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Studies on interventions to prevent eltor cholera transmission in urban slums*

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Transmission of eltor cholera infection in endemic communities continues without diminishing because of the absence of effective intervention measures. Two methods—chlorination of stored water and the use of a narrow-necked earthenware vessel (called a 'sorai') for storing the water—were found to be effective in reducing the transmission of infection among the family contacts of cholera patients. The cholera carrier rates in the chlorination and 'sorai' intervention groups were 7.3% and 4.4%, respectively, compared with 17.3% in the control group. The 'sorai' is cheap and was well accepted by the local communities; its narrow neck prevented the introduction of the hand and contamination of the stored water.

Since eltor cholera appears to have an endemic tendency, cases are regularly being reported from the city slums in many developing countries every year. Poverty, malnutrition, overcrowding, and unhygienic living conditions are important contributory factors, but persistence of the disease in these communities has been attributed to the large number of inapparent infections by the eltor organism and mild cases throughout the year (1).

However, the exact mode of transmission of the disease is still poorly understood and the role of drinking-water in the transmission of cholera in highly endemic areas is still debated (2, 3). For example, the provision of tube-well water of presumed good quality did not reduce the incidence of the disease (4-6). A number of hypotheses have been proposed to explain this failure, but have not satisfactorily explained the relationship of water use to cholera transmission. The use of water for other purposes, especially bathing, has been incriminated in the transmission of cholera in some areas (7). Lack of a clear correlation between the water supply and the causation of the disease, as well as the presence of a large number of inapparently infected persons in

the community, led us to the hypothesis that person-to-person transmission through contamination of domestic food and water, owing to poor hygienic practices, might be responsible for the maintenance of infection in endemic areas.

In an earlier study (8), we investigated the modes of intrafamilial transmission of *Vibrio cholerae* biotype *eltor* in cholera-affected houses in the Calcutta slums. The object was to determine the association between contamination of various items in the household and the incidence of cholera infection. Our results showed statistically significant higher contamination rates of stored water and cooked food in the houses with hospitalized cholera patients, compared with the control group of houses without cholera. This difference in contamination rates was not noticed when other categories of domestic environmental samples were tested. It was concluded that *V. cholerae*-infected persons—without symptoms—were contaminating through their infected fingers the clean water which was stored unhygienically in wide-mouthed vessels (e.g., a bucket) in the house, thus leading to the transmission of infection to other persons.

The present study was carried out to determine the effect of two hygienic measures to prevent transmission of infection through stored water.

MATERIALS AND METHODS

The study population was composed of the family contacts of bacteriologically proven, hospitalized

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Fig. 1. The 'sorai', an earthenware vessel, with separate openings (shown by the arrows) for putting in and pouring out the water.

cholera patients (index cases). As soon as a diarrhoea patient was admitted in the local Infectious Diseases Hospital, his or her stool sample was screened for the presence of *V. cholerae*. The house of the index case was visited within 18–24 hours and stool samples of all the family contacts were examined daily for 5 consecutive days to determine the incidence of carriers among them. If any index case was not proved to be a case of cholera, further studies in this family were discontinued.

Intervention measures

The first group of 31 families was provided with chlorine tablets and instructed to put them (1.25 mg/litre of water) in the buckets where the water was usually stored for drinking and other domestic use. The residual chlorine level in this stored water that had been treated with the chlorine tablets was estimated daily during surprise checks. A second group of 30 families was provided with narrow-necked earthenware pitchers (called 'sorais') and

instructed to store water in them for drinking and domestic purposes. Since each 'sorai' (Fig. 1) had a narrow inlet and a spout, into which the hand could not be placed, this source of contamination of the water could be prevented. A third group of 30 families, where neither of the above interventions was applied, served as a control. The index case families were randomly assigned to the two intervention and the control groups. The families were advised to follow only the suggested method of intervention (chlorine tablets or 'sorai') in their respective group and were not instructed in the use of other hygienic measures so as to avoid the introduction of other intervention variables.

RESULTS

A total of 466 persons from among the 91 index-case families in the three groups were studied. Their age distribution shows that the three groups were comparable (Table 1); there was also hardly any difference between the groups regarding sex distribution.

The study was conducted in the slums of the eastern part of Calcutta city where the incidence of diarrhoeal diseases including cholera is relatively higher than elsewhere. The study population in the three groups was more or less similar with regard to housing, religion, income, access to water supply and latrine facilities, and the literacy of the mothers (Table 2).

