

# Evaluation of a Rapid Cholera Response Activity—Nyanza Province, Kenya, 2008

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**Background.** In response to recurrent cholera outbreaks in Nyanza Province, Kenya, a local nongovernmental organization assisted the Ministry of Health by providing cholera education activities to some cholera-affected communities. We evaluated the impact on cholera prevention knowledge and practices.

**Methods.** In November–December 2008, we conducted a cross-sectional household survey and tested stored water for chlorine in 6 cholera-affected enumeration areas (intervention-EAs) where response activities had occurred between March–September 2008, and 6 comparison-EAs with no known reports of cholera outbreaks or response activities.

**Results.** We enrolled 358 individuals from intervention-EAs and 365 from comparison-EAs. Overall, >80% knew cholera symptoms and over 60% knew that water treatment prevented diarrhea; <20% had chlorine residual in stored water. More intervention-EA respondents than comparison-EA respondents recalled a cholera outbreak in their community (52% vs 19%,  $P < .0001$ ), and of those, 51% versus 39%, respectively, had attended a cholera response event. Detectable chlorine residuals in stored water were found in a higher percentage of intervention-EA and comparison-EA event attendees (21% and 25%, respectively) than nonattendees (17% and 8%, respectively).

**Conclusions.** There was a gap between knowledge and practice of water treatment as a cholera preventive measure. Cholera event attendance may have modestly motivated increased household water treatment.

**Keywords.** attitudes and practices; cholera; cholera response; hand-washing; impact; knowledge; water treatment.

## BACKGROUND

Epidemic cholera remains a persistent, intractable problem in many developing countries [1–3], with cholera-related morbidity and mortality rates in sub-Saharan Africa exceeding other regions until recently [2, 4]. Reported figures are conservative given the vast underreporting of cases [4]. The illness, caused by the toxigenic bacterium *Vibrio cholerae* serogroups O1 and O139, manifests as acute watery diarrhea, and can be rapidly fatal if not promptly treated [5]. The disease is transmitted through the fecal-oral route primarily through

contaminated water, and outbreaks occur most frequently in settings with poor water and sanitary infrastructure [5]. Long-term cholera control and prevention will require investments in improved drinking water and sanitation infrastructure [5], which are time and resource intensive. In the interim, immediate disease control and prevention efforts, especially in outbreak situations, focus on treatment (oral and intravenous rehydration, and antibiotics) and household-level safe water supply, sanitation, and hygiene promotion [6].

Since the advent of the seventh cholera pandemic in Africa, Kenya has been affected by numerous cholera occurrences [7]. Reported case-fatality rates have been high in some outbreaks [4, 8]. Further, latest estimates show that only 82% of urban and 52% of rural Kenyan populations have access to improved water sources, and only 32% of both urban and rural populations have access to improved sanitation [9]. Nyanza Province, on the border of Lake Victoria in rural western Kenya, has been the most frequently affected province in recent years [7, 10].

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Cholera response efforts of the Kenya Ministry of Health (KMOH) have included collaborations with nongovernmental organizations (NGOs) to implement various cholera outbreak response activities [11]. Typical partner-supported cholera response activities have included mass-media campaigning, cholera case management, distribution of water treatment and hygiene products, and environmental investigations consisting of collection and testing of water samples. The Safe Water and AIDS Project (SWAP), a Kenyan NGO that serves as an umbrella organization for hundreds of women's groups who promote and sell water treatment and hygiene products as an income-generating activity [11], assisted KMOH in cholera response activities in Nyanza province in 2008. In November–December 2008, we conducted an evaluation of the SWAP-assisted rapid cholera response activities to gain a better understanding of the impact of the activities on community knowledge, attitudes, and practices related to cholera prevention and control, and to provide recommendations for future cholera outbreak response activities in Nyanza Province.

## METHODS

### Population

Nyanza Province is one of Kenya's poorest areas with 63% of the estimated population living on less than \$1 a day [12]. The province has one of the highest prevalence rates of human immunodeficiency virus infection at 15.1%, and life expectancies are among the lowest in the country (43 years for women and 37 years for men). Nyanza Province also has high rates of infant mortality (133 deaths per 1000 live births) and under-5 mortality (206 per 1000 live births [12]).

