Nosocomial Cholera Outbreak in a Mental Hospital: Challenges and Lessons Learnt from Butabika National Referral Mental Hospital, Uganda

Godfrey Bwire, Mugagga Malimbo, Atek Kagirita, Issa Makumbi, Eric Mintz,* Martin A. Mengel, and Christopher Garimoi Orach

Control of Diarrheal Diseases Section, Ministry of Health, Kampala, Uganda; Epidemiological Surveillance Division, Ministry of Health, Kampala, Uganda; U.S. Centers for Disease Control and Prevention, Atlanta, Georgia; Central Public Health Laboratory, Kampala, Uganda; Agence de Médecine Préventive, Paris, France; Makerere University School of Public Health, Kampala, Uganda

Abstract. During the last four decades, Uganda has experienced repeated cholera outbreaks in communities; no cholera outbreaks have been reported in Ugandan health facilities. In October 2008, a unique cholera outbreak was confirmed in Butabika National Referral Hospital (BNMRH), Uganda. This article describes actions taken to control the outbreak, challenges, and lessons learnt. We reviewed patient and hospital reports for clinical symptoms and signs, treatment and outcome, patient mental diagnosis, and challenges noted during management of patients and contacts. Out of 114 BNMRH patients on two affected wards, 18 cholera cases and five deaths were documented for an attack rate of 15.8% and a case fatality rate of 28%. Wards and surroundings were intensively disinfected and 96 contacts (psychiatric patients) in the affected wards received chemoprophylaxis with oral ciprofloxacin 500 mg twice daily until November 5, 2008. We documented a nosocomial cholera outbreak in BNMRH with a high case fatality of 28% compared with the national average of 2.4% for cholera outbreaks in communities. To avoid cholera outbreaks and potentially high mortality among patients in mental institutions, procedures for prompt diagnosis, treatment, disinfection, and prophylaxis are needed and preemptive use of oral cholera vaccines should be considered.

INTRODUCTION

The usual place of treatment and consolation for serious infections such as cholera are the hospitals that are under the care of health workers. Cholera was first reported in Africa in the 1970s and many countries continue to report serious outbreaks annually.^{1–7} These outbreaks commonly occur in communities with poor sanitation, hygiene, or inadequate access to safe water.² Uganda has recorded numerous cholera outbreaks since 1971 when the first outbreak was noted.^{8–12} All previously reported outbreaks occurred in communities with factors similar to those responsible for outbreaks elsewhere in Africa. In October 2008, a unique outbreak was noted in Butabika National Referral Hospital (BNMRH), which was later confirmed as cholera. BNMRH is one of the cleanest hospitals in the country, and hygiene is a priority for the hospital administration.¹³ This was the first recorded cholera outbreak within a health facility in Uganda. Any cholera outbreak is a public health emergency,¹⁴ and when this life-threatening acute disease occurs in persons with mental illness, patient care becomes complex. This is worsened by the fact that persons with mental illness are often marginalized and difficult to reach through the usual community sensitization and education campaigns, a key strategy for cholera prevention and control.

Though patient care and cholera prevention in mental hospitals, prisons, and other institutions is challenging, it can be achieved if the institution is well-prepared and follows simple protocols. Unfortunately, available national cholera control and prevention guidelines for Uganda, which were adapted from World Health Organization (WHO) guidelines and last updated in 2007, offer little information to help address these challenges.¹⁵ The guidelines concentrate on prevention, control, and treatment of cholera originating in the communities

and are silent on cholera outbreaks in hospitals, prisons, and similar institutions. Furthermore, current guidelines do not advise health workers on how to handle aggressive, sedated, and other psychiatric patients such as epileptics who require special care in addition to cholera treatment. In this article, we describe the epidemiologic and microbiologic investigations of the outbreak, morbidity and case fatality rates, patient management, and challenges noted during the outbreak response. We offer recommendations to prevent, detect, and control similar future outbreaks.

METHODOLOGY

BNMRH is a government-owned health facility located in Kampala City. The hospital has bed capacity of 550 persons and offers specialized mental services to patients referred from all over Uganda and general outpatient services (treatment of common diseases) to surrounding communities. In 2008, BNMRH had a total of 11 wards consisting of separate admission wards, sick wards, convalescent wards, forensic wards, and alcohol/drug unit wards for men and for women, and a single ward for children. All patients were admitted to, and managed in, the appropriate admission ward according to sex, and were transferred from there to the appropriate inpatient ward. All wards were separated from each other and had independent sanitary and hygiene facilities. The cholera outbreak of 2008 occurred in the male admission and male sick wards.

