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Changing epidemiology of cholera due to *Vibrio cholerae* O1 and O139 Bengal in Dhaka, Bangladesh

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SUMMARY

At the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B) Dhaka we studied the trends in cholera for the period January 1992 to May 1995. *Vibrio cholerae* O139 Bengal emerged as a second aetiologic agent of cholera in Dhaka in January 1993. In 1993, the majority of cholera cases was due to *V. cholerae* O139, with *V. cholerae* O1 accounting for a small proportion of cases. During the latter part of the study period (Jan 1994–May 1995), *V. cholerae* O1 re-emerged as the predominant cholera strain. The predominant age group affected in endemic cholera due to *V. cholerae* O1 was children 2–9 years old, and the organism was isolated from more females than from males at all ages. In contrast, cholera due to *V. cholerae* O139 caused disease mostly in adults 15 years and older, which indicated that this organism was new in this population. As with *V. cholerae* O1, *V. cholerae* O139 was isolated from more females than males. The initial rapid emergence and predominance of *V. cholerae* O139 was considered possibly to herald the start of the eighth pandemic of cholera. However, just after a year, the prevalence of *V. cholerae* O139 decreased dramatically with *V. cholerae* O1 resuming the role of the dominant cholera strain. The factor(s) contributing to the dramatic decline in prevalence of *V. cholerae* O139 is not well understood.

INTRODUCTION

Cholera is endemic in Bangladesh. It is present throughout the year with two seasonal peaks: a spring peak in March–May, followed by a larger post-monsoon autumn peak in September–December [1].

V. cholerae belonging to serogroup O1 has been considered as the only causative agent of epidemic cholera. However, in October 1992, a new cholera strain, *V. cholerae* O139 (synonym Bengal), caused an outbreak of clinical cholera in the south Indian port city of Madras [2]. The same strain also caused an outbreak of cholera in southern coastal areas of Bangladesh in December 1992. *V. cholerae* O139 appeared in urban Dhaka in January 1993 following a large Muslim gathering of pilgrims from areas of India and Bangladesh which experienced cholera due to *V. cholerae* O139 [3]. In the ensuing months, *V. cholerae* O139 spread through the Indian subcontinent resulting in thousands of cholera cases and many deaths. During this period, the traditional causative agent of cholera, *V. cholerae* O1 was rarely isolated [4, 5]. *V. cholerae* O139 also caused cholera in several neighbouring countries of Nepal, Burma, Thailand, Malaysia, Pakistan, China and Sri Lanka [6]. Several industrialized countries reported imported cases [6]. This suggested that *V. cholerae* O139 might be the causative agent of the eighth pandemic of cholera [7]. We now report the trends in cholera due to *V. cholerae* O1 and O139 from information obtained through the International Centre for Diarrhoeal

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Table 1. *Isolation rates of* V. cholerae *O1 and O139 in surveillance patients in Dhaka, Bangladesh, January 1992 to May 1995*

Year	Number of surveillance patients			Number (%) positive for *V. cholerae* O1			*V. cholerae* O139*		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
1992	2191	1320	3511	293 (13·4)	224 (17·0)	517 (14·7)	0	0	0
1993	3355	2215	5570	156 (4·7)	113 (5·10)	269 (4·8)	665 (19·8)	470 (21·2)	1135 (20·4)
1994	2786	1768	4554	430 (15·4)	295 (16·7)	725 (15·9)	89 (3·2)	56 (3·2)	145 (3·2)
1995 (until May)	1184	767	1951	156 (13·2)	139 (18·1)	295 (15·1)	6 (0·51)	15 (2·0)	21 (1·1)

* *V. cholerae* O139 not detected until December, 1992 in southern coastal Bangladesh; it was subsequently detected in Dhaka in January, 1993

Disease Research, Bangladesh (ICDDR, B) surveillance system in Dhaka, for the period, January 1992 to May 1995.

MATERIALS AND METHODS

Since 1979, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR, B), Dhaka, has been conducting surveillance studies of major diarrhoeal pathogens including the traditional causative agent of cholera, *Vibrio cholerae* O1, through its surveillance system [1, 8]. In this system, stools from a 4% systemic sample of all diarrhoeal patients (every twenty-fifth patient) seeking treatment at the ICDDR, B are cultured.

