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Subject: Epi-Aid # 2010-029 Trip Report: **Nationwide Outbreak of Cholera in Kenya, 2009-2010**

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EXECUTIVE SUMMARY

In 2009, multiple areas in Kenya experienced cholera outbreaks with Case Fatality Rates (CFR) ranging from 0.4% to 19% in areas that had more than 2 cases. This country-wide outbreak resulted in over 11,000 cases of acute watery diarrhea, as reported by the Kenya Ministry of Public Health and Sanitation--Division of Disease Surveillance and Response (MoPHS – DDSR). The MoPHS defined the objectives of the investigation as follows: (a) to provide assistance with describing the epidemiology of cholera outbreaks in Kenya nationally during 2009-2010, (b) to evaluate the surveillance and response efforts during the 2009-2010 outbreaks, and (c) to evaluate water quality in select Nairobi informal settlements.

Descriptive Epidemiology

The Centers for Disease Control and Prevention (CDC) and Kenyan Field Epidemiology and Laboratory Training Program (FELTP) teams assisted DDSR with the compilation of acute watery diarrhea/cholera surveillance data to create a national overview of cholera in Kenya during 2009. The team created a national line list, merged and cleaned existing data from the district and provincial levels, and performed preliminary analysis of the data. The national line list included a total of 7392 cases of acute watery diarrhea/cholera in Kenya in 2009. Of the 7099 cases with gender information, 49.8% of cases were female. Of the 6124 cases with age information, the median age of cases was 17 years (range: 0-90 years). There were 122 deaths due to cholera reported on the national line list, and CFRs varied among districts, with a range of 0 to 14.3%, per the line list data available at the national level. Laboratory testing was

completed on 932 (13%) of 7392 cases with acute watery diarrhea/cholera per the national line list. Cultures yielding *Vibrio cholerae* were reported for 542 (58%) of the 932 specimens tested.

Cholera Surveillance System

The main reporting mechanism was of non-systematic aggregate data reported at variable intervals. This surveillance system did allow for some targeting needed supplies and medical attention, including supplies, but was incomplete. There was no national aggregated line list present prior to the initiation of this investigation.

Reporting of individual cases as a line listing offers important advantages, if it can be made simple and timely. There were a number of challenges associated with obtaining reliable line list data. Line listing-based surveillance is part of Integrated Disease Surveillance and Response (IDSR), yet many newly established districts did not receive IDSR training, including training on the cholera-specific IDSR module. The Kenya version of the World Health Organization (WHO) cholera case definition did not include age limits, so children less than 2 years old were included in the district line lists of surveillance data reported to DDSR. The lack of a standardized line list form made national data compilation and analysis difficult. No electronic national line list was established before the investigation team designed, entered the data, and implemented the national line list along with DDSR and the FELTP. DDSR did not receive district line lists in a timely manner, and districts were e-mailing electronic files or mailing hard copy files with surveillance data to different individuals within the Ministry. Files were getting lost and misplaced along the way. Also, file formats with surveillance data

included MS Word, MS Excel, Acrobat PDF's, and hard copy files with different templates and different variables on the various formats. There needs to be a standardized line list with consistent variables used in the districts to allow for timely data entry as file conversion from incompatible file formats is extremely time consuming, especially in the midst of a large outbreak with limited staff resources to reformat and re-enter data. The use of scannable forms may be worth considering as another alternative for outbreak data, if this is in line with IDSR objectives. Currently, all districts were required to report to the national level. The provincial levels were also receiving some reports and are responding to these. However, efficiency and accuracy of this system can be increased if there were systematic reporting from the local level to the district level, followed by district level reporting to the provincial level, and subsequent provincial level reporting to the national level.

It is necessary to ensure that the surveillance data captures institutional outbreaks appropriately; many outbreaks were identified among prisons and among schools on the line list. Both types of institutional settings were identified in many different areas spread across the country, however, investigation of how these may have been connected (such as inmate transfer from one prison to another, new inmates, etc.) was not possible as the surveillance data submitted to the national level was not timely enough, particularly with regard to institutional outbreaks outside of Nairobi. Characterization of the institutional outbreaks from 2009 would be very important as many deaths among institutionalized persons were noted, particularly among prison inmates, and therefore this may have influenced the district level CFRs.

Laboratory

Laboratory confirmation of cholera cases served to demonstrate the presence of cholera in a number of regions and districts, and determined local resistance patterns in order to guide antibiotic therapy. However, reporting of results back to the district or clinical level was variable and sometimes did not occur. Multiple laboratories collected and/or received and tested specimens from the 2009 cholera outbreaks. The supplies for specimen collection, transport and testing were not available in some areas. There were no clear protocols for storing or forwarding isolates.

The rapid cholera test kit (Crystal VC® Dipstick rapid test) could have benefit in the setting of acute watery diarrhea outbreaks to more swiftly identify *V. cholerae*. However, these were largely non-existent outside Nairobi, with the exception of some locations visited by the FELTP residents who brought the cholera rapid test kits with them during initial investigations.

Rural Cholera Knowledge Attitudes and Practices

A community Cholera Knowledge Attitudes and Practices (KAP) survey was conducted in two rural, nomadic, pastoral communities in two districts in the Rift Valley Province, specifically East Pokot and Turkana South. The CFR in East Pokot was 11.7%, while the CFR in Turkana South was 1.0%. The findings of the KAP survey suggested that there are small differences in cholera knowledge, attitudes, and practices among community members between these two populations of East Pokot and South Turkana; however, there were significant differences in access to health care and availability of

health products between the two communities (Section 2b). These differences may be related to the higher population density in Turkana South compared with East Pokot as well as to the larger NGO presence in Turkana South. In both districts, public health messages about cholera had reached remote areas; both communities were aware of cholera and many had experienced cholera within their villages and families.

Additionally, most families surveyed were aware of Oral Rehydration Salts (ORS) as a treatment for diarrhea and cholera, although most reported that ORS was not available within their village [East Pokot (14%) < Turkana South (38%) ($p<.0001$)]. Due to the high illiteracy rate (88%) in this region, much of the health messaging was delivered via village chiefs, and community health workers from the district level to the household level, as opposed to radio, print media or other communication channels.

Based on the findings of the community KAP survey, lack of access to healthcare in East Pokot, compared with Turkana South, likely contributed to the increased CFRs in this district as opposed to lack of community awareness of cholera or misunderstanding of public health messaging within the community. Distribution of supplies for the cholera response from the national level to the district level had occurred; however, distribution to the household level was limited, particularly in East Pokot, due to lack of transportation to remote and inaccessible areas. Due to the transportation constraints and the rough terrain, there were logistical delays in getting the interventions provided by the MoPHS and donors such as point-of-use household water treatment products, soap, jerrycans, water filters, etc. out to these communities after the rapid delivery of these interventions to the offices of the district public health officials and others at the district level.

Rural and Urban Health Care Worker Case Management

A survey evaluating health care worker knowledge of cholera transmission, prevention, and treatment practices, availability of supplies, and laboratory capacity in health facilities was conducted in two rural districts, East Pokot and Turkana South, and three urban informal settlements (Embakasi, Kasarani, and Kibera) in January, 2010. From these surveys, we identified low knowledge of cholera case definitions and a lack of recent training in cholera case management among health care workers in the rural and urban areas surveyed. It is important to note that health care workers had high knowledge of the symptoms and correct treatment of severe dehydration, which is critical life-saving knowledge in a cholera outbreak.

However, knowledge of the correct treatment for patients with some and no dehydration is lower, and overuse of intravenous fluids (IVF) and antibiotics was common among health care workers in rural and urban areas. The majority of health facilities in both rural districts experienced shortages of ORS, IVF, needles and tubing, and/or antibiotics for cholera treatment in 2009, and also had shortages during the time of the survey; health facilities in urban areas experienced fewer shortages of cholera treatment supplies. Fewer rural health facilities than urban health facilities had the capacity to collect and transport stool specimens, or conduct stool cultures or rapid cholera tests. In addition, only 3.5% of kiosks/chemists in both rural districts surveyed sold ORS, resulting in poor access to community availability of the treatments for dehydration and cholera outside of the health facility.

Nairobi Water Quality Study

The objectives of the Nairobi Water Quality Study were to assess water treatment practices at the municipal and household level, and to examine the microbiological quality of source and stored household drinking water in two informal settlements (Korogocho and Mukuru kwa Njenga) of Nairobi affected by recent cholera outbreaks. A random sample of drinking water sources was tested for total and free residual chlorine, and microbiologic quality; in parallel, we conducted interviews with selected household served by these sources and tested their stored drinking water for total and free chlorine residual and microbiologic quality. The majority of residents surveyed in Korogocho and Mukuru kwa Njenga use standpipe water and there is little reported variability of sources used during the rainy and dry seasons. The vast majority of households reported storing water in the house and very few reported using any type of household water treatment.

Contamination rates of source water were similar for both settlements. Of the 99 source waters tested in Korogocho, 27.1% showed total coliform contamination and 7.3% showed *E. coli* contamination. In Mukuru kwa Njenga, 32.7% of surveyed source waters were contaminated with total coliforms and 8.2% of source waters were contaminated with *E. coli*. Although these levels appear low, they were not insubstantial considering the piped water supply in these areas was thought to contain adequate chlorine levels necessary for inactivation of contaminants. While the rates of contamination were similar in the two informal settlements, median free chlorine levels varied substantially. In Korogocho, the median free chlorine level of contaminated water was slightly higher (0.6 mg/L) than the World Health Organization recommendations for standpipe water

(0.5 mg/L) from water distribution systems affected by cholera. In Mukuru kwa Njenga, a chlorine deficiency was observed for standpipe water with a median free chlorine level of 0.19 mg/L for sources contaminated with total coliforms and 0 mg/L for sources contaminated with *E. coli*. One possible explanation for this difference between settlements is very few "illegal" connections were observed in Korogocho as compared to Mukuru kwa Njenga.

As expected, contamination levels of stored household water were substantially higher than source waters, and free chlorine levels in stored household water were universally non-existent. Higher levels of contamination were observed in household water tested in Mukuru kwa Njenga. The median MPN count of total coliforms in Mukuru Kwa Njenga was 209.3 CFUs compared to 37.9 CFUs in Korogocho. One possible explanation for increased contamination levels could be initial chlorine deficiencies in the source water within this settlement, thus leaving the household waters more vulnerable to further contamination. Contamination levels did not vary substantially between types of storage container.

Although contamination levels were lower than expected in both settlements, water chlorination deficiencies were observed at both the source and household level. Interventions should be considered to address both discrepancies at the source and household level, especially during cholera outbreaks.

This large, prolonged, nationwide outbreak of acute watery diarrhea/cholera resulted in the highest case count of cholera in Kenya in the past decade. This comprehensive investigation of the 2009 cholera outbreaks in Kenya highlighted the significant impact these outbreaks had nationally as well as important challenges the

country faced with regard to surveillance for cholera and in the response to the outbreaks in both remote rural areas of the country as well as in the urban informal settlements of the capital city of Nairobi. As outlined in this report, there are considerable opportunities for targeted interventions to improve surveillance, prevention and control, and response efforts at the national level as well as at the provincial and district levels, not only for cholera, but other waterborne outbreaks and infectious disease outbreaks in general.

Based on the study findings, we recommend the following:

Cholera Surveillance System

- Continue surveillance for new cases using the established national line list
- Actively follow-up on known outstanding data from districts
    - Update 2009 national line list as outstanding data are received
- Maintain the new standardized electronic national line list
    - Create a national line list for 2010 cholera cases
- Create a standardized cholera line list form and train health facilities on its use
    - Roll out standardized line list forms to districts
    - Emphasize use of correct WHO cholera case definition for reporting
- Revise surveillance section in MoPHS Guidelines on Cholera Control
    - Include template for standardized cholera line list form
    - Explain importance of line list
    - Describe cholera case reporting protocol, such as deadlines for reporting

- Establish official lines of communication and deadlines for reporting line list data to the national level
    - Create a national line list e-mail inbox for receiving line lists from health facilities and districts with internet access
    - An alternative to consider in discussion with IDSR would be implementing the use of scannable forms, which could be sent to DDSR via e-mail, fax or mail and then optically scanned at DDSR into a database. Additional resources would be needed to implement such a system at DDSR
- Provide additional staffing, training, and IT capacity for the DDSR data section
- Ensure that the surveillance data captures institutional outbreaks appropriately
- Provide training on IDSR, including the cholera module, in districts not trained
- Consider transitioning to systematic aggregate data reporting within IDSR guidelines during an outbreak situation, once a national line list is established, functional and has been used to characterize the outbreak
- Improve systematic aggregate reporting using a standard reporting time frame, and collection of weekly summary number for cases identified that week
- Long term: Assess the behavioral, climatologic, and other environmental factors in Kenya that may be related to an upsurge in acute watery diarrhea/cholera

Laboratory

- Reemphasize/establish official lines of communication with respect to where specimens should be sent for testing at the districts. Require mandatory reporting of results back to districts
- Establish and provide resources for a national protocol for banking and storage of isolates
- Facilitate the distribution of laboratory supplies and reagents to districts most likely to be affected
- Consider procuring and distributing Crystal VC® Dipstick rapid test for early detection of cholera outbreaks

Rural Cholera Knowledge Attitudes and Practices

- Incorporate an ORS strategy into the draft Diarrhea Control Manual and other Ministry diarrheal disease strategies
- Initiate and increase utilization of the community health worker model which will assist with surveillance and response
- Promote universal ORS availability in the community, including at local shops and pharmacies, and from community health workers
- Encourage traditional healers to carry and distribute ORS, as part of their diarrhea treatment regimens
- Continue distribution of water treatment supplies such as Aquatabs, jerrycans, ORS, and soap for cholera response complemented with education on proper use of water treatment supplies and hygiene education

- Long term: Improve access to health care for remote areas
    - Consider using mobile health units during an outbreak situation
- Long term: Improve access to improved water sources and water availability

Health Care Case Management

- Revise and disseminate the revised version of the MoPHS/WHO Guidelines on Cholera Control book and ensure that all health facilities have copies
- Provide routine cholera case management refresher courses for health facility staff, especially during outbreaks
- Enhance capacity for laboratory confirmation by providing rapid cholera test kits, stool specimen cups, and transport media for health facilities and by facilitating transportation of specimens to laboratories
- Ensure that laboratories report back to the health facility the test results including antimicrobial susceptibility testing results if carried out
- Cholera treatment supplies should be monitored and inventoried at health facilities, and shortages and stock outs *(no supplies)* of ORS at health facilities should be addressed by health facility administrators immediately

Water and Sanitation

- Focus the distribution of cholera prevention interventions (e.g., water treatment products, jerricans, ORS, soap, etc.) to Nairobi areas with active cholera cases,

Use the DDSR Nairobi epidemiology data in order to inform target areas for interventions by MoPHS and partners

- Consider the language barriers within the sub-communities of the informal settlements, such as among the Ethiopian and Somali refugee populations living in the settlements
- Work with the water authorities to implement routine monitoring, analyses, and dissemination of water quality data in Nairobi's informal settlements for early detection of waterborne outbreaks
- Further investigate the potential correlation between enforcing laws against illegal tapping and reductions in disease as a possible intervention for informal settlements
- Long term: Investigate the reasons for source and stored water contamination and low residual chlorine levels in informal settlements
- Long term: Address sanitation issues in Nairobi's informal settlements

BACKGROUND

Cholera remains an important public health issue in Africa. In 2008, 94% of the 190,130 cholera cases reported world-wide occurred in sub-Saharan Africa[1]. In 2009, multiple areas in Kenya experienced cholera outbreaks with Case Fatality Rates (CFRs) ranging from 0.4% to 19% in areas that have had more than 2 cases. This country-wide outbreak resulted in over 11,000 cases of acute water diarrhea. The majority of the specific areas reporting increases in acute watery diarrhea had culture-confirmed cases of *Vibrio cholerae* identified from stool specimens. This burden of suspect cholera cases in 2009 is more than the country has experienced in the past decade.

On December 10, 2009, the widespread and ongoing cholera outbreaks prompted the Kenyan Ministry of Public Health and Sanitation (MoPHS) to request technical assistance from Centers for Disease Control and Prevention (CDC)-Kenya with investigation and assessment of the outbreaks and the response efforts. On January 4, 2010 Anagha Loharikar, MD, Epidemic Intelligence Service Officer, Elizabeth Cavallaro, MD, Epidemic Intelligence Service Officer, Elizabeth Blanton, MPH, Surveillance Epidemiologist, and Ciara O'Reilly, PhD, Staff Epidemiologist, Division of Foodborne, Waterborne and Environmental Diseases, CDC-Atlanta arrived in Kenya to assist the MoPHS with the investigation. The CDC-Atlanta team worked in collaboration with the Division of Disease Surveillance and Response (DDSR), and the Field Epidemiology and Laboratory Training Program (FELTP) of the MoPHS on this investigation. This report summarizes the field investigation. Additional analysis might

[1] World Health Organization Weekly Epidemiologic Record 31 July 2009, 84th year / No. 31, 2009, 84, 309–324

present results, interpretation, or recommendations that differ from those contained in this document.

OBJECTIVES

The objectives of the investigation were defined in conjunction with the MoPHS based on identified MoPHS priorities, and were as follows:

1. **To assist in describing the epidemiology of cholera outbreaks in Kenya nationally during 2009-2010**
    a. Summarize the descriptive epidemiology
    b. Examine the molecular epidemiology of toxigenic *Vibrio cholerae* O1
2. **To evaluate the surveillance and response efforts during the 2009-2010 outbreaks**
    a. Evaluate the current cholera surveillance system
    b. Examine cholera knowledge, attitudes and practices in the community
    c. Carry out a Health Care Worker Case Management Survey
3. **To evaluate Water Quality in Nairobi Informal Settlements**
    a. Nairobi Water Quality Study

RESULTS

1a. Descriptive Epidemiology

The CDC and FELTP teams assisted the DDSR of the MoPHS with the compilation of acute watery diarrhea/cholera surveillance data to create a national overview of cholera in Kenya during 2009.

Methods

CDC assisted in creating a national line list template in MS Excel with DDSR, which was then distributed to relevant parties that were assisted with compiling the data. Existing data from district and provincial level line lists were then incorporated into the newly established national line list for cholera. After merging data from all districts and creating a national line listing of cases, the national line list data was cleaned. The team then assisted with the construction of national epidemic curves and other relevant data to characterize the outbreak across the country during 2009. Of note, there are additional line lists from district and provincial levels which were not incorporated into the national line list for cholera because these were unavailable at the national level. The data presented in this trip report includes data provided by DDSR as available through February 5, 2010.

Results

There were a total of 11,769 cases of cholera reported across all provinces in Kenya during 2009 from DDSR using aggregate data collection (Table 1). The reporting on which this was based was variable and the data were difficult to analyze. All

subsequent results presented here are from the analysis of the newly created national line list which presently included 7392 (63%) of the 11,769 cases of cholera in Kenya in 2009.

Cholera occurred throughout 2009, across all 8 provinces (Figure 1). The national cholera epidemic curve shows peaks in cases occurring during March-April, June, and October-November, 2009 (Figure 2). Cases were reported in all provinces; however, data from Central province and large areas of the Rift Valley Province were not available at the national level and thus were not able to be included in the data presented in this report. Upon separating cases by province and looking at the dates of illness onset among the cases, it seems that cholera was present first in Nyanza, followed by Western, then Eastern, then North Eastern, then Rift Valley, then Coast, and finally Nairobi (Figure 3). However, many provinces had multiple peaks during the year, and some data are missing from this time trend analysis as it was not available at the national level.

Of the 7099 cases with gender information, 49.8% of cases were female. Of the 6124 cases with age information, the median age of cases was 17 years (range: 0-90 years). The percentage of cases in each group was as follows: 0-2 years (11.9%), 3-5 years (11.1%), 6-10 years (12.9%), 20-39 years (29.8%), 40-60 years (13.3%), and over 60 years (3.2%).

There were 122 deaths due to cholera reported on the national line list, and CRFs varied among districts and provinces from 0 to 14.3% according to the newly created national line list data.

Laboratory testing was completed on stool specimens from 932 (13%) of 7392 cases with acute watery diarrhea/cholera. Culture yielded *Vibrio cholerae* in 542 (58%) of the 932 specimens tested.

Of the 7392 reported cases in the 2009 line list, 331 (22%) were from the Nairobi Province. The epidemic curve for Nairobi shows a small number of cases from April to June and then a large peak of cases from September to December 2009 (Figure 4). Again, this does not include all data for Nairobi as not all district level data for Nairobi was available centrally at DDSR. Almost two-thirds of the cases 235 (71%) were among males. The high proportion of males is accounted for by 80 male cases who were prisoners at a male prison (Kamiti prison). Of the 255 cases in Nairobi for which age information was available, the median age of cases was 24 (range: 1 month to 81 years). The majority of cases occurring in Nairobi occurred in the following districts: Dagoretti 56 (17%), Starehe 55 (17%), Embakasi 39 (12%), and Kamukunji 24 (7%) (Figure 5). There are currently 3 deaths reported on the line list from the Nairobi area, however, anecdotally there may have been many more not reported to facility-based or district surveillance. Of the specimens that were tested, 123 (83%) of 273 specimens from Nairobi case patients that were positive for *V. cholerae*.

1b. <u>Molecular Epidemiology</u>

The objective of carrying out molecular testing on the outbreak isolates is to learn if there are many different *V. cholerae* strains circulating in Kenya, or just a small number, and are they the same or different from those that were circulating in 2007 and 2008.

Multiple laboratories collected and/or received and tested specimens from the 2009 cholera outbreaks. These laboratories included the National Public Health Laboratory, the KEMRI Centre for Microbiology Research laboratory (including the Nagasaki University laboratory), KEMRI/CDC laboratories, AMREF, from FELTP field investigations, and regional, and district laboratories.

In order to facilitate the characterization of the molecular epidemiology of the outbreaks it was necessary to determine what isolates were available for this analysis. The team cataloged all the nationally archived *V. cholerae* outbreaks isolates available from January 2007 to January 2010. Approximately 200 isolates of *V. cholerae* isolated from stool specimens taken during the period January 2007 to January 2010 were identified as archived and available for potential inclusion in the analysis.

Among the catalogue of isolates we identified both *V. cholerae* O1 Inaba and *V. cholerae* O1 Ogawa serotypes. Currently available antimicrobial susceptibility data were available for 110 of the catalogued isolates (Figure 6). Importantly for clinical management of non-pediatric cholera patients, there was only 3.6% resistance to tetracycline observed among the 110 isolates.

Of the 200 isolates, a total of 60 isolates were selected for inclusion in the molecular analysis. The criteria used for selection and inclusion of the 60 *V. cholerae* isolates was as follows: isolates were identified from as many different geographic clusters over a number or time points during 2007 to 2009, representing as many distinct outbreaks as possible. If more than two isolates were available from any one location at a certain time point then two isolates were randomly selected for inclusion using a random

numbers generator. A replacement list of 41 isolates was also generated, to be used if the initial isolate selected was not viable on work up in the lab once taken out of storage.

The 60 isolates will have their antimicrobial susceptibility profiles determined, and will be characterized molecularly by pulsed-field gel electrophoresis (PFGE) at the KEMRI Centre for Microbiology Research laboratory. Other testing such as toxin testing, and other molecular tests will be carried out in addition. Where possible, local laboratories in Kenya will be used for this molecular analysis of isolates; however, if expertise is not available or the specific techniques are not carried out currently in Kenya, then a laboratory outside the country will be identified to carry out this work.

As of the time of this report the molecular characterization of isolates is onging, isolates have been revived and as supplies and reagents have been shipped from CDC-Atlanta to the KEMRI Centre for Microbiology Research laboratory. Due to delays in sourcing some of the PFGE reagents the laboratory work was delayed, and only began in May 2010. As soon as the results are available they will be provided to MoPHS and relevant parties.

2a. <u>Evaluation of Cholera Surveillance System</u>

In 2003, the World Health Organization (WHO) Integrated Disease Surveillance and Response (IDSR) system, which includes cholera surveillance, was initiated in Kenya. The IDSR system was scaled up and implemented in districts in 2006. Since 2008, approximately 80% of districts have been reporting surveillance data. In 2002, the MoPHS developed a booklet entitled "Guidelines for Cholera Control", based on the WHO Guidelines for Cholera Control. The booklet includes information on case

management, disinfection in health facilities, and surveillance. Revision of the guidelines is planned for 2010.

We gathered information about the cholera surveillance system through discussions with DDSR staff, health care workers in East Pokot and Turkana South Districts, and laboratory staff in Nairobi and Marigot, and review of district line lists and health facility log registers in Nairobi, East Pokot, and Turkana South, and the MoPHS Guidelines for Cholera Control.

Description of System

The cholera case definition used in Kenya is a patient > 5 years of age with severe dehydration from acute watery diarrhea (>4 episodes of diarrhea in 12 hours), usually with vomiting. In an area where there is a laboratory-confirmed outbreak of cholera, any patient >2 years of age with acute watery diarrhea is considered a case.

According to the MoPHS cholera reporting protocol, any suspected cholera case at a health facility or case confirmed at a laboratory should be reported to the District Disease Surveillance Officer (DDSO) within 24 hours. The DDSO then reports to the Provincial Surveillance Officer and the DDSR at the national level. Cholera cases are reported to WHO by DDSR. Three DDSR staff manage the cholera surveillance data, in addition to all other IDSR data.

The total number of cholera cases and deaths are sent to the national level weekly, primarily by phone or SMS. Other demographic and clinical information (date of illness onset, laboratory results) is not systematically reported during weekly calls. Line lists are not routinely sent to the national level in a timely manner due to a lack of access to

internet or fax. Many DPHO in new districts have no transportation so are unable to visit remote health facilities to collect line lists. A standardized line list form is not used for cholera cases. Therefore, forms in a variety of formats are received from districts, including Word, Excel, and PDF files; this variation makes data compilation and analysis at the national level difficult. In addition, districts do not report the same information; for example, some districts only report deaths that occurred at health facilities and other districts include deaths that occurred at home. In addition, it appears that the correct case definition is not being used in the districts; among the cholera cases reported in the current national line list, 11.9% of cases were ≤2 years.

Due to recent increases in the number of districts from 78 to 250, many newly formed districts have not received training on IDSR or cholera surveillance. In a survey of 13 health facilities in East Pokot, staff at 4 (31%) health facilities were unaware of any cholera surveillance guidelines.

Laboratory confirmation is difficult in rural areas due to few health facilities with adequate laboratory capacity. Many health facilities lack specimen cups, transport media, and transportation to referral laboratories. Lack of supplies in referral laboratories is also a problem. For example, the DVBD laboratory in Marigot, Rift Valley, handles laboratory services for 6 districts but was unprepared for the cholera outbreak due to a lack of reagents, transport media, and proper antimicrobial susceptibility disks.

It is necessary to ensure that the surveillance data captures institutional outbreaks appropriately; many outbreaks were identified among prisons and among schools on the line list. Both types of institutional settings were identified in many different areas spread across the country, however, investigation of how these may have been connected

(such as inmate transfer from one prison to another, new inmates, etc) was not possible as the surveillance data submitted to the national level was not timely enough to detect these, particularly with regard to institutional outbreaks outside of Nairobi. Characterization of the institutional outbreaks from 2009 would be very important as many deaths among institutionalized persons were noted, particularly among prison inmates, and therefore this may have influenced the district level CFRs.

2b. Evaluation of Cholera Knowledge, Attitudes and Practices in the Community

Background

The high case counts or CFR in some areas and anecdotal reports of deaths occurring at home before visiting health care facilities raised concerns that communities may not be aware of cholera prevention and treatment options. In light of these observations, we conducted a community cholera knowledge, attitudes and practice survey in two districts in the Rift Valley Province in Kenya, East Pokot and Turkana South. Population in both districts is rural, nomadic/pastoral, with limited education and resources. Households in East Pokot are widely dispersed, oftentimes with 1-2 km of distance between individual family compounds. Households ('*manyatas*') in Turkana South are clustered together to form villages, in contrast to East Pokot. Households in both districts are often multi-unit with one husband, multiple wives and many children living in small huts.

Objectives

1. To understand the knowledge, attitudes and practices with regard to diarrhea, cholera, and water treatment among the community during the context of a cholera outbreak.
2. To evaluate the response to cholera in this community by governmental and non-governmental organizations.

Specific Objectives

- To survey households in rural districts in Northern Kenya regarding knowledge, attitudes and practices of diarrhea and cholera.
- To examine misconceptions that may exist with regard to diarrhea and cholera in the community.
- To understand what health messaging was received by the community and through what means, and if there were any changes before and after the outbreak.
- To determine possible barriers to accessing health care.
- To assess availability and utilization of Oral Rehydration Solution (ORS) and point-of-use household based safe water treatment interventions in the community during a cholera outbreak.
- To provide data to MoPHS that may be helpful in informing future community cholera health messages and response efforts.

Methods

Evaluation Population

The community survey was completed in rural settings in Rift Valley Province and urban settings in Nairobi, Kenya, in districts with high and low cholera CFR's during the 2009-2010 outbreaks.

The rural community survey was completed in 2 districts in Rift Valley Province in Kenya: East Pokot and Turkana South. After considering security and logistical issues, these districts were selected due to having a high CFR (East Pokot; 11.7%) or a high case count but low CFR (Turkana South; 1.0%), per data provided by DDSR (Table 1). Two divisions were selected to be areas of focus within each district as follows:

1. East Pokot: Mondi & Nginyang Divisions
2. Turkana South: Lokichar & Lokori Divisions

These divisions were selected because they were all affected by cholera in varying capacities, and they were logistically feasible to reach. Surveys were completed in the household; the team requested to interview the member of the household that cared for sick family members and/or arranged for the water for the family.

