



A new strategy for waterborne disease prevention



Robert E. Quick et al., USA

IN MANY PARTS of the developing world, drinking water is collected from unsafe sources and is further contaminated during storage in household vessels. We have developed a simple, inexpensive system for point-of-use disinfection and storage of water which has 3 elements: for disinfection, a sodium hypochlorite solution produced from water and salt using appropriate technology; for safe storage, a 20-litre plastic vessel with a narrow mouth, lid, and spigot (referred to hereafter as the special vessel); and community education to ensure proper use of this system and to teach populations about the association between contaminated water and disease (Mintz, 1995). A field test of this system in El Alto, Bolivia, demonstrated a high level of acceptance among impoverished Aymara Indian families (Quick, 1996). Stored water in households that used the system had lower levels of contamination with *E. coli* than water in households that used their traditional storage systems. A second field test among vendors in the markets of Guatemala City, Guatemala, showed that there were lower levels of contamination with fecal coliform bacteria in samples of stored water and beverages from vendors using this system than from vendors not using this system (Sobel, 1997). Two field trials have been conducted in the past 3 years to test the effectiveness of this system in preventing diarrhea and its sustainability on a large scale.

Field Trial I

Objectives

To evaluate the effectiveness of this water treatment and storage system in improving water quality and preventing diarrhea.

Methods

Baseline surveys of demographic characteristics, water handling practices, and water quality were conducted in households in 2 periurban communities in Montero, Bolivia. Households were then randomized into intervention and control groups; the intervention group received the water treatment and storage system and education about its use. Fresh disinfectant was provided weekly. Monthly water quality surveys and weekly active surveillance for diarrhea were conducted from September 1994 through February 1995.

Results

A total of 127 families with 790 members participated in the study, 64 in the intervention group and 63 in the control group. The baseline median *E. coli* colony count

for water stored in study households was 46,950/100 ml. Following distribution of the water treatment and storage system, stored water samples from intervention households had significantly lower median *E. coli* colony counts than stored water from control households in all 6 monthly sampling surveys ($p < 0.0001$). Among intervention households, the percent of water samples with no detectable *E. coli* colonies ranged from 56 per cent to 79 per cent in the 6 water quality surveys. During 5 months of diarrhea surveillance, intervention households had 83 cases of diarrhea, and control households 148 cases. The mean number of diarrhea cases per household was 1.30 for intervention families and 2.35 for control families, a difference that was statistically significant ($p < 0.05$). The effect was strongest in two age groups, infants <1 year old and children 5 to 14 years old, from intervention households who had significantly fewer episodes of diarrhea per person than their counterparts from control households ($p < 0.05$). Multivariate analysis showed that belonging to an intervention household ($p < 0.05$), having a functioning latrine ($p < 0.05$), and having no visible faeces in the yard ($p < 0.05$) were all independently associated with having fewer episodes of diarrhea in a family.

Field Trial II

Objectives

To test if this water treatment and storage system is sustainable and evaluate its effectiveness in preventing diarrhea under "real world" conditions.

Background

A social marketing campaign was designed in Bolivia to make the system sustainable by creating microenterprises to produce and sell the special water vessel and disinfectant solution, by promoting the products, and by educating the population in their use. The intervention was given a logo and a brand name, CLARO, which is Spanish for "clear" and "of course." A video-tape, pamphlets, and flip charts were produced to teach about the association between water and diarrhea and to demonstrate how CLARO could be used to prevent diarrhea. Promotional CLARO T-shirts and baseball caps were made to give to health personnel, public figures, and consumers. A rally with local and national leaders and the general public, with extensive media coverage, was held to launch the product. A radio and television advertising campaign was launched. A field team consisting of a social communicator, a salesman, and a driver began a series of visits to urban and rural

communities carrying the special vessels, disinfectant, and promotional material in a truck and trailer painted with the CLARO brand name and logo. In the evenings, the field team projected the video on a 2-by-3-metre screen, gave project demonstrations, and sold the special vessels and disinfectant to individuals and stores.

