

Cholera Epidemics in Bangladesh:1985-1991

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ABSTRACT

In 1991, a major epidemic of diarrhoea broke out in Bangladesh. To estimate the extent of cholera during diarrhoea epidemics and to focus on the public health issues related to cholera in Bangladesh, we have used the government figures of the 1991 epidemic and data from our own experience of epidemic interventions in nearly 400 rural upazilas (sub-district) between 1985 and 1989 and in 1991. Our data showed that *V. cholerae* 01 was the most frequently (40%) isolated enteropathogen during the epidemics. The disease is widely distributed in the country. Only 24% of the total 1,648 laboratory confirmed cholera patients were below 5 years of age, and children below 2 years of age accounted for only 10% of the total. Access difficulty to medical care and absence of a reliable surveillance were thought to be the constraints to early detection and appropriate intervention, thus, there were more deaths during the epidemics. We have shown that a high proportion (59%) of cholera patients during their illness in the rural areas were not visited by the government surveillance staff and that most (80%) were treated at home. Access to treatment by qualified physicians was limited to 23% of the patients, whereas a large proportion of the patients were treated by the unqualified rural practitioners (68%), and the others (9%) had no access to any health care providers. Our experience also indicated a higher case fatality ratio (14%) prior to intervention by qualified physicians during epidemics and an overall fatality ratio of 4%, despite the significant reduction (<1%) achieved by the intervention. Cholera is highly epidemic in Bangladesh. The 1991 epidemic was estimated to have produced between 210,000 and 235,000 cases and over 8,000 deaths. Improved methods that are adaptable to Bangladesh are urgently needed to control the scourge of the disease.

Key words: Diarrhoea; Cholera; Epidemiology.

INTRODUCTION

In September 1991, an out-break of cholera that started in the north-western region spread to most of northern Bangladesh. The government epidemic surveillance, between September and November 1991, reported 214,856 cases of diarrhoea with 2,620 deaths. These numbers were comparable to the 271,364 cases and 2,924 deaths reported between January 1 and July 31, 1991 from seven Latin American countries, where for the first time in this century epidemics of cholera broke out (1,2).

Cholera continues to be a very important and common cause of potentially fatal dehydrating diarrhoea, particularly in adults. The disease has long been recognised for its ability to cause epidemics, specially in the endemic regions. Cholera is known to

be associated with poverty, poor sanitation, and many of the environmental factors that foster the transmission of the disease (3-5). Despite significant advances in the understanding of the disease and improved methods of treatment, there are countries, including Bangladesh, where many people die of cholera every year. In this study we have determined the magnitude of the epidemic disease and some of the related public health issues in rural Bangladesh. The findings may be useful in planning control strategies for cholera epidemics throughout the world.

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MATERIALS AND METHODS

In 1985, escalation of cholera epidemics prompted the Government of Bangladesh (GOB) and the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) to develop an Epidemic Control Preparedness Programme (ECP). The ECP, between 1985 and 1991, collaborated with the GOB health services in the investigation of and intervention in diarrhoeal epidemics in nearly 400 rural upazilas (subdistricts). In response to the call from the GOB health services for assistance in an epidemic outbreak, ECP physicians first visited the office of the public health administrator (Civil Surgeon) of the affected district and then the Upazila Health Complex* to collect the initial information relating to the outbreak from the government epidemic surveillance system. This was done to identify the affected upazila, unions (smallest administrative units), and villages that needed immediate attention. The government diarrhoea surveillance system at the upazila level uses village health assistants (HA) who visit assigned households once a month to collect morbidity and mortality data, including that of diarrhoeal diseases. This information is compiled and recorded at the Upazila Health Complex every week. The district public health administrator receives compiled weekly reports from all upazilas in the district. During an epidemic outbreak, the information on disease and deaths from diarrhoea is collected every day and the upazila Health Inspector (HI) confirms reported deaths from diarrhoea by home visits before registering them at the health complex.