The evaluation population was mostly composed of the polygamous Luo tribe, who have typical dwellings in the form of compounds with 1 or more households. Household economies were largely supported by subsistence farming and fishing along the shores of Lake Victoria.

### Sampling

The evaluation was conducted in enumeration areas (EAs)—population groupings of approximately equal size used by the government of Kenya for conducting the decennial census. EAs were also the focus of cholera prevention activities. Intervention enumeration areas (intervention-EAs) were predetermined based on information from SWAP regarding the site of SWAP-assisted response activities from March to September 2008. We defined an intervention-EA as a community with a reported cholera outbreak between March and September 2008 that was visited by a cholera response team, including SWAP staff. Of a total of 8 EAs in which SWAP-assisted response activities occurred, 3 occurred in 1 district (3 separate locations); because of cost, logistical, and access considerations, we included the community with the largest number of reported cases in that

district in the evaluation. All EAs were rural and corresponded to a single village.

For each intervention-EA, we randomly selected 1 geographically-matched comparison-EA within the same administrative unit (referred to locally as "location"), to which no SWAP-assisted cholera response teams had been sent. For comparison-EA selection, we excluded the sublocation containing the intervention-EA to reduce the likelihood of overmatching by selecting a comparison-EA too close to the intervention-EA.

Our evaluation took place across 6 administrative units (6 "locations") in 6 intervention-EAs and 6 comparison-EAs. We included all compounds in the selected EAs in our evaluation and randomly selected 1 household per compound for enrollment by blindly drawing a numbered slip of paper out of a hat. A household was defined as all persons eating from the same cooking pot.

### Data Collection

We reviewed SWAP internal activity reports to obtain information regarding the number and nature of SWAP-assisted response activities from March to September 2008.

In November–December 2008, enumerators (hired, trained, and supervised by a research team independent of SWAP) administered a cross-sectional household survey in intervention-EAs and comparison-EAs. The questionnaire was offered to the female head of the household, or an alternative household adult member if the female head was not available. The questionnaire measured recall of cholera outbreaks and response activities; community knowledge, attitudes, and practices associated with recent cholera outbreaks, with a focus on water treatment and storage practices; sanitation and hygiene practices; and trusted sources of cholera prevention and health-promotion information. Observations were made of water storage containers, water treatment products, hand-washing facilities (defined as water and soap in the same place in the home), presence and type of latrines, and demographic and socioeconomic characteristics. Where available, water stored in the home was tested for residual chlorine using the N,N-diethyl-p-phenylenediamine method (Lamotte Co., Chestertown, MD).

### Data Analysis

Questionnaire data were collected by trained enumerators using personal digital assistants (PDAs). Data from PDAs were transferred into a Microsoft Access database, and analyzed using SAS software version 9.3 (SAS Institute, Cary, NC). We used exact conditional logistic regression to test differences in responses between intervention-EAs and comparison-EAs for various attributes. Six strata were defined by the 6 intervention-EAs and the corresponding matched comparison-EAs; *P* values are reported. Differences in attributes by event attendance were calculated separately for intervention-EAs and comparison-EAs using a Pearson  $\chi^2$  test. Statistical significance was determined

at  $P < .05$ ; missing data were excluded from all calculations. Open-ended data were analyzed descriptively.

### Ethical Review

The Centers for Disease Control and Prevention Institutional Review Board (IRB) determined that this activity was a program evaluation of public health practice and that IRB regulations did not apply; the evaluation was approved by the Kenya Ministry of Health. Verbal informed consent was obtained from all participants, and personal identifiers were permanently removed from the database.