Methods

Six rural communities (476 families, 2,395 persons) were selected from this region. Nine rural communities (500 families, 1,299 persons) from a neighbouring geographic region outside of the coverage area of the campaign were selected as controls. From July through October 1996, we conducted baseline demographic and water quality surveys and set up an active diarrhea surveillance system for children <15 years old was set up. Data collection from the surveillance system began 9 weeks prior to the product launch. A team of anthropologists was based in 7 of the study communities to investigate behavioural changes in the population. The social marketing campaign was launched in the region north of Santa Cruz, Bolivia, in November 1996. Families in intervention communities were offered the opportunity to receive the special water vessel and disinfectant in exchange for working on community improvement projects; approximately 50 per cent participated. A follow-up water quality survey was conducted 3 months after the launch of the campaign.

Results

Baseline median fecal coliform counts in domestic stored water in the dry season were 127/100 ml in intervention

communities and 195/100 ml in control communities, a difference that was not statistically significant. Three months after the launch of the social marketing campaign, in the intervention communities 50 per cent of households reported using the water vessel, 34 per cent said that they were using the disinfectant, but only 19 per cent had detectable levels of chlorine in their stored water. Median fecal coliform colony counts were significantly lower ($p < 0.05$) in domestic stored water in intervention households (1,960/100 ml) than in control households (4,000/100 ml); these measurements were taken during the rainy season when contamination of source water had increased substantially. Within intervention communities, households that reported using the special vessel or the disinfectant had significantly lower fecal coliform counts than households that reported not using these products ($p < 0.05$). During the 9-week prelaunch period, children <15 years old in intervention families had 0.22 episodes of diarrhea per person, and in control families had 0.28 episodes per person. During the 12-week post-launch period, children in intervention families had 0.12 episodes per person, a reduction of 54.5 per cent, and children in control families had 0.28 episodes per person. The slope of the curve describing the weekly incidence of diarrhea in families in intervention communities showed a rate of decrease of disease that was significantly greater than in control families ($p < 0.05$) [Figure 1]. The anthropologic study revealed that, in a ranking of village priorities, clean water was rated 10th by women and 14th by men, that only 30 per cent of respondents associated dirty water with diarrhea,