Sampling Selection

The sampling strategy for the rural component of the community survey utilized a cluster sampling method[2],[3]. We randomly selected 30 villages within 2 districts and

[2] Lemeshow S, Robinson D. Surveys to measure programme coverage and impact: a review of the methodology used by the expanded programme on immunization. *World Health Slat Q* 1985; 38: 65-75.

[3] Henderson R H, Sundaresan T. Cluster sampling to assess immunization coverage: a review of experience with a simplified sampling method. *Bull World Health Organ* 1982; 60: 253-60.

surveyed 8 randomly selected households within each of the 30 villages. The total sample size was 240 households. The sampling methodology for each district is outlined as follows:

1. East Pokot: A list of villages was compiled (no preexisting list was available for this area).
2. Turkana South: The team received a list of villages for Lokichar and Lokori Divisions from the District Commissioner.

Villages that met the following criteria in each district were included in the list for possible random selection:

1. Secure and safe during the study period (i.e. not undergoing violence associated with cattle rustling).
2. Feasible and accessible to reach by all-terrain vehicle in one day of travel.
3. Village has people presently residing there, as this is a semi-nomadic and pastoral community.

Fifteen villages were selected in each district using the Microsoft Excel random number generator function. Five alternate villages were selected in each district, as security issues and road conditions changed daily.

The survey was conducted in 8 randomly selected households in each village. The random selection of households is illustrated as follows for each district.

A central location within each village cluster was located. A random direction was then chosen by spinning a bottle, and a household in one direction from the central point were approached for participation in the survey. In East Pokot, subsequent households were selected by visiting the next household until 8 households were successfully interviewed

within each village. Given the differences in village structure in Turkana South, subsequent households were selected by approaching every second household until 8 households were successfully interviewed.

The respondent for the household was the person in the home responsible for caring for sick family members and/or bringing the water for the family.

Data Collection

The survey assessed community members' knowledge, attitudes and practices in relation to diarrhea and cholera, as well as response efforts within the community during the context of this cholera outbreak. The survey tool (Appendix A) included questions about the following:

- Socioeconomic Status
- Cholera knowledge
- Cholera experience in village and family
- Prevention and treatment methods
- Access to health care
- Care and management of cholera in a health facility
- Knowledge, availability and utilization of ORS
- Water sources and water availability
- Knowledge, availability and utilization of Safe Water Treatment programs
- Sanitation issues
- Home observations & stored water testing for residual chlorine

Trained local enumerators fluent in English, Swahili, and the local languages administered the survey. Surveys were written in English and administered in the local language (either Pokot or Turkana) after standardization of the local language translation during training.

Data Management & Analysis

Data were entered into a Microsoft Access database, and cleaned and analyzed using SAS version 9.2. Data between East Pokot and Turkana South were statistically compared using Rao-Scott chi-square comparison, clustered by village. Final results are outlined below in further detail.

Results

A total of 240 households were surveyed in East Pokot (n=120) and Turkana South (n=120) districts.

Demographics, Education & Socioeconomic Background

In total, 191 (80%) of 240 respondents were female (73% in East Pokot and 87% in Turkana South, $p<0.01$). The median age of respondents in both East Pokot and South Turkana was 40 years old with a range from 15-100 years old. The median number of persons living in the household was 7 in East Pokot (range=1-21 persons) and 6 in Turkana South (range is 2-14 persons). The median number of children less than 5 years old was 2 in East Pokot (range is 0-10 children) and 2 in Turkana South (range is 0-5 children). A similar proportion of respondents in East Pokot and Turkana South self-

reported that they are illiterate (89% versus 87% respectively, p=0.5430) and had no education (87% versus 87%, respectively, p=1.000). The primary source of income for 84% of households in East Pokot was herding animals, primarily goats, whereas in Turkana South the main sources of income included small business (31%), herding (22%) and salaried employment (22%) (Table 2).

Cholera Knowledge & Exposure

Among the survey population, 234 (98%) respondents had heard of cholera; furthermore, 178 (75%) had heard of cholera in the area where they live and 161 (67%) stated cholera had affected persons in their village in the past 6 months. Of the 161 persons that reported cholera in their village, 95 (59%) reported deaths occurring from cholera in their village. In East Pokot, 49 (41%) respondents had heard of cholera in their village, compared to 112 (93%) in Turkana South ($p<0.01$); 28 (23%) respondents in East Pokot reported cholera in their family compared to 57 (48%) in Turkana South (p=0.0142). Of those families reporting cholera in the household, 6 (21%) in East Pokot and 7 (13%) in Turkana South reported death from cholera in their household (p=0.2471) (Table 3).

Although both districts were aware of cholera, source of cholera public health messaging differed between districts. Of respondents who had heard of cholera in their village, 37% in East Pokot versus 5% in Turkana South reported hearing about the cholera outbreak from a family member ($p<0.0001$), 50% in East Pokot versus 14% in Turkana South heard from a neighbor ($p<0.0001$), and 4% in East Pokot versus 81% in Turkana South heard from a village chief / community meeting ($p<0.0001$).

Consequently, public health messages of prevention strategies at the household level were significantly less in East Pokot (49%), compared with Turkana South (95%) ($p<0.0001$) (Table 5). In East Pokot, 25 (21%) respondents identified boiling or treating water to prevent illness, compared with 84 (70%) respondents in Turkana South ($p<0.0001$) (Table 4.)

Access to Health Care

The mean number of hours to travel to a health facility for households in East Pokot was 31 hours (median=6 hours; range 0 – 168 hours), compared with a mean of 2 hours in Turkana South (median=1 hours; range 0 – 6 hours). Furthermore, in East Pokot, 112 (93%) of 120 respondents reported it to be "very difficult" to get to a health facility, compared with 46 (38%) in Turkana South (Table 3). Twenty-one respondents (72%) in East Pokot stated that they sought care for themselves or family members for cholera in the past 6 months, of which 46% visited a hospital for their illness, 32% went to a cholera treatment center (CTC), 47% went to a dispensary/ health center, and 32% went to a traditional healer. In contrast, 49 (88%) in Turkana South stated that they sought care for themselves or family members, of which 86% visited a hospital, 33% went to a CTC, 45% went to a dispensary or health center, and 0% went to a traditional healer. Overall, 17 (14%) in East Pokot versus 46 (38%) in Turkana South stated they sought care for a family member with cholera at a health facility in the past 6 months ($p=0.001$), defined as a government health facility, CTC, private clinic or dispensary (Table 6).

Oral Rehydration Solution (ORS)

Of respondents, 101 (84%) in East Pokot versus 110 (93%) in Turkana South reported having heard of ORS (p=.0616). Of these, 82 (80%) in East Pokot versus 104 (95%) in Turkana South stated they knew how to prepare ORS (p<0.001). Only 10 (10%) respondents in East Pokot compared with 37 (34%) in Turkana South stated that ORS is available in their village (p<0.0001) (Table 7).

Water Sources & Availability

Many households in East Pokot (48%) and Turkana South (41%) identified a shallow hand-dug well in dry river beds as their current main source for water. Other families reported digging shallow or deep wells alongside rivers; few households in Turkana South reported having access to boreholes (25%), deep protected wells (0%), and community taps (14%) as their current main water source. In East Pokot, 3% reported currently using a protected water source versus 41% in Turkana South (p<0.0001). In East Pokot, 100 (84%) of respondent reported water not being readily available at varying times during 2009, of which 67% stated it was not available between 3-6 months per year. This was significantly different from Turkana South, where 63 (53%) respondents stated water was not readily available at times during 2009 (p<0.01), of which 26 (41%) reported it was unavailable for 3-6 months per year (Table 8).

Household Water Treatment

Both government and non-governmental organizations were involved in the response to cholera in East Pokot and Turkana South, with distribution of water treatment

supplies and sanitation/hygiene supplies to the community. The Kenyan Red Cross, UNICEF and other agencies distributed Aquatabs, PuR, water filters, 20L jerrycans, soap, blankets, etc. to the affected areas. Of 78 (67%) respondents in East Pokot that had heard of water treatment products, 58 (74%) had heard of the product Aquatabs, 2 (3%) had heard of the product PuR, 9 (12%) had heard of the product WaterGuard. Of the 114 (96%) respondents in Turkana South that had heard of water treatment products, 91 (80%) heard of Aquatabs and 65 (57%) had heard of PuR, and 9 (8%) had heard of WaterGuard. In East Pokot, 34 (29%) of respondents reported receiving free household water treatment supplies or hygiene product supplies in the past 6 months to prevent cholera compared with 93 (77%) of respondents in Turkana South ($p<0.0001$). It was observed in East Pokot that supplies, including 20L jerrycans and Aquatabs, were received from the national level; however, due to inability to access households without adequate transportation vehicles for poor roads, distributing the products from the central storage points to the household level in the district was logistically challenging and therefore led to substantial delays in getting the product out to the community. Additionally, anecdotally, some households that had received PuR and Aquatabs had not received education on the use of these supplies so they had kept them in the home for 2 months without using them. Those who had received some education on the use of these cholera prevention supplies (116/126; 92%) had used them and were interested in receiving more (Table 9).

Sanitation & Hygiene

Of all respondents in both districts, 223 (94%) stated that they defecate in the bush, and do not have any latrines (Table, 10). Thirteen (5%) respondents stated they had access to a covered pit latrine. Most (90%) respondents identified when they washed hands to include before and after eating. Some respondents identified washing hands after using the toilet (40%) or after cleaning babies when they defecate (26%).
Fifty (42%) of respondents in East Pokot stated they had soap in the home, compared with 97 (82%) of respondents in Turkana South ($p<0.0001$). Most respondents, despite having soap or not in the home, stated uses for soap to include washing hands (67%), laundry (76%), cleaning utensils (70%), and bathing (70%). Most respondents in East Pokot (98%) and Turkana South (97%) demonstrate using jerrycans for water storage in the home.

Conclusions from the Rural Community Survey

1. There was a marked difference between these two seemingly similar rural, nomadic populations of East Pokot and Turkana South. East Pokot had lower water availability during 2009, less access to health care facilities, and lower availability of cholera prevention supplies in the community, when compared to Turkana South. This difference is likely related to the difference in density of the populations (East Pokot households are widely dispersed and therefore harder to reach, while Turkana South households are clustered in distinct villages), as well as a greater permanent NGO presence in Turkana South.

2. Public health messaging was received in both districts, as the majority of respondents were aware of cholera; however prevention messaging was significantly higher in Turkana South compared with East Pokot, including use of ORS for cholera treatment. Due to the high illiteracy rate in this region, much of the health messaging was delivered via family, neighbors, village chiefs and community health workers from the district level to the household level, as opposed to radio or print media.
3. Based on the findings of the survey, lack of access to healthcare and prevention supplies in East Pokot, compared with Turkana South, likely contributed to increased CFR in this district as opposed to lack of community awareness or misunderstanding of cholera related public health messaging within the community.
4. Distribution of supplies for the cholera response to the district level was demonstrated; however, distribution reaching the household level was limited, particularly in East Pokot, due to lack of appropriate transportation to access remote areas.

The community KAP survey carried out in two districts in Nairobi was carried out by the Kenya Field Epidemiology and Laboratory Program Residents and the results will be available through that program.

2c. Evaluation of Cholera Case Management; Rural and Urban Health Care Worker Surveys

The WHO has demonstrated that when cholera is treated promptly and appropriately, the CRF should remain below 1%. An elevated cholera CFR may be a sign of deficiencies in access to care, and case management.

General Objectives

The objectives of this survey were to assess health care worker knowledge and practice of and attitude toward cholera clinical case management guidelines in districts with high and low cholera CFR.

Specific Objectives

- Determine possible reasons for elevated CFR in selected districts
- Determine possible gaps in cholera clinical management training for health care workers
- Identify gaps that may exist in cholera clinical case management
- Provide data to the Kenyan MoPHS that will inform the planned revision of the Guidelines on Cholera Control
- Assess availability of ORS, anti-microbials, and anti-motility agents in kiosks and chemists in towns near surveyed health facilitates.

Evaluation Population

The case management survey was conducted in a random sample of government, private, and faith-based health facilities (HFs), including dispensaries, health centres, sub-district hospitals, district hospitals and provincial hospitals, in two districts with high cholera CFR and two districts with low cholera CFR during the 2009 cholera outbreaks. All health care workers (nurses, clinical officers, medical officers, and patient attendants) responsible for treatment of diarrheal illness in the selected HF, including within the casualty department, outpatient department, adult and pediatric in-patient ward, and the cholera ward on the day of the visit were interviewed.

Sampling Selection

After taking into consideration security and logistical issues, a list of possible study districts was compiled from the list of districts with cholera cases in 2009. One study district with high CFR (East Pokot) was selected. Turkana South, a rural district geographically similar to East Pokot with a lower CFR, was selected for comparison. Within Nairobi, two urban informal settlements with high CFR and recent cholera cases in two districts (Embakasi and Kasarani) were selected. An urban informal settlement in Langata district called Kibera which had a low case count and low CFR, was selected for comparison.

In East Pokot and Turkana South, a list of all government, private, and faith-based HFs currently operating in each district was obtained from the District Public Health Officer. HFs that were non-operational or inaccessible due to security concerns were excluded. A random sample of 15 HFs was selected using the random numbers generator

function of MS Excel; the district and sub-district hospital were forced into the selection. In Nairobi, a list of all government, private, and faith-based HFs currently operating in three districts was obtained from the District Medical Officer. From this list, a list of HFs within a 5 km radius of the epi center of the acute watery diarrhea/cholera outbreak within each of the study informal settlements was created. Fifteen HFs were randomly selected in Langata district, 8 in Embakasi district, and 10 in Kasarani district.

A convenient sample of kiosks/chemists was selected in the 15 towns in East Pokot and Turkana South districts where the HF survey was being carried out. If possible, all kiosks/chemists in the town were visited; if there were too many to survey all, a convenience sample of those nearest the road were selected, due to time, and resource constraints.

Data Collection

The survey (Appendix B) assessed health care workers' knowledge of cholera transmission and prevention, and the physical signs and treatment of dehydration. Hygiene practices and treatment practices such as the administration of intravenous (IV) fluid, Oral Rehydration Salts (ORS), and antibiotics were also be assessed. All questions assessing cholera case management were based on the MoPHS Guidelines on Cholera Control handbook. In addition, the survey evaluated the availability of appropriate cholera treatment supplies in HFs, building upon an assessment carried out by FELTP residents in December, 2009; supply questions were only asked of the nurse in charge at each facility.

Additionally, the hours of operation, average number of patients seen per week, and number of admission beds were noted at each HF. A review of the in-patient and out-patient register logs was conducted to determine the total number of hospitalizations and patients diagnosed with diarrheal illness and cholera during certain time periods. The months reviewed in each district corresponded to when the cholera outbreak in each district was reported, based on national surveillance data from DDSR; in East Pokot, surveillance data indicated that the cholera outbreak occurred between November and December, 2009; in Turkana South between September and December, 2009; and in Nairobi between November, 2009 and January, 2010.

Surveys were administered in English or Swahili. Trained local enumerators fluent in English, Swahili, and the local languages administered the survey.

Data Management and Analysis

All data collected were entered into a MS Assess database and analyzed using SAS 9.1. Preliminary findings were presented in a debriefing at the MoPHS prior to the team leaving the country.

Results

Health Facility Characteristics

Rural Health Facilities

A total of 19 HFs were identified in East Pokot, of which one was non-operational and one was chosen as a pilot facility and thus ineligible for selection; fifteen HFs were randomly selected from the remaining 17 HFs. Thirteen of the HFs selected had staff

present on the day of interview. A total of 21 health care workers (HCWs) were surveyed. A total of 25 HFs were identified in Turkana South, of which five were non-operational and four were inaccessible due to security reasons; fifteen HFs were randomly selected from the remaining 16 HFs. Fourteen of the HFs selected had staff present on the day of interview. A total of 22 HCWs were surveyed. In East Pokot, 9 (43%) HCWs interviewed worked in a dispensary, 5 (24%) in the sub-district hospital, 4 (19%) in the district hospital, and 3 (14%) in a health center. Seventeen (81%) HFs surveyed were government facilities, the remaining were faith-based facilities. In Turkana South, 14 (64%) HCWs interviewed worked in a dispensary, 7 (32%) in a health center, and 1 (5%) in the sub-district hospital; ten (45%) HFs were government facilities, 10 (45%) were faith-based, and 2 (10%) were NGO or community-based (Table 11).).

The average number of patients seen per day at HFs in East Pokot was 24 (range 10-60).Health facilities in East Pokot and Turkana South were open an average of 6 days (range 5-7) and were open an average of 13 hours per day (7-24 hours), not including on-call hours. The average number of admission beds in HFs surveyed in East Pokot and Turkana South was 3 (range 0-26).

Urban Health Facilities

A total of 8 HFs were identified in Embakasi and a total of 24 health care workers were surveyed. Sixteen (67%) HCWs interviewed worked in a health center, 4 (17%) in a dispensary, 2 (8%) in the sub-district hospital, and 2 (8%) in a nursing home clinic. Ten (42%) HFs surveyed were government facilities, the remaining were faith-based, NGO, or private facilities.

In Kasarani, a total of 10 HFs were identified and a total of 37 health care workers were surveyed. Twenty-two (60%) HCWs interviewed worked in a health center, 7 (19%) in a mission hospital or community based organization, three (8%) in the sub-district hospital, 4 (11%) in a dispensary, and one (3%) in the district hospital. The majority, 28 (78%), HFs surveyed were government facilities, and the remaining were faith-based, NGO, or private facilities. A total of 15 HFs were identified in Kibera with a total of 52 HCWs surveyed. Over half, 29 (56%), HCWs interviewed worked in a health center, 11 (21%) in a dispensary, 11 (21%) in the district hospital, and 1 (2%) in a nursing home clinic. Twenty-five (48%) HFs surveyed were government facilities, the remaining were faith-based, NGO, or private facilities (Table 12)).

Health Care Worker Characteristics

Rural Health Facilities

The majority of HCWs surveyed (14 (74%) in East Pokot and 15 (68%) in Turkana South) were male. The median age of HCWs in East Pokot and Turkana South were 38 (range 26-51) and 31 (range 22-50) years, respectively. In East Pokot, 12 (57%) HCWs were nurses, 5 (24%) were patient attendants, three (14%) were clinical officers, and one (5%) was a laboratory technician. In Turkana South, 9 (41%) were nurses, 12 (55%) were patient attendants, and 1 (5%) was a clinical officer. In East Pokot and Turkana South, 15 (71%) and 10 (46%) HCWs had completed formal clinical training (medical officer, clinical officer, or nursing school), respectively. Five (24%) and 3 (14%) HCWs had received no formal training or only on-the-job-training in East Pokot and Turkana South, respectively; one (5%) HCW in East Pokot and 9 (41%) in Turkana

South had been trained by an NGO or missionary, or attended pharmacy or laboratory technician training. The median number and range of years HCWs had practiced in their profession and the median number of years practiced in the present facility were 15 (range 1-28) and 4 (range 0.1 – 28) years, respectively, in East Pokot. In Turkana South, the median number and range of total years HCWs had practiced in their profession and median number of years practiced in the present facility were 7 (range 0.5 – 28) and 2 (range 0.3 – 18) years, respectively (Table 11).

Urban Health Facilities

The majority of HCWs surveyed in Nairobi (18 (86%) in Embakasi, 23 (62%) in Kasarani, and 32 (68%) in Kibera) were female. The median age of HCWs in Embakasi, Kasarani, and Kibera were 39 (range 24 – 68), 31 (range 22-50), and 33 (range 25 - 62) years, respectively. In Embakasi, 19 (83%) HCWs were nurses and 4 (17%) were medical or clinical officers. In Kasarani, 26 (70%) were nurses, 10 (27%) were medical or clinical officers, and one (3%) was a patient attendant. Twenty-eight (54%) HCWs interviewed in Kibera were nurses, 22 (42%) were medical or clinical officers, and 2 (4%) were patient attendants. Over 95% of HCWs in Embakasi, Kasarani, and Kibera had completed formal clinical training (medical officer, clinical officer, or nursing school). The median number of years HCWs had practiced in their profession and median number and range of years practiced in the present facility were 15 (range 2-40) and 3 (range 0.3 – 18) years, respectively, in Embakasi. In Kasarani, the median number of total years HCWs had practiced in their profession and median number of years practiced in the present facility were 7 (range 0.5 – 28) and 2 (range 0.3 – 18) years,

respectively. In Kibera, the median number of total years HCWs had practiced in their profession and median number of years practiced in the present facility were 9 (range 0.3 – 40) and 3 (range 0.02 – 16) years, respectively (Table 12).

Health Care Worker Cholera Experience and Training

Rural Health Facilities

The majority of HCWs (15 (71%) in East Pokot and 18 (82%) in Turkana South) treated cholera patients in 2009; ten (48%) HCWs in East Pokot and 10 (46%) in Turkana South treated between 1 and 50 cholera patients since October 1, 2009. In both districts, 2 (10%) HCWs treated cholera patients in the week before the interview; the number of cholera patients treated ranged from 2 in Turkana South to 5 in East Pokot. Seventeen (81%) HCWs in East Pokot and 16 (73%) in Turkana South reported receiving training in cholera care in the past. Of those HCWs who had received cholera training in the past, 13 (76%) HCWs in East Pokot and 7 (44%) in Turkana South, had received it during schooling. Seven (44%) HCWs in Turkana South had received cholera training facilitated by the MoPHS, while one (6%) HCW in East Pokot reported receiving cholera training facilitated by the MoPHS (Table 11).

Urban Health Facilities

The majority of HCWs (22 (92%) in Embakasi, 27 (73%) in Kasarani, and 39 (80%) in Kibera) treated cholera patients in 2009; nine (38%) HCWs in Embakasi, 17 (47%) in Kasarani, and 37 (76%) in Kibera treated between 1 and 50 cholera patients since October 1, 2009. In Embakasi, 7 (29%) HCWs treated cholera patients in the week

before the interview; the number of cholera patients treated ranged between 1 and 60. In Kasarani and Kibera, five (14%) and four (8%) HCWs treated cholera patients in the week before the interview, with a range of 1-3 and 2-6 patients, respectively. Nine (38%) HCWs in Embakasi, 28 (76%) in Kasarani, and 29 (58%) in Kibera reported receiving training in cholera care in the past. Of those HCWs who had received cholera training in the past, 7 (78%) in Embakasi, 24 (86%) in Kasarani, and 20 (69%) in Kibera had received it during schooling. Less than 10% of HCWs in all three districts had received cholera care training facilitated by the MoPHS (Table 12).

Health Care Worker Knowledge

Rural Health Facilities

When asked the case definition used for cholera, only one (5%) HCW in East Pokot and 2 (9%) HCWs in Turkana South mentioned at least one correct WHO cholera case definition. Three (14%) HCWs in East Pokot and 5 (23%) HCWs in Turkana South defined cholera as rice-water or watery diarrhea in a person of any age. Fourteen (67%) HCWs in East Pokot and 8 (36%) in Turkana South) defined cholera as rice-water or watery diarrhea, with severe dehydration, in a person of any age.

All HCWs in East Pokot and Turkana South knew that cholera can be prevented; all HCWs in East Pokot and 20 (91%) in Turkana South listed at least one correct method of prevention (washing hands, cooking food thoroughly, covering food, boiling or treating drinking water, washing fruits and vegetables, or cleaning cooking utensils, disposing of fecal matter appropriately). Eighteen HCWs (82-86%) in both districts knew that cholera was transmitted by contaminated water or food.

HCWs were asked when a cholera patient who is not vomiting can be given ORS; sixteen (76%) in East Pokot and 13 (62%) in Turkana South said ORS could be given immediately; five (24%) HCWs in East Pokot and 7 (33%) HCWs in Turkana South said ORS should only be given to a non-vomiting patient after IVF have been administered.

When asked which cholera patients should receive oral antibiotics, 19 (91%) HCWs in East Pokot and 21 (100%) HCWs in Turkana South stated all cholera patients should receive oral antibiotics, regardless of dehydration level. All HCWs in East Pokot and Turkana South correctly reported giving doxycycline to adult cholera patients; other commonly reported antibiotics given to adult cholera patients included chloramphenicol in East Pokot (4 (19%) HCWs) and erythromycin in Turkana South (14 (64%) HCWs). Fourteen (67%) HCWs in East Pokot and 18 (82%) HCWs in Turkana South reported giving erythromycin to pediatric cholera patients. In East Pokot, 4 (19%) HCWs did not know which antibiotics should be given to pediatric cholera patients. HCWs also commonly reported giving septrin to pediatric cholera patients [4(19%) HCWs in East Pokot and 7 (32%) in Turkana South] (Table 11).

Urban Health Facilities

When asked the case definition used for cholera, four (17%) HCWs in Embakasi, 8 (22%) in Kasarani, and 19 (37%) in Kibera mentioned at least one correct WHO cholera case definition. Five (10%) HCWs in Kibera defined cholera as rice-water or watery diarrhea in a person of any age; no HCWs in Embakasi or Kasarani mentioned this definition. Nineteen (79%) HFs in Embakasi, 31 (84%) in Kasarani, and 21 (40%) in

Kibera defined cholera as rice-water or watery diarrhea with severe dehydration in a person of any age.

All HCWs in Embakasi knew that cholera can be prevented and listed at least one correct method of prevention (washing hands, cooking food thoroughly, covering food, boiling or treating drinking water, washing fruits and vegetables, or cleaning cooking utensils, disposing of fecal matter appropriately). All HCWs in Kasarani and 50 (98%) in Kibera knew that cholera can be prevented; thirty-six (97%) HCWs in Kasarani and 50 (96%) in Kibera listed at least one correct method of prevention. The majority of HCWs in all districts (95-96%) knew that cholera was transmitted by contaminated water or food.

When HCWs were asked when a cholera patient who is not vomiting can be given ORS, 20 (83%) in Embakasi, 34 (92%) in Kasarani, and 49 (96%) in Kibera said ORS could be given to the patient immediately; only three HCWs in Embakasi (13%) and Kasarani (8%), and one (2%) in Kibera incorrectly said ORS should only be given to a non-vomiting patient after IVF have been administered.

All HCWs in Embakasi, 36 (97%) in Kasarani, and 47 (92%) in Kibera incorrectly stated all cholera patients should receive oral antibiotics, regardless of dehydration level. The majority of HCWs in all districts [23 (96%) in Embakasi, 37 (100%) in Kasarani, and 39 (75%) in Kibera] reported giving doxycycline to adult cholera patients; erythromycin was the second most commonly reported antibiotic for adult pediatric patients [20 (83%) in Embakasi, 10 (27%) in Kasarani, and 9 (17% in Kibera]. Twenty-three (96%) HCWs in Embakasi, 28 (76%) in Kasarani, and 31 (60%) in Kibera correctly reported giving erythromycin to pediatric cholera patients.

Chloramphenicol was the second most commonly reported antibiotic for pediatric cholera patients [2 (8%) in Embakasi, 3 (8%) in Kasarani, and 7 (13% in Kibera] (Table 12).

Treatment of Cholera Patients with Severe, Some, and No Dehydration

Rural Health Facilities

The majority of HCWs in East Pokot and Turkana South, 20 (95%) and 22 (100%), correctly identified a case of severe dehydration, respectively. All HCWs in East Pokot and 19 (86%) HCWs in Turkana South knew giving IVF with or without ORS was the correct management of a cholera patient with severe dehydration, respectively. When asked which IVF should be given to an adult cholera patient with severe dehydration, Ringer's Lactate was chosen by 10 (48%) and 12 (63%) HCWs in East Pokot and Turkana South, respectively. Normal saline was chosen by six (29%) HCWs in East Pokot and three (16%) in Turkana South; three HCWs in each district said 5% Dextrose solution should be given to adult cholera patients. Ringer's Lactate was reported as the IVF of choice for pediatric cholera patients by 11 (52%) and 13 (59%) HCWs in East Pokot and Turkana South, respectively. Three (14%) HCWs in East Pokot and 5 (23%) in Turkana South stated normal saline should be given to pediatric cholera patients with severe dehydration; 6 (29%) HCWs in East Pokot and 2 (9%) HCWs in Turkana South said 5% Dextrose solution should be given to pediatric cholera patients.

Seventeen (81%) HCWs in East Pokot knew the correct management of a cholera patient with some dehydration was ORS only; four (19%) HCWs stated cholera patients with some dehydration should receive IVF in addition to ORS. In Turkana South 13 (59%) HCWs knew the correct management of a cholera patient with some dehydration;

nine (41%) HCWs stated cholera patients with some dehydration should receive IVF in addition to ORS.

In East Pokot and Turkana South, 15 (71%) and 19 (86%) HCWs knew cholera patients with no dehydration should receive ORS to take home, respectively; three (14%) HCWs in East Pokot and 2(9%) in Turkana South stated cholera patients with no dehydration should receive ORS and antibiotics to take home (Table 11).