## RESULTS

### SWAP Response Activities

SWAP assisted KMOH on 8 reported cholera outbreaks response activities in 6 districts of Nyanza Province (Kisumu, Siaya, Nyando, Migori, Homa Bay, and Rachuonyo) that took place between March and September 2008. Each response activity was conducted during the outbreak. Three of 8 responses occurred in Migori District, but in separate locations (administrative units), which was our unit of geographic matching. SWAP sent personnel and supplies to provide education about cholera; demonstrate water treatment, safe water storage, sanitation, and hand-washing techniques; and distribute locally marketed water treatment products and soap. Because there was no standardized event, each event was adapted to the specific setting. In general, for each event, SWAP provided 1–3 field personnel who facilitated educational sessions that lasted from 1–4 hours and took place with a variety of audiences at different, locally determined venues in the cholera-affected EAs, which included schools, health facilities, chief's meetings, markets, and individual homes. The reported attendance at each event ranged from 20 to 100 individuals from affected communities.

### Community Survey

A total of 358 respondents (range, 34–93) in intervention-EAs and 365 respondents (range, 37–103) in comparison-EAs agreed to participate and were interviewed. The median number of days between cholera response activities in intervention EAs and the survey was 179 (range, 117–275).

### Demographic and Socioeconomic Characteristics

Approximately three-quarters of survey respondents in intervention-EAs and comparison-EAs were female with a median age of 40 years (Table 1). A higher proportion of respondents in comparison-EAs than intervention-EAs had completed primary school education (35% vs 26%;  $P < .01$ ) and used an improved water source (69% vs 47%;  $P < .001$ ). There were no other major demographic and socioeconomic differences between households in intervention-EAs and comparison-EAs.

**Table 1. Demographic and Socioeconomic Characteristics of Respondents in Intervention and Comparison Enumeration Areas, Cholera Response Evaluation, Nyanza Province, Kenya, 2008**

Characteristic	Intervention	Comparison	P Value
Number of respondents	N = 358	N = 365	...
Female, no. (%)	262 (74)	276 (76)	...
Age in years, median (range)	39 (17–84)	40 (17–94)	NS
Median household size	5	5	...
Completed primary education or higher	92 (26)	126 (35)	.01
	No. (%)	No. (%)	
Paraffin lantern as main lighting source	349 (99)	338 (96)	NS
Thatch or metal sheets as main roofing materials	349 (100)	356 (100)	NS
Floor material (dung/mud/metal/wood)	319 (91)	278 (78)	<.001
Own house	340 (96)	343 (95)	NS
Own land	342 (96)	332 (92)	NS
Own radio	245 (69)	257 (71)	NS
Improved household water sources	169 (47)	249 (69)	<.001
Presence of hand-washing station	7 (2)	1 (<1)	NS
Presence of latrine facility	143 (41)	155 (43)	NS

NS indicates  $P > .05$ .

Only 2% of intervention-EA respondents and 1% of comparison-EA respondents had hand-washing stations in their homes; fewer than half in either group had latrines (Table 1).

### Cholera Outbreak Awareness

At the time of interview, a higher percentage of intervention-EA than comparison-EA respondents recalled a cholera outbreak in their community since March 2008 (52% vs 19%;  $P < .0001$ ) (Table 2). The source of information of cholera outbreaks among intervention-EA and comparison-EA respondents who were aware of the outbreak included, respectively, social contacts such as friends, family, and neighbors (81% vs 59%), health workers or community groups (28% vs 35%), and mass media (11% vs 18%).

### Cholera Knowledge, Attitudes, and Behaviors

In intervention-EAs and comparison-EAs, >90% of respondents had heard about cholera, >90% knew it is contagious, and >80% respondents reported that the main symptom of cholera was watery diarrhea (Table 2). A higher percentage of intervention-EA than comparison-EA respondents reported having heard of a death due to cholera (46% vs 33%;  $P < .0001$ ). Additionally, >75% of respondents in both groups knew at least 1 vehicle for cholera transmission, including contaminated water, food, or poor hygiene; and >60% in both groups were

**Table 2. Percentage of Respondents That Recalled Cholera Outbreaks, and Reported Knowledge and Behaviors Regarding Cholera, Cholera Prevention, and Treatment, by Intervention and Comparison Enumeration Areas, Cholera Response Evaluation, Nyanza Province, Kenya, 2008**

