SHORT REPORT: DIARRHEA PREVENTION IN A KENYAN SCHOOL THROUGH THE USE OF A SIMPLE SAFE WATER AND HYGIENE INTERVENTION

JOHN MIGELE, SAM OMBEKI, MARY AYALO, MATTHEW BIGGERSTAFF, AND ROBERT QUICK*
CARE Kenya, Homa Bay, Kenya; Center for Global Safe Water, Rollins School of Public Health, Emory University, Atlanta, Georgia; Enteric Diseases Epidemiology Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract. To prevent diarrhea in rural Western Kenya, we implemented the Safe Water System (water treatment with bleach, safe storage, and behavior-change communications) in 2000. We implemented a pilot project in a school in May 2003. Teachers taught students about safe water and hygiene. Safe water storage vessels were placed between classrooms. Two large water tanks for handwashing were positioned by the kitchen and latrines. The vessels were filled daily with water, which was treated with bleach and monitored for free chlorine residuals. Daily student care logs at the local clinic were reviewed. Clinic visits for diarrhea peaked during the January through March period in 2002 at 130 and in 2003 at 71, but in 2004, after project implementation, only 13 diarrhea episodes were recorded. The project saved the school about $5.49 per student per year. The project has been expanded to 70 schools, and an evaluation is planned.

In the developing world, poor access to safe drinking water and inadequate sanitation are important contributors to the risk of diarrheal diseases, which cause an estimated two million deaths per year in children under 5 years old.¹ The World Health Organization estimates that over 1 billion people lack access to improved water supply worldwide.²

According to the 2003 Kenya Demographic and Health Survey, in Nyanza Province, nearly 75% of the population lacked access to improved water supplies,³ and they had the third highest reported diarrhea rates in the country.⁴ In response to the lack of access to safe water and high diarrheal disease rates in rural Western Kenya, CARE Kenya collaborated with the Centers for Disease Control and Prevention (CDC) to initiate a Safe Water System (SWS) program in 2000.⁵ The SWS (www.cdc.gov/safewater) is an inexpensive household water quality intervention with 3 components:

- Water treatment using 1.0% locally produced sodium hypochlorite solution;
- Safe water storage in clay pots modified with a narrow mouth, lid, and spigot;⁶ and
- Behavior-change techniques, including social marketing and community mobilization.

Field evaluations have demonstrated that use of the SWS results in a 25–85% reduction in diarrhea risk.⁷–¹⁰,¹²

After successful implementation of the SWS pilot program in Nyanza Province,⁷ the nongovernmental organization Population Services International (PSI) launched a national social marketing campaign in 2003, branding the water treatment solution as WaterGuard. In 2004, PSI sold over 520,000 bottles of WaterGuard in Kenya.

In 2003, we initiated a pilot project to implement the SWS and handwashing promotion in Rangwe Junior Academy, a private rural primary school that is primarily supported by donations and modest fees paid by some of the students’ families. The school is based in Rangwe Division, a largely rural region in which communities lack access to electricity, rely primarily on surface water sources, and have less than 50% latrine coverage. At the time of the project, there were 380 students in grades 1 through 8, of whom 63 were AIDS orphans who lived in the school full time in two classrooms converted into dormitories. The school water source was an unprotected shallow well, and there were two latrines each for girls and boys. School staff reported that diarrhea was a problem among the students because of a lack of safe drinking water and facilities for personal hygiene. To address these problems, students, teachers, and support staff were taught about use of the SWS and proper handwashing practices. The school purchased five 40-liter clay pots modified for safe water storage with a narrow mouth, lid, and spigot, WaterGuard solution, and two large (100- and 220-liter) plastic tanks, both fitted with taps for handwashing and placed by the kitchen and latrines. Each day, students collected water from the well, filtered it into the clay pots and plastic tanks through a double fold of cotton cloth, treated it with WaterGuard, covered the containers, and waited at least 30 minutes before consuming the water. Students and staff monitored soap supplies to ensure that soap was available at the handwashing stations. The school was given a Hach Free and Total Chlorine Test Kit (Hach Co., Loveland, CO) to test treated water with the N,N-diethyl-p-phenylenediamine (DPD) method to verify that free chlorine residuals in treated water exceeded 0.2 mg/L.

The project was monitored through biweekly visits during which the project was reviewed with teachers, the students were observed using the SWS and handwashing facilities, and the treated water was tested for free chlorine residuals. To evaluate the program’s impact, project staff took advantage of the fact that, from January 2002 through March 2004, a single local physician was available to provide care to the students; his daily log of student office visits and diagnoses was observed, and diarrhea episodes were summed for each 3-month school term. Project start-up and recurring costs were determined and compared with reductions in school expenses for water treatment, medical care, and staff time for tutoring absent students. Resource and logistical constraints did not permit surveys of the parents of day students at the school.

