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Global Societies



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Title:

Control and Intervention of Cholera Outbreaks in Refugee Camps

Journal Issue:

[Global Societies Journal, 1](#)

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Publication Date:

2013

Permalink:

<http://escholarship.org/uc/item/2rw706q3>

Keywords:

Cholera, Disease preventiom, refugees, displaced people, public health, sanitation

Local Identifier:

gis_globalsocieties_19747

Abstract:

Cholera, a disease with a long history, continues to devastate populations around the world. Due to the route of transmission of *Vibrio cholerae*, the bacterial pathogen that causes the disease, cholera only seems to affect developing countries, giving rise to a health disparity. For developed countries with adequate water and sewage treatment systems, the threat of cholera is irrelevant. Meanwhile, developing countries which have underlying vulnerabilities of poverty and lack basic access to clean water and proper sanitation are disproportionately affected. There are many factors that put different populations at risk for cholera outbreaks. Epidemiological studies of cholera outbreaks show that the combination of poverty with the effects of conflict or natural disaster produces the most vulnerable population of refugees or internally displaced persons (IDP). Not only are these populations more susceptible to the risk of cholera outbreak, but they are more vulnerable to its devastating effects. Refugee and IDP camps experience higher attack rates and case fatality rates (CFR) due to the scarcity of resources (Brown, Jacquier, Bachy, Bitar, & Legros, 2002). Cholera outbreaks in displaced populations present a public health hazard in an emergency context. If these outbreaks are not properly managed, they can develop into epidemics and pandemics. Thus, it is important to implement a swift and effective strategy to manage cholera outbreaks in refugee and IDP camps. To do this there are two main objectives: control transmission of the disease and emergency medical relief. Control of transmission must be accomplished through short- and long-term solutions: a supply of adequate water and sanitation combined with a public health campaign to promote knowledge and proper practices. Emergency medical relief would consist of establishment of cholera treatment centers (CTC) that would provide urgent intervention to efficiently diagnose and treat cases of cholera to reduce fatality rates.



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Control and Intervention of Cholera Outbreaks in Refugee Camps

By: Christianna Sim

ABSTRACT

Cholera, a disease with a long history, continues to devastate populations around the world. Due to the route of transmission of *Vibrio cholerae*, the bacterial pathogen that causes the disease, cholera only seems to affect developing countries, giving rise to a health disparity. For developed countries with adequate water and sewage treatment systems, the threat of cholera is irrelevant. Meanwhile, developing countries which have underlying vulnerabilities of poverty and lack basic access to clean water and proper sanitation are disproportionately affected. There are many factors that put different populations at risk for cholera outbreaks. Epidemiological studies of cholera outbreaks show that the combination of poverty with the effects of conflict or natural disaster produces the most vulnerable population of refugees or internally displaced persons (IDP). Not only are these populations more susceptible to the risk of cholera outbreak, but they are more vulnerable to its devastating effects. Refugee and IDP camps experience higher attack rates and case fatality rates (CFR) due to the scarcity of resources (Brown, Jacquier, Bachy, Bitar, & Legros, 2002). Cholera outbreaks in displaced populations present a public health hazard in an emergency context. If these outbreaks are not properly managed, they can develop into epidemics and pandemics. Thus, it is important to implement a swift and effective strategy to manage cholera outbreaks in refugee and IDP camps. To do this there are two main objectives: control transmission of the disease and emergency medical relief. Control of transmission must be accomplished through short- and long-term solutions: a supply of adequate water and sanitation combined with a public health campaign to promote knowledge and proper practices. Emergency medical relief would consist of establishment of cholera treatment centers (CTC) that would provide urgent intervention to efficiently diagnose and treat cases of cholera to reduce fatality rates.