Urban Health Facilities

The majority of HCWs in Embakasi, Kasarani, and Kibera, 23 (96%), 36 (97%), and 49 (96%), correctly identified a case of severe dehydration, respectively. Twenty-two (92%), 35 (95%), and 50 (96%) HCWs in Embakasi, Kasarani, and Kibera knew giving IVF with or without ORS was the correct management of a cholera patient with severe dehydration, respectively. When asked which IVF should be given to an adult cholera patient with severe dehydration, Ringer's Lactate was chosen by 16 (80%), 27 (79%), and 41 (82%) HCWs in Embakasi, Kasarani, and Kibera, respectively. Three (15%) HCWs in Embakasi, 4 (12%) in Kasarani, and 7 (14%) chose normal saline as the IVF of choice for adult patients with severe dehydration. One (5%) HCW in Embakasi, 2 (6%) in Kasarani, and 2 (4%) in Kibera said 5% Dextrose solution should be given to adult cholera patients. The majority of HCWs in Embakasi, Kasarani, and Kibera [20 (83%), 27 (73%), and 37 (71%), respectively] stated Ringer's Lactate should be given to pediatric cholera patients with severe dehydration. Three (13%) HCWs in Embakasi, 6 (16%) in Kasarani, and two (4%) in Kibera chose normal saline as the IVF of choice for pediatric cholera patients with severe dehydration. Two (5%) HCWs in Kasarani and

eight (15%) in Kibera reported giving Darrow's solution to pediatric patients with severe dehydration.

Sixteen (67%) HCWs in Embakasi knew the correct management of a cholera patient with some dehydration was ORS only; eight (33%) HCWs stated cholera patients with mild dehydration should receive IVF in addition to ORS. In Kasarani, 28 (76%) HCWs knew the correct management of a cholera patient with some dehydration; nine (24%) HCWs stated cholera patients with mild dehydration should receive IVF in addition to ORS. In Kibera, 48 (94%) HCWs knew patients with some dehydration should be treated with ORS only. Two (4%) HCWs stated cholera patients with mild dehydration should receive IVF in addition to ORS.

All HCWs in Embakasi correctly stated that cholera patients with no dehydration should receive ORS to take home; 26 (81%) HCWs in Kasarani and 44 (85%) in Kibera reported the correct treatment of no dehydration. Three (8%) HCWs in Kasarani and none in Embakasi or Kibera stated cholera patients with no dehydration should receive ORS and antibiotics to take home (Table 12).

Health Facility Supply Availability and Laboratory Capacity

Rural Health Facilities

In-charge staff members in 13 HFs in East Pokot and 14 in Turkana South were asked about supplies and laboratory capacity. Among these HF, 7 (54%) HFs in East Pokot and 4 (29%) in Turkana South had current stocks of one or more cholera management supplies (ORS, IVF, IV needles (IVN), IV tubing (IVT), or doxycycline) at the time of interview. Eight (62%) and 12 (86%) HFs experienced stock-outs of one or

more of these supplies in 2009 in East Pokot and Turkana South, respectively; stock-outs of one or more of these supplies in January occurred in 6 (46%) HFs in East Pokot and 11 (79%) HFs in Turkana South.

Of 13 HFs assessed in East Pokot, only one (8%) had an MoPHS Guidelines on Cholera Control handbook present. Nine (64%) of 14 HFs assessed in Turkana South had a handbook present. No HF in East Pokot and 1 (7%) in Turkana South had a flowchart illustrating the cholera clinical case management available in the facility.

Staff at 16 HFs in East Pokot and 22 in Turkana South were asked about stool culture capacity. Of these, 5 (31%) and 6 (27%) HFs had the capacity to collect stool samples in East Pokot and Turkana South, respectively. Of these, no HF in East Pokot or Turkana South were able to conduct stool cultures. In East Pokot, stool specimens were sent to either the district hospital or the DVBD laboratory in Marigot; both health facilities reported receiving culture results but not antimicrobial susceptibility results. In Turkana South, stool specimens were sent to Lodwar District Hospital for culturing; two HFs reported receiving culture results and no health facilities received antimicrobial susceptibility results. No HF in East Pokot or Turkana South had rapid cholera test kits (Table 11).

Urban Health Facilities

In-charge staff members in four HFs in Embakasi, 6 in Kasarani, and 7 in Kibera were asked about stocks of cholera treatment supplies. Among these HF, 2 (50%) HFs in Embakasi, 5 (83%) in Kasarani, and 2 (29%) in Kibera reported current stocks of one or more cholera management supplies at the time of interview. Three (43-75%) HFs in each

urban district reported stock-outs of one or more supplies in 2009; stock-outs of any of these supplies in January occurred in one (25%) HF in Embakasi, one (17%) in Kasarani, and 3 (43%) HFs in Kibera.

Of four HFs assessed in Embakasi, 2 (50%) had an MoPHS Guidelines on Cholera Control handbook present in their facility. Three (60%) of 5 HFs assessed in Kasarani and one (17%) of six in Kibera had a handbook present. A flowchart illustrating the cholera clinical case management was present in three (21%) of 14 HFs assessed in Embakasi, 8 (42%) of 19 HFs assessed in Kasarani, and 12 (43%) of 28 HFs assessed in Kibera.

Staff in 21 HFs in Embakasi, all HFs in Kasarani, and 49 HFs in Kibera were asked about stool culture capacity. Twelve (57%) HFs in Embakasi had the capacity to collect stool samples; only two (17%) HFs were able to conduct stool cultures. The majority of HFs in Kasarani, 30 (81%), and Kibera, 40 (82%), had the capacity to collect stool samples; one (3%) HF in Kasarani and 11 (28%) HFs in Kibera were able to conduct stool cultures. Only one out of 5 HFs assessed in Kasarani and Kibera had rapid cholera test kits available (Table 12).

ORS Use and Distribution in Health Facilities

Rural Health Facilities

A staff member in charge was asked about ORS practices in 13 HFs in East Pokot and 14 in Turkana South. The practitioner in-charge at 85% of HFs in East Pokot and all HFs in Turkana South reported making ORS for cholera patients. Of those, 7 (64%) and 9 (64%) reported boiling the water used for ORS in East Pokot and Turkana South,

respectively. The in-charge at 3 (27%) of 14 HFs in East Pokot reported chlorinating the water used to make ORS; of these, all used Aquatabs to chlorinate the water and had Aquatabs present in their facility. The practitioner in-charge at 6 (43%) of 14 HFs in Turkana South reported chlorinating the water used to make ORS; of these 2 HFs used Aquatabs, 2 HFs used Pur and Aquatabs, and 2 HFs used Purifast; four HFs had a water treatment product present. Staff at one (9%) of 12 HFs in East Pokot and 8 (57%) of 14 HFs in Turkana South pre-mixed ORS in large quantities for multiple cholera patients; all mixed the ORS in a jerrycan or bucket with a lid. Cholera patients in all HFs in East Pokot and Turkana South were reportedly discharged home with ORS packets; 11 (92%) of 12 HFs in East Pokot and 13 (87%) of 15 HFs in Turkana South had ORS packets available at the time of interview (Table 11).

Urban Health Facilities

A staff member in charge was asked about ORS practices in 4 HFs in Embakasi, 5 in Kasarani, and 7 in Kibera. The practitioner in-charge at three (75%) HFs in Embakasi, all HFs in Kasarani, and 6 (86%) in Kibera reported making ORS for cholera patients. Of those, 2 (67%) and 4 (80%), 6 (86%) of the practitioners in-charge reported boiling the water used for ORS in Embakasi, Kasarani and Kibera, respectively. Among HFs with ORS prepared for cholera patients, one practitioner in-charge in Embakasi, and two in Kasarani and Kibera reported chlorinating the water. In Embakasi and Kasarani, WaterGuard or Aquatabs were used; both were present in Embakasi and and Aquatabs were present in Kasarani. WaterGuard and PuR were used in Kibera and both were present. Staff at two (50%) HFs in Embakasi, all HFs in Kasarani, and no HF in Kibera

pre-mixed ORS in large quantities for multiple cholera patients; buckets or jerrycans with lids were used. Cholera patients at 22 (96%) of 23 HFs in Embakasi, 33 (94%) of 35 in Kasarani, and 45 (96%) of 47 HFs in Kibera were reportedly discharged home with ORS; the majority of HFs (23 (100%) in Embakasi, 32 (97%) in Kasarani, and 44 (98%) in Kibera) had ORS present in the facility (Table 12).

Supply Availability at Kiosks/Chemists in Rural Districts

Eighty-five kiosks/chemists were visited in 15 towns; 35 kiosks/chemists were in East Pokot and 50 in Turkana South. Less than a quarter of all kiosks/chemists surveyed had any of the supplies asked about. Three kiosks/chemists (3.5%) had ORS, 10 (11.8%) had doxycycline, 4 (4.7%) had tetracycline, 8 (9.4%) had metronidazole, 3 (3.5%) had ciprofloxacin, 8 (9.4%) had Diastop, 10 (11.8%) had Diadis, and no kiosks/chemists had Entamax. In general there were very few chemists in the area, the majority of participants were owners of kiosks. An assessment of supply availability in kiosks/chemists was not conducted in urban districts.

Conclusions

HCWs in both rural and urban districts have low knowledge of the correct cholera case definition. This may be due to a lack of recent training in cholera case management, and surveillance as evident by the low percentage of health care workers that received cholera training in 2009 or in recent years. In rural districts, few to no facilities had the Guidelines on Cholera Control handbook or case management flowcharts present, HCWs have no means of educating themselves about/referencing control guidelines. More

facilities in urban districts had the handbook or flowchart present, although there was variation among districts.

In both urban and rural districts, the majority of HCWs could correctly identify the symptoms of severe dehydration and know that IVF are the recommended treatment. However, knowledge of the recommended type of IVF is lower in rural health facilities. Using incorrect IVF for severely dehydrated patients may lead to electrolyte imbalances and other complications.

IVF seem to be administered more often than necessary in both urban and rural districts as evident by many HCWs stating IVF are necessary for patients without severe dehydration and that ORS should not be given to non-vomiting patients until IVF have been administered. The overuse of IVF increases the risk of infection and complications from fluid overload, and depletes supplies unnecessarily.

Antibiotic overuse also appears to be a problem in health facilities in rural and urban districts. When asked which cholera patients should receive oral antibiotics, few HCWs knew only cholera patients with severe dehydration should receive antibiotics. Prescribing antibiotics to patients that do not need them leads to the build up of antibiotic resistance and may send misleading messages about cholera treatment to patients. Although most HCWs know doxycycline is the first-line antibiotic of choice for adult cholera patients, fewer HCWs knew the correct antibiotic used for pediatric patients. Education regarding when and which antibiotics to prescribe for adult and pediatric cholera patients is needed.

Shortage of supplies necessary to treat cholera patients was a problem in rural and urban districts in 2009 and appeared to be continuing into 2010. During an outbreak,

where there are an increased number of patients requiring IVF and ORS, a lack of supplies may lead to an increased number of unnecessary and preventable deaths. The shortage of laboratory supplies also affects a health facility's ability to respond to an outbreak. Without specimen cups or transport media to process samples or transportation to carry samples to referral laboratories, health facilities are unable to confirm the start or monitor for the end of an outbreak. Rapid cholera tests would allow health facilities without lab capacity to quickly confirm the start of an outbreak and initiate control measures rapidly.

Based on results of the health care worker survey, and key informant interviews, it appears that most deaths in East Pokot occurred before patients reached the health facility, suggesting that the high CFR may not have been due to poor case management. Reports of people dying along the sides of rivers suggest that access to health care is limited and this hypothesis is supported by the findings in the community KAP survey outlined in this report. The District Commissioner in East Pokot reported that a two day helicopter search and rescue mission was conducted in November, 2009 to find and treat cholera patients in an area without roads. Anecdotally, thirteen people were rescued and many dead bodies were discovered along river-banks and were suspected to be due to cholera. A total of 27 cholera deaths were reported in East Pokot, three of which occurred in a health facility. The District Public Health Officer did not receive these stool test results back from specimens taken from these initial cholera patients in East Pokot after they had been sent to the KEMRI laboratories. It would be important for the MoPHS to follow up on getting these results clarified and sent back to the district, given the severity and the number of fatalities involved in the event.

In addition, the low percentage of kiosks/chemists with ORS also may be a contributing factor to the high CFR. Patients unable to reach a health facility also likely lack access to ORS in their villages and thus are unable to prevent progression to severe dehydration.

It appears that urban health facilities have similar deficiencies as rural health facilities. Therefore, interventions to improve and increase health care worker knowledge of cholera case definitions, ensure adequate supplies are consistently available, and strengthen laboratory testing capacity should be implemented in both urban and rural health facilities.

3a. Nairobi Water Quality Study

Background

Investigations completed by the Kenya Ministry of Public Health and Sanitation (MoPHS), and the Kenya Field Epidemiology and Laboratory Training Program (FELTP) residents in December 2009 identified ongoing cholera cases and potential deficiencies with water and sanitation systems in the informal settlements of Nairobi. In light of these findings, a rapid assessment of water quality , and a water knowledge, attitudes, and practices survey were carried out in two cholera affected informal settlements in Nairobi, Kenya.

Objectives

The objectives of the rapid assessment of water quality were to assess water treatment practices at the municipal and household level, and to examine the

microbiological quality of source and stored household drinking water in two informal settlements of Nairobi affected by recent cholera outbreaks.

Specific Objectives

- Assess total and free chlorine levels in source and stored household drinking water
- Conduct source and household level microbiological water quality testing for the presence of total coliform and *Escherichia coli* contamination of the water
- Conduct a household survey of knowledge, attitudes, and water handling practices in randomly selected households

Methods

Study Area

The study was carried out in the Korogocho and Mukuru kwa Njenga informal settlements in Nairobi. These two settlements were chosen based on meeting at least one of the following two criteria; having had cholera cases reported to the MoPHS in January 2010 (Korogocho), or having had a high number of cholera cases reported to the MoPHS since September 2009 (Mukuru kwa Njenga). In addition, safety assessments of the affected Nairobi informal settlements were taken into consideration in the final selection of the study areas. Security was provided for the study teams in both Korogocho and Mukuru kwa Njenga during data collection.

Cholera in the Study Area

Cholera cases from both settlements were reported to the MoPHS in 2009. Although national surveillance data describing the epidemiology of the reported cholera cases in Korogocho and Mukuru kwa Njenga was incomplete and subject to limitations, such as missing data or misclassification of data, the following information was available before the study was initiated:

Korogocho settlement: There were 29 cases of cholera in the Korogocho settlement reported to the MoPHS for which location information was available. The reported earliest illness onset dates in 2009 occurred in June and July (2 cases). The remainder of the illness onset dates ranged from September 23, 2009 to December 13, 2009. Among the cases, 10 (34.5%) were female and the median age was 5 (range of <1-79 years. Of 22 patients who had a stool culture carried out, 18 (81.8%) tested positive for *Vibrio cholerae*. One of the 29 reported cases died (CFR = 3.4%).

Mukuru kwa Njenga settlement: There were 43 cases of cholera in the Mukuru kwa Njenga settlement reported to the MoPHS for which location information was available. Reported illness onset dates in this settlement ranged from October 10, 2009 to November 23, 2009. Among these cases 20 (46.5%) were female and the median age was 14 (range 0.2-49 years). Of the 43cases in Mukuru Kwa Njenga, 23 patients have a culture carried out and 14 (60.9%) of 23 were positive for *Vibrio cholerae*. No deaths were reported to national surveillance.

It should be noted that there were many antidotal reports of cholera deaths in both Korogocho and Mukuru Kwa Njenga. Active case finding could have possibly revealed additional cases and deaths in both settlements.

Water Source and Household Sampling Selection

The sampling strategy was based on the consideration that the laboratory only had the capacity to test a maximum of 600 water samples for total coliform and *E. coli* contamination. A random sample of drinking water sources was tested for total and free residual chlorine, and microbiologic quality. In parallel, we conducted interviews with selected households served by these sources and tested their stored drinking water for total and free chlorine residual and microbiologic quality. To better characterize the quality of drinking water sources, we carried out a sub-set of selective repeat sampling of source waters that were negative for total coliform and *E. coli* contamination on an initial water quality test.

Sampling points were randomly selected from satellite images of the informal settlements of Korogocho and Mukuru kwa Njenga taken on March 22, 2009 and obtained from the US National Geospatial Intelligence Agency. Once the images of the informal settlements were obtained, a grid was superimposed on each of the images. The goal of overlaying a grid on the satellite images was to provide a systematic sampling scheme that would enable us to rapidly determine a random sample from an area where maps were unavailable. The spacing of the gridlines for each map was based on the estimated density of source waters, with the aim that each square on the grid would contain at least one operational water source. In addition the grid squares needed to be at

a resolution to contain enough visual information within the satellite image that the study team could easily discern its location. All sample grid square coordinates falling within the study population were exported into MS Excel and assigned a unique study code number. A random sample of 100 unique study code numbers were generated and used as the selected sampling locations within each settlement.

The randomly selected study sample points fell within each of the four quadrants of both of the informal settlement satellite images. High-resolution, enlarged images were created for the purposes of locating specific points on the map in the field. These images or maps were created and distributed to four village guides. The village guides used various landmarks and distinguishing points on the map to locate each of the randomly selected points on the map. Once each point was located, the study enumeration team spun a bottle at the central point of the grid square to randomly select the direction of the households to be approached for interview (one enumerator went in each direction pinpointed by the bottle). The enumerators then flipped a coin to randomly select from which sampling point a source and household water source sample would be taken. At each sampling point two household interviews were completed but the source and household water samples were only taken from one of the selected household. This was necessary due to resource and time constaints, but enabled the capture of a range of water sources.

Data collection

Ten local enumerators fluent in English and Swahili were hired and trained in survey administration and water sampling procedures. The survey was translated into

Swahili before the start of the study. Data from interviews were recorded on a paper-based survey instrument (Appendix C), and results of the testing for total and free chlorine residuals were recorded on both the survey instrument as well as a data collection sheet for recording water testing results (Appendix D). Samples of source and household water for microbiologic testing were collected by enumerators in sterile sample bottles, labeled, stored on ice, and transported within 6 hours of collection to the laboratory for processing.

Laboratory tests were conducted at the CDC/KEMRI laboratory in Nairobi, Kenya immediately after the return of the study team to the laboratory on a daily basis. We tested each water sample using Colilert® (Idexx Co., Westbrook, ME, USA) Quanti-Tray® test kits to obtain most probable number (MPN) estimates for each sample. Trained laboratory technicians followed the laboratory testing protocol outlined in Appendix E.

Data management and analysis

The survey data were entered into a MS Assess database and a MS Excel spreadsheet was used for compilation of the results of the water testing data. The data was analyzed using SAS version 9.2 and SAS EG (SAS Institute, Inc., Cary, North Carolina, USA).

Results

Based on the sampling considerations, from January 28, 2010 to February 10, 2010 we collected 100 source water samples, and 100 household water samples served by these points from each informal settlement. Additionally, approximately 50 repeat samples from water sources that had previously tested negative were collected and retested from each informal settlement. The breakdown of the results by settlement follows:

Korogocho Informal Settlement

Demographics

In total, 199 household interviews were completed in Korogocho. All respondents interviewed were primarily responsible for water within the household. The median age of respondent's was 26 years (range 13-85) and most respondents were female 166 (83.4%). The majority, 171 (85.9%), reported the ability to read and write and 143 (71.9%) reported at least completing primary school. The median household size was 4 persons (range of 1-15) and median number of children under five years old in the household was 1 (range 0-12). Thirty-two (16.1%) respondents reported having someone in the household with acute watery diarrhea/cholera since September 2009.

Water sources, storage, and treatment practices

Almost all, 197 (99%) respondents reported standpipes or taps as their primary source of drinking water on the day of interview. Two individuals reported purchasing water from a water vendor, who had likely obtained the vended water from a tap.

Primary water sources did not vary between the rainy season and the dry season and the majority of respondents, 162 (81.4%), reported having water from their primary source for all months out of the year. The average time reported to travel to the source, collect the water and return home was 5 minutes (range 1-42) and the cost for approximately 70% of respondents was ≤2 Ksh for a 20-L container of water. Several respondents reported rates of water ≥ 600 Ksh for a 20-L container of water. It is unclear if these respondents were reporting their monthly rent including a charge for water or if a 20-L container of water truly was that cost.

Most households, 184 (92.5%), reported storing drinking water in their household and the storage containers varied widely (Table 13). Many households, 129 (64.8%), stored their drinking water on the day of visit in a narrow-mouthed container. Additionally, most drinking water storage containers, 136 (68.3%), were covered and only 3 (<1%) had a spigot. Fifty-five (27.6%) respondents reported having ever treated the water in their household, with 33 (16.5%) respondents who reportedboiling and 17 (8.5%) who reported using WaterGuard. Of the 55 respondents who reported ever treating their water, 27 (49.1%) reported consistently treating their water. These categories were not mutually exclusive. Eleven respondents reported treating their drinking water on the day of the interview; 9 (4.5%) by boiling and one with WaterGuard.

Fourteen (7.0%) households reported having purchased a water treatment product since September 2009. Of these 14 households, 12 (85.7%) purchased WaterGuard, 2 (14.2%) Aquatabs, and 1 (7.1%) Aquaguard. These categories were not mutually exclusive. Additionally, fourteen households reported receiving a free water treatment

product since September 2009; 7 persons received Aquatabs, 4 WaterGuard, and 1 PuR. The following sources were sighted as providing the free water treatment supplies; Ministry of Health (3), CDC (1), a clinic (1), NGO (1), and a local public health officer (1). Of the 14 respondents who reported receiving a household water treatment product, 12 (85.7%) reported receiving instructions on how to use the product, and 9 (64.3%) persons reported seeing a demonstration of how to use the product.

In 10 (5.0%) of the 199 households visited, WaterGuard product was directly observed but only two had liquid product in the bottle and half (5) of the bottles were expired. The product PuR was observed in one household and Aquatabs were observed in three households.

Sanitation and Hygiene

All households reported having access to an improved source of feces disposal; 175 (87.9%) a latrine and 24 (12.1%) a flush toilet. The median distance to a toilet source was 5 meters (range 0-75) and 183 (92.0%) respondents reported their toilet source being functional on the day of interview. Fifty-one (25.6%) households reported having to pay for toilet facilities and 42 (21.1%) additional households reported that a fee for their toilet facilities is included in their rent. Handwashing stations were observed in 42 (21.1%) households and 40 (20.1%) respondents had soap present in their home at the time of interview.

Source Water Testing

Microbiological testing

Microbiological testing for total coliforms and *E. coli* was conducted on 192 samples from Korogocho; 96 from source water and 96 from household water. Of the 96 sources water samples, 92 (95.8%) were from taps/public standpipes, 3 (3.1%) were from storage tanks fed by taps/public standpipes, and 1 (1.0%) was from a water tanker. Of the 96 source water samples, 26 (27.1%) showed total coliform contamination (≥ 1 CFU/100 ml of water) with a median MPN of 19.1 (range 1-2420), and 7 (7.3%) showed *E. coli* coliform contamination with a median MPN of 13.1 (range 1-30.1). The median free chlorine level of sources positive for total coliform contamination was 0.6 mg/L (range 0-0.8). The median free chlorine level of sources positive for *E. coli* contamination was 0.6 mg/L (range 0.1-0.7). Complete chlorination ranges by type of water source are shown in Table 14.

Household water testing

Of the 96 household stored water samples, 56 (57.1%) showed total coliform contamination (≥ 1 CFU/100 ml of water) with a median MPN of 39.7 (range 1-2420) and 11 (11.5%) showed *E. coli* contamination with a median MPN of 6.3 (range 1-461.1). The median free chlorine level of household drinking water contaminated by total coliforms was 0.2 mg/L (range 0-0.7). The median free chlorine level of household water contaminated by *E. coli* was 0 mg/L (range 0-0.3). Contamination by type of household drinking water storage container and the corresponding total and free chlorine residual levels are shown in Table 14.

Re-sampling

We re-sampled 20 (28.6%) of the 70 source samples that yielded no contamination on the first microbiologic test. Three samples were contaminated with total coliform upon re-sampling on a different day within the same week. No water source re-samples showed contamination with *E. coli*.

Mukuru kwa Njenga Informal Settlement

Demographics

In total 199 household interviews were completed in the Mukuru kwa Njenga informal settlement. All respondents reported primary responsibility for water in the household. The majority of respondents 170 (85.4%) were female. The median age of all respondents was 27 years (range 13-53). Almost all respondents, 182 (91.5%), reported the ability to read and write and 156 (78.4%) reported at least completing primary school. The median size of households surveyed was 4 persons (range 1-21). Over half of the households, 116 (58.3%), had children under five years old in the household with a median of 1 child (range 0 – 5 children). Four households (2.0%) reported having a case of cholera since September 2009.

Water Source, Storage, and Treatment Practices

The majority of households, 150 (75.4%), reported using public taps/standpipes as their primary source of drinking water on the day of the interview. Other sources reported were water tankers 22 (11.1%), water vendors 15 (7.5%), and boreholes 12

(6.0%)(Table 1). Water sources reported in the rainy and dry seasons did not differ substantially and were reported in similar proportions for water sources reported for the day of interview. The median number of months households reported their primary source was available was 12 months (range 1-12). The median time to travel to the source, collect water and return home was 5 minutes (range 1-30) and the median distance in meters to the source was 10 meters (range 1-400). The median cost of a 20-L container of was 5 Ksh (range 0-3000 Ksh). Over 90% of respondents reported paying ≤ 10 Ksh for a 20-L container of water. Thirty-two households (16.1%) reported that water was available 24 hours a day, 7 days a week.

Almost all 195 (98.0%) reported storing their drinking water on the day of interview. The storage containers were variable, the most common being 20L jerrycans, 5L jerrycans, superdrums (50-200L), and 5L wide-mouth buckets (Table 13). It was confirmed that 131 (65.8%) households stored their water in a narrow-mouthed container and 171 (85.9%) of the drinking water containers were covered. Only 2 household drinking water containers had a spigot.

Over half of the respondents, 114 (57.3%), reported ever treating their drinking water in the household. The treatment methods respondents reported ever using were boiling 54 (27.1%), WaterGuard 48 (24.1%), Aquatabs 9 (4.5%), AquaGuard 2 (1.0), PuR 1 (0.5%), and solar disinfection 1 (0.5%). These categories were not mutually exclusive. Half of the respondents, 99 (49.7%), reported always treating their drinking water. Of the 57 (28.6%) respondents that reported treating their drinking water on the day of the interview, 33 (57.9%) reported boiling, 24 (42.1%) reported using WaterGuard, 1 (1.8%) solar disinfection, and 1 (1.8%) used Alum. Twenty one (10.6%)

respondents reported performing the water treatment on that day. The presence of WaterGuard was confirmed in 35 (17.6%) households, however, 25 of the bottles were empty and 5 of the bottles were expired. In addition, Aquatabs were present in 20 (10.1%) homes. No other household water treatment products were observed in Mukuru Kwa Njenga at interview.

Of the 46 (23.1%) respondents that reported purchasing a household water treatment product since September 2009, 46 (100%) reported purchasing WaterGuard, 6 (13.0%) Aquatabs, and 2 (4.3%) AquaGuard. Of the 73 (36.7%) respondents that reported being given a free product to treat their drinking water, 70 (95.9%) reported receiving Aquatabs, 2 (2.7%) AquaGuard, 1 (1.4%) WaterGuard, and 1 (1.4%) chorine powder. Organizations who reportedly distributed these products were the Ministry of Health (50), churches (9), clinics (7), NGOs (3), local public health officers (2), and CDC (1). Of the 73 respondents who received a free product, 68 (93.2%) reported being given instructions on how to use the product and 23 (31.5%) reported seeing a demonstration on how to use the products.

Sanitation and Hygiene

Almost all respondents reported having access to an improved toilet source; 183 (92.0%) latrines, 13 (6.5%) flush toilets, 1 (<1%) reporting using the ground, and 1 (<1%) reported using flying toilets. The majority of respondents, 193 (97.0%), reported sharing the latrine or toilet with another person. Almost all, 193 (97.0%), reported their toilet being functional on the day of interview. Fifty-five (27.6%) reported paying a fee to use the facility and 38 (19.1%) additional persons reported a fee being included for use

of the facility in their monthly rent. A handwashing station was observed in 39 (19.6%) households and soap was observed in 50 (25.1%) households on the day of interview.

Source Water Testing

Microbiological testing

Microbiological testing for total coliforms and *E. coli* was conducted on 196 samples from Mukuru kwa Njenga; 98 from source water and 98 from household water. Of the 96 sources water samples 75 (78.1%) were from taps/public standpipes, 15 (15.6%) were from storage tanks fed by taps/public standpipes, 7 (7.3%) were from boreholes and 1 (1.1%) was from a water vendor also likely from a standpipe. Of the 98 source water samples, 32 (32.7%) showed total coliform contamination (≥ 1 CFU/100 ml of water) with a median MPN of 5.2 (range 1-2420), and 8 (8.2%) showed *E. coli* contamination with a median MPN of 64.9 (range 1-307.6). The median free chlorine level of sources positive for total coliform contamination was 0.1 mg/L (range 0-0.65). The median free chlorine level of sources positive for *E. coli* contamination was 0 mg/L (range 0-0.4). Complete chlorination ranges by type of water source are shown in Table 15.

Household Water Testing

Microbiological testing

Of the 98 household stored water samples, 66 (67.3%) showed total coliform contamination (≥ 1 CFU/100 ml of water) with a median MPN of 209.3 (range 1-2420) and 31 (31.6%) showed *E. coli* contamination with a median MPN of 5.2 (range 1-

1732.9). The median free chlorine level of household drinking water contaminated by total coliforms was 0 mg/L (range 0-1.5). The median free chlorine level of household water contaminated by *E. coli* coliforms was 0 mg/L (range 0-0.5). Contamination by storage container and corresponding chlorine residual levels are shown in Table 15.