We reviewed the outbreak investigation report, patient records, and hospital patient registers to establish the date the outbreak started and ended, the number of cases and deaths, the clinical symptoms and signs of reported cholera cases, treatment and outcomes, psychiatric diagnoses of patients, and challenges noted during management of patients and contacts. Inclusion criteria were based on the standard case definition for cholera as per national cholera guidelines of 2007 that was adopted from the WHO, which identifies a suspected cholera case in an area where the disease is not known to be present as “a patient aged 5 years or

*Address correspondence to Eric Mintz, Centers for Disease Control and Prevention, Mailstop C-09, Atlanta, GA 30333. E-mail: emintz@cdc.gov

more [who] develops severe dehydration or dies from acute watery diarrhea; [and], in an area where there is a cholera epidemic, a patient aged 5 years or more [who] develops acute watery diarrhea, with or without vomiting. A case of cholera is confirmed when *Vibrio cholerae* O1 or O139 is isolated from any patient with diarrhea.”¹⁶

Data were entered and analyzed in Microsoft Excel. As a non-research public health outbreak investigation, this activity was not subject to Institutional Review Board (IRB) requirements.

RESULTS

Index case for the outbreak and initial spread. The index case was a known male psychiatric schizophrenic patient who had been on and off the psychiatric ward and was last readmitted on October 18, 2008 at 2:00 PM when he was picked up by police and brought to BNMRH. Health workers in BNMRH readmitted the patient as per hospital admission protocol, since he was known to have a history of multiple admissions. The health workers noted that he had dirty soiled clothes and was weak and severely dehydrated, which they attributed to inadequate intake of fluids and food and poor hygiene resulting from his mental status. Treatment was initiated by intravenous rehydration using normal saline (0.9% sodium chloride solution) and 5% dextrose. However, despite treatment he progressively deteriorated and died within 24 hours.

The following day (October 20, 2008) another BNMRH patient in the same ward as the index case developed profuse watery diarrhea with vomiting. He was given oral rehydration therapy followed by intravenous rehydration, this time with lactated Ringer's solution, and was treated with ciprofloxacin and metronidazole, but continued to deteriorate and also died within 24 hours. At this moment the hospital team suspected cholera infection and submitted stool samples for laboratory investigations. On the third day (October 21, 2008), three more patients presented with severe diarrhea, vomiting, and dehydration. These patients initially received

oral rehydration salt solution at BNMRH but when symptoms continued, they were referred to Mulago Cholera Treatment Center, where cholera patients originating from Kampala City are usually managed. This same day, a cholera outbreak was declared in BNMRH and measures to equip and transform the male admission ward into a cholera treatment center, including universal infection control precautions for isolation, restriction, and disinfection, were instituted. Beginning on the afternoon of October 22, BNMRH patients with cholera symptoms were admitted to the new treatment center. When the four patients (first three patients plus one patient sent in the early morning of October 2008) who had been sent to the Mulago Cholera Treatment Center had been stabilized, they were transferred back to the BNMRH cholera treatment center for continuing care.

The cholera outbreak started on October 19, 2008 and lasted for 10 days with the last case presenting on October 28, and the last death occurring on October 25, 2008. The severe diarrhea, vomiting, severe dehydration, generalized weakness, and the associated rapid mortality that occurred within 24 hours of development of symptoms in five patients prompted the health workers to conduct further investigations. Four (44.4%) of 9 stool samples collected from suspected cases yielded *V. cholerae* O1, serotype Ogawa. The organisms were sensitive to ciprofloxacin, gentamicin, cefuroxime, erythromycin, augmentin, and tetracycline, but resistant to ampicillin, nalidixic acid, and co-trimoxazole. Among a population of 114 mental health patients at BNMRH in the two affected male wards, a total of 18 cholera cases with five deaths were registered (attack rate 15.8%, case fatality rate 28%). Figure 1 shows cases by date of presentation and outcome. The average hospital stay (in Mulago Cholera Treatment Center and in BNMRH treatment center) was 2.8 days (range: 1–9 days). There were no reported cholera cases on the other wards or among female patients, pediatric patients, or hospital staff. These groups where no cholera cases were reported did not receive chemoprophylaxis, however infection control and health education were stepped up.