Fresh stool specimens are obtained for microscopy and are cultured using TTGA (taurocholate-tellurite-gelatin agar) for isolation of vibrios. Suspected *V. cholerae* O1 and O139 were confirmed by slide agglutination with specific antisera [9].

RESULTS

In 1993, the first year of the epidemic of *V. cholerae* O139, the isolation of *V. cholerae* O139 predominated (Table 1). However, beginning in 1994 and continuing through the first 5 months of 1995, *V. cholerae* O1 has remerged as the predominant strain.

The isolation rate of *V. cholerae* is shown in Figure 1. In 1992 cholera was caused by *V. cholerae* O1 only. Two peaks of infection were observed, April to June and August to November. In 1993, the spring peak appeared earlier, in February instead of April, and was replaced by *V. cholerae* O139. The second peak appeared on schedule, but continued to be dominated by *V. cholerae* O139. However, towards the end of the year, *V. cholerae* O1 began to appear in increasing numbers.

The isolation rates of *V. cholerae* O1 and O139 by age are shown in Table 2. The isolation of *V. cholerae* O1 was greatest in children 2–9 years old, and was comparatively lower in adults, 15 years and older. In contrast, *V. cholerae* O139 affected all age groups, and infection rate increased with age.

Even though in all years, less females than males were treated, the isolation rates of both *V. cholerae* O1 and *V. cholerae* O139 were greater in females than in males (Table 1).

DISCUSSION

Within a few months of its first appearance, *V. cholerae* O139 spread rapidly throughout the Indian subcontinent and invaded several neighbouring countries. During the epidemic spread in the Indian subcontinent, *V. cholerae* O139 initially suppressed the prevalent El Tor biotype [4, 5]. Moreover, in an initial study conducted in Bangladesh, 12% of surface water samples tested contained *V. cholerae* O139 [10]. In contrast, *V. cholerae* O1 was isolated from less than 1% of water samples during epidemic periods [11]. The above observations suggested the following: (1) *V. cholerae* O139 is hardier than *V. cholerae* O1 El Tor, (2) *V. cholerae* O139 would replace *V. cholerae* O1 El Tor as the predominant strain and (3) *V.*

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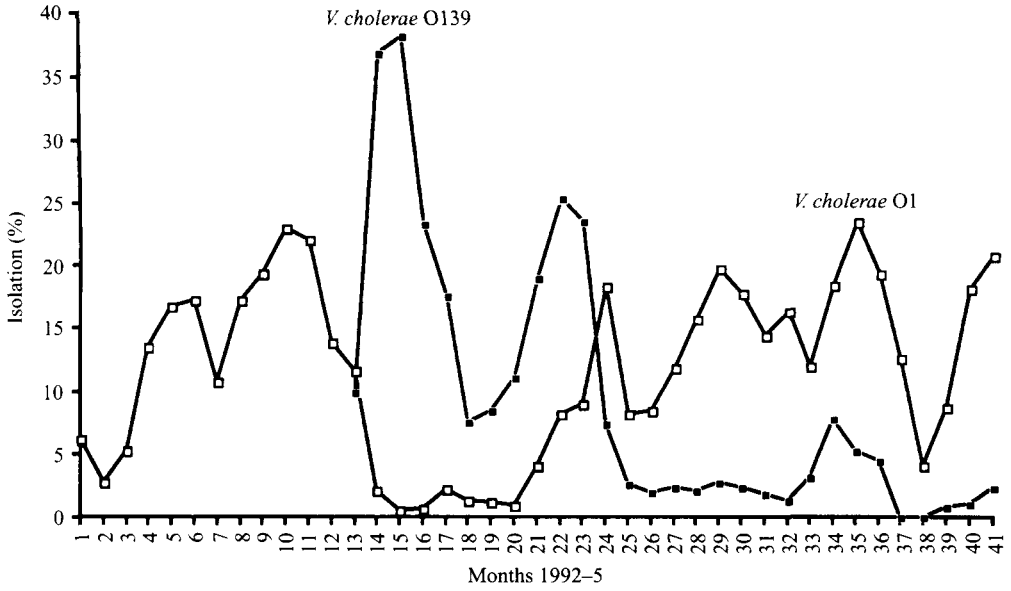

Fig. 1. Monthly isolation rate of *V. cholerae* O1 and O139 in surveillance patients in Dhaka, Bangladesh during January 1992–May 1995. *V. cholerae* O139 was first detected in Dhaka in January, 1993.