Re-sampling

We re-sampled 53 (80.3%) of the 66 source samples that yielded no contamination on the first microbiologic test. Fourteen (26.4%) samples were contaminated with total coliforms upon re-sampling on a different day within the same week. Three (5.6%) water sources re-sampled showed contamination with *E. coli* on the day of re-sampling.

Conclusions

From this assessment we were able to ascertain that the majority of residents surveyed in Korogocho and Mukuru kwa Njenga use standpipe water and there is little reported variability of sources used during the rainy and dry seasons. The vast majority of households reported storing water in the house and very few reported using any type of household water treatment.

Households in Mukuru kwa Njenga reported slightly higher rates of household water treatment practices than Korogocho. Of the known household water treatment practices reported boiling water was predominant followed by use of WaterGuard. Household water treatment products were observed in very few households and included WaterGuard, Aquatabs, and PuR. The survey indicated that an intervention was carried

out in Mukuru kwa Njenga, specifically households being given Aquatabs but only 20 (10.1%) of households had this product observed in the house at the time of the survey.

Contamination rates of source water were similar for both settlements. Of the 99 source waters tested in Korogocho, 27.1% showed total coliform contamination and 7.3% showed *E. coli* contamination. In Mukuru kwa Njenga, 32.7% of surveyed source waters were contaminated with total coliforms and 8.2% of source waters were contaminated with *E. coli*. Although these levels appear low they are not insubstantial considering the piped water supply in these areas is thought to contain adequate chlorine levels necessary for inactivation of contaminants. While the rates of contamination were similar in the two informal settlements, median free chlorine levels varied substantially. In Korogocho, the median free chlorine level of contaminated water was slightly higher (0.6 mg/L) than the World Health Organization recommendations for standpipe water (0.5 mg/L) from water distribution systems affected by cholera. In Mukuru kwa Njenga, a chlorine deficiency was observed for standpipe water with a median free chlorine level of 0.19mg/L for sources contaminated with total coliforms and 0 mg/L for sources contaminated with *E. coli*. One possible explanation for this difference between settlements is very few "illegal" connections were observed in Korogocho as compared to Mukuru kwa Njenga. It was difficult to obtain data on "illegal" versus "legal" connections due to safety considerations of the enumerators in this area who reported feeling 'scared' to document this type of information. When the chief of Korogocho was interviewed regarding the scarcity of illegal connections in his settlement, he reported taking strict action against individuals who illegally tapped into water connections and he

reported arresting individuals who carried out such activities, This same enforcement of illegal water tapping was not noted by the chief of Mukuru kwa Njenga.

As expected, contamination levels of stored household water were substantially higher than source waters, and free chlorine levels in stored household water were universally non-existent. hHigher levels of contamination were observed in household water tested in Mukuru kwa Njenga. The median MPN count of total coliforms in Mukuru Kwa Njenga was 209.3 CFUs compared to 37.9 CFUs in Korogocho. One possible explanation for increased contamination levels could be initial chlorine deficencies in the source water within this settlement, thus leaving the household waters more vulnerable to further contamination. Contamination levels did not vary substantially between types of storage container.

Although contamination levels were lower than expected in both settlements, water chlorination deficiencies were observed at both the source and household level. Interventions should be considered to address both discrepancies at the source and household level, especially during cholera outbreaks.

DISCUSSION AND RECOMMENDATIONS

This large, prolonged, nationwide outbreak of acute watery diarrhea/cholera resulted in the highest case count of cholera in Kenya in the past decade. This comprehensive investigation of the 2009 cholera outbreaks in Kenya brings to light the significant impact these outbreaks had nationally as well as important challenges the country faced with regard to surveillance for cholera and in the response to the outbreaks in both remote rural areas of the country as well as in urban informal settlements of the capital city of Nairobi. As outlined in this report, there are considerable opportunities for targeted interventions to improve surveillance, prevention and control, and response efforts at the national level as well as at the provincial and district levels, not only for cholera, but other waterborne outbreaks and infectious disease outbreaks in general.

The resource allocation for surveillance for priority infectious diseases in Kenya needs to be strengthened. Considerable basic requirements such as adequate computer resources, adequate staffing, and capacity building for documenting, managing and analyzing data at the national level, in addition to additional training in IDSR for districts, and provision of supplies for stool collection would assist with more timely and complete surveillance data, not only for cholera surveillance but for other priority infectious disease surveillance.

In line with the new Policy Guidelines on Control and Management of Diarrhoeal Diseases in Children Below Five Years in Kenya[4], ensuring the availability and strengthening the logistical management of commodities for diarrheal disease

[4] Kenyan Ministry of Public Health and Sanitation (2010) Policy Guidelines on Control and Management of Diarrhoeal Diseases in Children Below Five Years in Kenya, Division of Child and Adolescent Health, March 2010

management such as low osmolarity ORS, and IV fluids will not only impact the population of children under 5 years old but will enhance cholera response efforts and may prevent escalations in CFRs. It is essential that prevention and control strategies also be emphasized at the community level in addition to at the health facility level, particularly in remote areas with poor access to health case such as those identified in this investigation. Universal access to and community education on the use low osmolarity ORS is imperative as it can aid in management of diarrheal disease at the household/community levels, and when utilized appropriately, may prevent progression to severe dehydration. The healthcare sector should emphasize, promote and counsel patients on home management of cholera and diarrheal disease in general.

Access to adequate healthcare poses a major challenge for rural, remote areas of the country, which comprise a large majority of Kenya. Creative alternatives to the traditional model of healthcare must be considered, like mobile units or stepping up the community healthcare worker model. These methods can be used for continual public health education in the community, as well as for targeted health care during outbreaks, such as this large scale cholera epidemic. In addition, existing healthcare facilities and personnel need continual education on current and correct diarrheal case management, treatment and prevention guidelines, as well as sustained supplies and resources.

Furthermore, lack of access to sufficient and/or safe drinking water and proper sanitation remains difficult for many areas of Kenya, including among persons living in rural areas and among residents of urban informal settlements such as those surveyed in Nairobi. Improved water sources should be investigated, and low cost point-of-use household water treatment products should be widely promoted, in a more

comprehensive way into overall diarrheal prevention strategies. Having such products widely available and familiar to the community will assist at times when waterborne outbreaks occur. Water availability and sanitation are issues where solutions are more challenging but should be considered in longer term cholera control and prevention strategies.

Ongoing monitoring and evaluation of surveillance data, community-based prevention programs, health care case management, and water/sanitation interventions at the local levels, including in informal settlements, as well at the national level are crucial to understanding the challenges and reducing the burden and high CFR's from cholera and diarrheal diseases in general in Kenya.

Based on the study findings we recommend the following:

Cholera Surveillance System

- Continue surveillance for new cases using the established national line list
- Actively follow-up on known outstanding data from districts
    - Update 2009 national line list as outstanding data are received
- Maintain the new standardized electronic national line list
    - Create a national line list for 2010 cholera cases
- Create a standardized cholera line list form and train health facilities on its use
    - Roll out standardized line list forms to districts
    - Emphasize use of correct WHO cholera case definition for reporting
- Revise surveillance section in MoPHS Guidelines on Cholera Control
    - Include template for standardized cholera line list form

    - Explain importance of line list
    - Describe cholera case reporting protocol, such as deadlines for reporting
- Establish official lines of communication and deadlines for reporting line list data to the national level
    - Create a national line list e-mail inbox for receiving line lists from health facilities and districts with internet access
    - An alternative to consider in discussion with IDSR would be implementing the use of scannable forms, which could be sent to DDSR via e-mail, fax or mail and then optically scanned at DDSR into a database. Additional resources would be needed to implement such a system at DDSR
- Provide additional staffing, training, and IT capacity for the DDSR data section
- Ensure that the surveillance data captures institutional outbreaks appropriately
- Provide training on IDSR, including the cholera module, in districts not trained
- Consider transitioning to systematic aggregate data reporting within IDSR guidelines during an outbreak situation, once a national line list is established, functional and has been used to characterize the outbreak
- Improve systematic aggregate reporting using a standard reporting time frame, and collection of weekly summary number for cases identified that week
- Long term: Assess the behavioral, climatologic, and other environmental factors in Kenya that may be related to an upsurge in acute watery diarrhea/cholera

Laboratory

- Reemphasize/establish official lines of communication with respect to where specimens should be sent for testing at the districts. Require mandatory reporting of results back to districts
- Establish and provide resources for a national protocol for banking and storage of isolates
- Facilitate the distribution of laboratory supplies and reagents to districts most likely to be affected
- Consider procuring and distributing Crystal VC® Dipstick rapid test for early detection of cholera outbreaks

Rural Cholera Knowledge Attitudes and Practices

- Incorporate an ORS strategy into the draft Diarrhea Control Manual and other Ministry diarrheal disease strategies
- Initiate and increase utilization of the community health worker model which will assist with surveillance and response
- Promote universal ORS availability in the community, including at local shops and pharmacies, and from community health workers
- Encourage traditional healers to carry and distribute ORS, as part of their diarrhea treatment regimens

- Continue distribution of water treatment supplies such as Aquatabs, jerrycans, ORS, and soap for cholera response complemented with education on proper use of water treatment supplies and hygiene education
- Long term: Improve access to health care for remote areas
    - Consider using mobile health units during an outbreak situation
- Long term: Improve access to improved water sources and water availability

Health Care Case Management

- Revise and disseminate the revised version of the MoPHS/WHO Guidelines on Cholera Control book and ensure that all health facilities have copies
- Provide routine cholera case management refresher courses for health facility staff, especially during outbreaks
- Enhance capacity for laboratory confirmation by providing rapid cholera test kits, stool specimen cups, and transport media for health facilities and by facilitating transportation of specimens to laboratories
- Ensure that laboratories report back to the health facility the test results including antimicrobial susceptibility testing results if carried out
- Cholera treatment supplies should be monitored and inventoried at health facilities, and shortages and stock outs *(no supplies)* of ORS at health facilities should be addressed by health facility administrators immediately

Water and Sanitation

- Focus the distribution of cholera prevention interventions (e.g., water treatment products, jerricans, ORS, soap, etc.) to Nairobi areas with active cholera cases, Use the DDSR Nairobi epidemiology data in order to inform target areas for interventions by MoPHS and partners
- Consider the language barriers within the sub-communities of the informal settlements, such as among the Ethiopian and Somali refugee populations living in the settlements
- Work with the water authorities to implement routine monitoring, analyses, and dissemination of water quality data in Nairobi's informal settlements for early detection of waterborne outbreaks
- Further investigate the potential correlation between enforcing laws against illegal tapping and reductions in disease as a possible intervention for informal settlements
- Long term: Investigate the reasons for source and stored water contamination and low residual chlorine levels in informal settlements
- Long term: Address sanitation issues in Nairobi's informal settlements

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TABLES

Table 1. Cholera outbreaks by district as identified through surveillance data maintained nationally at the Kenyan MoPHS, Kenya - 2009

No	Districts	Cases	Lab confirmed	Deaths	CFR	Date of onset of outbreak	Last Date new case reported
1	Siaya	127	78	3	2.3	08/2/09	30/10/09
2	Kisumu East	230	155	5	2.2	02/1/09	26/3/09
3	Nyando	118	6	1	0.8	02/1/09	30/10/09
4	Rachuonyo	111	35	5	4.5	03/1/09	15/3/09
5	Homa Bay	81	45	3	3.7	17/1/09	02/4/09
6	Kisumu West	58	6	1	1.7	08/2/09	19/4/09
7	Nandi South	21	21	3	14.3	22/2/09	25/3/09
8	Moyale	559	19	10	1.7	30/1/09	16/6/09
9	Machakos	179	6	6	3.3	11/3/09	26/3/09
10	Kakamega Central	30	13	2	6.6	11/3/09	23/3/09
11	Busia	18	3	1	5.5	14/3/09	21/4/09
12	Nakuru	16	5	1	6.3	21/3/09	23/3/09
13	Kericho	21	6	4	19	20/3/09	6/12/09
14	Isiolo	420	23	23	5.4	21/3/09	13/7/09
15	Bungoma East	117	35	1	0.8	27/3/09	21/4/09
16	Rongo	89	4	2	2.2	30/3/09	22/4/09
17	Tinderet	59	2	1	1.7	01/4/09	16/5/09
18	Wajir North (Bute)	250	2	1	0.4	07/4/09	23/4/09
19	Garissa	35	0	1	2.8	09/2/09	06/3/09
20	Bungoma South	27	7	1	3.7	08/4/09	29/4/09
21	Gucha S	2	1	1	50	08/3/09	10/3/09
22	Naivasha	200	5	4	2.0	03/5/09	11/5/09
23	Embakasi	142	25	16	11.3	05/5/09	20/12/09

24	Nairobi West	8	7	0		24/6/09	28/6/09
25	Kajiado	34	7	2	5.8	28/4/09	23/6/09
26	Laisamis	1131	2	17	1.5	12/5/09	16/11/09
27	Mombasa	204	18	4	1.9	31/5/09	07/7/09
28	Suba	33	3	2	6.0	24/6/09	17/6/09
29	Kasarani	105	28	10	9.5	23/9/09	24/11/09
30	Garbatulla	352	9	6	1.7	23/5/09	30/9/09
31	malindi	64	16	0		10/6/09	19/7/09
32	Kilifi	106	34	0		04/6/09	06/9/09
33	Turkana Central	1314	34	34	2.6	08/8/09	28/12/09
34	Turkana South	1493	10	16	1.0	21/9/09	17/12/09
35	Turkana North	406	12	6	1.5	20/9/09	10/12/09
36	Kipkelion	80	2	5	6.3	27/10/09	18/10/09
37	Mutomo	1565	1	13	0.8	20/9/09	29/10/09
38	Kitui North	289	1	2	0.7	19/9/09	21/11/09
39	Mbooni	240	4	3	1.3	1/9/09	16/10/09
40	Makueni	163	6	3	1.8	29/9/09	29/10/09
41	Thika East	25	2	0		4/10/09	20/10/09
42	Lamu	257	8	6	2.3	01/9/09	4/12/09
43	Msambweni	82	2	0		16/10/09	7/12/09
44	Kwale	14	14	0		5/10/09	16/10/09
45	Ruiru	61	4	7	11.5	12/11/09	14/12/09
46	Kamukunji	26	23	1	3.8	25/10/09	14/12/09
47	Starehe	65	12	4	6.2	24/10/09	31/12/09
48	Chalbi	503	5	11	2.2	10/12/09	31/12/09
49	East Pokot	224	12	26	11.7	20/11/09	27/12/09
50	Makadara	15	3	0		22/10/09	23/11/09
Total		**11769**	**781**	**274**			

Table 2. Demographic Characteristics in East Pokot (n=120) and Turkana South (n=120), Kenya – 2010.

Demographic Characteristic	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Female	191 (80)	87 (73)	62.3 - 82.7	104 (87)	81.5 - 91.8	0.0016
Median Age in years (range)	40 (15 - 100)	40 (20 - 100)	---	40 (15 - 86)	---	---
No. of people in household	7 (1 - 21)	7 (1 -21)	---	6 (2 - 14)	---	---
No. less than 5 years in household	2 (0 - 10)	2 (0 - 10)	---	2 (0 - 5)	---	---
Self-reported Literacy	29 (12)	13 (11)	5.0 - 16.9	16 (13)	6.9 - 20.2	0.5430
No education	206 (87)	103 (87)	79.4 - 92.3	103 (87)	78.5 - 93.1	1.0000
Income						
Herding	133 (56)	100 (84)	---	33 (27)	---	---
Farming	6 (3)	0 (0)	---	6 (5)	---	---
Small Business	44 (19)	8 (7)	---	36 (31)	---	---
Unskilled Labor	16 (7)	6 (5)	---	10 (8)	---	---
Employed/Salaried	31 (13)	5 (4)	---	26 (22)	---	---
Religious denomination						
Christian	168 (70)	53 (44)	25.4 - 63.0	115 (96)	90.5 - 100.0	<.0001
Muslim	0 (0)	0 (0)	---	0 (0)	---	---
None	57 (24)	53 (44)	24.0 - 64.4	4 (3)	0.0 - 7.2	<.0001
Assets						
Electricity at home	0 (0)	0 (0)	---	0 (0)	---	---
Bicycle at home	18 (8)	6 (5)	0.0 - 12.3	12 (10)	3.9 - 16.1	0.3459
Phone	26 (11)	11 (9)	2.0 - 16.3	15 (13)	5.6 - 19.4	0.4997
Radio at home	36 (15)	13 (11)	2.0 - 19.6	23 (19)	9.4 - 28.9	0.2010
Own land	8 (3)	5 (4)	0.0 - 11.0	3 (3)	0.0 - 6.1	0.6277
Own none of the items asked	185 (77)	100 (83)	71.2 - 95.5	85 (71)	60.2 - 81.4	0.1298
Type of cooking fuel						
Wood	234 (98)	119 (99)	97.5 - 100.0	115 (96)	90.5 - 100.0	0.1106
Charcoal	23 (10)	0 (0)	---	23 (19)	7.4 - 30.9	---
Animals in home						
Goat	190 (79)	111 (93)	85.2 - 99.8	79 (66)	51.9 - 79.8	<.0001
Sheep	106 (44)	50 (42)	29.5 - 53.8	56 (47)	33.4 - 60.0	0.5684
Dog	56 (23)	21 (18)	8.7 - 26.3	35 (29)	14.1 - 44.2	0.1379
Cow / cattle	57 (24)	51 (43)	31.9 - 53.1	6 (5)	0.2 - 9.8	<.0001
Chickens, ducks, poultry	57 (24)	20 (17)	7.6 - 25.7	37 (31)	23.1 - 38.5	0.0157
Camel	29 (12)	27 (23)	15.1 - 29.9	2 (2)	0.0 - 5.0	<.0001
Donkey	5 (2)	3 (3)	0.0 - 5.2	2 (2)	0.0 - 5.0	0.7124
No animals	22 (9)	6 (5)	0.0 - 10.4	16 (13)	6.2 - 20.5	0.0635
Home Information / Observations						
Roofing material of home						
Thatch	204 (85)	115 (96)	---	89 (74)	---	---
Metal / iron sheets	22 (9)	4 (3)	---	18 (15)	---	---
Flooring material						
Earth / sand / mud	229 (96)	114 (96)	---	115 (97)	---	---
Wall material of home						
Dung / mud	74 (31)	21 (18)	---	53 (45)	---	---
Twigs	117 (49)	67 (56)	---	50 (42)	---	---
Wood	40 (17)	29 (24)	---	11 (9)	---	---
Metal sheets	2 (1)	1 (1)	---	1 (1)	---	---

Table 3. Cholera Experience in 2009 in East Pokot (n=120) and Turkana South (n=120); Kenya – 2010.

Characteristic	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Heard of illness called cholera	234 (98)	116 (97)	92.8 - 100.0	118 (98)	97.5 - 100.0	0.1752
Heard of cholera in area	178 (75)	68 (58)	40.3 - 75.0	110 (92)	86.3 - 100.0	<.0001
Cholera in village	161 (67)	49 (41)	21.5 - 60.2	112 (93)	87.4 - 99.2	<.0001
Cholera in village in last 7 days	30 (13)	21 (42)	---	9 (8)	---	---
Cholera in village in last month	68 (28)	8 (16)	---	30 (25)	---	---
Cholera in village in last 6 months	154 (46)	19 (38)	---	67 (56)	---	---
Died from cholera in village	95 (59)	24 (48)	23.2 - 72.8	71 (63)	46.8 - 80.0	0.2831
Cholera in family	86 (36)	29 (24)	11.6 - 36.8	57 (48)	31.4 - 63.6	0.0142
Death from cholera in family	13 (15)	6 (21)	6.2 - 35.1	7 (13)	3.4 - 21.2	0.2471
Mean/average number of hours to healthcare	20	31	---	1.7	---	---
Median no. of hours to healthcare (range)	4 (0 - 168)	6 (0 - 168)	---	1 (0 - 6)	---	---
Difficulty level in reaching health facility						
No difficulty	29 (12)	2 (2)	---	27 (23)	---	---
Some difficulty	50 (21)	5 (4)	---	45 (38)	---	---
Very difficult	158 (66)	112 (93)	---	46 (38)	---	---
Don't know	2 (1)	0 (0)	---	2 (2)	---	---
Sought care at health facility for family member with cholera	63 (26)	17 (14)	4.7 - 23.6	46 (38)	24.8 - 51.9	0.0010
ORS available in village	47 (23)	10 (10)	3.9 - 16.1	37 (34)	24.3 - 50.4	<.0001

Table 4. Cholera Knowledge & Attitudes in East Pokot (n=240) and Turkana South (n=240) in Kenya, 2010.

Cholera Knowledge	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Symptom of Cholera						
Watery diarrhea	193 (80)	86 (72)	60.9 - 82.5	107 (89)	82.7 - 95.6	0.0008
Bloody diarrhea	62 (26)	36 (30)	20.9 - 39.1	26 (22)	13.4 - 30.1	0.1562
Vomiting	200 (83)	88 (73)	60.6 - 86.0	112 (93)	89.2 - 97.5	<.0001
Fever	66 (28)	22 (18)	11.0 - 25.6	44 (37)	27.0 - 46.3	0.0003
Dehydration	64 (27)	2 (2)	0.0 - 3.9	62 (52)	36.6- 66.8	<.0001
Decreased appetite	13 (5)	2 (2)	0.0 - 3.9	11 (9)	2.9 - 15.4	0.0038
Other	4 (2)	2 (2)	0.0 - 3.9	2 (2)	0.0 - 3.9	1.0000
Don't know	12 (5)	10 (8)	3.0 - 13.6	2 (2)	0.0 - 3.9	0.0067
Cause of Cholera						
Drinking bad water	161 (67)	64 (53)	42.5 - 64.1	97 (81)	69.1 - 92.6	0.0002
Eating bad food	109 (45)	25 (21)	10.2 - 31.4	84 (70)	58.3 - 81.7	<.0001
Unwashed fruit/vegetables	24 (10)	1 (1)	0.0 - 2.5	23 (19)	7.4 - 30.1	<.0001
Flies/Insects	88 (37)	12 (10)	6.4 - 13.6	76 (63)	51.2 - 75.4	<.0001
Poor hygiene	108 (45)	18 (15)	5.1 - 24.9	90 (75)	66.5 - 83.5	<.0001
Spirits/Curses/Bad Omens	2 (1)	2 (2)	0.0 - 3.9	0 (0)	---	---
People from other tribes	11 (5)	11 (9)	1.6 - 16.7	0 (0)	---	---
Other (ex. Public places, ceremonies, wind)	5 (2)	4 (3)	0.0 - 7.2	1 (1)	0.0 - 2.5	0.1722
Don't know	56 (23)	47 (39)	28.5 - 49.8	9 (8)	1.1 - 13.9	<.0001
Believe that Cholera can spread person to person	208 (87)	103 (95)	91.7 - 99.0	105 (91)	84.6 - 96.4	0.1194
Severity of cholera vs. diarrhea						
Less severe	12 (5)	0 (0)	---	12 (10)	---	---
Equally severe	3 (1)	2 (2)	---	1 (1)	---	---
More severe	219 (91)	112 (93)	---	107 (89)	---	---
How to prevent cholera						
Cannot prevent	12 (5)	12 (10)	6.4 - 13.6	0 (0)	---	---
Herbs	48 (20)	42 (35)	24.8 - 45.2	6 (5)	0.9 - 9.1	<.0001
Wash hands	101 (42)	7 (6)	1.7 - 10.0	94 (78)	67.2 - 89.4	<.0001
Cook food thoroughly	65 (27)	9 (8)	1.6 - 13.4	56 (47)	38.7 - 54.6	<.0001
Reheat stored food	34 (14)	3 (3)	0.0 - 5.2	31 (26)	14.0 - 37.7	<.0001
Cover food	75 (31)	7 (6)	0.4 - 11.2	68 (57)	46.3 - 67.0	<.0001
Boil or treat water	109 (45)	25 (21)	10.0 - 31.7	84 (70)	56.8 - 83.2	<.0001

Wash vegetables and fruit	26 (11)	2 (2)	0.0 - 3.9	24 (20)	8.0 - 32.0	<.0001
Clean cooking utensils/vessels	107 (45)	23 (19)	9.4 - 28.9	84 (70)	59.7 - 80.3	<.0001
Other (ex. Isolation, Cat method, clean compound)	15 (6)	10 (8)	1.5 - 15.1	5 (4)	0.0 - 8.9	0.2885
Don't know	44 (18)	33 (28)	17.9 - 37.1	11 (9)	4.0 - 14.3	<.0001
How to treat cholera						
Increase liquid intake	54 (23)	20 (17)	7.6 - 25.7	34 (28)	20.8 - 35.9	0.0473
Decrease liquid intake	0 (0)	0 (0)	---	0 (0)	---	---
Increase food intake	1 (0)	1 (1)	0.0 - 2.5	0 (0)	---	---
Decrease food intake	0 (0)	0 (0)	---	0 (0)	---	---
Use oral rehydration solution (ORS)	28 (12)	0 (0)	---	28 (23)	11.4 - 35.3	---
Use sugar-salt solution	106 (44)	24 (20)	9.1 - 30.9	82 (68)	59.2 - 77.5	<.0001
Pill or syrup medication	4 (2)	0 (0)	---	4 (3)	0.4 - 6.3	---
Injection	0 (0)	0 (0)	---	0 (0)	---	---
Go to doctor	0 (0)	0 (0)	---	0 (0)	---	---
Go to hospital	24 (10)	3 (3)	0.0 - 5.2	21 (18)	6.6 - 28.4	<.0001
Go to traditional healer	50 (21)	33 (28)	19.7 - 35.3	17 (14)	6.1 - 22.2	0.0150
Home remedy (herbs, ant hill, animal slaughter)	41 (17)	41 (34)	23.9 - 44.4	0 (0)	---	---
Other	6 (3)	6 (5)	0.9 - 9.1	0 (0)	---	---
Do not treat	0 (0)	0 (0)	---	0 (0)	---	---
Don't know	38 (16)	25 (21)	12.5 - 29.2	13 (11)	2.0 - 19.6	0.1104
Feeding Practices during diarrhea/cholera						
Amount given to drink when family member has diarrhea						
More than usual	168 (71)	75 (63)	---	93 (78)	---	---
Usual	12 (5)	9 (8)	---	3 (3)	---	---
Somewhat less than usual	8 (3)	8 (7)	---	20 (17)	---	---
Much less than usual	1 (0)	6 (5)	---	2 (2)	---	---
Amount given to eat when family member has diarrhea						
More than usual	59 (25)	19 (16)	---	40 (34)	---	---
Usual	8 (3)	2 (2)	---	6 (5)	---	---
Somewhat less than usual	72 (30)	24 (20)	---	48 (40)	---	---
Much less than usual	74 (31)	50 (42)	---	24 (20)	---	---
Believe that more food than usual is good for child with diarrhea	107 (50)	58 (60)	50.7 - 70.2	48 (41)	26.3 - 55.8	0.0174
Reasons giving more food that usual is better for child with diarrhea						
Gives more energy	94 (89)	51 (88)	78.7 - 97.2	43 (90)	79.6 - 99.6	0.8033
Prevents weight loss	40 (38)	7 (12)	1.5 - 22.6	33 (69)	55.3 - 82.2	<.0001
Helps fight infection	12 (11)	6 (10)	3.0 - 17.7	6 (13)	6.3 - 18.7	0.6507

Reasons giving more food that usual is not good for child with diarrhea						
Gut needs rest	9 (8)	3 (8)	0.0 - 16.0	6 (9)	1.7 - 15.7	0.8784
Child may vomit	60 (56)	22 (58)	41.8 - 74.0	38 (55)	41.4 - 68.7	0.7829
Foods make diarrhea worse	13 (12)	11 (29)	11.7 - 46.2	2 (3)	0.0 - 7.0	<.0001
Child does not want more food/will waste food	53 (50)	15(39)	16.1 - 62.8	38 (55)	46.2 - 63.9	0.2052

Table 5. Cholera Public Health Messaging among those having heard of cholera in their village in East Pokot (n=49) and Turkana South (112).