In the villages, during the epidemic investigation, patients with acute watery diarrhoea were identified by the ECP physicians from households with the help of the village practitioners (6), community leaders, and health assistants. Rectal swabs were collected in Cary-Blair medium from a non-random sample of acute watery diarrhoea patients who had not received any antibiotic treatment. The ECP physicians were instructed to collect a rectal swab from every 3rd case of acute diarrhoea seen by them. However, this was not always strictly followed due to logistic problems. The swabs were transported to the ICDDR,B laboratory in Dhaka and analysed within 72 hours of collection. Pathogens were identified by standard laboratory methods. Serotyping and biotyping of *V. cholerae* O1 was done by the World Health Organization methods (7). The antibiotic sensitivity of the isolates was determined by the Kirby Bauer disk (BBL) diffusion methods (8).

For each patient seen by the ECP physicians, a pretested questionnaire was used and information including age, gender, time of onset of illness, clinical signs and symptoms, consultation with other health care providers, if any, and other relevant data

were recorded. The hydration status of the patients was assessed using World Health Organization criteria (9). Information on patients treated at the upazila health centre and temporary treatment centres was also obtained.

Information concerning the total number of diarrhoea cases and deaths reported by the government epidemic surveillance presented in this study was collected from the National Headquarters for epidemic surveillance and from the records of the district Civil Surgeons and Upazila Health Complexes that were visited by us.

RESULTS

Table I shows the number of epidemic diarrhoea cases reported between 1985 and 1990 by the GOB epidemic surveillance. It shows a large number of cases in 1987 and 1988. In those years there were severe floods that affected most of the country, particularly the northern and the middle regions, perhaps increasing the number of cases during these periods. The table also presents the number of cases treated by the ECP physicians and the rate of *V. cholerae* O1 isolations.

Table I. Diarrhoea Epidemic Surveillance: Epidemics in Bangladesh: 1985-1990

Year	Government Epidemic Surveillance		ECP Epidemic investigation		
	No. Attack	No. Death	No. cases examined	No. R/S§ collected	<i>V. cholerae</i> O1 No. positive Percent
1985	47,150	4,101	4,983	296	112 37.8
1986	53,046	3,997	3,432	211	78 36.9
1987*	303,391	4,726	3,692	312	141 45.1
1988*	988,391	3,676	13,879	1967	764 38.8
1989	43,535	1,783	**1,821	419	226 53.9
1990	48,916	1,309	** -	-	- -

** ECP non-operational from June 1989 - December 1990

* Years of heavy flooding

§ R/S = Rectal Swabs

Distribution of *V. cholerae* O1 by districts is presented in Table II which shows a wide spread distribution of the disease, with classical biotypes being confined almost exclusively to the southern parts of the country.

The 1991 diarrhoea epidemic affected the northern districts. The 214,852 cases reported in 12 weeks are shown in the figure (p. 82). The highest number of cases reported was 25,000 per week. Interestingly, the number of cases observed at the beginning and at the end of the epidemic were quite high (4,000-5,000 cases/week). The ECP physicians saw 4,018 diarrhoea patients during their epidemic investigations in 1991 (Table III); 3,025 (75%) of these had acute watery diarrhoea from which 829

*An Upazila Health Complex is a 31 bed government-run health centre that provides free health care (both in-patient and out-patient), primary care, and family planning through a number of categories of health personnel, although laboratory diagnostic facilities offered by the centre are few.

rectal swabs were collected. The table also shows *V. cholerae* isolation rates from each of the regions. The overall *V. cholerae* 01 isolation was 569 cases per thousand rectal swabs (95% confidence intervals: 535–603).

Table II. Distribution of *Vibrio cholerae* 01 by Biotype and Region: Bangladesh Sep 1988–May 1989