Table 1. Age distribution of the study population in the three groups

Age group (years)	No. of family contacts of index cases			
	Chlorination group	'Sorai' group	Control group	Total
<1	9	7	5	21 (4.5)
1-4	17	19	20	56 (12.0)
5-9	22	22	22	66 (14.2)
10-14	17	21	20	58 (12.5)
≥15	86	90	89	265 (56.9)
All ages	151	159	156	466 (100.0)

* Figures in parentheses are percentages.

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'i' p	Control group	Total
5	21 (4.5) ^a	
20	56 (12.0)	
22	66 (14.2)	
20	58 (12.5)	
89	265 (56.9)	
156	466 (100.0)	

ntages.

Table 2. Comparability of the three groups in economic and social terms

Criteria for comparison	Percentage of families		
	Chlorination group	'Sorai' group	Control group
Housing:			
Slum	83.3	90.0	83.3
Non-slum	6.7	10.0	6.7
Religion:			
Hindus	90.3	90.0	86.7
Muslims	9.7	10.0	13.3
Monthly income (US\$):			
<25	41.9	40.0	40.0
25-40	48.4	53.3	50.0
>40	9.7	6.7	10.0
Water supply:			
Tap + tubewell	90.3	93.3	90.0
Pond	3.2	3.3	3.3
Open well	6.5	3.3	6.7
Latrine facilities:			
Service type	29.0	36.7	40.0
Sanitary	58.1	56.7	50.0
Open	12.9	6.7	10.0
Mother's education:			
Primary school or below	35.5	30.0	33.3

Table 3 shows the rates of inapparent infections detected in families practising the two methods of intervention as compared to those in the control group. Out of the 151 persons in the chlorinated group, 11 (7.3%) were detected with cholera infection; the mean residual chlorine level in the treated water was found to be 0.2 mg/l. Seven (4.4%)

Table 3. Effect of the two intervention measures compared with the control group

	Family contacts of index cases	
	No. studied	No. +ve for <i>V. cholerae</i>
Chlorination group (31 families)	151	11 ^a (7.3) ^b
'Sorai' group (30 families)	159	7 ^c (4.4)
Control group (30 families)	156	27 (17.3)

^a Chlorination vs control groups ($P < 0.01$).

^b Figures in parentheses are percentages.

^c 'Sorai' vs control groups ($P < 0.001$).

infected persons were detected among the 159 persons in the 'sorai' group of families. In contrast, 27 (17.3%) inapparently infected persons were identified among the 156 persons in the control group. The differences in the number of detected infections between the chlorination and control groups ($P < 0.01$) and between the 'sorai' and control groups ($P < 0.001$) were found to be statistically significant.

Fig. 2 shows the occurrence of asymptomatic infections among the contacts of index cholera patients in the three groups, on different days of follow-up. Two intervention measures were applied from day 0. On day 1 there was little difference in the number of infected individuals in the three groups, but the differences were considerable from day 2 onwards between the study and the control groups. Use of the 'sorai' gave a slightly better result than chlorination.

DISCUSSION

The explosive outbreaks of classical cholera due to contamination of a water source are now rarely encountered in eltor infections. However, sporadic cases due to the latter biotype still continue in endemic areas, and scientists have been trying to elucidate the mechanism by which the eltor organism is transmitted from one person to another, thereby contributing towards the endemicity of an area.

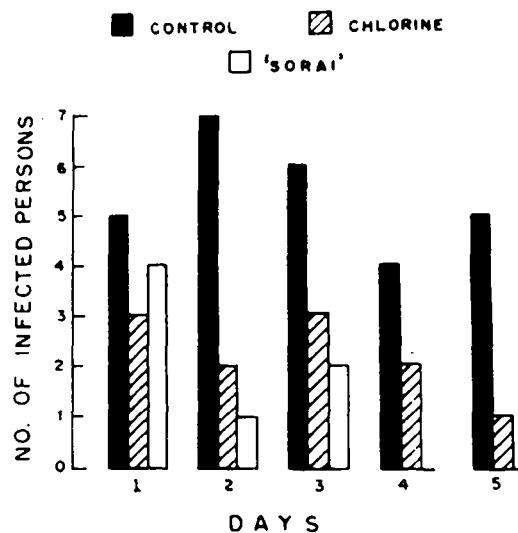


Fig. 2. Number of infected persons in the three groups during the first five days of the intervention.