	Total n=161* (%)	East Pokot n=49* (%)	95% CI	Turkana South n=112* (%)	95% CI	p-value
Source of knowledge of cholera outbreak						
Family	23 (14)	18 (37)	18.1 - 55.3	5 (5)	0.2 - 8.8	<.0001
Neighbor	41 (25)	25 (50)	39.3 - 60.7	16 (14)	6.0 - 22.6	<.0001
Friend	16 (10)	11 (22)	7.7 - 37.2	5 (5)	0.1 - 8.8	0.0004
Village Chief / Community meeting	93 (58)	2 (4)	0.0 - 9.2	91 (81)	70.3 - 92.2	<.0001
Community health worker	22 (14)	1 (2)	0.0 - 6.1	21 (19)	6.7 - 30.8	0.0012
Health Worker	65 (40)	12 (24)	15.1 - 33.9	53 (47)	37.3 - 57.3	<.0001
Women's group	2 (1)	1 (2)	0.0 - 6.1	1 (1)	0.0 - 2.7	0.5320
Church, Mosque, Other religious place	20 (12)	0 (0)	---	20 (18)	9.1 - 26.6	---
School	17 (11)	0 (0)	---	17 (15)	5.3 - 25.1	---
NGO	67 (42)	2 (4)	0.0 - 9.2	65 (58)	48.0 - 68.1	<.0001
Radio	22 (14)	1 (2)	0.0 - 6.0	21 (19)	8.4 - 29.1	0.0006
TV/internet/other electronic media	1 (1)	0 (0)	---	1 (1)	0.0 - 2.7	---
Newspaper	0 (0)	0 (0)	---	0 (0)	---	---
Poster / Wall hanging	0 (0)	0 (0)	---	0 (0)	---	---
Other	1 (1)	1 (2)	0.0 - 6.1	0 (0)	---	---
Don’t know	0 (0)	0 (0)	---	0 (0)	---	---
Prevention Information provided by source	130 (81)	24 (49)	33.8 - 64.2	106 (95)	90.1 - 99.2	<.0001
Boil or treat water	116 (72)	13 (26)	16.2 - 35.8	103 (92)	86.1 - 97.9	<.0001
Build / Use latrines	45 (28)	3 (6)	0.1 - 12.2	42 (38)	26.0 - 49.0	<.0001
Wash hands	96 (60)	7 (9)	2.2 - 26.4	89 (72)	70.1 - 88.8	<.0001
Cover food	66 (41)	3 (6)	0.7 - 11.6	63 (56)	47.8 - 64.7	<.0001
Cook food thoroughly	63 (39)	4 (8)	1.9 - 14.4	59 (53)	44.0 - 61.3	<.0001
Wash vegetables and fruit	17 (11)	0 (0)	---	17 (18)	15.2 - 4.5	---
Clean cooking utensils / vessels	100 (62)	10 (20)	6.1 - 34.7	90 (80)	72.8 - 88.0	<.0001
Seek treatment if you have severe diarrhea	21 (13)	4 (8)	2.1 - 14.2	17 (15)	6.8 - 23.5	0.1427
Other	13 (8)	6 (12)	2.0 - 22.5	7 (6)	0.0 - 12.6	0.2739

Table 6. Cholera Practices in Household & Health Care Facility by those reporting cholera in their family in 2009 in East Pokot (n=29) and in Turkana South (n=57); Kenya – 2010.

Cholera in Family	Total n=86* (%)	East Pokot n=29* (%)	95% CI	Turkana South n=57* (%)	95% CI	p-value
Median number of family members ill with cholera (range)	2 (0 - 5)	2 (0 - 5)	---	1 (1 - 3)	---	---
Median number of children less than 5 ill with cholera (range)	0 (0 - 3)	0 (0 - 3)	---	0 (0 - 2)	---	---
Deaths from cholera in family in past 6 months	13 (15)	6 (21)	6.2 - 35.1	7 (13)	3.4 - 21.2	0.2471
Median number of deaths in family due to cholera (range)	1 (0 - 2)	1 (1 - 2)	---	1 (0 - 2)	---	---
Median number of children under 5 in family died from cholera (range)	0 (0 - 2)	0	---	0 (0 - 2)	---	---
Home Treatment of Cholera in family member						
Herbal Treatment	32 (38)	19 (66)	46.5 - 84.5	13 (23)	8.1 - 37.5	<.0001
Oral rehydration solution (ORS)	56 (65)	8 (28)	11.8 - 43.3	48 (84)	77.0 - 91.4	<.0001
Other solution prepared at home	63 (73)	16 (55)	42.6 - 67.8	47 (82)	74.9 - 90.0	<.0001
Ingredients: Salt	60 (95)	14 (88)	---	46 (98)	---	---
Sugar	63 (100)	16 (100)	---	47 (100)	---	---
Herbs	10 (16)	5 (31)	---	5 (11)	---	---
Other (tea, water)	7 (11)	0 (0)	---	7 (15)	---	---
Prayer	19 (22)	10 (34)	15.5 - 53.5	9 (16)	2.4 - 29.1	0.0651
Oral medicine/Antibiotics	56 (65)	16 (55)	40.0 - 70.3	40 (70)	59.3 - 81.0	0.0650
Sought healthcare for family member with cholera	**n=70 (82)**	**n=21 (72)**	**59.4 - 85.5**	**n=49 (88)**	**80.0 - 95.0**	**0.0124**
Hospital / government health facility	52 (74)	10 (48)	23.3 - 71.9	42 (86)	73.0 - 98.4	0.0007
Cholera treatment center	22 (32)	6 (32)	10.3 - 52.9	16 (33)	17.4 - 47.9	0.9317
Private clinic	10 (15)	2 (11)	0.0 - 22.2	8 (17)	2.1 - 31.2	0.4939
Dispensary / health center	31 (46)	9 (47)	22.9 - 72.8	22 (45)	22.9 - 66.9	0.8744
Chemist	5 (7)	1 (5)	0.0 - 15.4	4 (8)	0.0 - 17.8	0.6820
Kiosk / shop	9 (13)	5 (26)	10.0 - 42.6	4 (8)	0.0 - 18.0	0.0208
Community health worker	16 (24)	4 (21)	6.8 - 35.4	12 (24)	9.2 - 39.8	0.7318
Traditional healer	6 (9)	6 (32)	8.2 - 54.9	0 (0)	---	---
Spiritual leader	6 (9)	0 (0)	---	6 (12)	2.4 - 22.1	---
Other	2 (3)	2 (13)	0.0 - 30.2	0 (0)	---	---
Treated at health facility (hospital, CTC, dispensary, private clinic)	**n=63 (26)**	**n=17 (14)**	**4.7 - 23.6**	**n=46 (38)**	**24.8 - 51.9**	**0.0010**
Oral rehydration solution (ORS)	46 (72)	8 (47)	28.6 - 65.6	38 (81)	67.8 - 93.9	<.0001
Intravenous (IV) fluids	18 (29)	8 (47)	18.2 - 75.9	10 (22)	8.8 - 34.7	0.0497
Oral syrup / pill medication	4 (6)	1 (6)	0.0 - 17.3	3 (7)	0.0 - 13.8	0.9224
Injection	13 (21)	3 (18)	0.0 - 39.5	10 (22)	6.0 - 37.5	0.7551
Antibiotics	52 (81)	16 (94)	83.6 - 100.0	36 (77)	63.1 - 90.1	0.0538

Anti-motility medicine	4 (6)	0 (0)	---	4 (9)	1.0 - 16.4	---
Zinc sulfate	2 (3)	1 (6)	0.0 - 17.3	1 (2)	0.0 - 6.7	0.4340
Admitted overnight at health facility	28 (45)	7 (41)	2.9 - 79.5	21 (47)	33.5 - 59.9	0.7775
Blood test done	24 (39)	5 (31)	0.0 - 65.7	19 (42)	22.0 - 62.5	0.5768
Stool test done	17 (28)	2 (13)	0.0 - 26.1	15 (34)	14.2 - 54.0	0.0495
Treatment given to take home from health facility						
Nothing	7 (11)	2 (12)	0.0 - 28.4	5 (11)	1.3 - 20.4	0.9205
ORS	42 (67)	9 (53)	19.3 - 86.6	33 (72)	59.0 - 84.5	0.2373
Oral syrup / pill medication	7 (11)	2 (12)	0.0 - 24.6	5 (11)	0.9 - 20.9	0.9068
Antibiotics	46 (72)	12 (71)	48.7 - 92.5	34 (72)	57.2 - 87.5	0.8893
Anti-motility medicine	5 (8)	2 (12)	0.0 - 24.6	3 (7)	0.0 - 13.8	0.4013
Discussion of preventive measures from health facility	**51 (82)**	**10 (59)**	**42.5 - 75.1**	**41 (91)**	**83.6 - 98.7**	**<.0001**
Treat water	48 (94)	7 (70)	46.4 - 93.6	41 (100)	100.0 - 100.0	
Build and use latrines	20 (39)	1 (10)	0.0 - 29.3	19 (46)	29.3 - 63.4	0.0194
Wash hands	42 (82)	5 (50)	28.4 - 71.6	37 (90)	80.5 - 100.0	<.0001
Cover food	31 (61)	2 (20)	0.0 - 47.3	29 (71)	55.6 - 85.8	0.0003
Cook food thoroughly	25 (49)	1 (10)	0.0 - 29.3	24 (59)	38.1 - 78.9	0.0073
Reheat stored food	16 (31)	2 (20)	0.0 - 43.6	14 (34)	12.7 - 55.6	0.3605
Wash vegetables and fruit	18 (35)	0 (0)	---	18 (44)	19.2 - 68.6	---
Clean cooking utensils / vessels	41 (80)	4 (40)	6.6 - 73.4	37 (90)	81.4 - 99.1	<.0001
Seek treatment if having severe, watery diarrhea	10 (20)	2 (20)	0.7 - 39.3	7 (20)	6.5 - 32.5	0.9644

Table 7. Knowledge, Availability and Use of ORS in East Pokot (n=120) and Turkana South (n=120); Kenya – 2010.

Knowledge, Availability & Use of ORS	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Know how to prepare home-made rehydration solution	161 (69)	54 (46)	30.5 - 61.8	107 (91)	85.9 - 95.4	<.0001
Home-made rehydration Solution ingredients:						
Sugar	127 (78)	28 (51)	29.7 - 72.1	99 (93)	85.2 - 99.9	<.0001
Salt	128 (79)	30 (55)	36.6 - 72.5	98 (92)	84.3 - 98.9	<.0001
Herbs	25 (16)	24 (44)	22.2 - 66.7	1 (1)	0.0 - 2.8	0.0007
Water	95 (59)	11 (20)	4.4 - 35.6	84 (79)	71.0 - 86.0	<.0001
ORS packet	10 (6)	0 (0)	---	10 (9)	1.1 - 17.6	---
Other (honey, soil, ant-hill)	4 (2)	4 (7)	0.0 - 15.2	0 (0)	---	---
Heard of ORS	**211 (89)**	**101 (84)**	**76.2 - 92.1**	**110 (93)**	**87.2 - 99.2**	**0.0616**
Source of knowledge of ORS						
Family member	2 (1)	1 (1)	0.0 - 3.0	1 (1)	0.0 - 2.7	0.9512
Neighbor	18 (9)	1 (1)	0.0 - 3.0	17 (15)	7.0 - 23.9	<.0001
Village chief / community meeting	70 (33)	0 (0)	---	70 (64)	52.6 - 74.6	---
Community health worker	27 (13)	3 (3)	0.0 - 6.2	24 (22)	14.6 - 29.0	<.0001
Health worker	66 (31)	23 (23)	14.7 - 30.8	43 (39)	31.3 - 46.9	0.0012
NGO or volunteer organization	46 (22)	6 (6)	0.3 - 11.6	40 (36)	24.9 - 47.8	<.0001
Radio	18 (9)	0 (0)	---	18 (16)	6.1 - 26.7	---
Health facility	136 (64)	81 (80)	71.6 - 88.7	55 (50)	39.6 - 60.4	<.0001
Purpose of ORS treatment						
Dehydration	87 (41)	43 (43)	32.4 - 52.7	44 (40)	34.0 - 46.0	0.6516
Diarrhea	178 (84)	87 (86)	78.0 - 94.2	91 (83)	72.4 - 93.0	0.5888
Children	15 (7)	8 (8)	1.7 - 14.1	7 (6)	1.8 - 10.9	0.6706
Know how to prepare ORS	186 (89)	82 (81)	72.0 - 90.4	104 (95)	91.1 - 99.8	0.0007
ORS available in village	47 (23)	10 (10)	3.9 - 16.1	37 (34)	24.3 - 50.4	<.0001
ORS is available at Health care facility / hospital	200 (95)	92 (91)	85.5 - 96.7	108 (98)	95.7 - 100.0	0.0075
ORS is available at Chemist / pharmacy	32 (15)	4 (4)	0.0 - 8.4	28 (25)	9.6 - 41.3	0.0001
ORS is available at Kiosk / village shop	30 (14)	4 (4)	0.0 - 8.5	26 (24)	10.2 - 37.1	0.0001
ORS is available at NGO or volunteer organization	19 (9)	0 (0)	---	19 (17)	9.4 - 25.2	---
Don't know where ORS is available	8 (4)	5 (5)	0.2 - 9.6	3 (3)	0.0 - 6.7	0.4808
ORS is available for free at health facility	128 (61)	57 (57)	---	71 (65)	---	---
Cost of ORS	**n=37**	**n=8**		**n=29**		
Median reported price of ORS (range)	15Ksh (5 - 50)	35Ksh (10 - 50)	---	15Ksh (5 - 50)	---	---
Perception of cost of ORS						
Cheap	24 (62)	0 (0)	---	24 (77)	---	---
Fair	6 (15)	3 (34)	---	3 (10)	---	---
Expensive	9 (23)	5 (63)	---	4 (13)	---	---
Purchased ORS in past 6 months	16 (39)	1 (11)	0.0 - 34.6	15 (47)	27.2 - 66.5	0.0486
ORS in home (subjective response)	32 (15)	7 (7)	0.0 - 13.8	25 (23)	11.3 - 34.5	0.0096
Presence of ORS in home (objective observation)	29 (85)	7 (78)	50.1 - 100.0	22 (88)	75.8 - 100.0	0.4028

Table 8. Water Sources & Water Availability in 2009 in East Pokot (n=120 and Turkana South (n=120); Kenya – 2010.

Water Sources & Water Availability	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Source of Water during DRY season						
Open deep well	64 (27)	20 (17)	---	44 (37)	---	---
Protected deep well	20 (8)	19 (16)	---	1 (1)	---	---
Shallow well / hand-dug well	50 (21)	31 (26)	---	19 (16)	---	---
Spring	10 (4)	9 (8)	---	1 (1)	---	---
River	26 (11)	18 (15)	---	8 (7)	---	---
Borehole	42 (18)	11 (9)	---	31 (26)	---	---
Piped water to house	3 (1)	1 (1)	---	2 (2)	---	---
Community tap	13 (5)	0 (0)	---	13 (11)	---	---
Water vendor	0 (0)	0 (0)	---	0 (0)	---	---
Dam	7 (3)	7 (6)	---	0 (0)	---	---
Other	3 (1)	3 (3)	---	0 (0)	---	---
Protected source	78 (33)	31 (27)	10.8 - 42.7	47 (39)	22.1 - 56.9	0.2641
Unprotected source	157 (67)	85 (73)	57.3 - 89.2	72 (61)	43.1 - 77.9	0.2641
Source of Water during RAINY season						
Open deep well	9 (4)	1 (1)	---	8 (7)	---	---
Protected deep well	2 (1)	2 (2)	---	0 (0)	---	---
Shallow well / hand-dug well	123 (52)	53 (45)	---	70 (59)	---	---
Spring	2 (1)	2 (2)	---	0 (0)	---	---
River	49 (21)	45 (38)	---	4 (4)	---	---
Borehole	30 (13)	3 (3)	---	27 (23)	---	---
Piped water to house	2 (1)	0 (0)	---	2 (2)	---	---
Community tap	7 (3)	0 (0)	---	7 (6)	---	---
Water vendor	0 (0)	0 (0)	---	0 (0)	---	---
Dam	12 (5)	12 (10)	---	0 (0)	---	---
Other	0 (0)	0 (0)	---	0 (0)	---	---
Protected source	41 (17)	5 (4)	0.0 - 9.6	36 (31)	12.9 - 48.0	<.0001
Unprotected source	195 (83)	113 (96)	90.4 - 100.0	82 (69)	52.0 - 87.0	<.0001
Current Source of Water						
Open deep well	13 (5)	0 (0)	---	13 (11)	---	---
Protected deep well	0 (0)	0 (0)	---	0 (0)	---	---
Shallow well / hand-dug well	106 (45)	57 (48)	---	49 (41)	---	---
Spring	3 (1)	2 (2)	---	1 (1)	---	---
River	50 (21)	43 (36)	---	7 (6)	---	---
Borehole	33 (14)	3 (3)	---	30 (25)	---	---
Piped water to house	2 (1)	0 (0)	---	2 (2)	---	---
Community tap	17 (7)	0 (0)	---	17 (14)	---	---
Water vendor	1 (0)	1 (1)	---	0 (0)	---	---
Dam	11 (5)	11 (9)	---	0 (0)	---	---
Other	1 (0)	1 (1)	---	0 (0)	---	---
Protected source	52 (22)	3 (3)	0.0 - 7.6	49 (41)	21.2 - 61.1	<.0001
Unprotected source	185 (78)	115 (97)	92.4 - 100.0	70 (59)	38.9 - 78.8	<.0001
Water not available during times in the year	n=163 (68)	n=100 (84)	70.9 - 97.2	n=63 (53)	39.8 - 66.1	0.0009
One month during year	5 (3)	1 (1)	---	4 (6)	---	---
Between 1 - 3 months during year	29 (18)	12 (12)	---	17 (27)	---	---
Between 3 - 6 months during year	93 (57)	67 (67)	---	26 (41)	---	---
Over 6 months during year	28 (17)	18 (18)	---	10 (16)	---	---

Table 9. Household Water Treatment Knowledge and Practices in East Pokot (n=120) and Turkana South (n=120); Kenya – 2010.

Household Water Treatment	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
"Do something" to make water safe	**123 (52)**	**12 (10)**	**4.5 - 15.7**	**111 (95)**	**88.8 - 100.0**	**<.0001**
Boil	114 (93)	9 (75)	48.5 - 100.0	105 (95)	90.2 - 99.0	0.0136
Decanting	30 (24)	0 (0)	---	30 (27)	13.7 - 40.3	---
Filter	33 (27)	0 (0)	---	33 (29)	14.8 - 44.1	---
Cloth filter	7 (6)	0 (0)	---	7 (6)	0.0 - 13.9	---
Sand (shallow hand-dug well)	2 (2)	0 (0)	---	2 (2)	0.0 - 4.3	---
Alum	5 (4)	5 (42)	2.3 - 81.1	0 (0)	---	---
WaterGaurd	1 (1)	0 (0)	---	1 (1)	0.0 - 2.7	---
PuR	37 (31)	0 (0)	---	37 (33)	21.7 - 44.9	---
Aquatabs	74 (60)	3 (25)	0.0 - 51.5	71 (64)	48.1 - 79.8	0.0135
"Do something" to make water safe when family member is ill	**140 (59)**	**29 (24)**	**15.3 - 33.8**	**111 (96)**	**92.3 - 99.0**	**<.0001**
Boil	129 (92)	24 (83)	66.7 - 98.9	105 (95)	90.2 - 98.9	0.0415
Decanting	30 (21)	0 (0)	---	30 (27)	14.1 - 39.9	---
Filter	31 (22)	0 (0)	---	31 (28)	11.6 - 44.2	---
Cloth filter	9 (6)	0 (0)	---	9 (8)	1.2 - 15.0	---
Sand (shallow hand-dug well)	3 (2)	1 (3)	0.0 - 10.5	2 (2)	0.0 - 4.3	0.5839
Alum	2 (1)	2 (7)	0.0 - 16.7	0 (0)	---	---
Watergaurd	0 (0)	0 (0)	---	0 (0)	---	---
PuR	32 (23)	0 (0)	---	32 (29)	19.6 - 38.0	---
Aquatabs	62 (44)	2 (7)	0.0 - 16.3	60 (54)	39.9 - 68.2	<.0001
Heard of water treatment products	**192 (82)**	**78 (67)**	**54.9 - 79.6**	**114 (96)**	**92.6 - 99.0**	**<.0001**
WaterGuard	18 (9)	9 (12)	5.7 - 17.4	9 (8)	2.9 - 12.9	0.3236
PuR	67 (35)	2 (3)	0.0 - 6.0	65 (57)	49.6 - 64.5	<.0001
Aquatabs	149 (78)	58 (74)	64.1 - 84.6	91 (80)	70.3 - 89.3	0.4151
Other (Alum)	16 (8)	13 (17)	5.7 - 27.7	3 (3)	0.0 - 5.5	<.0001
Source of water treatment product knowledge						
Family	6 (3)	1 (1)	0.0 - 3.9	5 (4)	0.2 - 8.5	0.2173
Neighbor	27 (14)	6 (8)	1.4 - 14.0	21 (18)	7.0 - 30.0	0.0642
Friend	7 (4)	4 (5)	0.7 - 9.5	3 (3)	0.0 - 5.5	0.3039
Village Chief / Community meeting	81 (42)	0 (0)	---	81 (71)	57.8 - 84.3	---
Community health worker	44 (23)	16 (21)	12.9 - 28.1	28 (25)	16.1 - 33.0	0.4588
NGO or volunteer organization	78 (41)	26 (33)	24.0 - 42.7	52 (45)	35.7 - 55.6	0.0545
Radio	19 (10)	0 (0)	---	19 (17)	6.9 - 26.4	---
Newspaper	1 (1)	0 (0)	---	1 (1)	0.0 - 2.6	---
Poster / Wall hanging	0 (0)	0 (0)	---	0 (0)	---	---

School	17 (9)	0 (0)	---	17 (15)	5.8 - 24.1	---
Church, mosque, or religious group	10 (5)	2 (3)	0.0 - 7.8	8 (7)	0.2 - 13.8	0.3266
Health facility	73 (38)	32 (41)	30.5 - 51.6	41 (36)	20.8 - 51.2	0.5778
Received water treatment / hygiene product for free in past 6 months	**126 (53)**	**34 (29)**	**16.4 - 40.7**	**93 (77)**	**65.1 - 89.5**	**<.0001**
WaterGuard	6 (5)	1 (1)	0.0 - 8.9	5 (5)	1.3 - 9.6	0.3660
PuR	50 (39)	0 (0)	---	50 (54)	41.0 - 66.6	---
Aquatabs / chlorine tabs	103 (82)	23 (68)	49.1 - 86.2	80 (87)	76.4 - 97.5	0.0385
Soap	18 (14)	3 (9)	0.0 - 24.3	15 (16)	6.4 - 26.2	0.4759
Jerrycan	13 (10)	4 (12)	0.0 - 26.7	9 (10)	0.9 - 18.7	0.8068
Bucket	1 (1)	1 (3)	0.0 - 8.9	0 (0)	---	---
Medicine / antibiotics	1 (1)	1 (3)	0.0 - 8.1	0 (0)	---	---
ORS	3 (2)	0 (0)	---	3 (3)	0.0 - 7.9	---
Other	10 (8)	6 (18)	0.0 - 37.5	4 (4)	0.0 - 11.0	---
Received water treatment product (includes WG, PuR, Aquatabs)	116 (92)	23 (68)	---	93 (100)	---	---
Given counseling on use of free water treatment product	116 (100)	23 (100)	---	93 (100)	100.0 - 100.0	---
Used the free water treatment product	116 (100)	23 (100)	---	93 (100)	---	---
WaterGuard	6 (5)	1 (4)	0.0 - 12.1	5 (5)	1.4 - 9.4	0.7561
PuR	52 (44)	0 (0)	---	52 (56)	44.7 - 67.1	---
Aquatabs / chlorine tabs	103 (85)	24 (89)	73.1 - 100.0	79 (84)	74.9 - 93.2	0.6144
Water storage in home (observation)						
Jerrycan	234 (98)	118 (98)	96.1 - 100.0	116 (97)	92.8 - 100.0	0.4140
Bucket	39 (16)	1 (1)	0.0 - 2.5	38 (32)	21.9 - 41.4	<.0001
Cooking pot	10 (4)	0 (0)	---	10 (8)	2.5 - 14.2	---
Residual chlorine test Positive	**52 (22)**	**23 (19)**	---	**29 (24)**	---	---
Products observed at home (purchased or received free)						
None	95 (40)	70 (58)	---	25 (21)	---	---
Soap	73 (30)	26 (22)	11.4 - 31.9	47 (39)	28.5 - 49.8	0.0114
WaterGuard	7 (3)	0 (0)	---	7 (6)	1.6 - 10.0	---
PuR	43 (18)	0 (0)	---	43 (36)	23.9 - 47.8	---
Aquatabs	72 (30)	9 (8)	0.7 - 14.3	63 (53)	40.0 - 65.0	<.0001
Medicine / antibiotics	3 (1)	0 (0)	---	3 (3)	0.0 - 5.2	---
ORS	17 (7)	2 (2)	0.0 - 3.9	15 (13)	5.6 - 19.4	<.0001
Other (Jerrycan, blanket, plates/pots)	7 (3)	6 (5)	0.0 - 10.4	1 (1)	0.0 - 2.5	0.0529
Own none	95 (40)	70 (58)	47.7 - 68.9	25 (21)	6.8 - 34.8	<.0001

Table 10. Hygiene and Sanitation Knowledge and Practices in East Pokot (n=120) and Turkana South (n=120); Kenya – 2010.

Handwashing	Total n=240 (%)	East Pokot n=120 (%)	95% CI	Turkana South n=120 (%)	95% CI	p-value
Reported time of washing hands						
After using the toilet	97 (40)	6 (5)	0.0 - 10.4	91 (76)	65.6 - 86.1	<.0001
Before eating	215 (90)	108 (90)	82.2 - 97.8	107 (89)	84.3 - 94.0	0.8550
After eating	197 (82)	91 (76)	63.0 - 88.7	106 (88)	82.1 - 94.6	0.0361
When serving meals	32 (13)	10 (8)	4.3 - 12.3	22 (18)	8.6 - 28.1	0.0142
Before cooking	74 (31)	24 (20)	11.9 - 28.1	50 (42)	30.3 - 53.1	0.0002
After cleaning babies / nappy change	62 (26)	14 (12)	3.0 - 20.3	48 (40)	30.8 - 49.2	<.0001
Other (after work, milking animals)	23 (10)	17 (14)	6.9 - 21.5	6 (5)	1.7 - 8.3	0.0027
Never wash hands	1 (0)	1 (1)	0.0 - 2.5	0 (0)	---	---
Soap in house (subjective)	147 (63)	50 (42)	29.2 - 55.6	97 (82)	73.0 - 91.4	<.0001
Soap in house (observed)	73 (30)	26 (22)	11.4 - 31.9	47 (39)	28.5 - 49.8	0.0114
Purpose of soap						
Washing hands	161 (67)	68 (57)	44.9 - 68.4	93 (78)	66.2 - 88.8	0.0061
Laundry	183 (76)	72 (60)	52.6 - 67.4	111 (93)	88.4 - 96.6	<.0001
Cleaning utensils / vessels	168 (70)	71 (59)	47.0 - 71.3	97 (81)	71.7 - 90.0	0.0010
Bathing	168 (70)	63 (53)	45.5 - 60.0	105 (88)	80.6 - 94.4	<.0001
Place of defection						
Uncovered pit latrine	2 (1)	0 (0)	---	2 (2)	---	---
Covered pit latrine	13 (5)	1 (1)	---	12 (10)	---	---
Bush	223 (94)	118 (99)	---	105 (88)	---	---
Lake or river	0 (0)	0 (0)	---	0 (0)	---	---

Table 11. Health Care Worker Survey results for rural districts

Health Care Worker Characteristics	Rural					
	East Pokot (n*=21)			Turkana South (n=22)		
	N	Median	Range	N	Median	Range
Median # (range) years practicing	21	15	(1-28)	22	7	(0.5-28)
Median # (range) years practicing in current facility	21	4	(0.08-28)	22	2	(0.25-18)
Median age (range)	21	38	(26-51)	21	31	(22-50)
	N	n	%	N	n	%
Female	19	5	26.3	22	7	31.8
Position						
Medical or Clinical Officer	21	3	14.3	22	1	4.6
Nurse	21	12	57.1	22	9	40.9
Community Health Worker/Patient Attendant/Lab Tech/Nurse Aid	21	6	28.6	22	12	54.6
Location Employed						
District Hospital	21	4	19.1	22	0	0.0
Sub-district Hospital	21	5	23.8	22	1	4.6
Health Center	21	3	14.3	22	7	31.8
Dispensary	21	9	42.9	22	14	63.6
Other	21	0	0.0	22	0	0.0
Facility Type						
MOH	21	17	81.0	22	10	45.6
Other (private, faith-based, NGO)	21	4	19.1	22	12	54.6
Health Care Profession Training						
On-the-job training or No formal training	21	5	23.8	22	3	13.6
Training by NGO/missionary, pharm or lab tech training	21	1	4.8	22	9	40.9
Medical or clinical officer, or nursing school	21	15	71.4	22	10	45.6
Health Care Worker Cholera Experience and Training						
Treated cholera patients in 2009	21	15	71.4	22	18	81.8
Number of patients seen in past three months						
None	21	6	28.6	22	5	22.7
1-50	21	10	47.6	22	10	45.5
>50	21	5	23.8	22	7	31.8
Received training in cholera care in the past	21	17	81	22	16	72.7
Received training in 2009 or 2010**	17	2	40	16	4	36.4
Received training from MOH	17	1	5.9	16	7	43.8
Received training from NGO/missionary	17	1	5.9	16	2	12.5
Received training during schooling	17	13	76.5	16	7	43.8
Other	17	0	0	16	0	0