Region (districts)	No.R/S* collected	<i>V. cholerae</i> 01 positive		
		Classical	El Tor	Rate/1000 swabs
North – Western:				
Rajshahi	50	00	18	360
Kurigram	19	00	06	316
Sirajganj	38	00	13	342
Rangpur	24	00	18	750
North – Eastern:				
Mymensingh	31	00	06	194
Sherpur	31	00	05	161
Netrokona	307	00	79	257
Jamalpur	34	00	15	441
Hobiganj	190	02	124	663
Kishoreganj	58	00	19	328
Sunamganj	51	00	24	471
Middle belt:				
Comilla	193	01	59	311
Brahmanbaria	294	00	125	425
Narsingdi	61	00	18	295
Manikganj	36	00	06	167
Tangail	426	00	202	474
Rajbari	11	00	04	364
Southern:				
Narail	66	19	13	485
Barisal	139	32	06	273
Pirojpur	69	35	07	609
Jhalokathi	50	06	05	220
Bhola	109	36	03	358
Bagerhat	80	33	09	525
Patuakhali	19	03	00	158
Total	2386	167	784	

*R/S = Rectal swab

In the 1988–89 epidemic season, we looked for a larger spectrum of enteric pathogens associated with the diarrhoea epidemics. A total of 2,386 rectal swabs were collected from patients from 24 districts. An enteric pathogen was isolated from 1373 (58 %) swabs. *V. cholerae* 01 was isolated from 40 % of the swabs (Table IV); it was the most commonly isolated pathogen. A sample of 514 swabs which were negative for vibrio, *Shigella* and *Salmonella* were tested for ETEC; 9.5% were positive. The heat-stable toxin (ST) positive strains accounted for most (79%) of the ETEC isolates, whereas heat-labile (L-T) only strains accounted for 19% of the total. *Aeromonas* sp. accounted for 10.5% of the positive isolates as a single pathogen. However, we have not determined the toxigenicity of this group of organisms.

We have reported that in 1988–1989 nearly all classical biotypes of *V. cholerae* were resistant to tetracycline, the most commonly used drug in cholera, whereas the El Tor biotypes were sensitive to the drug (10). After almost a decade (11–13), re-emergence of tetracycline-resistant El Tor biotype was observed during the 1991 epidemic. The two districts where the resistant epidemic strains were detected are Thankurgaon and Jhenaidah, a northwest and a midwest district where the proportion of tetracycline resistance *V. cholerae* 01 positive isolates was found to be 21% (n=58) and 97% (n=26) respectively. Only El Tor biotypes were isolated from these areas.

Table III. Epidemic Investigation by Epidemic Control Preparedness Programme: 1991 Cholera Epidemic in Bangladesh

Regions	Nos. with watery diarrhoea	No. R/S collected	<i>V. cholerae</i> 01	
			Positive	Rate/1000 Swabs
North – west	1265	266	137	515
North – east	1598	507	299	589
Mid – west	162	56	36	642
Total	3025	829	472	569*

*(95% CI: 535–603)

R/S = Rectal swabs

Between 1985 and 1991, we identified 1,684 laboratory confirmed *V. cholera* 01 cases. Age and gender distribution of these patients is presented in Table V. The distribution of cases between males (52%) and females was almost equal. Children less than 5 years of age accounted for only 24% of the total; and only 10% of the cases were less than 2 years of age.

Table IV. Aetiological Agents Identified in Diarrhoea Epidemics in 24 Districts September 1988–May 1989

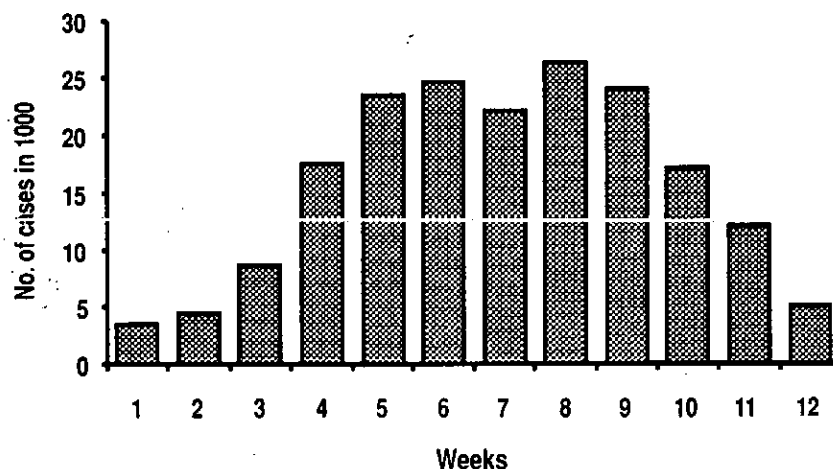
	(Number of rectal swabs tested: 2386)	
	No.	%
<i>V. Cholerae</i> 01	951	39.9
<i>V. Cholerae</i> non-01	20	0.8
Other vibrios	10	0.4
<i>Shigella</i> Spp.	71	3.0
ETEC*	48	9.3
LT 9(18.8%)		
ST 38(79.2%)		
LT/ST 1 (2.1%)		
<i>Aeromonas</i> Spp.	251	10.5
<i>Plesiomonas Shigelloides</i>	14	0.6
<i>Salmonella</i> Spp.	5	0.2
No pathogen detected	1016	42.6