FIGURE 1. Cholera cases and deaths by date of illness onset, Butabika National Mental Referral Hospital, Uganda, October 17–November 5, 2008.

FIGURE 2. Distribution of cholera cases and deaths by psychiatric and neurologic diagnoses, Butabika National Referral Hospital, Uganda, 2008.

Figure 2 shows the distribution of cholera cases and deaths by patients' mental condition. Eight (44%) cholera patients had a diagnosis of schizophrenia, followed by four (22%) who had a diagnosis of epilepsy; one additional patient had a diagnosis of both schizophrenia and epilepsy. The case fatality rate was highest among schizophrenics of whom four (50%) died, compared with only one death (10%) among 10 patients with other psychiatric or neurologic diagnoses ($P = 0.06$ by χ^2 test). Patients were treated with oral rehydration therapy, intravenous fluids (Ringer's lactate), and oral ciprofloxacin 500 mg twice daily for 5 days. Beginning on October 25, 2008, 96 cholera patient contacts (all patients on the male admission and male sick wards without cholera symptoms or signs) were given oral ciprofloxacin tablets 500 mg as chemoprophylaxis twice daily until November 5, 2008. The last patient with cholera symptoms was recorded on October 28, 2008. Disinfection was maintained in the BNMRH cholera treatment center and on the affected wards by use of chlorine sprays and solutions (0.05%, 0.2%, and 2%).

During the course of treatment, 4 of 18 patients were reportedly aggressive, removing intravenous fluid lines and refusing to drink oral rehydration solution. For those patients who were referred to Mulago Cholera Treatment Center, regular health workers faced difficulties with continuation of psychotic medications. This was due in part to the abnormal behavior of the patients and to the fact that the cholera treatment center did not stock all required psychiatric medicines (trihexyphenidyl [Artane], chlorpromazine, haloperidol, phenobarbital, and diazepam). Special skills were used to improve compliance with rehydration treatment including persuasion, rewarding, sedation, and control of convulsions using anticonvulsants (ordered from the main Mulago National Referral Hospital).

General cleanliness, hygiene, sanitation, safe water availability, and food preparation. The epidemic investigation report by the joint Uganda Ministry of Health Rapid Response Team and WHO, Uganda office, commended the BNMRH for the high level of cleanliness and infection control observed during the assessment. The joint investigation team was composed of the following experts—two epidemiologists, two physicians, two sanitarians, a water specialist, a logistician, and a

laboratory expert. Their report noted that the BNMRH was very clean, with adequate hygienic facilities for food preparation and sanitation and a constant supply of piped water. The investigation found no evidence to suggest the outbreak could be attributed to these factors: water supply, sanitation, food preparation and handling, and environmental hygiene. However, since the index case was a readmission, the rapid response team recommended that all readmissions should undergo the same thorough preadmission screening to rule out infectious conditions that is applied to all new admissions.

DISCUSSION

Nosocomial infections, defined as infections acquired in hospital, are common worldwide with prevalence of 8.7% among all hospitalized patients. The most frequently reported nosocomial infections are infections of surgical wounds, the urinary tract, and the lower respiratory tract.¹⁷ Though these infections are common globally, very few reports mention *V. cholerae* as the responsible pathogen for outbreaks recorded in hospitals.^{18–22} Some reports documented high case fatality rates associated with these outbreaks,¹⁷ yet little specific information is available to help health facilities prepare for and prevent nosocomial cholera transmission.

In Uganda, communities with poor sanitation, hygiene, and inadequate safe water have been the most affected by cholera outbreaks, with the hospital acting as a safe haven and place of healing.^{8–12} However, this investigation shows that hospitals in countries with endemic or epidemic cholera can also be a source of cholera outbreaks. A cholera outbreak was previously reported in a psychiatric hospital only once¹⁹ (in Singapore) where, as in previously reported nosocomial cholera outbreaks,^{18,20} transmission was attributed to "close person-to-person contact among individuals living in overcrowded unhygienic environments." The authors of one report noted that by person to-person transmission they mean "spread through close direct physical contact or indirectly through contaminated food, water, or fomites."²⁰ Our investigation suggests this was also the most likely means of transmission in BNMRH. Other reported nosocomial

cholera outbreaks were attributed to inappropriate infection control,^{19,22} and a previous study demonstrated the potential for nosocomial cholera transmission through improper preparation, storage, and dispensing of oral rehydration solution in cholera treatment centers or hospitals.²³