Health Care Worker Knowledge						
Cholera case definition reported by HCW						
Severe dehydration from acute watery diarrhea (>4 episodes in 12 hours) in a patient >5 years old (WHO definition)	21	1	**4.8**	22	1	**4.5**
Acute watery diarrhea in a person >2 yr in an area where there is an outbreak of cholera (WHO definition)	21	1	**4.8**	22	2	**4.5**
Rice-water or watery diarrhea in a person of any age	21	3	**14.3**	22	5	**22.7**
Rice-water or watery diarrhea with severe dehydration in a person of any age	21	14	**66.7**	22	8	**36.4**
Test of Cholera Knowledge						
Know cholera is transmitted either by food or water	21	18	**85.7**	22	18	**81.8**
Know cholera can be prevented	21	21	**100**	21	21	**100**
Know at least one correct method of cholera prevention	21	21	**100**	22	20	**90.9**
Know at least one correct WHO case definition of cholera	21	1	**4.8**	22	2	**9.1**
Correctly identify case of severe dehydration	21	20	**95.2**	22	22	**100**
Know Ringer's Lactate is the correct IVF to treat severe dehydration						
in an adult	21	10	**47.6**	19	12	**63.2**
in a child	21	11	**52.4**	22	13	**59.1**
Know correct management of patient with						
severe dehydration (IVF +/- ORS)	21	21	**100**	22	19	**86.4**
some dehydration (ORS only)	21	17	**81**	22	13	**59.1**
no dehydration (ORS to take home)	21	15	**71.4**	22	19	**86.4**
Know the correct way to determine pediatric IV flow rate	21	13	**62**	22	16	**72.7**
Know correct use of ORS for non-vomiting patient	21	16	**76.2**	21	13	**61.9**
Know correct rapid fluid resuscitation for cholera patient >1 yr	21	10	**47.6**	20	7	**35**
Know breastfeeding is appropriate for infants with diarrhea	21	21	**100**	22	21	**95.5**
Know correct use of antibiotics for cholera patients	21	1	**4.8**	21	0	**0**
Know correct first-line antibiotics for						
Adult cholera patient (doxycycline/tetracycline)	21	21	**100**	22	22	**100**
Pediatric cholera patients (erythromycin)	21	14	**66.7**	22	18	**81.8**
Overall test percent >80%	21	4	**19.1**	22	5	**22.7**

Health Facility Supply Availability and Laboratory Capacity						
MOPHS Guidelines on Cholera Control book present in HF	13	1	**7.7**	14	9	**64.3**
Cholera clinical management flowchart present in HF	13	0	**0**	14	1	**7.1**
Currently have ORS, IVF, IVN, IVT, and doxycylcine	13	7	**53.9**	14	4	**28.6**
Ran out of either ORS, IVF, IVN, IVT, doxycycline in 2009	13	8	**61.5**	14	12	**85.7**
Ran out of either ORS, IVF, IVN, IVT, doxycycline in January	13	6	**46.2**	14	11	**78.6**
Have capacity to collect stool samples	16	5	**31.3**	22	6	**27.3**
Have capacity to conduct stool culture in facility* **	16	0	**0**	22	0	**0**

***Denominator is the total number of health care workers surveyed. Denominator changes are due to missing data, unless otherwise stated.**

****Denominator for received training in 2009/2010 is n=5 for East Pokot and n=11 for Turkana South**

*****Denominator for those with capacity to collect stool samples is n=5 for East Pokot and n=6 for Turkana South**

Table 12. Health Care Worker Survey results for urban districts

	Urban								
	Embakasi (n*=24)			Kasarani (n*=37)			Kibera (n*=52)		
Health Care Worker Characteristics	N	Median	Range	N	Median	Range	N	Median	Range
Median # (range) years practicing	24	15	(1.5-40)	37	7	(0.5-28)	52	9	(0.3-40)
Median # (range) years practicing in current facility	24	2.8	(0.3-18)	37	2	(0.25-18)	52	3	(0.02-16)
Median age (range)	23	39	(24-68)	37	31	(22-50)	49	33	(25-62)
	N	n	%	N	n	%	N	n	%
Female	21	18	85.7	37	23	62.2	47	32	68.10
Position									
Medical or Clinical Officer	23	4	17.4	37	10	27.0	52	22	42.3
Nurse	23	19	82.6	37	26	70.3	52	28	53.9
Community Health Worker/Patient Attendant/Lab Tech/Nurse Aid	23	0	0.0	37	1	2.7	52	2	3.9
Location Employed									
District Hospital	24	0	0.0	37	1	2.7	52	11	21.2
Sub-district Hospital	24	2	8.3	37	3	8.1	52	0	0
Health Center	24	16	66.7	37	22	59.5	52	29	55.8
Dispensary	24	4	16.7	37	4	10.8	52	11	21.2
Other	24	2	8.3	37	7	18.9	52	1	1.9
Facility Type									
MOH	24	10	41.7	37	28	75.7	52	25	48.1
Other (private, faith-based, NGO)	24	14	58.3	37	9	24.3	52	27	51.9
Health Care Profession Training									
On-the-job training or No formal training	24	1	4.2	37	2	5.4	52	1	1.9
Training by NGO/missionary, pharm or lab tech training	24	0	0	37	0	0.0	52	1	1.9
Medical or clinical officer, or nursing school	24	23	95.8	37	35	94.6	52	50	96.2
Health Care Worker Cholera Experience and Training									
Treated cholera patients in 2009	24	22	91.7	37	27	72.8	49	39	79.6
Number of patients seen in past three months									
None	24	8	33.3	36	13	36.1	49	11	22.5
1-50	24	9	37.5	36	17	47.2	49	37	75.5
>50	24	7	29.2	36	6	16.7	49	1	2
Received training in cholera care in the past	24	9	37.5	37	28	75.7	50	29	58
Received training in 2009 or 2010**	9	1	16.7	28	4	17.39	29	5	16.7
Received training from MOH	9	0	0	28	2	7.1	29	2	6.9
Received training from NGO/missionary	9	1	11.1	28	0	0	29	7	24.1
Received training during schooling	9	7	77.8	28	24	85.7	29	20	69
Other	9	1	11.1	28	0	0	29	0	0

Health Care Worker Knowledge									
Cholera case definition reported by HCW									
Severe dehydration from acute watery diarrhea (>4 episodes in 12 hours) in a patient >5 years old (WHO definition)	24	1	**4.2**	37	5	**13.5**	52	11	**21.2**
Acute watery diarrhea in a person >2 yr in an area where there is an outbreak of cholera (WHO definition)	24	3	**12.5**	37	3	**8.1**	52	8	**15.4**
Rice-water or watery diarrhea in a person of any age	24	0	**0**	37	0	**0**	52	5	**9.6**
Rice-water or watery diarrhea with severe dehydration in a person of any age	24	19	**79.2**	37	31	**83.7**	52	21	**40.4**
Test of Cholera Knowledge									
Know cholera is transmitted either by food or water	24	23	**95.8**	37	35	**94.6**	52	50	**96.2**
Know cholera can be prevented	24	24	**100**	37	37	**100**	51	50	**98**
Know at least one correct method of cholera prevention	24	24	**100**	37	36	**97.3**	52	50	**96.2**
Know at least one correct WHO case definition of cholera	24	4	**16.7**	37	8	**21.6**	52	19	**36.5**
Correctly identify case of severe dehydration	24	23	**95.8**	37	36	**97.3**	51	49	**96.1**
Know Ringer's Lactate is the correct IVF to treat severe dehydration									
in an adult	20	16	**80**	34	27	**79.4**	50	41	**82**
in a child	24	20	**83.3**	37	27	**73**	52	37	**71.2**
Know correct management of patient with									
severe dehydration (IVF +/- ORS)	24	22	**91.7**	37	35	**94.6**	52	50	**96.2**
some dehydration (ORS only)	24	16	**66.7**	37	28	**75.7**	51	48	**94.1**
no dehydration (ORS to take home)	24	24	**100**	32	26	**81.3**	52	44	**84.6**
Know the correct way to determine pediatric IV flow rate	24	16	**66.7**	37	23	**62.2**	52	20	**38.5**
Know correct use of ORS for non-vomiting patient	24	20	**83.3**	37	34	**91.9**	51	49	**96.1**
Know correct rapid fluid resuscitation for cholera patient >1 yr	23	15	**65.2**	36	20	**55.6**	51	39	**76.5**
Know breastfeeding is appropriate for infants with diarrhea	24	24	**100**	37	36	**97.3**	52	50	**96.2**
Know correct use of antibiotics for cholera patients	24	0	**0**	37	1	**2.7**	51	2	**3.9**
Know correct first-line antibiotics for									
Adult cholera patient (doxycycline/tetracycline)	24	23	**95.8**	37	37	**100**	52	39	**75**
Pediatric cholera patients (erythromycin)	24	23	**95.8**	37	28	**75.7**	52	31	**59.6**
Overall test percent >80%	19	12	**63.2**	37	15	**40.5**	52	23	**44.2**

Health Facility Supply Availability and Laboratory Capacity									
MOPHS Guidelines on Cholera Control book present in HF	4	2	**50**	5	3	**60**	6	1	**16.7**
Cholera clinical management flowchart present in HF	14	3	**21.4**	19	8	**42.1**	28	12	**42.9**
Currently have ORS, IVF, IVN, IVT, and doxycylcine	4	2	**50**	6	5	**83.3**	7	2	**28.6**
Ran out of either ORS, IVF, IVN, IVT, doxycycline in 2009	4	3	**75**	6	3	**50**	7	3	**42.9**
Ran out of either ORS, IVF, IVN, IVT, doxycycline in January	4	1	**25**	5	1	**20**	7	3	**42.9**
Have capacity to collect stool samples	21	12	**57.14**	37	30	**81.1**	49	40	**81.6**
Have capacity to conduct stool culture in facility* **	21	2	**15.4**	37	1	**3.3**	49	11	**27.5**

***Denominator is the total number of health care workers surveyed. Denominator changes are due to missing data, unless otherwise stated.**
****Denominator for received training in 2009/2010 is n=6 for Embakasi, n=4 for Kasarani, and n=30 for Kibera**
*****Denominator for those with capacity to collect stool samples is n=12 for Embakasi, n=30 for Kasarani, and n=40 for Kibera**

Table 13. Water Source, Storage, and Treatment Practices in the Korogocho and Mukuru Kwa Njenga Informal Settlements of Nairobi, February 2010*

	Korogocho N=199 N (%) / median (range)	Mukuru Kwa Njenga N=199 N(%) / median (range)
Drinking Water Sources		
Public taps / standpipes	197 (99)	150 (75.4)
Water vendor	2 (<1)	15 (7.5)
Water tanker	--	22 (11.1)
Borehole	--	12 (6.0)
Distance to source (meters)	5 (1-800)	10 (1-400)
Fee for a 20-L jerrycan (Ksh)	2 (1-2000)	5 (1-3000)
Water Storage Practices		
Stored water	184 (92.5)	195 (98.0)
Narrow-mouthed container	129 (64.8)	131 (65.8)
Covered storage container	136 (68.3)	171 (85.9)
20-L jerrycan	79 (39.7)	100 (50.3)
5-L jerrycan	29 (14.6)	31 (15.6)
Superdrum (50-200L)	33 (16.6)	26 (13.1)
Water Treatment Practices		
Treated water	11 (5.5)	57 (28.6)
Boiling	9 (4.5)	33 (16.6)
WaterGuard	1 (<1)	24 (12.1)
Solar	--	1 (<1)
Alum	--	1 (<1)
Observed products in the home		
WaterGuard	10 (5.0)	35 (17.6)
Aquatabs	3 (1.5)	20 (10.1)
PuR	1 (<1)	--

****All data described in table 1 refers to water source, storage, and treatment practices on the day of the interview***

Table 14. Water Quality of Sources and Household Waters in the Korogocho Informal Settlement in Nairobi, February 2010

	% (n)	Median MPN (range)	Median Free Chlorine* (range)	Median Total Chlorine (range)
Source Waters				
Total coliform contamination	26 (27.1)	19.1 (1-2420)	0.6 (0-0.8)	0.8 (0.1-1)
Public tap/standpipe (n=92)	23 (25.3)	14.8 (1-2420)	0.6 (0.35-0.8)	0.8 (0.35-1)
Storage tank (n=3)	2 (66.7)	12.11 (2-2420)	0.05 (0-0.1)	0.15 (0.1-0.2)
Water vendor (n=1)	1 (100)	90.9	0.5	0.7
E.coli contamination	7 (7.3)	13.1 (1-30.1)	0.6 (0.1-0.7)	0.75 (0.2-1)
Public tap/standpipe (n=92)	5 (5.4)	13.1 (1-30.1)	0.6 (0.5-0.7)	0.82 (0.65-1)
Storage tank (n=3)	1 (33.3)	17.1	0.1	0.2
Water vendor (n=1)	1 (100)	1	0.5	0.7
Household Waters				
Total coliform contamination	56 (57.1))	37.9 (1-2420)	0.2 (0-0.7)	0.35 (0-0.8)
Narrow-mouthed container (n=61)	31 (50.8)	46.1 (1-2420)	0.2 (0-0.7)	0.3 (0-0.8)
Covered container (n=69)	42 (60.9)	37.15 (1-2420)	0.2 (0-0.7)	0.33 (0-0.8)
20-L jerrycan (n=36)	20 (55.6)	28.55 (1-2420)	0.3 (0-0.7)	0.5 (0-0.8)
5-L jerrycan (n=12)	10 (83.3))	95.15 (1-2420)	0.2 (0-0.5)	0.35 (0-0.8)
Superdrum (50-200L) (n=18)	11 (61.1)	36.4 (1-2420)	0 (0-0.5)	0.12 (0-0.52)
E. coli contamination	11 (11.7)	6.3 (1-461.1)	0 (0-0.3)	0.1 (0-0.5)
Narrow-mouthed container (n=61)	5 (8.2)	1 (1-461.1)	0 (0-0.29)	0.1 (0-0.35)
Covered container (n=69)	9 (13.0)	10.8 (1-461.1)	0 (0-0.3)	0.1 (0-0.5)
20-L jerrycan (n=36)	4 (11.1)	32.85 (6.3-461.1)	0.05 (0-0.3)	0.2 (0-0.5)
5-L jerrycan (n=12)	1 (8.3)	1	0	0
Superdrum (50-200L) (n=18)	5 (27.8)	2 (1-33.6)	0 (0-0.29)	0.1 (0-0.35)

**Recommended free chlorine residuals in water distribution systems in areas affected by cholera are: 0.5mg/L for piped water, 1.0 mg/L with standposts, and 2.0 mg/L in tanker trucks, at filling. These recommendations are taken from the WHO "Guildlines for Cholera Control."*

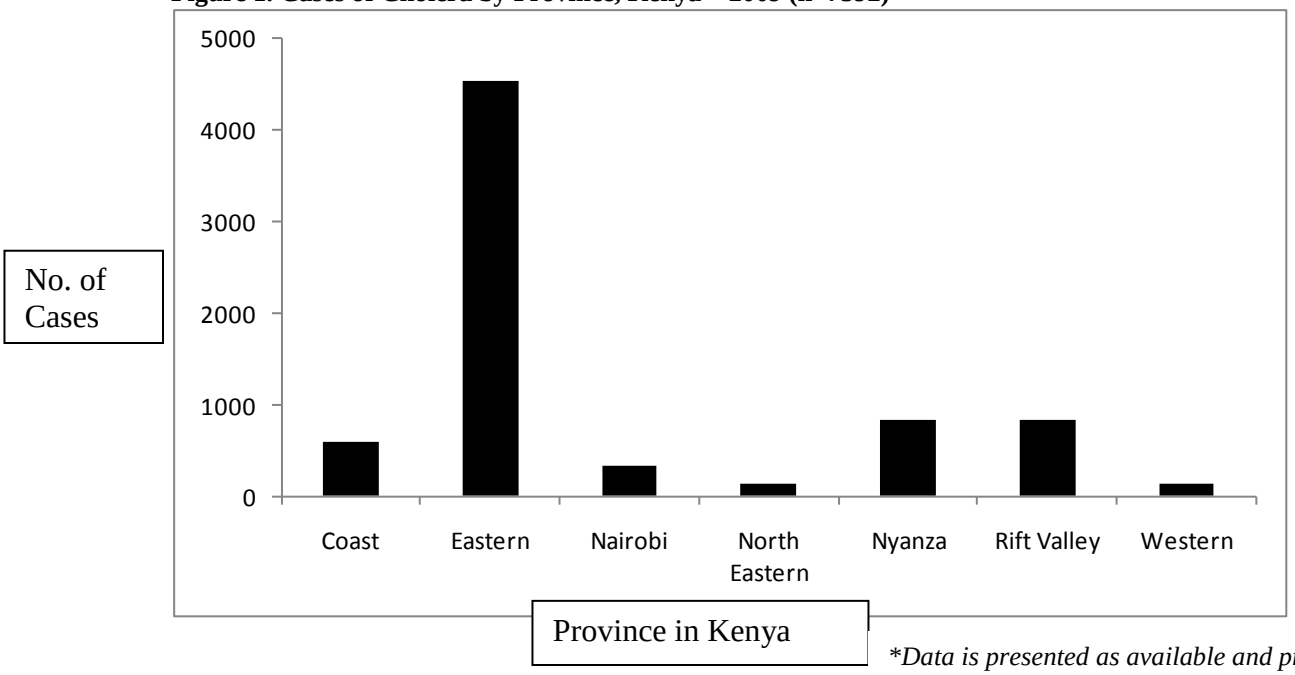
Table 15. Water Quality of Sources and Household Waters in the Mukuru Kwa Njenga Informal Settlement in Nairobi, February 2010

	% (n)	Median MPN (range)	Median Free Chlorine* (range)	Median Total Chlorine (range)
Source Waters				
Total coliform contamination	32 (32.7)	5.2 (1-2420)	0.1 (0-0.65)	0.25 (0-0.7)
Public tap/standpipe (n=75)	19 (25.3)	146.7 (1-2420)	0.19 (0-0.65)	0.27 (0-0.7)
Storage tank (n=1)	0	--	0.4	0.5
Water tanker (n=14)	8 (57.1)	3.55 (1-20.1)	0.15 (0-0.35)	0.20 (0-0.5)
Borehole (n=7)	4 (57.1)	3.65 (1-2420)	0 (0-0)	0 (0-0.05)
Water vendor (n=1)	1 (100)	3.1	0.5	0.7
E.coli contamination	8 (8.2)	64.9 (1-307.6)	0 (0-0.4)	0 (0-0.5)
Public tap/standpipe (n=75)	7 (9.3)	11 (1-307.6)	0 (0-0.4)	0 (0-0.5)
Storage tank (n=1)	0	--	0.4	0.5
Water tanker (n=14)	0	--	0.27 (0-0.68)	0.45 (0-0.78)
Borehole (n=7)	1 (14.3)	118.7	0	0
Water vendor (n=1)	0	--	0.5	0.7
Household Waters				
Total coliform contamination	66 (64.3)	209.3 (1-2420)	0 (0-1.5)	0.015 (0-1.6)
Narrow-mouthed container (n=67)	46 (68.7)	64.4 (1-2420)	0 (0-1.5)	0 (0-1.6)
Covered container (n=79)	54 (68.4)	209.3 (1-2420)	0 (0-1.5)	0 (0-1.6)
20-L jerrycan (n=51)	36 (70.6)	32.5 (1-2420)	0 (0-1.5)	0 (0-1.6)
5-L jerrycan (n=13)	8 (61.5)	1553.35 (30.7-2420)	0 (0-0.5)	0.05 (0 -0.7)
Superdrum (50-200L) (n=11)	6 (54.5)	2420 (195.6-2420)	0	0 (0-0.1)
E. coli contamination	31 (31.6)	5.2 (1-1732.9)	0 (0-0.5)	0 (0-0.6)
Narrow-mouthed container (n=67)	19 (28.4)	5.2 (1-1732.9)	0 (0-0.5)	0 (0-0.6)
Covered container (n=79)	25 (31.6)	5.1 (1-307.6)	0 (0-0.5)	0 (0-0.6)
20-L jerrycan (n=51)	13 (25.5)	5.1 (1-165)	0 (0-0.5)	0 (0-0.6)
5-L jerrycan (n=13)	3 (23.1)	201.4 (33.1-204.6)	0	0 (0-0.1)
Superdrum (50-200L) (n=11)	5 (45.5)	6.1 (2-1732.9)	0	0 (0-0.1)

**Recommended free chlorine residuals in water distribution systems in areas affected by cholera are: 0.5mg/L for piped water, 1.0 mg/L with standposts, and 2.0 mg/L in tanker trucks, at filling. These recommendations are taken from the WHO "Guildlines for Cholera Control."*

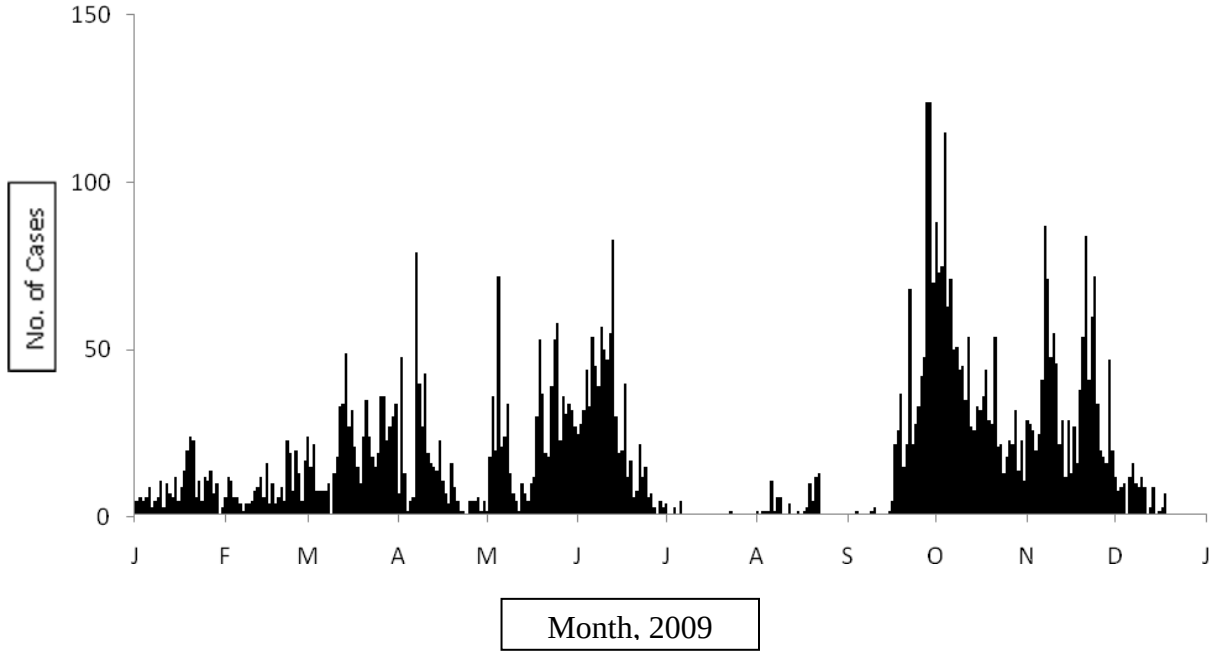
FIGURES

Figure 1. Cases of Cholera by Province, Kenya – 2009 (n=7392)*



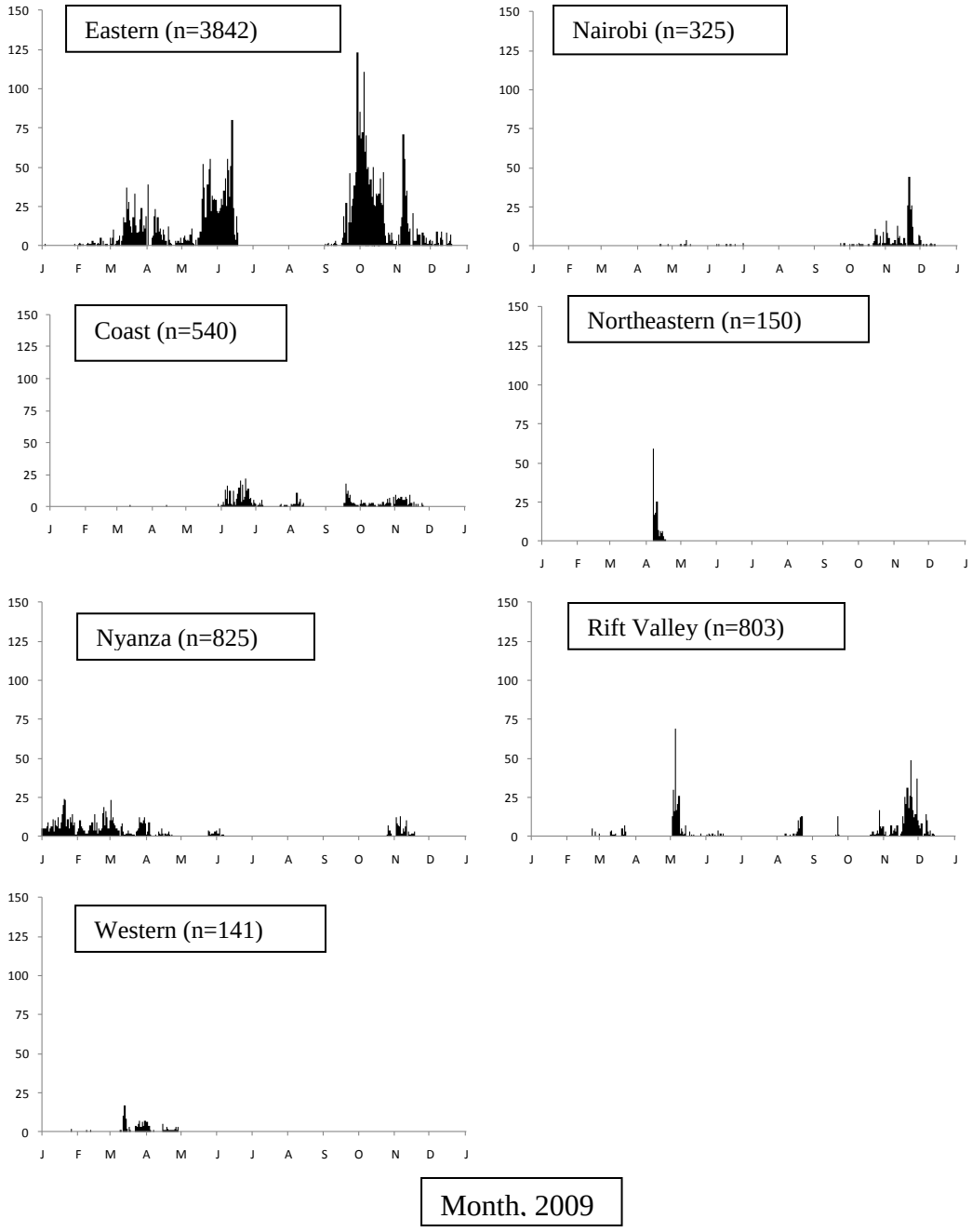
**Data is presented as available and provided by DDSR. Does not represent local or provincial level data that was not reported to DDSR.*

Figure 2. Cases of Cholera in Kenya; January – December, 2009 (n=6632)*



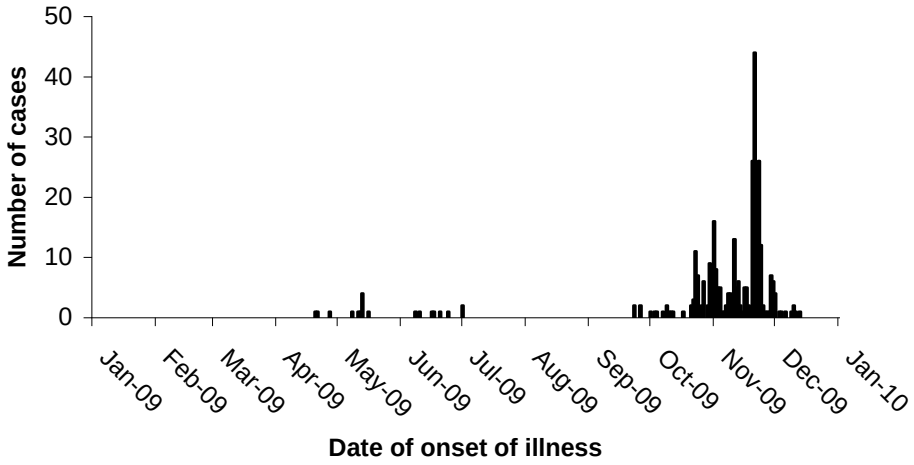
**Data is presented as available and provided by DDSR. Does not represent local or provincial level data that was not reported to DDSR.*

Figure 3. Cases of Cholera by Province over 2009; Kenya – 2009 (n=6626)*



**Data is presented as available and provided by DDSR. Does not represent local or provincial level data that was not reported to DDSR.*

Figure 4: Reported cases of acute watery/cholera in Nairobi Province, 2009*



NOTE: Data for Nairobi is only current up to December 2009. 2010 data is not included on this epidemic curve.