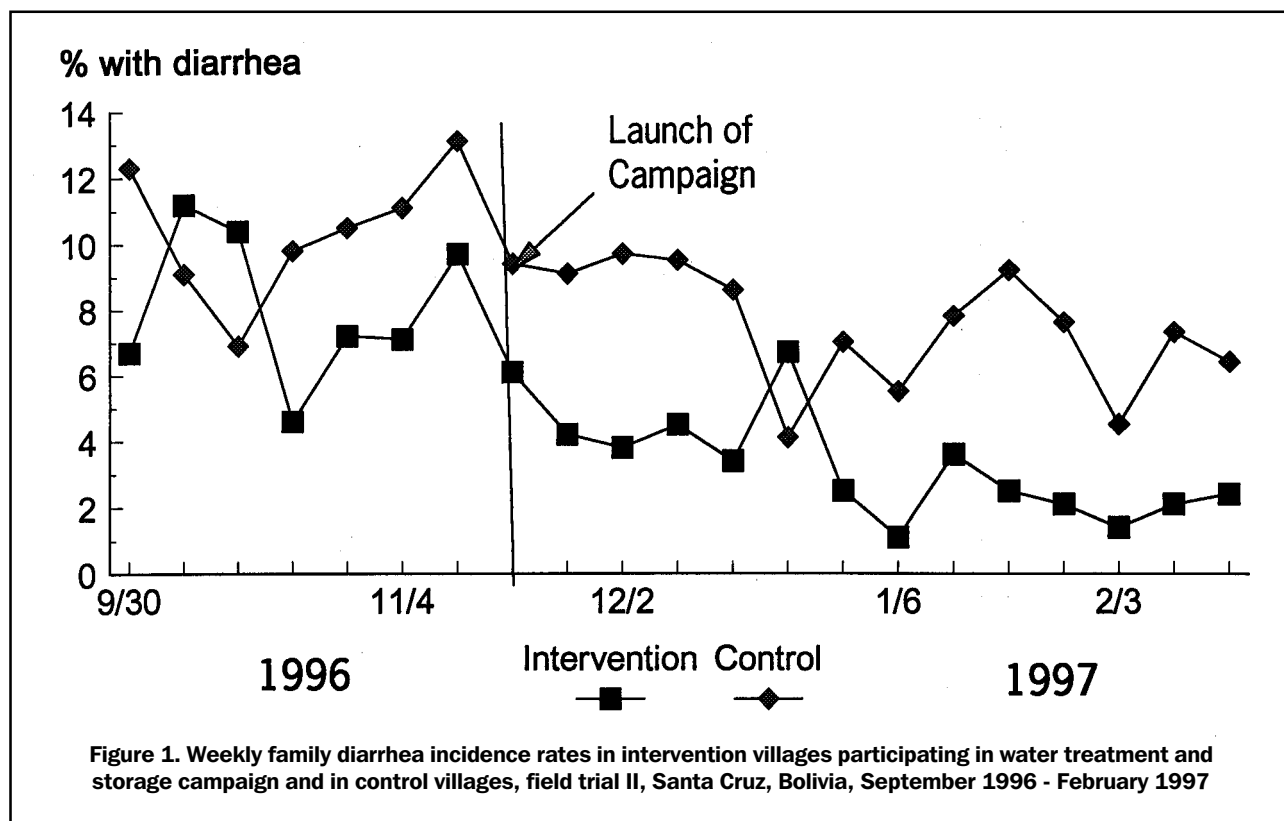


Figure 1. Weekly family diarrhea incidence rates in intervention villages participating in water treatment and storage campaign and in control villages, field trial II, Santa Cruz, Bolivia, September 1996 - February 1997

and that many regarded diarrhea as a normal occurrence of childhood.

Discussion

The water treatment and storage system described here appears to be effective in improving water quality and preventing diarrheal diseases. Compliance with the use of the special water vessel was high in both studies. Although compliance with point-of-use water disinfection was high in Field Trial I, it was much lower in Field Trial II. Consequently, median levels of contamination of stored water were much higher in intervention households in Field Trial II than in Field Trial I. This finding can be explained in part by the relatively low priority the population in Field Trial II placed on clean water, by the low level of recognition of water's role as a vehicle of disease, and by the prevalent opinion that diarrhea is not necessarily a disease. To enhance acceptance of the intervention, we recommend that the social marketing campaign emphasize education on the association of contaminated water with disease, the importance of diarrhea prevention, and the proper use of the water treatment and storage system.

Conclusion

This community-based approach can be a prevention strategy for waterborne diseases that is inexpensive, sustainable, and applicable in a broad variety of developing country settings. Partnerships between health agencies, nongovernmental groups, and private industry will enable

broad implementation of this low-cost, effective intervention.

References

- MINTZ, E., et al. Safe water treatment and storage in the home: a practical new strategy to prevent waterborne disease. *JAMA* 1995;273:948-53.
- QUICK, R., et al. Narrow-mouthed water storage vessels and in-situ chlorination in a Bolivian community: a simple method to improve drinking water quality. *Am J Trop Med Hyg* 1996;54:511-16.
- SOBEL J, et al., A simple system reduces fecal contamination of street-vended beverages in Guatemala. In: Program and Abstracts, International Night, 46th Annual Epidemic Intelligence Service (EIS) Conference, Centers for Disease Control and Prevention, April 15, 1997; Atlanta, GA. Abstract.

-
- ROBERT E. QUICK, Epidemiologist, Centres for Disease Control and Prevention.
- ERIC D. MINTZ, Centres for Disease Control and Prevention.
- JEREMY SOBEL, Centres for Disease Control and Prevention.
- PAUL S. MEAD, Centres for Disease Control and Prevention.
- FRED M. REIFF, Private Consulting Engineer.
- ROBERT V. TAUXE, Centres for Disease Control and Prevention.
-