Characteristic	Intervention n = 358 No. (%)	Comparison n = 365 No. (%)	P Value
<b>Outbreak recall</b>			
Remembered a cholera outbreak in village since March 2008 at time of interview	186 (52)	71 (20)	<.0001
Heard of a death due to cholera during the year	163 (46)	117 (33)	<.0001
<b>Knowledge</b>			
Ever heard about cholera	322 (92)	332 (92)	NS
Knew that main symptom of cholera is watery diarrhea	266 (83)	279 (84)	NS
Knew that cholera is contagious	315 (98)	310 (94)	NS
Knew at least 1 vehicle for cholera transmission	263 (75)	281 (78)	NS
Knew about boiling/treating water for cholera prevention	221 (63)	238 (66)	NS
Knew about hand-washing for cholera prevention	108 (31)	137 (38)	NS
Knew about rehydration for cholera treatment	165 (47)	174 (48)	NS
<b>Behavior</b>			
Stored drinking water in the household	356 (99)	363 (100)	NS
Used improved storage container to store drinking water (with tap and lid)	1 (<1)	3 (<1)	NS
Used soap for hand-washing	206 (59)	219 (61)	NS
Washed hands at all key times (before eating/cooking, after visiting toilet/cleaning babies)	12 (3)	16 (4)	NS
Reported water treatment on day of interview	199 (56)	134 (37)	<.0001
Residual chlorine detected in household stored water	53 (17)	45 (14)	NS

NS indicates  $P > .05$ . Multiple responses were possible. Categories not mutually exclusive. Denominators differ due to missing data.

aware that water treatment could prevent cholera. However, <40% mentioned hand-washing as a cholera prevention method, and fewer than 50% of respondents in both groups identified rehydration as a treatment modality for cholera (Table 2). Although approximately 60% of respondents in both groups reported using soap for hand-washing, less than 5% reported washing hands at all 4 key times (before eating, before cooking, after visiting the toilet, and after cleaning babies) (Table 2). A higher percentage of intervention-EA than comparison-EA

respondents reported treating water on the day of interview (56% vs 37%;  $P < .0001$ ). However, a substantially lower percentage of stored water samples in both groups had detectable chlorine residuals (17% vs 14%;  $P = NS$ ).

Most respondents (71% intervention, 62% comparison) in both groups reported feeling compassion for, and a desire to help, cholera patients, and felt that the community would generally be friendly or supportive toward them (88%).

### ***Cholera Response Activity Attributes***

Among 186 respondents from intervention-EAs who remembered at least 1 cholera outbreak in their community, 94 (51%) reported attending a specific cholera education event, and 28 (39%) of 71 respondents from comparison-EAs reported attending a similar event (Table 3); the principal cholera prevention topics recalled by intervention-EA and comparison-EA respondents, respectively, included water treatment (83% and 89%), building and using latrines (72% and 75%), cleaning cooking utensils (50% and 54%), hand-washing with soap (27% and 36%), and seeking treatment for severe diarrhea (13% and 29%) (Table 3). A higher percentage of intervention-EA than comparison-EA attendees reported receiving a water treatment product (66% vs 43%), soap (15% vs 0%), medicines (13% vs 7%), and oral rehydration salts (5% vs 0%) at the event (Table 3).

### ***Comparison of Cholera Event Attendees Versus Nonattendees***

Intervention-EA respondents who attended cholera events were significantly more likely than nonattendees from intervention EAs to report receiving specific cholera prevention and treatment information (94% vs 54%;  $P < .0001$ ), and to specifically identify water treatment (75% vs 60%;  $P = .03$ ) and hand-washing (42% vs 25%;  $P = .01$ ) as preventive measures (Table 4). Comparison-EA respondents who reported attending cholera education events were also more likely than nonattendees from comparison EAs to report receiving specific cholera prevention and treatment information (89% vs 63%;  $P = .01$ ), to identify rehydration as a cholera treatment method (68% vs 42%;  $P = .03$ ), and hand-washing (46% vs 21%,  $P = .02$ ) as a cholera preventive measure. A higher percentage of comparison-EA event attendees than nonattendees had detectable residual chlorine in water stored in their homes (25% vs 8%;  $P = .05$ ) (Table 4).