* 514 tested for ETEC

An analysis of the initial hydration status of the watery diarrhoea patients during the 1991 epidemic revealed that 18.9% were severely dehydrated, and 37.6% of the patients were moderately dehydrated.

Results of our investigations in 1988 and 1989 indicated 'home' as the most common (80%) place of treatment of cholera patients. Only about 20% of the cases were treated at the government health facilities. Further analysis, as shown in Table VI, revealed that a higher proportion (68%) of cholera patients were treated by unqualified practitioners than by qualified physicians (22.9%). It also shows that nearly 10% of the patients had no consultation from any health care providers during their illness.

We also enquired about the frequency of home visits by the government epidemic surveillance staff in 1,157 houses where there were suspected cholera cases and deaths. We found that a high proportion (59%) of patients were not visited by the GOB health personnel during the illness.



Diarrhoea epidemic in Bangladesh: reported cases per week
(GOB epidemic surveillance report:
September 1 - November 23, 1991)

Because of the absence of a nation-wide systematic or reliable surveillance and lack of adequate laboratory diagnostic facilities, assessment of the magnitude of the cholera epidemics in Bangladesh was difficult. The ECPP surveillance was the only epidemic surveillance that was supported by laboratory diagnostic facilities. The estimate of the total number of cholera cases during the 1991 epidemics was, therefore, made by using the ECPP experience and the following assumptions: (a) that the proportion of laboratory confirmed *V. cholerae* O1 cases seen among the patients investigated by the ECPP physicians was the same as that for the cases reported by GOB surveillance, and (b) the GOB surveillance under-reported nearly half the true number of diarrhoea cases. The latter

was based on our observation that 59% of the patients were not visited by the GOB staff during the illness. Our figures showed that in the 1991 epidemics, the GOB surveillance underreported nearly 309,174 cases; therefore, the estimated total number of diarrhoea cases was 524,025 (309,173 + 214,852). By applying the proportion (75%) of watery diarrhoea seen by us, the number of patients with watery diarrhoea among the total diarrhoea cases ($524,025 \times 0.75 = 393,018$) was calculated. Further, by applying the rate (535 - 603/1000 positive Rectal Swabs:CI 95%) of laboratory confirmed cholera cases, we further estimated that the number of cholera cases in the 1991 epidemics was between 210,265 and 235,810 (CI 95%).

For estimating the total cholera deaths during the 1991 epidemic, we used the ECPP experience of 1986 (14) in the southern region of the country where our intervention succeeded in reducing the pre-intervention mortality significantly. However, the fatality ratio calculated for the whole epidemic period (pre- and post-intervention) was 4%. Similar observations were made in the past (15). The case fatality ratio varies with appropriate treatment and speed with which treatment is undertaken. However, for a cholera patient in rural Bangladesh the conditions are still adverse. The total number of cholera deaths in 1991 was therefore estimated to be between 8,410 and 9,432 by assuming a 4% case-fatality ratio.