Figure 5: Reported cases of acute watery/cholera by district in Nairobi Province, 2009*

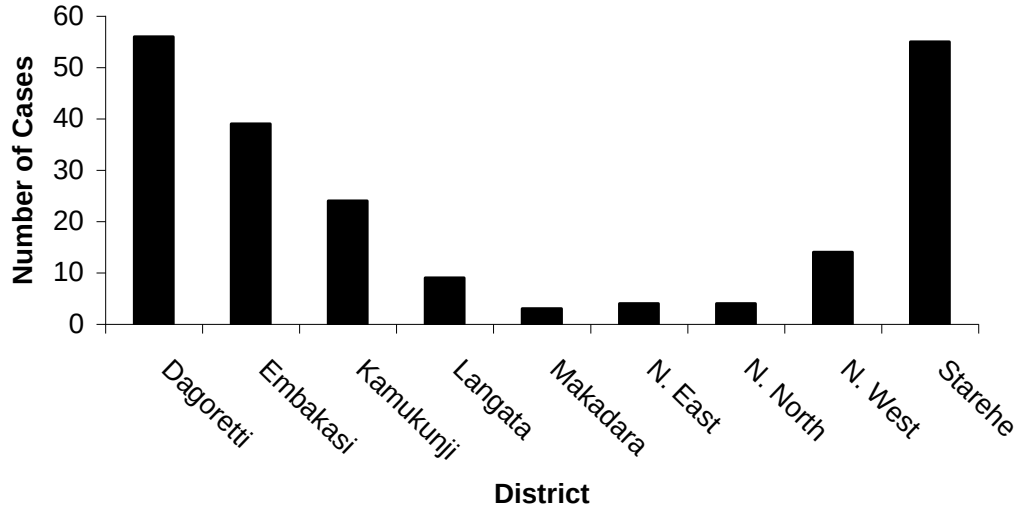
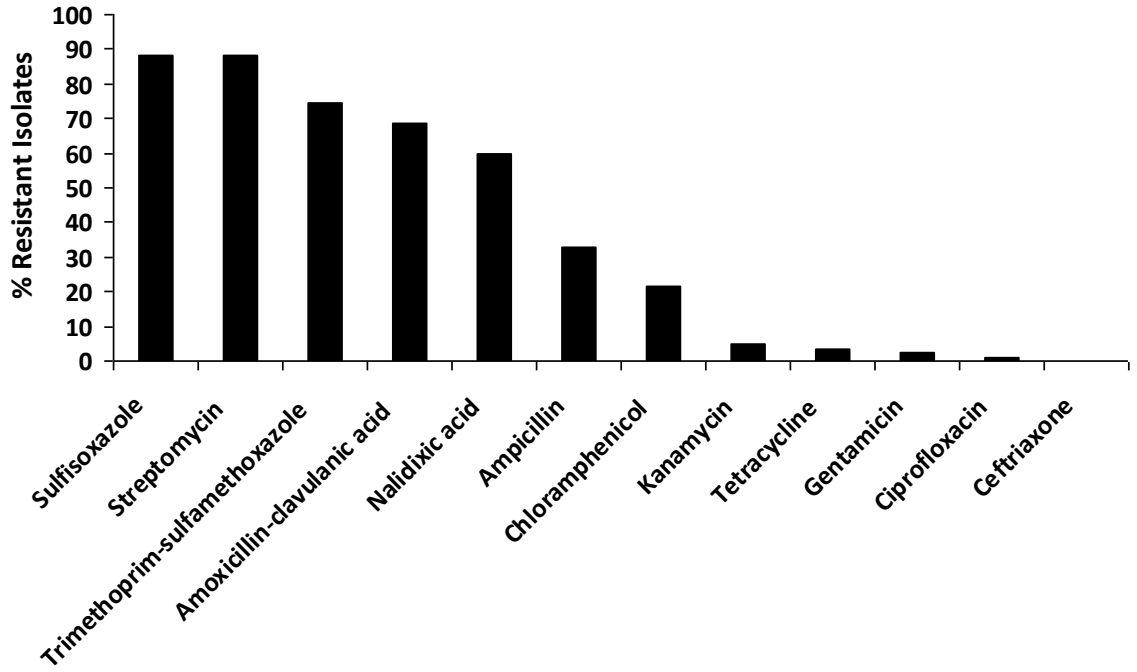


Figure 6: Antimicrobial susceptibility of *V. cholerae* isolates from outbreaks – Kenya, 2009 (n=110)



Appendix A
Cholera Community Knowledge, Attitudes & Practices Survey
Date of Interview_____ Interviewer_____
Identification and Demographic Information
Province_____District_____Division_____
Location_____Sub-location_____Village/Town_____

Hello, my name is _____. I am working with the Kenyan Ministry of Public Health to investigate illnesses in the community. We have a few questions about illness in the community and water issues. This may take about 20-30 minutes. May I please speak to the person in the home who usually takes care of the ill family members and brings the water for the family? ***If YES, begin the interview. If NO, thank you.***

What is your age in years?		Gender	1	Male
What is your year of birth?			0	Female

Background Socioeconomic & Education

1. How many people live in your household?		
2. How many children less than 5 years old live in your household?		

Cholera General Knowledge Information

3. Have you ever heard of an illness called cholera?	1 0 99	Yes No Don't Know
4. Have you heard about the cholera outbreak in your area recently?	1 0 99	Yes No Don't Know
5. Can you tell me what the main symptoms of cholera are? ***(Do not read. Check all that are mentioned.)***	1 2 3 4 5 6 7 99	Watery diarrhea Bloody diarrhea Vomiting Fever Dehydration Decreased appetite Other(specify)_____ Don't Know
6. Do you know what causes cholera? ***(Do not read. Check all that are mentioned.)***	1 2 3 4 5 6 7 8 99	Drinking bad water Eating bad food Unwashed fruit/vegetables Flies/Insects Poor hygiene Spirits/Curse/Bad Omen People from other tribes Other (specify) _____ Don't Know
7. Can cholera spread from one person to another?	1 0 99	Yes No Don't know

8. How severe is cholera compared to other types of diarrhea? ***(Read all choices. Choose only 1.)***	1 2 3 99	Less severe Equal severity More severe Don't know
9. How can you prevent you or your family members from getting cholera? ***(Do not read. Check all that are mentioned. Prompt after each response.)***	0 1 2 3 4 5 6 7 8 9 99	Cannot prevent Herbs Wash hands Cook food thoroughly Reheat stored food Cover food Boil or treat water Wash vegetables and fruit Clean cooking utensils/vessels Other (specify)_____ Don't Know
10. How can you treat cholera for yourself or your family members when you are at home and cannot get to a health facility? ***(Do not read. Check all that are mentioned. Prompt after each response)***	1 2 3 4 5 6 7 8 9 10 11 12 13 14 0 99	Increase liquid intake Decrease liquid intake Increase food intake Decrease food intake Use oral rehydration solution (ORS) packets Use sugar-salt solution Pill or syrup medicine Injection Go to doctor Go to hospital Go to church/ mosque/other religious place Go to traditional healer Home remedy (specify)_____ Other (specify)_____ Do not treat Don't Know

Cholera in Village

11. Have you heard that people in your village had cholera in the past 6 months?	1 0 99	Yes → **Go to 12** No → **Go to 17** Don't Know → **Go to 17**
12. When was the most recent time you heard of cholera in your village?	0 1 2 3 4 99	Never heard Past 7 days In the past month Between 2-6 months Over 6 months ago Don't know
13. Have you heard that people in your village died from cholera in the past 6 months?	1 0 99	Yes No Don't know

14. Please tell me all the ways you heard about the cholera outbreak. ***(Do not read. Check all that are mentioned. Prompt after each response.)***	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 99	Family member Neighbor Friend Chief (*Baraza*) Community Meeting Community health worker Health Worker Women's group Church, Mosque or religious group School NGO or Volunteer Organization (ex.Red Cross, MSF, UNICEF) Radio Electronic media (TV, internet) Newspaper Poster or Wall Hanging Other (specify)_____ Don't know
15. Did you hear messages about how to prevent cholera from these sources of information? ***(Please refer to sources identified in question 4.)***	1 0 99	Yes → **Go to 16** No → **Go to 17** Don't know → **Go to 17**
16. What did you hear? ***(Do not read. Check all that are mentioned. Prompt after response.)***	1 2 3 4 5 6 7 8 9	Boil or treat water Build/Use latrines Wash hands Cover food Cook food thoroughly Wash vegetables and fruit Clean cooking utensils/vessels Seek treatment if you have severe, watery bloody diarrhea Other_____

Cholera in Family Member

17. Did you or any of your family members become ill with cholera in the past 6 months?	1 0 99	Yes → **Go to 18** No → **Go to 35** Don't know → **Go to 35**
18. How many family members became ill with cholera?		
19. How many children under 5 years age became ill with cholera?		
20. Have there been any deaths in your family due to cholera in the past 6 months?	1 0	Yes → **Go to 21** No → **Go to 23**
21. How many family members passed away due to cholera?		
22. How many children under 5 passed away with cholera?		

23. Did you use any of the following to treat yourself or your family member in the home when having diarrhea? ***(Ask each item. Choose Yes, No or Don't know for each item)***				
Herbal Treatment		Yes	No	Don't Know
Fluid prepared from ORS packet		Yes	No	Don't Know
Other solution prepared at home		Yes	No	Don't Know
Ingredients of other solution	Salt	Sugar	Herbs	Other_____
Prayer therapy		Yes	No	Don't Know
Oral medicine/Antibiotics		Yes	No	Don't Know
Other (specify)_____		Yes	No	Don't Know

24. Did you or your family member seek care for cholera?	1 0 9	Yes → **Go to 25** No → **Go to 35** Don't know → **Go to 35**
25. When was the last time you sought care for cholera for you or your family member?	1 2 3 4 99	In past 7 days Between 1 week - 1 month ago Between 1 month - 6 months ago Over 6 months ago Don't know
26. Who was the person you last sought care for cholera?	1 2 3	Respondent Respondent's family member → Age of family member_____years Other (specify)_____ → Age of other person _____years

(The following questions 27 - 34 are about the person identified in question 26)

27. Did you/your family member seek care at:			
Hospital/Government Facility	Yes	No	Don't Know
Cholera Treatment Center	Yes	No	Don't Know
Private Clinic	Yes	No	Don't Know
Dispensary/Health Center	Yes	No	Don't Know
Chemist	Yes	No	Don't Know
Kiosk/Shop	Yes	No	Don't Know
Community Health Worker	Yes	No	Don't Know
Traditional Healer	Yes	No	Don't Know
Spiritual Leader	Yes	No	Don't Know
Other (specify)_____	Yes	No	Don't Know

Health Facility=Government Hospital, Cholera Treatment Center Private Clinic, Dispensary
If YES to Health Facility, → Go to 28
If NO or Don't know to Health Facility → Go to 35

28. What did they give you at the health facility to treat your cholera illness? ***(Read all choices and check all that apply.)***	1 2 3 4 5	ORS Fluid through a needle / IV Fluids Syrup or pill medicine by mouth Injection Antibiotics

	6 7 8 9 99	Anti-motility medicine Zinc sulfate Special air through a tube or mask / Oxygen Other (specify)_____ Don't Know
29. Were you/your family member hospitalized overnight?	1 0 99	Yes No Don't know
30. Did the hospital take a blood test?	1 0 99	Yes No Don't know
31. Did the hospital take a stool test?	1 0 99	Yes No Don't know
32. What did the doctor/hospital give you/your family member to take home to treat cholera?	0 1 2 3 4	Nothing ORS Packet(s) Syrup or Pill Antibiotic Medicine Anti-motility Medicine
33. Did anyone at the health facility talk to you about preventing cholera?	1 0 99	Yes → **Go to 34** No → **Go to 35** Don't know → **Go to 35**
34. What did they talk about? ***(Do not read. Check all mentioned. Prompt after response).***	1 2 3 4 5 6 7 8 9 10 11 99	Treat water Build and use latrines Wash hands Cover food Cook food thoroughly Reheat stored food Wash vegetables and fruit Clean cooking utensils/ vessels Seek treatment if severe, watery, bloody diarrhea Diarrhea and children Other (specify) _____ Don't know
35. How many hours does it take to get to the health facility from your home?	0 # 99	Less than one hour _____ hours _____days Don't know
36. How difficult is it to get to the health facility? ***(Read responses and check all that apply.)***	1 2 3 99	No difficulty Some difficulty Very difficult Don't Know

Oral Rehydration Solution (ORS)

37. Has anyone taught you how to prepare a home-made rehydration solution at home to treat diarrhea?	1 0 99	Yes → **Go to 38** No → **Go to 40** Don't know → **Go to 40**
38. Who taught you to prepare the solution?	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 99	Spouse Mother Mother-in-law Father Father-in-law Co-wife Government Hospital/Clinic Private clinic Community health worker Traditional healer Spiritual healer Village chief Older woman in community Older man in community Other (specify)_____ Don't know
39. What does this solution contain? ***(Do not read. Check all mentioned.)***	1 2 3 4 5 6 7 8 99	Sugar Salt Herbs Water Tea Other fluid (specify)_____ Contents of ORS Packet Other (specify)_____ Don't know
40. Have you heard of Oral Rehydration Solution or ORS?	1 0 99	Yes → **Go to 41** No →**Go to 51** Don't know → **Go to 51**
41. From who or where have heard of ORS? ***(Do not read. Check all that are mentioned.)***	1 2 3 4 5 6 7 8 9 10 11 12	Family member Neighbor Friend Chief (Baraza) Community Meeting Community health worker Health worker Women's group NGO or Volunteer Organization (ex. Red Cross, MSF, UNICEF) Radio Electronic media such as TV, internet Newspaper Poster or wall hanging

	13 14 15 99	School Health Facility Other, Specify _____ Don't know
42. What is ORS used as a treatment for?	1 2 3 4 99	Dehydration Diarrhea Children Other (specify)_____ Don't Know
43. Do you know how to prepare ORS?	1 0 99	Yes No Don't know
44. Is ORS available in your village?	1 0 99	Yes No Don't know
45. Where is it available? ***(Do not read. Check all that are mentioned.)***	1 2 3 4 5 6 99	Health care facility Chemist/Pharmacy Kiosk/Shop in Village Supermarket NGO Other (specify)_____ Don't know
46. How much does one ORS packet cost?	1 2 99	_____Ksh → **Go to 47** Can get it free at health facility → **Go to 49** Don't know → **Go to 49**
47. How do you find the price of ORS? ***(Read all choices. Mark only 1)***	1 2 3	Cheap Fair Expensive
48. Have you purchased ORS in the past 6 months?	1 0 99	Yes No Don't know
49. Do you have one or more packets of ORS in the home?	1 0 99	Yes → **Go to 50** No → **Go to 51** Don't know → **Go to 51**
50. May I see the ORS packet(s)?	1 0 99	Present Absent Refused

Feeding Practices

51. When you or your family member has diarrhea, how much do you give to drink? ***(Read all choices. Choose only 1).***	1 2 3 4 5 99	More than usual Usual Somewhat less than usual Much less than usual Nothing to drink Don't know

52. When you or your family member has diarrhea, how much do you give them to eat? ***(Read all choices. Choose only 1.)***	1 2 3 4 5 99	More than usual Usual Somewhat less than usual Much less than usual Nothing to eat Don't know
53. Do you think giving more food than usual is good for a child with diarrhea?	1 0 99	Yes → **Go to 54** No → **Go to 55** Don't know → **Go to 56**
54. Why is giving more food than usual for a child with diarrhea good? ***(Do not read. Mark all that are mentioned.)*** **→ Go to 56**	1 2 3 4 99	Gives energy Prevents weight loss Helps fight infection Other (specify)_____ Don't know
55. Why is giving more food than usual for a child with diarrhea not good? ***(Do not read. Mark all that are mentioned.)***	1 2 3 4 5 99	Child's gut needs rest Child may throw up Foods may make diarrhea worse Child does not want more food/will waste it Other (specify)_____ Don't know

Water and Water Treatment Information

56. What is the main source of your household's drinking water during the DRY season? ***(Do not read; Choose 1)***	1 2 3 4 5 6 7 8 9 10 11 12 13 14	Open deep well Protected deep well Shallow well/hand-dug well Spring Lake Pond/Seasonal lake River Borehole Rain water catchment from roof Piped water to house Community tap Water vendor Dam Other (specify)_____
57. What is your main source of drinking water during the RAINY season? ***(Do not read; Choose 1)***	1 2 3 4 5 6 7 8 9 10	Open deep well Protected deep well Shallow well/hand-dug well Spring Lake Pond/Seasonal lake River Borehole Rain water catchment from roof Piped water to house

	11	Community tap
	12	Water vendor
	13	Dam
	14	Other (specify)_____
58. Where are you presently getting your water? ***(Do not read; Choose 1)***	1	Open deep well
	2	Protected deep well
	3	Shallow well/hand-dug well
	4	Spring
	5	Lake
	6	Pond/Seasonal lake
	7	River
	8	Borehole
	9	Rain water catchment from roof
	10	Piped water to house
	11	Community tap
	12	Water vendor
	13	Dam
	14	Other (specify)_____
59. Are there any times during the year, when water is not readily available?	1	Yes → **Go to 60**
	0	No → **Go to 61**
60. During the past year, how often was water not readily available? ***(Read choices. Choose only 1.)***	1	One week during year
	2	One month during year
	3	Between 1- 3 months during year
	4	Between 3- 6 months during year
	5	Over 6 months during year
	6	Other (specify)_____
	99	Don't know
61. Do you do something to your drinking water to make it safe to drink?	1	Yes → **Go to 62**
	0	No → **Go to 63**
	99	Don't know → **Go to 63**
62. What do you do to treat the water? ***(Do not read. Check all that are mentioned. Prompt after each response.)***	1	Boil
	2	Decanting
	3	Keep water in hot sun
	4	Filter
	5	Cloth filter
	6	Sand (shallow dug well)
	7	Alum
	8	WaterGuard
	9	PuR
	10	AquaGuard
	11	Aquatabs
	12	Use a ceramic/biosand filter
	13	Other *(Specify)* _____
	99	Don't know

63. Do you do something to your drinking water when you or your family member is ill and has diarrhea to make the water safe to drink?	1 0 99	Yes → **Go to 64** No → **Go to 65** Don't know → **Go to 65**
64. What do you do to treat the water? ***(Do not read. Check all that are mentioned. Prompt after each response.)***	1 2 3 4 5 6 7 8 9 10 11 12 99	Boil Decanting Keep water in hot sun Filter Cloth filter Sand (shallow dug well) Alum WaterGuard PuR AquaGuard Aquatabs Use a ceramic/biosand filter Other *(Specify)* _____ Don't know
65. Have you ever heard about water treatment products?	1 0 99	Yes → **Go to 66** No → **Go to 68** Don't know →**Go to 68**
66. Which water treatment product have you heard of?	1 2 3 4 5	WaterGuard PuR AquaGuard Aquatabs Other (specify)_____
67. How did you hear about (***Name of water treatment product***)? ***(Do not read. Check all mentioned.)***	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 99	Family member Neighbor Friend Chief (Baraza) Community Meeting Community health worker Women's group NGO or Volunteer Organization (ex. Red Cross, MSF, UNICEF) Radio Electronic media such as TV, internet Newspaper Poster or wall hanging School Church, Mosque or religious group Health Facility Other (Specify) _____ Don't know

68. In the last 6 months, have you ever received any water treatment products or hygiene products for free from the government, NGO, or another organization to prevent or treat cholera?	1 0 99	Yes → **Go to 69** No → **Go to 74** Don't know →**Go to 74**
69. What were you given? ***(Do not read. Check all that are mentioned.)***	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	WaterGuard → **Go to 70** PuR → **Go to 70** AquaGuard → **Go to 70** Aquatabs/chlorine tabs → **Go to 70** Bottles of chlorine → **Go to 70** Drums of chlorine → **Go to 70** Soap Jerrycan Bucket Ceramic water filter Medicine/Antibiotics ORS Print material Incentives Advice Other_____ **Go to 74**
70. Were you given any counseling or education on how to use these water treatment products?	1 0 99	Yes No Don't know
71. Did you use any of these products?	1 0 99	Yes → **Go to 72** No → **Go to 73** Don't know → **Go to 74**
72. What did you use? → **Go to 74**	1 2 3 4 5 6 99	WaterGuard PuR AquaGuard Aquatabs/chlorine tabs Bottles of chlorine Drums of chlorine Don't know
73. Why did you not use these products?	1 2 3 4 5 6 7 99	Bad Taste Dangerous to use these products No container to treat water No need to treat water Did not know how to use the product Did not get education on how to use the product Other (specify)_____ Don't know

Handwashing Information

74. When do you wash your hands? ***(Do not read. Check all that are mentioned.)***	1 2	After using the toilet Before eating

	3	After eating
	4	When serving meals
	5	Before cooking
	6	After cleaning babies when they defecate
	7	Other (Specify) _____
	8	Never wash hands
	99	Don't Know
75. Do you have soap in the house?	1	Yes
	0	No
	99	Don't know
76. For which purposes, do you use the soap? ***(Do not read. Check all that are mentioned).***	1	Washing hands
	2	Laundry
	3	Cleaning utensils/ vessels
	4	Bathing
	5	Other (*Specify)*_____
	99	Don't know

Education/Socioeconomic/Personal Information

77. Can you read and write?	1	Yes
	0	No
	99	Don't know
78. What is the highest level of education you have attended? ***(Choose only 1)***	0	None
	1	Lower Primary
	2	Upper Primary
	3	Secondary or Higher
	4	Other (specify)_____
	99	Don't know
79. Does your household have the following? ***(Read all choices. Mark all that apply.)***	1	Electricity
	2	Television
	3	Radio
	4	Animal-drawn cart
	5	Motorcycle/Scooter
	6	Bicycle
	7	Car/truck
	8	Refrigerator
	9	Telephone (mobile or non-mobile)
	10	Agricultural land
	0	None of the above
80. What type of cooking fuel does your household use? ***(Read all choices. Mark all that apply.)***	1	Charcoal
	2	Wood
	3	Straw/shrubs/grass
	4	Animal dung
	5	Agricultural crop residue
	6	Electricity
	7	Liquid Propane Gas
	8	Natural Gas

	9	Kerosene
	10	Other (specify)_____
	0	None
81. Do you/your family own any of the following animals? ***(Read all choices. Mark all that apply.)***	1	Goat
	2	Sheep
	3	Dog
	4	Cat
	5	Cow/Cattle
	6	Chicken, Ducks, other poultry
	7	Other (specify)_____
	0	No animals
82. What is the main source of family income? ***(Do not read. Choose only 1.)***	1	Herding of Domestic Animals
	2	Fishing
	3	Small Business
	4	Farmer
	5	Employed/Salaried
	6	Unskilled labor
	7	Unemployed
	99	Don't Know
83. What is your religious denomination? ***(Do not read. Check all that are mentioned.)***	1	Christian
	2	Muslim
	3	Hindu
	4	None
	5	Other (specify)_____
	6	Refused

Home Information/Observations

84. Where do you defecate? ***(Do not read. Circle the one that applies.)***	1	Flush Latrine
	2	Covered pit latrine
	3	Uncovered dry pit latrine
	4	Flying toilet
	5	Bush
	6	Lake or River
	7	Other, (Specify) _____
85. What is the main roofing material for the household's dwelling? ***(Choose 1.)***	1	Thatch
	2	Metal/Iron Sheets
	3	Tile/Asbestos sheets
	4	Wood
	5	Cement
	6	None; no household dwelling/structure
	7	Others (Specify)_____
86. What is the main flooring material? ***(Choose 1)***	1	Dung
	2	Earth/ sand/ mud
	3	Metal
	4	Wood
	5	Broken bricks
	6	Cement

	7	Tile
	8	None; no household dwelling/structure
	9	Other (Specify) _____
87. What is the material used for the walls? ***(Choose 1)***	1	Dung/Mud
	2	Metal sheets
	3	Twigs
	4	Wood
	5	Cement/Plaster
	6	Bricks/blocks/stones
	7	None; no household dwelling/structure
	8	Other(Specify) _____
88. May I see where you store your water? ***(Mark all that are seen.)***	1	Jerrycan
	2	Bucket
	3	Pot
	4	Cooking pot *(Sufuria)*
	5	Refused
	6	None
89. May I see the products you have purchased or have received from the government or NGOs? ***(Mark all that are seen.)***	1	Soap
	2	WaterGuard
	3	PuR
	4	Aquatabs/chlorine tabs
	5	Bottles of chlorine
	6	Drums of chlorine
	7	Ceramic water filter
	8	Medicine/Antibiotics
	9	ORS
	10	Food
	11	Print material
	12	Other (specify)_____
	13	None in the home
90. May I test a sample of drinking water to see if there is chlorine in it? ***Result of chlorine test:***	1	Positive
	2	Negative
	3	No water stored
	4	Refused
	5	Test not done
	6	Other (specify)_____

"The interview is now finished. Thank you."

Appendix B

HCW Case Management Survey

Elicit answers from all nurses, clinical officers, and medical officers working in the medical and pediatric ward and outpatient section of the health center, dispensary, or hospital.

<u>NOTE: If more than one staff in the clinic/hospital, interview the NURSE IN CHARGE first and ask all questions, then interview other staff and ask only questions in Section A, B, C, D, and questions 6C, 7, 11, and 24 in Section E.</u>

The Ministry of Public Health and Sanitation is conducting a study on cholera. We would like to ask you some questions about the types of cholera patients you are seeing and how they are being treated. We are wondering if you would be willing to answer some questions.

Yes →**continue to Section A** No → If **NO**, thank them for their time.

A. IDENTIFYING INFORMATION		
1. Date of interview		_____
2. Age of Respondent		_____ (years)
3. Sex of Respondent		Male Female (circle)
4. Location Employed	1.	District Hospital
	2.	Sub-district Hospital
	3.	Provincial Hospital
	4	Health Centre (name:_____)
	5.	Dispensary (name:_____)
	6	Other, specify_____
5. What type of medical facility is this facility? **(*read all options, select <u>one</u>*)**	1	Government (MOH)
	2	Private
	3	Faith-based
	4	NGO
	5	Other (specify)_____
6. Which one of the following healthcare worker categories best describes your current position? **(*read all options, select <u>one</u>*)**	1.	Medical officer
	2.	Clinical officer
	3.	Nurse
	4.	Community Health Worker/Patient attendant
	5.	Other (specify)_____
	6.	Nurse in charge
7. Please indicate the training you have completed for your	1	No formal training

chosen healthcare profession **(*read all options, select <u>one</u>*)**	2 3 4 5	Medical school Clinical officer training Nursing school Other (specify)_____
8. How many years have you been practicing in your chosen health profession?		_____ years
9. How many years have you been practicing in this facility?		_____ years

Now I will ask you about cholera patients you have seen.

B. PATIENTCHARACTERISTICS		
1. Did you see any cholera (suspected or confirmed) patients in 2009?	1 2 9	Yes No Don't know
1a. In the past week how many patients with cholera (suspected or confirmed) have you treated?		_____
2. In the past 3 months (since October 1, 2009) how many cholera patients (suspected or confirmed) have you treated?	1. 2. 3. 4. 5 6 9	None 1-10 10-50 50-100 100-200 >200 Don't know
3. Are overnight admissions possible at this facility?	1 2 9	Yes No Don't know
4. What case definition do you use for cholera? **(*<u>do not read</u>, circle all that are mentioned)***	1. 2. 3. 4. 5 6 9.	Severe dehydration from acute watery diarrhea (>4 episodes in 12 hours) in a patient of any age Severe dehydration from acute watery diarrhea (>4 episodes in 12 hours) in a patient >5 years old Acute watery diarrhea in a person >2 yr in an area where there is an outbreak of cholera Acute watery diarrhea in a person >2 yr Any diarrhea Other (specify)_____ Don't Know
5. Of all the cholera patients you treated in the past 3 months (since October 1, 2009) how many were severely dehydrated when you first saw them? **(*read all options, select <u>one</u>*)**	1. 2. 3 4 5	None of the patients Some of the patients Half of the patients Most of the patients All of the patients

	6	Have not seen cholera pts in past 3 mos
	9.	Don't know
6. Of all the cholera patients you treated in the past 3 months (since October 1, 2009) how many appeared dead when they came to the health facility but improved with treatment? **(*read all options, select <u>one</u>*)**	1.	None of the patients
	2.	Some of the patients
	3	Half of the patients
	4	Most of the patients
	5	All of the patients
	6	Have not seen cholera pts in past 3 mos
	9.	Don't know
7. Of all the cholera patients you treated in the past 3 months (since October 1, 2009) how many died within 1 hour of arriving at the health facility? **(*read all options, select <u>one</u>*)**	1.	None of the patients
	2.	Some of the patients
	3	Half of the patients
	4	Most of the patients
	5	All of the patients
	6	Have not seen cholera pts in past 3 mos
	9.	Don't know
8. Of all the cholera patients you treated in the past 3 months (since October 1, 2009) how many died more than 4 hours after arriving at the health facility? **(*read all options, select <u>one</u>*)**	1.	None of the patients
	2.	Some of the patients
	3	Half of the patients
	4	Most of the patients
	5	All of the patients
	6	Have not seen cholera pts in past 3 mos
	9.	Don't know
9. What is the average wait time (defined as the amount of time from arrival until the patient is seen by any healthcare worker) for a patient with cholera at your medical facility? **(*read all options, select <u>one</u>*)**	1	Immediately
	2	Less than 15 minutes
	3	16-30 minutes
	4	30 minutes-1 hr
	5	>1 hour
	9.	Don't Know

Now I will ask you about the disease cholera.