It should be noted that although patients were under the care of health workers, which should result in a low case fatality rate, the case fatality rate was very high at 28% compared with a national average of 2.4% recorded over the same period for cholera outbreaks in communities.¹¹ A high case fatality rate was also noted in the outbreak among psychiatric patients in Singapore (11%; 18 cases and two deaths)¹⁹ and in an outbreak in a pediatric ward in Maputo, Mozambique (30%; 20 cases and six deaths).¹⁸ In our investigation, the case fatality rate was higher among schizophrenic patients than among all other patients although this did not quite reach statistical significance.

High case fatality rates in community outbreaks are commonly attributed to poor access to health facilities, late care-seeking practices, and inadequate treatment.²⁴ In this investigation, patients were in the national referral hospital under the care of qualified health workers; however, the abnormal uncooperative behavior that is characteristic of severe poorly controlled schizophrenia could have been a contributing factor, along with hypotension and other common side effects of antipsychotic and other medications.

Although the last cholera death occurred on October 25, when chemoprophylaxis was initiated on both affected wards, six additional patients in these wards developed cholera on October 27 and 28 while presumably receiving ciprofloxacin prophylaxis. We offer three hypotheses to account for this phenomenon: 1) ciprofloxacin resistance may have emerged, and the six patients who developed cholera symptoms while receiving chemoprophylaxis may have been infected with a ciprofloxacin-resistant strain; 2) the patients may have surreptitiously not ingested the oral ciprofloxacin administered to them, as psychiatric patients have been known to do with other oral medications, and may have been infected with the ciprofloxacin-susceptible strain identified in earlier patients; 3) although all six patients had acute watery diarrhea and were considered to have cholera in the setting of a cholera outbreak, they may have been infected with another gastrointestinal pathogen, perhaps a virus or a *Salmonella* or enterotoxigenic *Escherichia coli* strain that was ciprofloxacin resistant. As no stool samples were obtained from these patients for stool culture or viral testing, we were unable to confirm or rule out any of these hypotheses.

Unhygienic behaviors may be an important factor that puts patients with severe psychiatric disorders in cholera-endemic countries at greater risk for acquiring cholera and other enteric infections. It is likely the index case in our investigation acquired infection through eating or handling contaminated material outside the hospital. The first cholera case in 2010 in Haiti was reportedly traced in a 32-year-old man with mental illness who died in the community.²⁵

Given the high case fatality rate in our investigation and others,^{18,19} persons with mental illness may be at higher risk for severe cholera and poor outcomes, and warrant special attention along with other vulnerable groups. This includes ensuring a hygienic in-hospital environment, access to safe drinking water and food, and inclusion in preventive oral cholera vaccination campaigns.²⁶

In institutions such as mental hospitals and prisons,²¹ the usual strategy for control of community cholera outbreaks through health education and promotion of personal hygiene is insufficient. The institution has a responsibility to provide safe water and food and to ensure adequate access to safe facilities for sanitation and hand washing. Institutional staff should be trained to recognize the signs and symptoms of cholera, and provide timely appropriate treatment and infection control measures on-site or at a referral center where the diagnosis can be confirmed by laboratory testing. In addition, complementary strategies, including chemoprophylaxis, disinfection, and environmental hygiene, can be successfully used for outbreak control as they were in this instance. Reactive oral cholera vaccination, even if it had been initiated at the first suspicion of cholera in the index case, would not have been completed in less than 14 days because of the requirement for two doses, and full protection would have required an additional week¹⁰; however, institutionalized persons should not be excluded from preemptive cholera vaccination campaigns that could help avert outbreaks.

Limitations. The findings of our investigation could be affected by the following limitations. First, because this was a rare disease outbreak with few cases, our findings may not be generalizable to larger outbreaks in similar institutional settings. Second, because of inadequate laboratory capacity, we were unable to screen for asymptomatic infections among patients or staff through stool culture or serologic testing.

Third, we could not analyze for age distribution and other variables, such as status of control of mental illness, because few patient records (8 of 18) had complete information on age and even fewer on the status of control of mental illness.