Urban slums in most developing countries are now provided with a filtered and chlorinated water supply as the only source of water for most of the people living in these communities, alternative sources being rare or not accessible. Because of the irregular common water supply, however, the water has to be stored, and when this is done in an unhygienic fashion, the consequence is often secondary contamination of the water by already infected persons in the house. This fact was amply demonstrated by our earlier study (8).

The results of the present study on interrupting the transmission of *V. cholerae* infection within the household strongly suggest a causal relationship between contamination of the stored water and the high infection rate in the family as observed during the intrafamilial transmission study (8). Other factors capable of interrupting the transmission of cholera infection remaining the same in our three groups, it

can be reasonably concluded that the two intervention measures in our two study groups were responsible for lowering the transmission of *V. cholerae* from an infected to other persons in the household. A notable feature of this study was that a simple and cheap earthenware pitcher with a narrow neck (the 'sorai'), which was well accepted by the local community, was effective in reducing the transmission of infection.

The results given in Table 3 show that by using either of our two interventions it was possible to reduce the spread of *V. cholerae* infection among household contacts to the extent of 74.6% and 57.8% in the 'sorai' and chlorinated groups, respectively. This suggests that in our study groups the exposure to infection outside the home was relatively less important so far as spread of eltor cholera infection was concerned.

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RÉSUMÉ

ETUDES SUR LES MESURES DESTINÉES À PRÉVENIR LA TRANSMISSION DU CHOLÉRA ELTOR DANS LES TAUDIS URBAINS

Pauvreté, malnutrition, surpeuplement et manque d'hygiène dans les taudis urbains sont autant de facteurs qui contribuent à la persistance du choléra dans les pays en développement d'Asie et d'Afrique. On ne connaît pas exactement les modes de transmission de la maladie dans ces collectivités. Des études ont montré que la fourniture d'eau de bonne qualité n'entraînait aucune réduction de l'incidence du choléra. Une étude que nous avons faite antérieurement à Calcutta a révélé que, malgré l'existence de puits tubés et d'un réseau de canalisations d'eau, le fait de conserver l'eau à domicile dans de mauvaises conditions d'hygiène entraînait une contamination par *Vibrio cholerae*, d'où une incidence plus élevée des infections inapparentes dans ces familles par rapport à un groupe témoin.

La présente étude a été faite en vue de déterminer l'impact de mesures d'hygiène simples — fourniture de jarres de terre cuite à goulot étroit (appelées "sorai") pour garder l'eau destinée à la boisson et à d'autres usages domestiques, prévention de la contamination due au contact manuel de personnes infectées et enfin chloration de l'eau conservée traditionnellement dans des seaux non fermés — destinées à empêcher la transmission de l'infection à *V. cholerae*.

Trente et une familles, comptant chacune un premier cas de choléra, composaient le groupe où l'eau était chlorée et

30 autres le groupe auquel on a fourni des "sorai". Trente autres familles dans lesquelles aucune mesure n'a été appliquée ont servi de groupe témoin. Dans le groupe où la chloration était pratiquée, l'eau conservée dans des seaux a été traitée à l'aide de comprimés de chlore (1,25 mg/litre d'eau) tandis que des "sorai" ont été fournies aux familles du deuxième groupe en échange des seaux dans lesquels elles conservaient habituellement l'eau provenant d'un puit tubé ou du robinet. On a examiné quotidiennement pendant cinq jours consécutifs 466 contacts familiaux dans les trois groupes (151 dans le groupe où l'eau a été chlorée, 159 dans le groupe auquel des "sorai" ont été fournies et 156 dans le groupe témoin) afin de rechercher la présence de *V. cholerae* dans les selles.

On a constaté que les taux d'infection inapparente à *V. cholerae* dans le groupe où l'eau était chlorée et le groupe auquel des "sorai" ont été fournies étaient de 7,3% et de 4,4%, respectivement, contre 17,3% dans le groupe témoin.

Ces différences entre chacun des deux groupes cibles et le groupe témoin étaient statistiquement significatives.

Ces mesures simples, en particulier l'utilisation des "sorai", coûtent peu cher et ont été très bien acceptées par les communautés locales.

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