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An Outbreak of Cholera due to Contaminated Water, Medak District, Andhra Pradesh, India, 2013

Sir,

Cholera is a diarrheal disease caused by infection with the bacterium *Vibrio cholera*, either type O1 or O139.[1] About 20% of those who are infected with *V. cholera* develop acute, watery diarrhea and 10-20% of those infected develop severe diarrhea with vomiting.[2] As the incubation period is very short (2 h-5 days) the number of cases can rise quickly; thereby, resulting in disease outbreaks. Cholera continues to be an important public health problem in India where it is mainly transmitted in environments characterized by inadequate water supply and poor sanitation.[3] Cholera outbreaks were reported from West Bengal, Delhi, Orissa, Chandigarh, Tamil Nadu, Andhra Pradesh, and Andaman.[4]

On 23 August 2013, the District Medical and Health Officer of Medak district in Andhra Pradesh informed the state surveillance unit about a cluster of diarrheal disease with three deaths at Ranzole village (population = 6,556). We investigated this cluster to confirm the etiology, identify risk factors, and make recommendations for prevention. We defined a case of acute diarrhea as the occurrence of ≥3 loose watery stools in a day among residents of Ranzole between August 15 and September 12, 2013.

Trained community health workers conducted house to house case search to identify the case patients. Stool samples were collected from 10 case-patients meeting the case definition. Water specimens were collected from all water sources in the village and were sent for water quality testing. All the tube-wells in six localities of the village were enumerated and water samples were collected from all the 21 tube-wells for bacteriological examination. We hypothesized that the outbreak was associated with drinking water from unprotected tube-wells which were in the vicinity of open defecation sources. To test this hypothesis, we conducted a retrospective cohort study. Household members drinking water from such tube-wells were considered as exposed and the remaining villagers as unexposed.

We identified 218 case patients of acute diarrhea with an attack rate of 3.3%. Three case patients died (case fatality ratio: 1.4%). All the age groups were affected with higher attack rates among children aged 5-14 years (5.7%) and those aged 60 years and above (6%). Males had higher attack rates compared to female [Table 1].

The index case patient, aged 60 years was hospitalized for severe dehydration on 16 August 2013. Subsequently, the number of cases in the village increased and peaked on 23 August 2013. The number of cases declined following chlorination of water sources supply of alternate source of water and temporary closure of the unprotected tube-wells. The shape of the epidemic curve suggested a common source outbreak with continuous exposure [Figure 1]. The cases were clustered in four of the six localities (locality 1-4) of the village, with attack rates ranging between 2.5 and 9.6%. No cases were reported from locality 5 and 6 [Table 2]. One of the 10 stool specimens was culture positive for *V. cholera*, serogroup O1 El Tor, while the other nine did not grow any pathogen on thiosulfate-citrate-bile salts-sucrose (TCBS) agar. The water specimens collected from four

Table 1: Age group-specific attack rate of cholera in Ranzole, Medak, Andhra Pradesh, India, August 2013

Population groups	No. of cases	Population	Attack rate (per 100)
Age group (years)			
0-4	8	524	1.5
5-14	34	598	5.7
15-29	58	1,213	4.8
30-44	47	2,513	1.9
45-59	28	1,015	2.8
60-74	43	693	6.2
Sex			
Male	127	3,605	3.5
Female	91	2,951	3.1
Total	218	6,556	3.3

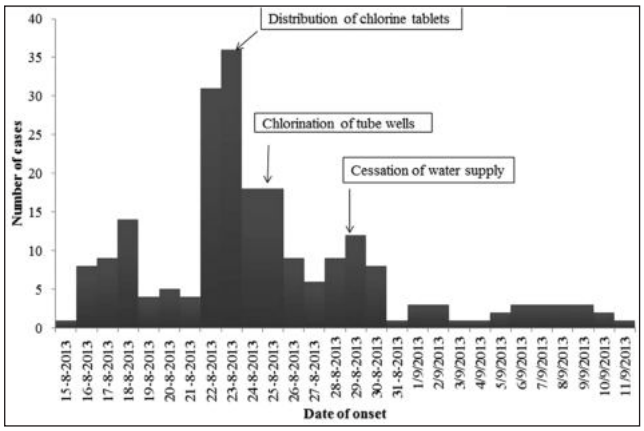

Figure 1: Cases of diarrhea by date of onset, Ranzole, Medak, Andhra Pradesh, India, August-September 2013

of the 21 tube-wells (numbers: 1, 5, 7, and 10) had high coliform counts.

The village had six localities, several open defecation places and a large pond where the waste and sewage was let in. There were 21 tube wells in the village, with a temporary storage facility next to each of the tube-well constructed using concrete. Water from the tube-wells was drawn out through electric pump. Villagers accessed water directly from the tube-well or from temporary storage facility. Four tube-wells (number 1, 5, 7, and 10) which supplied water to localities 1, 2, 3, and 4, respectively were unprotected with no concrete platform around them. These wells were in close proximity to open defecation sites [Figure 2]. Few days before the onset of outbreak, there was heavy rainfall which has led to flooding of sewage from the open defecation areas which were in close proximity to the tube-wells. Cases of acute diarrhea first occurred in locality 1 and in other three localities 2-3 days later.