Finally, we could not identify where, when, or how the index case acquired the infection. We only suspect that he could have been exposed as a result of risky behaviors related to his psychiatric condition.

CONCLUSION

This review documented a nosocomial cholera outbreak among psychiatric patients hospitalized in BNMRH, which sickened 18 patients of whom five died. The outbreak was controlled by treatment, intensive disinfection of the wards and surroundings, and mass chemoprophylaxis of contacts (psychiatric patients without cholera symptoms in two affected wards). The case fatality rate was very high at 27.7% compared with a national average of 2.4%. Given the treatment challenges among hospitalized patients with severe psychiatric disorders, reducing the risk of cholera outbreaks, detecting cholera quickly, and being prepared to treat it and institute appropriate outbreak control measures rapidly is paramount. The inclusion of these patients as a vulnerable population at high risk for cholera infection and death should be considered when making decisions about target populations for preventive vaccination with new long-acting oral cholera vaccines.

Received November 19, 2014. Accepted for publication May 12, 2015.

Published online July 20, 2015.

Acknowledgments: We thank the health workers in BNMRH and Mulago Cholera Treatment Centre for their useful contribution toward this investigation. We are grateful to Brian Maskery of the U.S. Center for Disease Control and Prevention (CDC) for his excellent technical support in writing of this article.

Disclaimer: The findings and conclusions in this report are those of the authors and should not be construed to represent any agency determination or policy.

Authors' addresses: Godfrey Bwire, Diarrheal Diseases Section, Ministry of Health Uganda, Kampala, Uganda, E-mail: cddmoh@yahoo.com. Mugagga Malimbo, Epidemiological Surveillance Division, Ministry of Health Uganda, Kampala, Uganda, E-mail: malimbom@yahoo.co.uk. Atek Kagirita, Central Public Health Laboratories, Ministry of Health Uganda, Kampala, Uganda, E-mail: akagirita@gmail.com. Issa Makumbi, Epidemiological Surveillance Division, Ministry of Health Uganda, Kampala, Uganda, E-mail: issamakumbi@gmail.com. Eric Mintz, Global WASH Epidemiology, Centers for Disease Control and Prevention, Atlanta, GA, E-mail: emintz@cdc.gov. Martin A. Mengel, Agence de Médecine Préventive, Paris, France, E-mail: mmengel@aamp.org. Christopher Garimoi Orach, Community Health and Behavioral Sciences, School of Public Health, Makerere University, Kampala, Uganda, E-mail: cgorach@musph.ac.ug.