Table 2. *Isolation of* V. cholerae *O1 and* V. cholerae *O139 by age in surveillance patients in Dhaka, Bangladesh*

	Number (%) positive for						
	V. cholerae O1 during				*V. cholerae* O139 during		
Age strata (yrs)	Jan–Dec 1992	Jan–Dec 1993	Jan–Dec 1994	Jan–May 1995	Jan–Dec 1993	Jan–Dec 1994	Jan–May 1995
0– < 2	90 (5·5)	45 (2·3)	125 (6·5)	61 (6·0)	82 (4·3)	11 (0·6)	5 (0·5)
2–9	192 (28·6)	102 (10·4)	270 (32·7)	101 (31·5)	234 (23·8)	32 (3·9)	2 (0·6)
10–14	36 (25·2)	23 (9·8)	58 (31·2)	20 (28·2)	60 (25·5)	10 (5·4)	0 (0·0)
15–34	121 (19·4)	60 (4·6)	187 (18·5)	70 (23·5)	334 (25·8)	50 (5·0)	5 (1·7)
35–49	53 (19·5)	22 (3·6)	45 (13·5)	26 (18·1)	203 (33·5)	14 (4·2)	6 (4·2)
50+	25 (15·4)	17 (3·2)	40 (14·5)	17 (16·2)	222 (42·0)	28 (10·1)	3 (2·9)
Total	517 (14·7)	269 (4·8)	725 (15·9)	295 (15·1)	1135 (20·4)	145 (3·2)	21 (1·1)

cholerae O139 would be the causative agent of the eighth pandemic of cholera. Against this background, it was surprising to note the diminished isolation of *V. cholerae* O139 subsequent to 1993. A number of host and environmental factors may be responsible for this. Aquatic environment is the main reservoir for vibrios [12]. One possible explanation is that after the initial period when it caused large epidemics and survived well in the surface water, the organism might have undergone changes, for example in colonization factors that determine long-term persistence in the aquatic environment. This in turn would have made the organism less suited for survival in the environment. Alternatively, subsequent to the emergence and peak prevalence of *V. cholerae* O139, *V. cholerae* O1 might have undergone changes that would have enabled it to outcompete *V. cholerae* O139 and become the predominant strain again.

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In endemic cholera due to *V. cholerae* O1 in Bangladesh, it has been reported that the predominant age group affected is children between 2–9 years of age [13]. Our findings also suggested that for *V. cholerae* O1, the predominant age group affected was 2–9 years. This was consistent in 1992 when there was no isolation of *V. cholerae* O139 as well as after the appearance of *V. cholerae* O139. However, the age distribution of patients infected with *V. cholerae* O139 was somewhat different. Although all age groups were affected, the majority of cases occurred in adults 15 years and older. This suggested that *V. cholerae* O139 cholera is a new disease in the population. The age distribution was the same in 1993, the peak year of the *V. cholerae* O139 epidemic, as well as in subsequent periods when the number of cases was low. This suggested that in regard to age distribution of cases, *V. cholerae* O139 continues to behave as an epidemic disease strain.

The hospital admissions suggested that more males than females were treated. This may relate to male preference in seeking medical care in the poor socioeconomic strata of the Bangladeshi society [14] and suggests that mostly very sick females are brought to the treatment facility. In spite of lower admission of females, isolation of vibrios was greater in females than in males. This is not surprising because patients who are very sick (with greater dehydration) are likely to have cholera than those who are not.

The data presented in this report pertain to urban Dhaka only. However, unpublished data of colleagues for other parts of Bangladesh and various parts of India suggest a similar trend in the prevalence of *V. cholerae* O1 and O139 as presented in this report. It is difficult to predict the future course of *V. cholerae* O1 and O139 infections. Both strains may coexist with one strain as the dominant strain or one strain may completely replace the other.

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