Table V. Age and Gender Distribution of Laboratory Confirmed Cholera Patients: Epidemics in Bangladesh 1985 - 1991

Age (years)	No. cases		Total	Percent
	Male	Female		
< 1	16	8	24	1.4
1 - 2	82	61	143	8.5
3 - 4	120	117	237	14.0
5 - 9	209	179	388	23.1
10 - 14	129	75	195	12.2
15 - 39	229	285	514	30.5
40 +	86	88	174	10.3
Total	871	813	1684	100.0

Table VI. Types of Health Care Provider During Cholera Epidemics in Bangladesh: 1988-1989

Providers	Number	%
None	106	9.2
*Village practitioners	656	56.7
Qualified physicians	265	22.9
*Health Assistants	116	10.0
*Homeopaths/Others	14	1.2
Total	1157	100.0

*Unqualified

DISCUSSION

Despite the endemicity of cholera in Bangladesh, an accurate assessment of cases and deaths remains as difficult as ever. The absence of a reliable surveillance system is the main constraint. Our study was also limited, since only selected epidemics that needed external assistance were studied. Furthermore, in the field, we have not applied sampling techniques; patients were selected as encountered during house to house search by our physicians and by information from local health care providers. Estimates of the total number of cholera cases in the 1991 epidemic were calculated on the basis of our experience through the ECPP, and the observation that 59% of the patients had not been visited by the GOB staff. The latter may have been an over-estimate as it was not known what proportion of the total number of patients visited by the GOB staff were actually seen by the ECPP investigators. However, we were called to assist in epidemics that attracted the attention of the GOB epidemic surveillance staff, presumably where they were most active. A different situation could be true for epidemics that were not large enough to attract the attention of the GOB staff. Furthermore the ECPP investigations were the only epidemic surveillance that was supported by reliable laboratory facilities.

Estimates of deaths presented in this study were based mainly on our own experience of case-fatality ratios during outbreaks, rather than nation-wide information, since there was none. Further, the under-reporting may be greater for mild cases than for severe cases and use of the same under-reporting rates may have resulted in an over-estimation of deaths. Our experience suggests, however, that access difficulty (6) and delayed information are probably the major constraints to appropriate and timely intervention during epidemics in rural Bangladesh. Thus the case fatality ratio could also be higher than we observed.

We estimate that within the span of 12 weeks during the 1991 epidemic of cholera in Bangladesh, there were between 210,000 and 235,000 cases and over 8,000 deaths. Bangladesh probably had more cholera deaths than any country in the world in 1991.

The history of cholera in the Ganges delta, the greater part of which is now Bangladesh, goes back as far as the sixteenth century (16). Presumably it occurred even before that, since history took note only of the great epidemics. In 1817 a violent cholera epidemic broke out in Jessore, which is now in Bangladesh, and rapidly spread through India to China, Japan, European Russia, and as far as Syria (17,18). This was the beginning of the first of the seven cholera pandemics the world would experience in the next 150 years. Since then, the record shows that cholera epidemics have always been a public health problem in this part of the Ganges delta (17-18).

Diarrhoea epidemics are still common in Bangladesh. This study has shown that *V. cholerae* O1 is the most frequent cause of the epidemics investigated by us. *Shigella* dysentery has also caused epidemics in Bangladesh; however, the last one was recorded in 1985 (19). This was possibly the tail end of the cycle of *Shigella* epidemics that started in the early seventies (20). The disease is still endemic in Bangladesh (21-23).

This study indicates that in rural areas most of the cholera patients are treated at home. Only a small proportion of the cases availed the services of the health centre's facilities. We have already reported that two reasons for this are the distance of the health centre from the home of the patients and the lower socioeconomic status of the patients (6). The study has also shown that the unqualified village practitioners are the most frequently consulted health care providers during the epidemics. Obviously, the qualified physicians in the villages are very few, since they are mainly located in the upazila health centres. The constraints that prevent cholera patients from consulting qualified physicians are the same as those that prevent them from using the health centres.

The rapid rate of fluid loss in cholera can lead quickly to life threatening dehydration. Although oral rehydration therapy (ORT) has the potential of reversing severe degrees of dehydration, intravenous fluid therapy is often indicated as a life saving method for patients with cholera. Further, IV fluids must have appropriate electrolyte concentrations and be given appropriately for preventing deaths. Delivering these services could not be expected from the village practitioners unless they are educated and trained for the specific purpose.