Keywords: Cholera; Disease prevention; refugees; displaced people; public health; sanitation

INTRODUCTION

Cholera remains a global threat and is one of the key indicators of social development. While the disease no longer poses a threat to countries with minimum standards of hygiene, it remains a challenge to countries where access to safe drinking water and adequate sanitation cannot be guaranteed. Almost every developing country faces cholera outbreaks or the threat of a cholera epidemic. (WHO, 2012)

Cholera is a disease usually associated with times of antiquity. However, the World Health Organization reports an estimated 3-5 million cases and 100,000-120,000 deaths due to cholera per year (WHO, 2012). The disease is caused by the microbial pathogen *Vibrio cholerae*, a bacterium which colonizes the small intestines where it secretes a toxin that causes excessive diarrhea, which can lead to severe dehydration and, ultimately, death (Finkelstein, 1996). It is excreted through the feces and enters a new host orally (Morris, 2008). This fecal-oral route of transmission and its ability to survive as free-living bacteria in water is the reason why contaminated water is the most prevalent cause of outbreaks and epidemics.

However, cholera disproportionately affects developing countries due to underlying vulnerabilities—their lack of resources and barriers to access. Cholera outbreaks in populations displaced by man-made or natural disasters present a global health emergency due to their high risk, elevated rates of fatality, and their ability to carry cholera abroad (Brown, Jacquier, Bachy, Bitar, & Legros, 2002). Refugee and internally displaced person (IDP) camps present a number of challenges: their inadequate water supply, poor sanitation, dense population, and lack of resources.

Cholera is easily treatable and prevention is simple (Morris, 2008). An appropriate strategy of control of transmission and emergency medical intervention can help alleviate the devastating effects an outbreak can have. This report recommends proper management of cholera outbreaks in refugee and IDP camps through the control of transmission and urgent intervention. The management of cholera transmission would entail a strategy to supply sufficient water sources, adequate sanitation, and a public health campaign to maximize the effects of these measures. Urgent medical intervention is necessary to ease the burden of disease on refugee and IDP camps, especially during a cholera outbreak.

PATHOLOGY

Cholera has long been a cause of fear and has had devastating effects across the globe. Though it is thought to have originated from the Ganges River in India, the extent of its reach has passed beyond India to Asia, the Middle East, Africa, and the Americas (Morris, 2008). The modern history of cholera began in 1817 with the advent of the first of seven cholera pandemics (Morris, 2008). It was in 1854, during the third pandemic, that John Snow traced the pattern of outbreak to the sewage-contaminated Broad Street water pump in London (Morris, 2008). Snow's discovery established the role of epidemiology in public health and demonstrated the efficacy of simple interventions in the spread of cholera.

Due to its history, this pathogenic agent has been extensively studied. *Vibrio cholerae*, the bacterial pathogen responsible for cholera, is a highly-motile, gram-negative, rod-shaped bacterium. There are over 150 currently recognized strains of *V. cholerae*, but very few are recognized as being pathogenic (Morris, 2008). There are two prominent strains known to be pathogenic, the classical biotype and the newly emerging El Tor biotype that has been shown to be more virulent than the previous (Mutreja et al., 2011). *V. cholerae* once ingested, colonizes

the small intestine where it produces and secretes Cholera Toxin (CT), the toxin accountable for the symptoms of cholera (Finkelstein, 1996). CT enters intestinal cells and causes increased excretion of electrolytes and water into the intestinal lumen (Finkelstein, 1996).

CLINICAL PRESENTATION

The primary symptom of cholera is the abrupt onset of water diarrhea which appears pale gray, often referred to as “rice-water stool,” and is usually accompanied by vomiting (Finkelstein, 1996). Patients may lose up to 20 L of fluid a day which can lead to severe dehydration (Morris, 2008). As the disease progresses, the patient may become severely dehydrated. As fluid is lost, this may lead to muscle cramps, poor skin turgor, low blood pressure, and weak pulse (Morris, 2008). If the dehydration goes untreated, this may lead to hypovolemic shock, metabolic acidosis, circulatory collapse, and ultimately, death (Morris, 2008).

However, there is another danger that *V. cholera* presents: the majority of people infected with epidemic strains may not show any symptoms of the disease or these symptoms may be very mild (Morris, 2008). While this may seem like a benefit, it is already shown that cholera outbreaks still have very high attack rates in areas where it is endemic. Furthermore, this only adds to the ability of *V. cholera* to be carried by asymptomatic persons, contributing to the spread of outbreaks and leading to possible epidemics or worse, pandemics.