REFERENCES

- Bhattacharya S, Black R, Bourgeois L, Clemens J, Cravioto A, Deen JL, Dougan G, Glass R, Grais RF, Greco M, Gust I, Holmgren J, Kariuki S, Lambert PH, Liu MA, Longini I, Nair GB, Norrby R, Nossal GJ, Ogra P, Sansonetti P, von Seidlein L, Songane F, Svennerholm AM, Steele D, Walker R, 2009. Public health. The cholera crisis in Africa. *Science* 324: 885.
- Gaffga NH, Tauxe RV, Mintz ED, 2007. Cholera: a new homeland in Africa? *Am J Trop Med Hyg* 77: 705–713.
- Glass RI, Claeson M, Blake PA, Waldman RJ, Pierce NF, 1991. Cholera in Africa: lessons on transmission and control for Latin America. *Lancet* 338: 791–795.
- Naidoo A, Patric K, 2002. Cholera: a continuous epidemic in Africa. *J R Soc Promot Health* 122: 89–94.
- Nkoko D, Giraudoux P, Plisnier P-D, Tinda A, Piarroux M, Sudre B, Horion S, Tamfum JJ, Ilunga BK, Piarroux R, 2011. Dynamics of cholera outbreaks in Great Lakes region of Africa, 1978–2008. *Emerg Infect Dis* 17: 2026–2034.
- Mintz ED, Tauxe RV, 2013. Cholera in Africa: a closer look and a time for action. *J Infect Dis* 208 (Suppl 1): S4–S7. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24101644>. Accessed August 25, 2014.
- World Health Organization, 2014. Cholera, 2013. *Wkly Epidemiol Rec* 89: 345–356. Available at: <http://www.who.int/wer/en/>. Accessed August 25, 2014.
- Alajo SO, Nakavuma J, Erume J, 2006. Cholera in endemic districts in Uganda during El Niño rains: 2002–2003. *Afr Health Sci* 6: 93–97.
- Andrawa M, Anguzu P, Anguaku A, Nalwadda C, Namusisi O, Tweheyo R, 2010. Risk factors for repeated cholera outbreak in Arua municipal council, north-western Uganda. *Int J Infect Dis* 14: e65.
- Bwire G, Malimbo M, Maskery B, Kim YE, Mogasale V, Levin A, 2013. The burden of cholera in Uganda. *PLoS Negl Trop Dis* 7: e2545.
- Bwire G, Malimbo M, Makumbi I, Kagirita A, Wamala JF, Kalyebi P, Bingi A, Gitta S, Mukanga D, Mengel M, Dahlke M, 2013. Cholera surveillance in Uganda: an analysis of notifications for the years 2007–2011. *J Infect Dis* 208 (Suppl 1): S78–S85. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/24101649>.
- Cummings MJ, Wamala JF, Eyura M, Malimbo M, Omeke ME, Mayer D, Lukwago L, 2012. A cholera outbreak among semi-nomadic pastoralists in northeastern Uganda: epidemiology and interventions. *Epidemiol Infect* 140: 1376–1385.
- Health Service Commission (Uganda), 2009. *Health Service Commission Annual Report F/Y 2008/2009*. Available at: <http://www.hsc.go.ug/content/hsc-annual-report-20082009>.
- Ball L, 2009. Cholera and the pump on Broad Street: the life and legacy of John Snow. *History Teacher* 43: 105–119.
- UNICEF, 2013. *UNICEF Cholera Toolkit 2013*, 251–255. Available at: <http://www.unicef.org/cholera/Cholera-Toolkit-2013.pdf>.
- World Health Organization, 2015. *Prevention and Control of Cholera Outbreaks: WHO Policy and Recommendations*, 5–6. Available at: http://www.who.int/cholera/prevention_control/recommendations/en/#.
- World Health Organization, 2002. *Prevention of Hospital-Acquired Infections: A Practical Guide*, 2nd edition. Available at: http://www.who.int/csr/resources/publications/WHO_CDS_CSR_EPH_2002_12/en/.
- Cliff JL, Zinkin P, Martelli A, 1986. A hospital outbreak of cholera in Maputo, Mozambique. *Trans R Soc Trop Med Hyg* 80: 473–476.
- Goh KT, Teo SH, Lam SLM, 1990. Person-to-person transmission of cholera in a psychiatric hospital. *J Infect* 20: 193–200. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/2341728>.
- Mhalu FD, Mtango FSEMA, 1984. Hospital outbreak of cholera transmitted through close person-to-person contact. *Lancet* 2: 82–83.
- Guévart E, Solle J, Noeske J, Amougou G, Mouangue A, Fouda AB, 2005. Mass antibiotic prophylaxis against cholera in the New Bell central prison in Douala during the 2004 epidemic. *Sante* 15: 225–227.
- Vo TH, Le NH, Nuorti JP, Phan LT, Nhu N, Minh T, 2010. A cluster of cholera among patients in a Vietnamese district hospital in 2010. *J Infect Dev Ctries* 7: 910–913.
- Daniels NA, Simons SL, Rodrigues A, Gunnlaugsson G, Forster TS, Wells JG, Wells JG, Hutwagner L, Tauxe RV, Mintz ED, 1999. First do no harm: making oral rehydration solution safer in a cholera epidemic. *Am J Trop Med Hyg* 60: 1051–1055.
- Routh JA, Loharikar A, Fouché M-DB, Cartwright EJ, Roy SL, Ailes E, Archer WR, Tappero JW, Roels TH, Dahourou G, Quick RE, 2011. Rapid assessment of cholera-related deaths, Artibonite Department, Haiti, 2010. *Emerg Infect Dis* 17: 2139–2142.
- Ivers LC, Walton DA, 2012. The “first” case of cholera in Haiti: lessons for global health. *Am J Trop Med Hyg* 86: 36–38. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3247106&tool=pmcentrez&rendertype=abstract>. Accessed July 3, 2014.
- UNICEF, 2012. *Guidance Note on the Use of Oral Cholera Vaccines for UNICEF Guidance*, 209–218. Available at: http://www.unicef.org/immunization/files/UNICEF_OCV_Guidance_20_July2012_final.pdf.