biotype El Tor serotype Ogawa as the causative

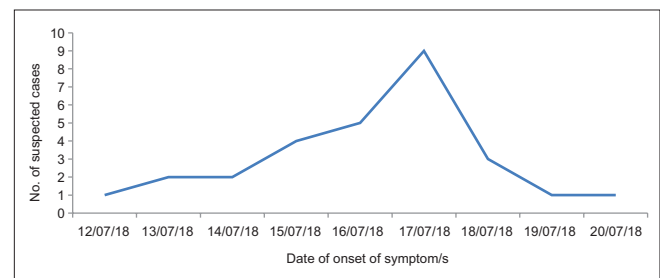


Figure 1: Epidemic curve

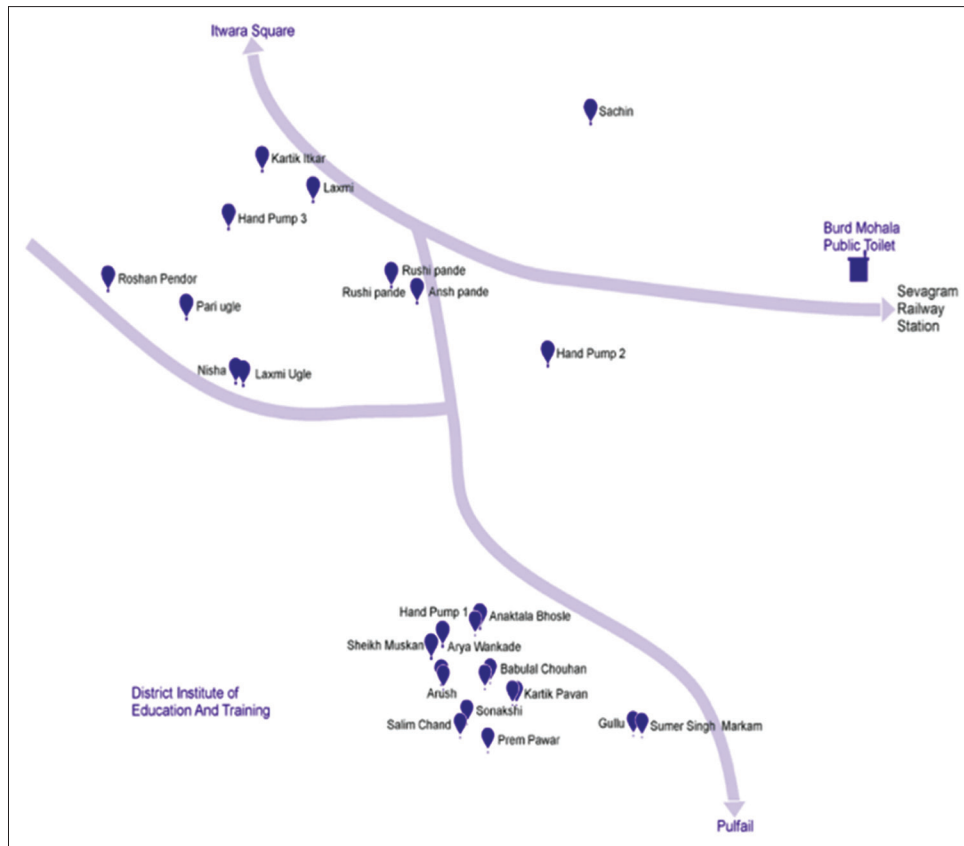


Figure 2: Spot map

organism. Many other outbreak investigations^[9-11] carried in different parts of India at different time intervals also reveal the same organism responsible for cholera.

Of 28 suspected cases, we found 57% of cases in 0–10 years of age, while a similar study done by Panda *et al.* also showed that the majorities of cases reported were under 18 years of age,^[12] and in another study by Mahanta *et al.* all cases ranged from 0 to 70 years.^[13] Male-to-female ratio in our study was 1.8:1, while in a study by Panda *et al.* it was 1:1.2^[12] and Masthi *et al.* showed a male-to-female ratio of 1:1.55.^[14]

We have also used Global Positioning System (GPS) for making spot map and marked houses of suspected cases. Similarly, Masthi *et al.* also used GPS for in their study for outbreak investigation of cholera and they also mentioned that it was very useful in follow-up of cases.^[14] We also followed up the cases again for recovery and any complications. We did not find any history of travel in the past 15 days in most of the suspected cases and a similar finding was seen in other studies too.^[14]

In our study, except one of them (of total 28 suspected cases), all of them attended hospitals or clinics and received full treatment. There was no mortality reported till the date of survey from the locality as a result of the symptoms mentioned. In a study conducted by Masthi *et al.*, 5 of 27 suspected cases did not receive any medications.^[14]

The sources of contaminated water were often reported as the sources of infection during outbreak of cholera in India.^[15,16] In our study, the presumptive *Coliform* count based on multiple tubes' method showed unsatisfactory count in four samples of water except in one of the samples, but *V. cholerae* was not found in any of the samples. Bhunia R *et al.* in their findings stated that of the 12 tap water specimens collected from the affected area, 8 were positive for fecal contamination with *Coliform*.^[17]

We proposed the following recommendations to prevent such outbreaks in near future:

1. Nagar Panchayat, Wardha, needs to be informed regarding the unsatisfactory nature of water drawn from the hand pump used for drinking purposes
2. Health awareness among the slum dwellers for maintaining hygienic conditions in their huts/tents
3. Practicing hand washing after defecation and before taking meals
4. Rigorous steps to be taken to avoid open field defecation
5. Sanitary latrines need to be constructed
6. Pipe water to be introduced in the slum area also
7. Regular chlorination of the water sources, especially during rainy seasons
8. IEC materials need to be distributed with hoardings in the slum area regarding practicing of hygienic conditions and keeping the environment clean.