The effectiveness of ORT in preventing and correcting diarrhoeal dehydration has been proven beyond any doubt. However, the advantage of ORT as insurance against developing severe dehydration may be lost during the epidemic because: (a) the village mothers and family members have very little education or guidance from qualified health care providers and (b) the vomiting produced by cholera and aggravated by acidosis tends to inhibit the use of ORT by family members caring for the patient.

Most cholera outbreaks in Bangladesh occur in rural areas; these are also difficult to reach for

health care providers. Temporary treatment centres have been shown to be effective in preventing deaths during cholera epidemics in rural Bangladesh (14). During an epidemic outbreak in 1986 in southern Bangladesh, the estimated case fatality ratio before arrival of the ECPP team was 14%; following appropriate intervention and the setting up of a makeshift treatment centre the rate decreased to less than 1%. However, this strategy can only be optimal if the epidemics are identified early in their course.

Cholera epidemics are repeated disasters in Bangladesh; however, unlike other disasters they are nearly always predictable. Studies have shown that they break out in distinct seasons; the peak incidence of El Tor and Classical cholera is in the months of October and December respectively (24). Also at different geographic locations the epidemic is caused by different biotypes; we have reported that Classical biotypes are the predominant epidemic strains in the southern region, whereas the El Tor biotype dominates the epidemics of the northern region (25).

Cholera outbreaks also often follow cyclones and floods in Bangladesh (26-27). Surface water has been implicated in transmission of epidemic cholera in Bangladesh (28). High population density is a factor for such transmission (29). Bangladesh has a high population density, and it is continuously increasing - as is the frequency of its floods (30). Therefore, these factors may increasingly continue to play an important role in epidemic outbreaks of cholera in Bangladesh.

During the last three decades, cholera in Bangladesh has been the subject of numerous studies which have increased our understanding of the clinical management of the disease (31-37), epidemiology (38-47), pathogenesis (48,49), and immunology (50-54). In recent years the largest field trial of a potentially effective cholera vaccine was conducted in Bangladesh. The results indicated that during the first year the vaccine conferred a high degree of protection, which was also significant in persons over 5 years of age during the second and third years of vaccination (55,56). Our study indicated that a large majority (75%) of the cholera patients in Bangladesh were over 5 years of age, suggesting that vaccine protection against the disease would be optimal in the large majority of recipients.

It is known that cholera is associated with a lack of safe water, poor domestic and personal hygiene, illiteracy, poverty, and cultural practices that foster transmission of the disease. It is also known that improvement of these factors could eliminate the threat of the disease but for a country such as Bangladesh, improvement of these factors will need long term efforts and demand considerable resources that would not be easy to generate.

Our study suggests that improved methods of prevention that are adaptable to countries such as

Bangladesh are urgently needed to eliminate the scourge of cholera. The dilemma that torments the public health physicians of Bangladesh searching for measures that could be implemented urgently for control and prevention of cholera epidemics is having to choose from the following strategies along with the searching questions that are associated with them: (a) make adequate case management facilities for prompt treatment - how would it influence the incidence of the disease and the epidemic outbreaks, beside the practical difficulties of implementing such a strategy in a short time, (b) eliminate the risk factors for transmission of the disease by improving water supply and sanitation and by eliminating illiteracy and poverty - within what foreseeable future and at what human cost, or (c) use the vaccine that has been tried in Bangladesh - how soon and at what cost. Meanwhile, the public health physicians continue to search for indicators that would tell them how and when the next epidemic will start.

Given the magnitude of the problem of cholera epidemics in Bangladesh we recommend that the current strategies for prevention and control of cholera epidemics should include; (a) an effective, simple and representative surveillance in the country which could provide early warning signals for impending outbreaks, (b) recognition of the importance of the role of unqualified health care providers in the cholera case management and improvement of their skills and attitudes in treating cholera patients, (c) implementation of low-cost methods of preventing epidemics, for example, protecting domestic water supply by using alum potash which is available and was traditionally used in Bangladesh and found to be effective in preventing secondary attacks during cholera outbreaks (57), and (d) further improvement of the vaccine that has been tried in Bangladesh and insurance of its cost effectiveness as a public health tool to control cholera in the future.

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