### ***Other Cholera Information Venues***

Intervention-EA and comparison-EA respondents also reported receiving cholera-related information outside of cholera events, most frequently during health care visits (35% vs 37%). Reported education topics at these visits included water treatment (92% vs 93%), building and using latrines (72% vs 56%), and seeking immediate treatment for illness (31% vs 13%).

**Table 3. Percentage of Respondents Who Were Aware of Cholera in Their Community and Reported Response Activity Attendance, With Reported Venues, Speakers, and Topics, by Intervention and Comparison EAs, Cholera Response Evaluation, Nyanza Province, Kenya 2008**

Characteristics	Intervention n = 186 No. (%)	Comparison n = 71 No. (%)
Attended a cholera education event	94 (51)	28 (39)
	n = 94 No. (%)	n = 28 No. (%)
Reported event venues		
School	32 (34)	6 (21)
Clinic/health facility	22 (23)	13 (46)
Chief's barasa	24 (25)	7 (25)
Community meeting	21 (22)	4 (14)
Someone's compound	27 (29)	1 (4)
Reported person(s) who talked about cholera prevention and treatment at event		
MOH	59 (63)	14 (50)
Red Cross	13 (14)	1 (4)
NGO	20 (21)	12 (43)
SWAP	5 (5)	1 (4)
Community health worker	13 (14)	6 (21)
Village chief	25 (27)	9 (32)
Reported Education Topics		
Water treatment	78 (83)	25 (89)
Hand-washing	25 (27)	10 (36)
Build and use latrines	68 (72)	21 (75)
Seek treatment for severe diarrhea	12 (13)	8 (29)
Cover food	24 (26)	10 (36)
Cook food thoroughly	36 (38)	11 (39)
Wash fruits and vegetables	10 (11)	5 (18)
Clean cooking utensils	47 (50)	15 (54)
Free product received		
Water treatment product	62 (66)	12 (43)
Soap	14 (15)	0
Oral rehydration solution	5 (5)	0
Medicines (type unknown)	12 (13)	2 (7)

Some open-ended questions. Multiple responses were possible. Categories not mutually exclusive. No statistical testing performed.

Abbreviations: MOH, Ministry of Health; NGO, nongovernmental organization; SWAP, Safe Water and AIDS Project.

About 15% of intervention-EA and 6% of comparison-EA respondents also reported receiving cholera information during a home visit by health or NGO personnel.

## DISCUSSION

The results of this evaluation highlight several challenges to successful implementation of a rapid cholera response activity and behavior change in a cholera-endemic area. First, although

awareness of the disease in this endemic area was high, knowledge of cholera preventive practices was modest, and actual preventive practices lagged behind. While this finding was consistent with at least 1 other study conducted during a cholera outbreak [13] and highlights the challenge of motivating sustained behavior change [14], it is surprising because of the relatively high local awareness of the risk of death from cholera [8]. Second, relatively low numbers of respondents were aware of an outbreak in their home village during that year. Third, despite efforts to respond rapidly to the outbreaks, only 26% of the affected population in intervention-EAs recalled attending an event. Reasons for low attendance were not found in the data, but possible explanations include poor publicity, poor community mobilization, competing economic and health priorities in intervention-EA households, or apathy toward cholera, particularly given that the educational events occurred a median of 6 months (range, 4–9 months) after the cholera outbreak. We noted that in general there was no stigma associated with the disease, which may indicate that the disease is viewed as a routine occurrence by the population. Finally, knowledge of cholera treatment was low in both groups, despite being endemic and associated with high case fatality rates in this area [8, 10]. Effective rehydration is essential to the first priority of cholera outbreak management, which is preventing death. Lack of awareness of the need for immediate rehydration has been a leading factor identified in studies of cholera mortality [15]. Low knowledge and use of oral rehydration salts and poor household case management of diarrhea in children was recently documented in 2 studies in western Kenya [16, 17].

Although response activities had low attendance and possibly a modest impact, our evaluation found that, in both groups, attendance at a cholera education event was associated with an increase in cholera prevention and treatment knowledge and practices. Specifically, knowledge regarding hygiene and cholera treatment, and reported and observed water treatment practices were higher among event attendees. In addition, detectable residual chlorine levels in stored water, an objective measure of water treatment, were higher among event attendees than non-attendees, and exceeded levels observed in other populations in the region in recent studies [13, 17].