As part of the retrospective cohort study, we interviewed 440 (90%) of 487 households from four localities in the village. The remaining houses were locked. The risk of developing illness was six to eight times higher among households drinking water from unprotected tube-wells (no. 1, 5, and 7) as compared to other wells [Table 3]. Drinking water from well 10 was not associated with any increased risk. The attributable risk percentage associated with use of drinking water from these three tube-wells was 79.8 (73.6-84.6). This exposure accounted for about 42% of the cases in the population [Table 3].

Table 2: Attack rate of cholera according to the source of water supply, in Ranzole, Medak, Andhra Pradesh, India, August 2013

Designated locality	Well supply in designated locality	No. of cases	Population	Attack rate per 100
Locality-1	1,2,3	87	835	9.6
Locality-2	4,5,6	62	750	6.5
Locality-3	7,8,9	32	577	4.5
Locality-4	10,11,14,15	37	1,473	2.5
Locality-5	16,17,18	0	800	0
Locality-6	19,20,21	0	900	0

Our investigations pointed to the contamination of tube-wells as the source of the outbreak, with more than 40% of the cases being attributed to this exposure. The number of new cases declined following the chlorination of tube-wells and cessation of water supply. Several factors supported our finding that the outbreak was due to fecal contamination of the tube-well water: First, the outbreak occurred in four localities, where the consumption of water from unprotected tube-wells was found to be a significant risk factor associated with the illness. Second, water samples from these wells were found to be fecally contaminated. Third, the shape of the epidemic curve suggested a common source, continuous exposure. Although we did not attempt to isolate *V. cholerae* from water, occurrence of cases following the flooding in the area and the findings of our investigation support our hypothesis that reservoir water was contaminated with *V.cholerae*.

The outbreak lasted for about 1 month. Immediately after reporting of cluster of cases, health workers distributed chlorine tablets to the villagers. Three days later, chlorination of all the tube-wells in the village was undertaken by the outbreak investigation team. The delay in chlorinating the tube-wells could be the reasons for continued transmission of infection for a relatively long period.

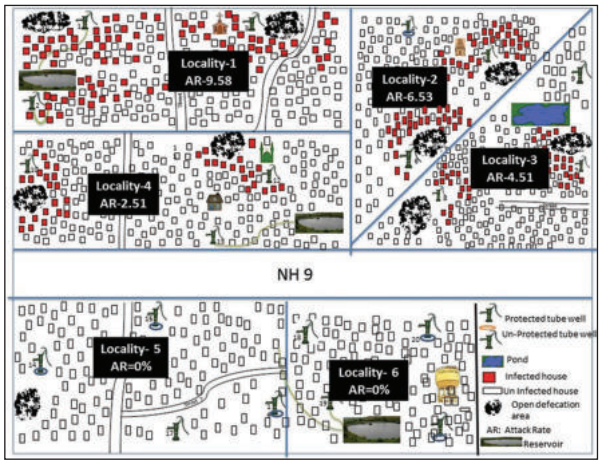

Figure 2: Attack rate of Cholera in different localities, Ranzole, Medak, Andhra Pradesh, India, August 2013

Table 3: Relative risk of cholera according to different sources of drinking water, Ranzole, Medak, Andhra Pradesh, India, August 2013

Exposure (source of drinking water)	Risk among exposed			Risk among unexposed			RR (95% CI)	Attributable risk percent in exposed (95% CI)	Population attributable risk percent (95% CI)
	#	N	%	#	N	%			
Well no. 1	39	79	49	48	756	6	7.8 (5.5-11.1)	87.1 (81.7-91.0)	39.1 (28.2-49.9)
Well no. 5	36	129	28	26	621	4	6.7 (4.2-10.6)	85.0 (76.1-90.6)	49.4 (35.1-63.7)
Well no.7	19	117	16	13	460	3	5.8 (2.9-11.3)	83.1 (66.7-91.4)	49.3 (28.6-70.1)
Well no. 10	22	706	3	15	767	2	1.6 (0.8-3.1)	—	—
Well nos. 1, 5, or 7	94	325	29	87	1,837	5	5.0 (3.8-6.5)	79.8 (73.6-84.6)	41.5 (32.9-50.0)

RR = Relative risk, CI = Confidence interval.

Our investigation had certain limitations. First, we collected information about most commonly used source of drinking water of the household and classified the households as exposed and unexposed based on this information. We did not collect information about the possibility of multiple sources of water supply. Second, only one stool sample was found positive for cholera in spite of the best efforts of sample collection and transportation. This low isolation could be due to prescription of antibiotics before sample collection. Third, drinking contaminated water from three tube-wells closer to defecation sites accounted for little over 40% of the diarrhea cases in the population. We were not able to identify other sources of transmission, such as person-to-person transmission, during this outbreak.

As an immediate control measure, all the water sources were chlorinated and alternate source of water was supplied. For preventing such outbreaks in the future, it is necessary to disinfect the tube-wells following flooding.

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RRA, PRU, GPT, and MVM conceived the study; RRA and CKU designed the study protocol; RRA, CKU, and NC analyzed and interpreted the data. RRA, CKU, and MVM drafted the manuscript; PRU, GP, and MVM critically revised the manuscript for intellectual content. All authors read and approved the final manuscript. RRA is the guarantor of the paper.

Ramesh R. Allam, Chengappa K. Uthappa, Chava Nalini, Prasada R. Udaragudi[1], Geetha P. Tadi[1], Manoj V. Murhekar[2]

SHARE India, Division of Health Research, [1]Directorate of Health, Hyderabad, Andhra Pradesh, [2]National Institute of Epidemiology, Chennai, Tamil Nadu, India
E-mail: mmurhekar@gmail.com

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