Recently, Swachh Bharat Abhiyan was announced by the Prime Minister of India on the Independence day,^[18] and it was launched on 2nd October 2014 on Gandhiji's birth anniversary. The objectives of the mission include developing public awareness regarding drawbacks of open field defecation and promotion of latrine use in the villages. Four years since the launch of the mission, 86,700,446 household toilets are built, 504,316 villages, 513 districts, and 25 states are declared free from open field defecation. This mission has good future prospects to help reduce occurrences of diseases such as cholera in the communities and indirectly help in developing the nation.

Conclusion

An outbreak of cholera is an alarming sign of weaknesses of water and sanitation infrastructures, poor hygiene, and not healthy social practices and a weak public health system. Investigation of a cholera outbreak will help identify the cause of the outbreak, which in turn can help in recommending the control measures. Proper allocation of resources for timely detection through surveillance along with health awareness among the common masses can help in the prevention and preparedness against diseases such as cholera.^[19,20]

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Conflicts of interest

There are no conflicts of interest.

References

- World Health Organization. Weekly epidemiological record. 2015. Available from: <http://www.who.int/wer/2015/90/517-544No.40>. [Last cited on 2018 Sep 29].
- Ali M, Nelson AR, Lopez AL, Sack DA. Updated global burden of cholera in endemic countries. *PLoS Negl Trop Dis* [Internet]. 2015 [cited 2018 Sep 29];9:e0003832. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26043000>.
- WHO. Cholera Surveillance and Number of Cases. Geneva: WHO; 2014.
- Cholera: Clinical features, diagnosis, treatment, and prevention - UpToDate [Internet]. [cited 2018 Sep 30]. Available from: https://www.uptodate.com/contents/cholera-clinical-features-diagnosis-treatment-and-prevention?search=cholera&source=search_result&selectedTitle=1~86&usage_type=default&display_rank=1.
- Cholera | MSF India [Internet]. [cited 2018 Sep 30]. Available from: <https://www.msfindia.in/cholera>.
- Azman AS, Rudolph KE, Cummings DAT, Lessler J. The incubation period of cholera: A systematic review. *J Infect* [Internet]. 2013 May [cited 2018 Sep 29];66:432-8. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0163445312003477>.
- Sarkar BL, Kanungo S, Nair GB. How endemic is cholera in India? *Indian J Med Res* [Internet]. 2012 [cited 2018 Sep 30];135:246-8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22446869>.
- Assessing the Outbreak Response and Improving Preparedness; WHO, Global Task Force on Cholera Control. Cholera Outbreak: p. 3. Available from: http://www.who.int/cholera/publications/cholera_outbreak/en. [Last accessed on 2018 Aug 16].
- Bara D, Dhariwal AC, Jain DC, Sachdeva V, Vohra JG, Prakash RM, *et al.* *Vibrio cholerae* O1 outbreak in remote villages of Shimla district, Himachal Pradesh, 1994. *J Commun Dis* 1997;29:121-5.
- Khera AK, Jain DC, Datta KK. Profile of epidemic emergencies in India during 1991-1995. *J Commun Dis* 1996;28:129-38.
- Radhakutty G, Sircar BK, Mondal SK, Mukhopadhyay AK, Mitra RK, Basu A, *et al.* Investigation of the outbreak of cholera in Alleppey & Palghat districts, South India. *Indian J Med Res* 1997;106:455-7.
- Panda S, Pati KK, Bhattacharya MK, Koley H, Pahari S, Nair GB. Rapid situation & response assessment of diarrhoea outbreak in a coastal district following tropical cyclone AILA in India. *Indian J Med Res* 2011;133:395-400.
- Mahanta BN, Mahanta TG, Sinha R, Dutta A, Payeng D, Jawed Q. Investigation of a cholera outbreak in a tea garden of Sivasagar District of Assam. *Indian J Community Med Off Publ Indian Assoc Prev Soc Med* 2013;38:240-3.
- Masthi NRR, Madhusudan M, Puthussery YP. Global positioning system & Google Earth in the investigation of an outbreak of cholera in a village of Bengaluru Urban district, Karnataka. *Indian J Med Res* 2015;142:533-7.
- Gupta DN, Mondal SK, Sarkar BL, Mukherjee S, Bhattacharya SK. An el tor cholera outbreak amongst tribal population in Tripura. *J Commun Dis* 2004;36:271-6.
- Hammer S, Tripathi A, Mishra RK, Bouskill N, Broadaway SC, Pyle BH, *et al.* The role of water use patterns and sewage pollution in incidence of water-borne/enteric diseases along the Ganges river in Varanasi, India. *Int J Environ Health Res* 2006;16:113-32.
- Bhunia R, Ramakrishnan R, Hutin Y, Gupte MD. Cholera outbreak secondary to contaminated pipe water in an urban area, West Bengal, India, 2006. *Indian J Gastroenterol* 2009;28:62-4.
- Ministry of Drinking Water and Sanitation. Swachh Bharat Mission - Gramin. . Available from: <http://swachhbharatmission.gov.in/sbmcms/index.htm>. [Last cited on 2018 Oct 01].
- Kanungo S, Sah BK, Lopez AL, Sung JS, Paisley AM, Sur D, *et al.* Cholera in India: An analysis of reports, 1997-2006. *Bull World Health Organ* [Internet]. 2010 Mar [cited 2018 Sep 30];88:185-91. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20428385>.
- Ngwa MC, Liang S, Mbam LM, Mouhaman A, Teboh A, Brekmo K, *et al.* Cholera public health surveillance in the Republic of Cameroon - Opportunities and challenges. *Pan Afr Med J* 2016;24:222.