Our data also highlight several potential deficiencies of the SWAP cholera response events. First, there may have been insufficient emphasis on hand-washing behaviors, as suggested by the low proportion of respondents who reported receiving hand-washing education during events, had awareness of the importance of hand-washing, and had installed hand-washing stations (ie, soap and water in the same location) in their homes. At least 1 study in sub-Saharan Africa has documented the protective effect of having soap and reporting hand-washing in a cholera outbreak [18]. Second, there may have been inadequate information about cholera treatment, as awareness of the need to seek care immediately for severe diarrhea was

**Table 4. Percentage of Respondents With Cholera Prevention and Treatment Knowledge and Water Treatment Practices, by Event Attendance, Intervention Comparison EAs, Cholera Response Evaluation, Nyanza Province, Kenya, 2008**

	Intervention			Comparison		
	Attendees n = 94 No. (%)	Nonattendees n = 92 No. (%)	P Value	Attendees n = 28 No. (%)	Nonattendees n = 43 No. (%)	P Value
Received information on cholera prevention and treatment	80 (94)	45 (54)	<.0001	25 (89)	24 (63)	.01
Knowledge of rehydration for cholera treatment	48 (52)	39 (43)	NS	19 (68)	18 (42)	.03
Knowledge regarding cholera prevention by water treatment	69 (75)	55 (60)	.03	24 (86)	30 (70)	NS
Knowledge regarding cholera prevention by hand-washing	39 (42)	23 (25)	.01	13 (46)	9 (21)	.02
Reported water treatment on day of interview	69 (74)	59 (65)	NS	16 (57)	20 (47)	NS
Water treatment product observed in the home	73 (78)	61 (66)	.06 (NS)	14 (54)	24 (60)	NS
Residual chlorine detected in household stored water	19 (21)	16 (17)	NS	7 (25)	3 (8)	.05

NS indicates  $P > .05$ . Denominators differ due to missing data.

relatively low. This finding is concerning because survival from an episode of cholera can depend on prompt initiation of oral or intravenous rehydration [8, 16].

Among people who had heard of the outbreak, the principal information source was social contacts (friends, family, and neighbors), which suggests that social networks can be a valuable resource to increase outbreak awareness, spread prevention and treatment messages, and notify community residents about the location of response activities [19]. Other alternative information sources—in particular, health care visits—have been shown to be effective venues for disseminating key messages related to cholera treatment [8], safe water and hygiene [15, 20], and distributing water treatment products and soap [20].

Our evaluation had several limitations. First, because we were limited to a convenience sample of intervention-EAs, results are neither representative of Nyanza Province nor generalizable beyond the communities in the evaluation. Second, there may have been inadequate geographic separation between intervention-EAs and comparison-EAs, enabling both groups to be exposed to similar cholera prevention interventions. Third, because there were no specific markers to differentiate an event where SWAP was involved, survey responses may have referred to an activity performed by another organization. Finally, recall of cholera response activities may have been poor because interviews were conducted 3 or more months after the events.

The results of this evaluation have informed efforts by SWAP, the KMOH, and other partners to plan for future cholera response activities. In particular, partner organizations will share information on personnel, resources, and types of activities they can contribute to future outbreaks in order to collaborate more effectively and avoid duplication of effort. Educational content of outbreak response efforts will include harmonization of key messages regarding cholera prevention and treatment, with adequate emphasis on hygiene and cholera

treatment. Future response activities will attempt to make use of local residents, opinion leaders, community health workers, and community-based organizations as educators and promoters to take advantage of the importance of local residents as sources of information. Educational materials will be developed with this type of information source in mind, using as a model simplified materials used in the response to the Haiti cholera epidemic in 2011 (<http://www.cdc.gov/cholera/pdf/Five-Basic-Cholera-Prevention-Messages.pdf>). Alternative approaches to information dissemination, particularly door-to-door, will be explored in future outbreaks. Finally, as new approaches are piloted, partners will evaluate their impact on cholera prevention knowledge and practices.

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