C. Knowledge		
1. Have you received any training in how to manage cholera patients?	1	Yes→**go to 1A**
	2	No→**go to 2**
1A. *If **YES***, what year was this training?		_____(year only)
1B. *If **YES***, from whom did you receive the training?	1	Ministry of Public Health and Sanitation
	2	Private organization (specify)_____
	3	During schooling
	4	NGO (specify)_____
	5	Other (specify)_____
	9	Don't know
2. Name at least one way that cholera is transmitted **(*<u>don't read</u>, select all that apply*)**	1	Contaminated Food
	2	Contaminated Water
	3	Other (specify)_____

	9	Don't Know
3. Can cholera be prevented?	1	Yes→**go to 3A**
	2	No→**go to 4**
	9	Don't Know→**go to 4**
3A. *If **YES,*** how can cholera be prevented? **(*Don't read, select all that apply*)**	1	Wash hands
	2	Cook food thoroughly
	3	Cover food
	4	Boil or treat water
	5	Wash fruits and vegetables
	6	Clean cooking utensils
	7	Other (specify)_____
	9	Don't know
4. If you see a lethargic patient with very sunken eyes, very dry mouth, and a skin pinch that goes back very slowly, what is his level of hydration? **(*read all options, select one*)**	1	No dehydration
	2	Some Dehydration
	3	Severe Dehydration
	9	Don't Know
5. If you see a patient who is alert, talking normally, has a moist mouth, tears, and a skin pinch that goes back slowly, what is his level of hydration? **(*read all options, select one*)**	1	No dehydration
	2	Some Dehydration
	3	Severe Dehydration
	9	Don't Know
6. When you see a cholera patient with *severe* dehydration, what type of fluids would you give them ideally? **(*read all options, select one*)**	1	Oral Rehydration Solution (ORS) only→**go to 7**
	2	Intravenous fluid and/or ORS→**go to 6A**
	9	Don't Know→**go to 7**
	3	None of the Above→**go to 7**
6A. What type of intravenous fluids would you give this patient ideally? **(*read all options, select one*)**	1	Ringer's Lactate (LR)/ Hartmann's solution
	2	0.9% Normal Saline (NS)
	3	5% Dextrose (D5W)
	4	Other_____
	9	Don't Know
7. When you see a ***pediatric*** cholera patient with *severe* dehydration, what type of fluids would you give them ideally? **(*read all options, select one*)**	1	Ringer's Lactate (LR)/ Hartmann's solution
	2	0.9% Normal Saline (NS)
	3	5% Dextrose (D5W)
	4	Other_____
	9	Don't Know
8. If you see a cholera patient with *some* dehydration, what type of fluids would you give them ideally? **(*read answers, select only one*)**	1	Oral Rehydration Solution (ORS) only
	2	Intravenous fluid +/- ORS
	9	Don't Know
	3.	None of the Above
9. If you see a cholera patient with *no* signs of dehydration, what do you do? **(*read answers, select only one*)**	1	Nothing, send them home
	2	Give ORS to take home
	3	Give intravenous fluids
	4	Other (specify)_____

	9	Don't Know
10. Does the facility have IV flow regulators for children?	1 2 9	Yes →**go to 10A** No →**go to 10B** Don't Know →**go to 10B**
10A. *If **YES***, what kind of flow regulator?	1 2 3	Thumb regulator Manual dial Other (specify)_____
10B. *If **YES***, how do you determine flow rates for children < 1 year? **(*read answers, circle all that apply)***	1 2 3 4 5 9	Count drops per minute Hang a maximum volume for the child for a certain time period Hang a large bag and monitor bag volume visually Monitor clinically for fluid overload Other (specify)_____ Don't know
11. **TRUE/FALSE**: If you see a patient >1 year of age with severe dehydration that you decide to give intravenous fluids to, you should give them 30 ml/kg in 30 minutes and 70 ml/kg in next 2 ½ hours.	1 2	True False
12. If you see a cholera patient who is not vomiting when can you give them ORS? **(*read answers, select only <u>one</u>*)**	1 2 3 4 9.	Immediately After IV fluids When diarrhea has stopped Other (specify)_____ Don't Know
13. When is it appropriate to feed a cholera patient? **(*read answers, select only <u>one</u>*)**	1 2 3 9	Never As soon as they are able to eat without vomiting Other Don't Know
14. **TRUE/FALSE:** Infants and young children with cholera should continue breast-feeding as long as they are not vomiting	1 2	True False
15. Which cholera patients should receive oral antibiotics? **(*read answers, select only <u>one</u>*)**	1 2 3	All patients Only patients with severe dehydration Don't know
16. Which antibiotics are given to adult cholera patients in your facility? **(*read answers, select all that apply)***	1 2 3 4 5 9	Doxycycline Tetracycline Chloramphenicol Erythromycin Other (specify)_____ Don't know
17. Which antibiotics are given to pediatric cholera patients in your facility? **(*read answers, select all that apply)***	1 2 3 4	Doxycycline Tetracycline Chloramphenicol Erythromycin

	5	Other (specify)_____
	9	Don't know

D. ATTITUDE		
1. Are you worried about getting cholera from your patients?	1	Yes
	2	No

E. PRACTICES		
E1. Supplies **Now I will ask you some questions about the availability of supplies in your facility**		
1. Do you have ORS in your facility?	1	Yes
	2	No
	9	Don't know
1A. In 2009, did you run out of ORS?	1	Yes
	2	No
	9	Don't know
1B. How many months out of the last year did you run out of ORS?		_____months
	99	Don't know
1C. In the last *month*, did you run out of ORS?	1	Yes
	2	No
	9	Don't know
2. Do you have intravenous fluids in your facility?	1	Yes
	2	No
	9	Don't know
2A. In 2009, did you run out of intravenous fluids?	1	Yes
	2	No
	9	Don't know
2B. How many months out of the last year did you run out of intravenous fluids?		_____months
	99	Don't know
2C. In the last *month*, did you run out of intravenous fluids?	1	Yes
	2	No
	9	Don't know
3. Do you have intravenous needles (branular) in your facility?	1	Yes
	2	No
	9	Don't know
3A. In 2009, did you run out of intravenous needles (branular)?	1	Yes
	2	No
	9	Don't Know
3B. In the last *month*, did you run out of intravenous needles (branular)?	1	Yes
	2	No
	9	Don't know
4. Do you have intravenous tubing in your facility?	1	Yes

	2	No
	9	Don't know
4A. In 2009, did you run out of intravenous tubing?	1	Yes
	2	No
	9	Don't Know
4B. In the last *month*, did you run out of intravenous tubing?	1	Yes
	2	No
	9	Don't know
5. Do you have doxycycline in your facility?	1	Yes
	2	No
	9	Don't know
5A. In 2009, did you run out of doxycycline?	1	Yes
	2	No
	9	Don't Know
5B. In the last *month*, did you run out of doxycycline?	1	Yes
	2	No
	9	Don't know
5C. What antibiotics do you use after running out of doxycyline?	1	Tetracycline
	2	Chloramphenicol
	3	Other (specify)_____
6. Do you have zinc in your facility?	1	Yes
	2	No
	9	Don't know
6A. In 2009, did you run out of zinc?	1	Yes
	2	No
	9	Don't Know
6B. In the last *month*, did you run out of zinc?	1	Yes
	2	No
	9	Don't know
6C. Which patients are given zinc treatments? ***(read answers, select <u>one</u>)***	1	All patients with any diarrhea
	2	Patients with severe diarrhea
	3	Other (specify)_____
	9	Don't know
E2. Laboratory **Now I will ask some questions about cholera laboratory tests**		
7. Are stool samples collected from suspected cholera patients?	1	Yes →**go to 7A**
	2	No →**go to 8**
	9	Don't Know →**go to 8**
7A. How do you decide which patients should have stool samples collected? ***(do not read, check all that apply)***	1	All patients have stool samples collected
	2	Only those with severe diarrhea
	3	Whenever I remember to ask for a sample
	4	Every 10th patient has a stool sample taken

	5	Other (specify)_____
	9	Don't know
7B. Are stool samples cultured for cholera in your facility?	1	Yes →**go to 8**
	2	No →**go to 7C**
	9	Don't Know →**go to 7C**
7C. Where are stool samples sent for culture?	1	District hospital lab
	2	National lab
	3	Other (specify)_____
	9	Don't know
7D. Are culture results sent back to your facility?	1	Yes
	2	No
	9	Don't Know
7E. Are antimicrobial susceptibility results sent to your facility?	1	Yes
	2	No
	9	Don't Know
8. Do you have rapid cholera tests in your facility?	1	Yes →**go to 8A**
	2	No →**go to 9**
	9	Don't Know →**go to 9**
8A. Did you conduct a rapid cholera test on any patients in 2009?	1	Yes
	2	No
	9	Don't Know
8B. Have you conducted a rapid cholera test on any patients in the past month?	1	Yes
	2	No
	9	Don't Know
E3. ORS **Now I will ask you some questions about ORS**		
9. Do you make ORS for cholera patients in this facility?	1	Yes →**go to 9A**
	2	No→**go to 11**
	9	Don't know→**go to 11**
9A. Is the water used to make ORS boiled?	1	Yes →**go to 9B**
	2	No →**go to 9B**
	9	Don't Know→**go to 9B**
9B. Is the water used to make ORS treated with any water treatment product (WaterGuard, AquaTabs, etc)?	1	Yes →**go to 9C**
	2	No →**go to 10**
	9	Don't Know →**go to 10**
9C. *If **YES***, what water treatment product is used? (***read answers, circle all that apply)***	1	WaterGuard →**go to 9D**
	2	AquaTabs→**go to 9D**
	3	AquaGuard→**go to 9D**
	4	Pur→**go to 9D**
	5	Other _____→**go to 9D**
	9	Don't know what water treatment is used→**go to 17**
9D. May I see the water treatment used? (***observe the water treatment and circle all the water treatments***	1	WaterGuard present
	2	AquaTabs present

observed. If no water treatment available to view, mark No water treatment available)	3 4 5 6 7	AquaGuard present Pur present Other present (specify)_____ No water treatment available Refused to show water treatment
9E. From whom did you receive the water treatment products?	1 2 9	Government NGO (specify)_____ Don't know
10. Is the ORS ever pre-mixed in a large container for many patients?	1 2 9	Yes→**go to 10A** No→**go to 11** Don't know→**go to 11**
10A. *If **YES***, may I see the container where the ORS is stored? (***observe the ORS storage container and circle all containers observed. If no container available, mark no container available)***	1 2 3 4 5 6 7 8	Bucket Jerry Can Ordinary clay pot Improved clay pot (a spigot/narrow opening) Barrel Other_____ No container available Refused to show container
10B. Does the container have a lid?	1 2 9	Yes No Don't Know
10C. How do you get ORS out of this container? (***read answers, circle all that apply)***	1 2 3 4	By pouring out the top By using a cup or similar item dipped into the ORS By a spigot on the bottom Other_____
11. Are cholera patients discharged home with ORS packets?	1 2 9	Yes →**go to 11A** No →**go to 12** Don't Know →**go to 12**
11A. *If **YES,*** how many packets of ORS are they discharged home with? **(*read answers, circle one*)**	1 2 3 4 9	1-2 packets→**go to 11B** 3-5 packets→**go to 11B** >5 packets→**go to 11B** The number given varies→**go to 11B** Don't know→**go to 11B**
11B. May I see a sample of the ORS packets? (***ask to see a sample of the ORS packet and circle if packet is available)***	1 2 3	Packet available No packet available Refused
E4. Cholera treatment areas **Now I will ask some questions about the set-up of your cholera treatment areas**		
12. Within this facility, where are/where were suspected or confirmed cholera cases treated?	1 2	Regular ward/clinic Separate cholera ward (within the hospital/health centre

	3	Cholera Treatment Centre (CTC), separate from the hospital/health centre
	4	Other (specify)_____
	5	No cholera cases admitted in this facility **→go to E5**
13. May I see the area where cholera cases are/were treated?	1	Yes
	2	No
	3	Refused
Questions 14-21 are asked about the area where cholera cases are/were treated		
14. Do you/did you have an ORS rehydration room/area for cholera patients?	1	Yes
	2	No
	9	Don't Know
15. Do you/did you have an IV rehydration room/area for cholera patients?	1	Yes
	2	No
	9	Don't Know
16. Do you/did you have a decontamination room/area for cholera patients?	1	Yes
	2	No
	9	Don't Know
17. Do you/did you have a room/area for disinfecting the bodies of those who died from cholera?	1	Yes
	2	No
	9	Don't Know
18. Do you have/did you a handwashing station in the area where cholera patients are treated?	1	Yes **→go to 19**
	2	No **→go to 20**
	9	Don't Know
19. How many handwashing stations do you/did you have in the area where cholera patients are treated?		_____(# of stations)
	9	Don't know
19A. Can you show me the handwashing stations? **(*Observe if soap is present. If there is more than one handwashing station, observe soap at each station and mark if soap is present at each)***	1	Present
	2	Absent**→go to 19E**
	3	No, because cholera treatment area not set up now/no cholera patients currently**→go to 20**
19B.Handwashing station #2 – is soap present?	1	Present
	2	Absent
19C.Handwashing station #3– is soap present?	1	Present
	2	Absent
19D. Handwashing station #4– is soap present?	1	Present
	2	Absent
19E. If soap absent at any handwashing stations, ask to see soap.	1	Has soap
	2	Doesn't have soap
	9.	Refused to show soap
20. Are there/were there separate latrines for cholera patients who can walk? ***(ask to see the separate latrines and mark present or asent)***	1	Separate latrines present
	2	No separate latrines present
	3	Refused to show latrines
21. Do you/did you have cholera cots in the area where cholera patients are treated?	1	Yes **→go to 21A**
	2	No

	9	Don't know
21A. May I see the cholera cots? ***(ask to see the cots and mark present or absent)***	1 2 3	Cots present No cots present Refused to show cots
E5. Education **I have only a few more questions to ask about cholera education**		
22. Are MOH Guidelines on Cholera Control books available in your facility?	1 2 9	Yes →**go to 22A** No →**go to 23** Don't Know →**go to 23**
22A. May I see one of the books?	1 2 3	Present Not available Refused to show
23. Are flowcharts illustrating the cholera clinical case management available in your facility?	1 2 9	Yes →**go to 23A** No →**go to 24** Don't Know →**go to 24**
23A. May I see one of the flowcharts?	1 2 3	Present Not available Refused to show
24. Are cholera patients given health education before discharge?	1 2 9	Yes →**go to 24A** No →**go to end** Don't Know →**go to end**
24A. *If **YES,*** what educational messages are they given? **(*do not read, check all that apply)***	1 2 3 4 5 6 7 8 10 11 9	Wash hands before handling food Wash hands after using the toilet Eat food while still hot Boil water or milk before drinking Treat water with WaterGuard or another chlorine product Return to HF if any signs of diarrhea, vomiting, or poor appetite Use ORS if have vomiting or diarrhea Use a latrine for defecation Other (specify)_____ Don't know

This is the end of the interview. Thank you for your assistance.

HCW KAP Study: HOSPITAL/HEALTH CENTER LEVEL DATA ONLY

Ask these questions of the medical officer, clinical officer, or nurse in charge.

The Ministry of Public Health and Sanitation is conducting a study on cholera. We would like to ask you some questions about your facility. We are wondering if you would be willing to answer some questions?

Yes → continue No → If **NO**, thank them, and note on log sheet.

FACILITY NAME:_____

DATE:_____

1. Respondent Name		_____
2. Title		_____
3. Location		
4. Profession	1 2 3 4	Medical doctor Nurse Clinical officer Other (specify)_____
6. How many patients does this facility see in a day?		
7. How many medical officers work here?		
8. How many clinical officers work here?		
9. How many nurses work here?		
10. How many community health workers/patient attendants work here?		
12. How many days of the week is this facility open?		
13. How many hours per day is this facility open?		
14. How many admission beds do you have?		
15. What percentage of your patients go to a traditional healer before coming here?		_____%

Log books: all log books (in-patient and out-patient) added up :

How many people were seen at the hospital (in registration book) between November-December, 2009?	
How many people of all ages were diagnosed with ***any diarrhea*** between November-December, 2009?	
How many patients were diagnosed with ***cholera*** between November and December?	
How many were >5 years of age?	
How many were >2 years of age?	
How many patients were diagnosed with cholera in November?	
How many of these November cholera patients died?	
How many of cholera patients that died were <5 years of age?	
How many patients were diagnosed with cholera in December?	
How many of these December cholera patients died?	
How many of cholera patients that died were <5 years of age?	

How many people were seen at the hospital (in registration book) in January, 2010?	
How many people of all ages were diagnosed with ***any diarrhea*** in January?	
How many patients were diagnosed with ***cholera*** in January?	
How many were >5 years of age?	
How many were >2 years of age?	
How many of these January cholera patients died?	
How many of cholera patients that died were <5 years of age?	

Appendix C

QUESTIONNAIRE: NAIROBI WATER QUALITY SURVEY

Hello, my name is _____. I am working with the Ministry of Health and CDC Kenya to conduct a survey in your settlement about some household characteristics and water. I would like to ask you questions regarding your sources of drinking water and how you store and treat it in your home. People in your area who are being asked if they would like to take part in this survey were chosen by chance (like flipping a coin). The questionnaire should take about 15 minutes of your time. In addition, I would like to take a small sample of your drinking water to test the quality of the water and will request to see a few items in your household. If you agree to participate all answers will be kept confidential and used only for public health purposes. No information will be used to identify you or members of your household. If you agree we can continue.
Do you agree? Yes / No

HH Number			

A	Interviewer		
B	Date (dd/mm/year)	__ __/ __ __/2010	
C	Settlement	Korogocho	Njenga
D	Village		

Q1.	Are you the person primarily responsible for managing water in this household?	Yes	1	No*	0

(if not, ask to speak to such person. If the person is not available during that time, please try to visit the same household three times within the survey period. If at the end of the three possible visits the person is not there, disregard this house for this survey)

HOUSEHOLD DEMOGRAPHICS:

(please circle the number associated with each response)

Q2.	Respondents' gender	Male	1	Female	0
Q3.	How old are you? (in years)				
Q4.	Can you read and write	Yes	1	No	0

Q5.	What is your highest level of education?	No education	1	Some primary	2	Completed primary	3

Some secondary	4	Completed Secondary	5	College or University	6

Q6. How many years did you go to school?

Q7. How many individuals live in this household?

Q8. How many children under the age of 5 live in this household?

WATER SOURCES:

Q9. Where are the primary sources of **drinking water** for your household during the rainy season? ***(do not read choices, mark all those that apply, multiple responses possible)***

Public tap/ standpipe	1	Water vendor	2	Rainwater	3
Water tanker	4	Borehole	5	Well	6
Other	7	Specify:			

Q10. Where are the primary sources of **drinking water** for your household during the dry season? ***(do not read choices, mark all those that apply, multiple responses possible)***

Public tap/ standpipe	1	Water vendor	2	Rainwater	3
Water tanker	4	Borehole	5	Well	6
Other	7	Specify:			

Q11. What was the source of the **drinking water** for your household today? ***(do not read choices, mark only one response)***

Public tap/ standpipe	1	Water vendor	2	Rainwater	3
Water tanker	4	Borehole	5	Well	6
Other	7	Specify:			

Q12. For how many months of the year is this water source available to you?

Q13. How many minutes do you take to travel to this

source, collect the water and return home?

Q14. What is the approximate distance to this source (in meters)?

Q15. How much do you pay for water from this source for a 20-Liter bucket? (Ksh)

Q16. How many hours (in a day) is water available from your source?

Q17. How many days a week is water available from your source?

Q18. How many times **per week** do you or someone from your household travel to the source to collect water for your household?

WATER STORAGE:

Q19. Do you store drinking water in the household?

Yes	1	No => ***if No, skip to Q21***	0

Q20. If yes, what type of container do you use to currently store drinking water at this point in your household? ***(do not read choices, mark only one response)***

20L jerrycan	1	10L jerrycan	2	5L jerrycan	3
20L clay pot	4	10L wide mouth bucket	5	5L wide-mouth bucket	6
Superdrum (50-200L)	7	Other	8	Specify:_____	

WATER TREATMENT:

Q21. Do you do anything to make your drinking water safe in the household?

Yes	1	No = > ***if No, skip to Q27***	0

Q22. If yes, what methods do you use to make your water safe? (***do not read choices, mark all those that apply, multiple responses possible)***

Boil	1	Filter with cloth?	2a	Solar disinfection	3
		Filter with ceramic?	2b		
		Filter with other:	Specify: _____		
Chlorinate:		Treat with alum	5	Other: _____	

With WaterGuard	4a			
With Aquaguard	4b			
With Aquatabs	4c			
With PuR	4d			

Q23. How often do you treat the drinking water for the household?

Always	1	Sometimes	2
Rarely	3	Never	4

Q24. Did you or someone in your household treat the drinking water that is stored in your house **<u>today</u>**?

Yes	1	No = > ***If No, skip to Q27***	0

Q25. If yes, what method did you/they use to treat this water **<u>today</u>**?***(do not read choices, mark only one response)***

Boil	1	Filter with cloth?	2a	Solar disinfection	3
		Filter with ceramic?	2b		
		Filter with other:	Specify: _____		
Chlorinate:		Treat with alum	5	Other: _____	
With WaterGuard	4a				
With Aquaguard	4b				
With Aquatabs	4c				
With PuR	4d				

Q26. If yes, when did you/they perform this water treatment?

Today	1	Yesterday	2	More than two days ago	3

Q27. Have you purchased anything to treat your drinking water since September 2009?

Yes	1	No = > ***if No, skip to Q29***	0

Q28. If yes, what have you purchased? ***(do not read choices, mark all that apply, multiple responses possible)***

WaterGuard	1	AquaGuard	2	Chlorine powder	3
PuR	4	Aquatabs	5	Alum	6
A ceramic filter	7	A biosand filter	8	Other: _____	

Q29. Has anyone given you anything to treat your drinking water since September 2009?

Yes	1	No = > ***if No, skip to Q35***	0

Q30. If yes, what were you given? ***(do not read choices, mark all that apply, multiple responses possible)***

WaterGuard	1	AquaGuard	2	Chlorine powder	3
PuR	4	Aquatabs	5	Alum	6
A ceramic filter	7	A biosand filter	8	Other: _____	

Q31. Who gave you this/these item(s)? ***(do not read choices, mark all that apply, multiple responses possible)***

Ministry of Health	1	CDC	2	Clinic	3
Church	4	NGO	5	Specify:_____	
Local public health officer	6	Other	7	Specify: _____	
Don't know	8				

Q32. When you were given this/these item(s), did they come with any additional instructions?

Yes	1	No = > ***if No, skip to Q34***	0

Q33. If yes, could I see the instructions? (***Please record any donor information on them)***

Q34. Did you witness any demonstrations regarding the use of water treatment products?

Yes	1	No	0

SANITATION AND HYGIENE:

Q35. How do the members of your

Latrine	1	Flush toilet	2	On the ground	3

household most often dispose of feces? ***(do not read options, circle only one response)***	Flying toilet	4	Other	5	Specify: _____

Q36. If you use a latrine or toilet, how far is the latrine or toilet from your household (in meters)? | |

Q37. Is the latrine or toilet shared with other households?	Yes	1	No	0
Q38. Is the latrine or toilet currently in use?	Yes	1	No	0
Q39. Do you pay a fee to use the latrine or toilet?	Yes	1	No	0

Q40. If yes, what is the fee that you pay? | |

Q41. Do you wash your hands with soap and water?	Yes	1	No	0

HOUSEHOLD OBSERVATIONS:

Q42. Can I see the container you use to store drinking water in your household? ***(tick one of each)***	Wide-mouth		Narrow-mouth	
	Covered		Not-covered	
	Contains spigot		Does not contain spigot	

Q43. Can I see where you wash your hands? ***(Please tick if there is a handwashing station in the house and if there is soap present there)***	Handwashing station present		Handwashing station absent	
	Soap present		Soap absent	

Q44. If the household uses WaterGuard, can I see your WaterGuard? ***(please tick one of each and fill in the expiration date as it reads on the bottle)***	WaterGuard present		WaterGuard absent	
	Bottle not empty		Bottle empty	
	Expiration date: __ __/__ __/ __ __ __ __ ***(dd/mm/year)***			

Q45. If the household uses PuR, can I see your PuR? ***(please tick one and record the number of sachets in the household)***

PuR present		PuR absent	
Number of PuR sachets: _____			

Q46. If the household uses Aquatabs, can I see your Aquatabs?***(please tick one and record the number of tablets in the household)***

Aquatabs present		Aquatabs absent	
Number of tablets: _____			

WATER TESTING:

Q47. May I test a sample of your drinking water?

Free chlorine: _____mg/L
Total chlorine: _____mg/L

(Collect a sample for microbiological water testing in plastic bottle containing thiosulfate and place on ice)

Q48. Could you please show me where your water source is located? ***(record location of water source and corresponding sample code from water data collection sheet, if tested)***

Appendix D. Water Quality Data Collection:

Date Collected	Date Entered	Code	Household	Source	Treated	Free Chlorine	Total Chlorine	IDEXX	IDEXX	Total Coliforms	E. coli
Date Collected	**Date Entered**	**Sample Code**	**Household #**	**Source:**	**Sample Treated?: 0=no, 1=yes**	**mg/L free Cl-**	**mg/L total Cl-**	**Big/small wells yellow**	**Big/small wells fluorescent**	**MPN/100mL**	**MPN/100mL**

Appendix E

Microbiological Water Testing Protocol

TOTAL COLIFORM AND *ESCHERICHIA COLI* CONCENTRATION TESTING

Background and rationale

Measurement of *Escherichia coli* and total coliform concentration is widely used to measure the level of fecal contamination of water. The results may be used as surrogates for the risk for diarrheal disease associated with drinking from the water source tested. Colilert simultaneously detects *E. coli* and total coliforms in water. It is based on IDEXX's patented Defined Substrate Technology (DST). When coliforms metabolize Colilert's nutrient indicator, ONPG, the sample turns yellow. When *E. coli* metabolize Colilert's nutrient indicator, MUG, the sample fluoresces. Colilert can simultaneously detect these bacteria at 1 CFU/100 mL within 24 hours even with as many as 2 million heterotrophic bacteria per 100 mL present.

We will be testing household and source water samples from a random sample of household selected from two informal settlements within Nairobi. We will take two samples per household (one for stored household drinking water and one for each household's source water). In addition, we will be testing positive and negative controls in our study.

Equipment Required (for 600 samples)

600 Plastic Water Vessels (with thiosulfate)
IDEXX Quanti-Tray Sealer
600 Colilert test kit reagent
600 Quanti-Trays/2000
Quanti-Tray/2000 rubber insert
35ºC air incubator
IDEXX P/A Comparator
Quanti-Tray/2000 Most Probable Number table
6-watt 365 nm ultraviolet light source

Sample collection and transportation

1. Label each sample vessel with the source or household identifiers and date and time of collection. Other data should be recorded according to the study.

2. Collect sample in sterile plastic water vessels containing thiosulfate. Thiosulfate neutralizes chlorine activity to prevent ongoing bactericidal activity during transportation. Use sterile technique. In order to collect a representative sample, be careful not to disturb the water during collection.

3. Transport samples to the laboratory in a cooler with ice packs.

4. Process samples within 6 hours of collection.

Processing samples for the Quanti-Tray/2000 system

1. Turn on power switch for IDEXX Quanti-Tray Sealer. The amber power light should illuminate. The sealer will warm up while you are preparing samples. This takes about 10 minutes. The green light will illuminate when the sealer is warmed up.

2. Add one ampoule of Colilert test kit reagent to each 100 mL water sample. Shake each sample until the reagent has dissolved.

3. Label a new Quanti-Tray with the sample number and collection date, using a felt-tipped pin.

4. Use one hand to hold a Quanti-Tray upright with the well side facing the palm.

5. Squeeze the upper part of the Quanti-Tray so that the Quanti-Tray bends towards the palm.

6. Gently pull the foil tab to separate the foil from the tray. Avoid touching the inside of the foil or tray.

7. Pour the reagent/sample mixture directly into the Quanti-Tray avoiding contact with the foil tab. Tap the small wells 2-3 times to release air bubbles. Allow foam to settle.

8. Check that both the amber and green lights are illuminated on the IDEXX Quanti-Tray Sealer. Place the sample-filled Quanti-Tray onto the Quanti-Tray/2000 rubber insert of the Quanti-Tray Sealer with the well side (plastic) of the Quanti-Tray facing down.

9. Slide the rubber insert with tray into the sealer until the motor grabs the rubber insert and begins to draw it into the sealer.

10. In approximately 15 seconds, the tray will be sealed and partially ejected from the rear of the sealer. Remove the rubber insert and tray from the rear of the sealer.

11. If at any time you wish to reverse the motor drawing the rubber insert into the sealer (e.g., misaligned tray is accidentally fed into sealer), press and hold the reverse button. However, do not reverse motor once rubber insert has been drawn fully into the input slot.

12. Multiple rubber inserts can be run consecutively without pausing.

13. Turn of sealer when not in use.

Incubation

1. Place labeled and sealed sample tray in a 35ºC air incubator.

2. Results are definitive at 18 hours of incubation, so may be read at any time during this period according to preference and work flow.

Result interpretation

1. For inexperienced technologists, ONPG (for total coliforms) may be interpreted by comparison with an IDEXX P/A Comparator. The following table may be use for interpretation.

Appearance	Result
Less yellow than comparator	Negative for total coliforms and *E. coli*
Yellow equal to or greater than the comparator	Positive for total coliforms
Yellow and fluorescence greater than the comparator	Positive for *E. coli*

Count the number of large wells positive and the number of small wells positive. Note that the very large well at the end of the tray is counted as a large well. With experience it is not necessary to use a Comparator tray. Use the Quanti-Tray/2000 Most Probable Number table to calculate the total coliform concentration in colony forming units (CFU) per mL.

2. MUG (for *E. coli*) is read with a 6-watt 365 nm ultraviolet light source (e.g., Wood's lamp) held 5 inches from the sample. Positive wells fluoresce blue. Count the number of large wells positive and the number of small wells positive. Note that the very large well at the end of the tray is counted as a large well. Use the Quanti-Tray/2000 Most Probable Number table to calculate the *E. coli* concentration in colony forming units (CFU) per mL.

Waste management

Dispose of media on accordance with Good Laboratory Practices.