During each of the biweekly school visits, Rangwe Academy was observed to have an adequate supply of full WaterGuard bottles and chlorine residuals ≥ 0.2 mg/L were detected in water stored in the clay pots and tanks on each occasion. Analysis of the local physician’s daily student care logs showed a peak in the number of clinic visits by students...
for diarrhea in 2002 and 2003 during the January to March school term, with 130 and 71 visits, respectively (Figure 1). After the May 2003 implementation of the SWS/handwashing intervention, however, only 13 clinic visits for diarrhea were recorded during the 2004 January to March term, the lowest number of quarterly visits recorded during the period of review.

The start-up cost for SWS totaled $123 ($34 for pots, $32 for tanks, and $57 for a handwashing station). Recurring monthly costs were $152 ($8 for 14 bottles of WaterGuard per month, $143 for staff costs, and $1 for filter cloth). Overall annual SWS operating costs were $1824, or about $4.80 per pupil. Reduced diarrhea rates resulted in average monthly reductions of $250 in medical costs, $40 in personnel costs required for tutoring absentee children, and $46 for firewood purchases for boiling drinking water. The annual cost reduction was $4032, or $10.61 per pupil. After subtracting start-up costs, the SWS and handwashing program saved the school $2085 a year, or $5.49 per pupil.

A number of organizations promote the concept of teaching students about water, sanitation, and hygiene to reduce the risk of disease, enable students to develop good hygienic habits early in life, and give them tools to motivate their parents to improve their hygienic habits. However, few evaluations of school hygiene programs in the developing world have been published. Findings from the evaluation of this project suggest that diarrhea incidence rates decreased in the Rangwe Academy student population after implementation of the intervention, and that the intervention may have saved money for the school. However, because this evaluation was retrospective and ecological in nature, it was difficult to assess to what extent the SWS/handwashing intervention may have been responsible for the decrease in diarrhea episodes. Indeed, before the implementation of the intervention, the number of clinic visits for diarrhea during the January to March period in 2002 and 2003 had decreased from 130 to 71. However, in each of those 2 years, there was a spike in the number of clinic visits for diarrhea in the January to March term, while during the same term in 2004, the expected increase in diarrhea episodes was not observed, and, in fact, the lowest number of visits during the entire evaluation period was recorded. School faculty indicated that this trend of a very low number of diarrhea cases has continued after transfer of student health care to a Ministry of Health clinic in May 2004. The observation of a decrease in diarrhea rates is consistent with the results found in household studies of SWS use and handwashing.6–10,12

Because of resource limitations, we were unable to determine other factors that might have contributed to the reduced risk of diarrhea. For example, a survey of households of students who did not live at the school might have provided insight into whether parents’ water handling or hygiene practices had changed and influenced the risk of disease among students who were exposed to the home environment for part of each day. We do know, however, that no water, hygiene, or sanitation programs were implemented in Rangwe Division during the evaluation period of this program, and it is therefore likely that the school intervention had a major impact on the reduced risk of diarrhea experienced by the students. Nevertheless, future evaluations of school programs would benefit from surveys of students’ households to determine the transfer of hygiene knowledge and practices from students to parents, to assess the relative contribution of the home environment to the risk of disease in students and other household members, and to ascertain the cost effectiveness of the intervention.

Results of this evaluation cannot be generalized because Rangwe Junior Academy is not typical of public schools in Kenya. As a private school, it is supported by donations and modest fees that enabled the school to purchase WaterGuard and soap and to cover some health-care costs for students. Despite this limitation, this combined intervention is accessible to public schools because hardware costs for a similar-sized school would be less than US $200 per school and annual recurring costs would be less than $150.

This intervention is still in place and functioning in 2006. The school invests about $72 per year for WaterGuard and a similar sum for soap, the availability of which is ensured by school staff. Students continue to monitor chlorine residuals. The handwashing tanks and water vessels are still in use. The school successfully solicited a donation for a handpump and cover for the well to protect the source and facilitate removal of water. The well water is not microbiologically pure and still requires treatment.

Results of this pilot project suggest that this approach to improving water quality in schools and hand hygiene among students is promising and deserves further study in the public sector. To evaluate the potential of this approach to diarrhea prevention, the project has been expanded to 70 public schools.

Received March 18, 2006. Accepted for publication October 31, 2006.

Acknowledgments: We are grateful to John Peterson of Balboa City, CA, for his support of this project.

Authors’ addresses: John Migele, Sam Ombeki, and Mary Ayalo, CARE Kenya, P.O. Box 88, Kisumu, Kenya, Telephone: +254-57-2020010, Fax: +254-57-2043820. Matthew Biggerstaff, Emory University, Center for Global Safe Water, Rollins School of Public Health, 1520 Clifton Rd., NE, Atlanta, GA 30333, Telephone: +1 (404) 727-6123, Fax: +1 (404) 776-9853; Robert Quick, Enteric Diseases Epidemiology Branch, Mailstop A38, Centers for Disease Control and Prevention, Atlanta, GA 30333, Telephone: +1 (404) 639-2208, Fax: +1 (404) 639-2205, E-mail: rxq1@cdc.gov.

Figure 1. Number of pupils visiting local clinic for diarrhea, January 2002 through March 2004, Rangwe Junior Academy, Rangwe, Kenya.
REFERENCES