TREATMENT

Treatment of cholera is rather simple: replenishing lost fluids and electrolytes (Morris, 2008). For moderate cases, oral rehydration salts (ORS), which come in sachets that are dissolved in water, may be used, but for more severe cases of dehydrations, intravenous fluids must be used (Morris, 2008). The amount of watery stool excreted is carefully monitored, and after initial stabilization, oral intake of fluids is matched to its loss (Morris, 2008). Antibiotics can reduce the period of excretion of the pathogen, shortening the duration of disease, but are used only as a supplementary treatment to rehydration (Morris, 2008).

TRANSMISSION

V. cholerae can exist as free-living bacteria in aquatic environments and prefer warmer waters, which is why it is more prevalent in places like Africa and Southeast Asia (Morris, 2008). Due to this environmental vector, cholera can lay dormant in water, attaching to plankton and the chitin in the shells of mollusks and other crustaceans, thus making it prone to seasonal outbreaks (Morris, 2008). *V. cholerae* enters a human host through the mouth, colonizes the gut, and exits through excretion of rice-water stool characteristic of cholera. Due to this mechanism, cholera is transmitted from host-to-host through the fecal-oral route (See Appendix, Figure 1). The cholera pathogens excreted in the feces can be carried on hands and flies and can contaminate soil, water, and food, which can directly enter its new host (Morris, 2008). Though there are many routes through which cholera is transmitted, due to its ability to survive as free-living microbes in water, outbreaks most often originate from and are perpetuated by contaminated water (Morris 2008).

EPIDEMIOLOGY

For developed countries, cholera is a thing of the past. For example, in the US, there has not been an outbreak of cholera in over 100 years (Poirier, Izurieta, Malavade & McDonald, 2012). Yet cholera is far from eradicated from the world. There are an estimated 3-5 million cases and 100,000-120,000 deaths due to cholera each year (WHO, 2012).

THE SEVENTH PANDEMIC (1961-PRESENT)

There are considered to be seven major cholera pandemics, or global epidemics, that have claimed millions of lives since the 19th century (WHO, 2012). Whereas the first six pandemics are believed to have originated out of India, the seventh and current pandemic, which began in 1961, has been traced back to Southeast Asia (Mutreja et al., 2011). Also, in the current pandemic, the El Tor biotype has been recognized as the pathogenic agent, replacing the classical biotype which has been to blame for the previous six pandemics (Mutreja et al., 2011).

A NEW PATTERN OF OUTBREAK

Sewage and water treatment systems have mostly eliminated cholera from developed countries, but for developing countries that lack basic access to clean water, cholera is still a major threat. In the past, cholera pandemics swept across the world, affecting countries indiscriminately. However, with John Snow's historical discovery connecting cholera outbreaks in London to the sewage-contaminated Broad Street pump and the industrialization of developed countries, cholera outbreaks began to emerge in a new pattern. This new pattern of outbreak and disparity is strikingly obvious in its link to poverty.

These countries with underlying vulnerabilities—their lack of resources and barriers to access—are at the most risk for cholera outbreaks. For countries like the US and the UK, there may be rare instances of imported cholera cases, but because of the level of development, access to healthcare, and proper sanitation, they do not become epidemic. When comparing a map of regions where cholera outbreaks have occurred in 2010-11 (See Appendix, Figure 2) to a map that shows the level of poverty (See Appendix, Figure 3), it is apparent that there is a strong correlation between poverty and outbreaks of cholera. According to the World Bank map, the poorest countries consist of much of Sub-Saharan Africa, Southeast Asia, and Haiti (See Appendix, Figure 3). The areas of outbreak match up nearly perfectly with the poorest countries (See Appendix, Figure 2). These areas of overlap include Haiti, the Democratic Republic of Congo, Nigeria, Chad, Bangladesh, etc.

There is a pattern of disparity and correlation between the effect cholera has on a country and its level of poverty. For example, following the devastating cholera outbreaks in Hispaniola (Haiti and the Dominican Republic) that claimed thousands of lives, there were only 23 confirmed cases of cholera within the US (Newton et al., 2011). Of these cases, 13 reported recent travel to Haiti, 9 to the Dominican Republic, and one reported no travel, but had consumed seafood brought from Haiti by a relative (Newton et al., 2011). All 23 patients were treated, none died, and there were no instances of human-mediated transmission (Newton et al., 2011). As can be seen in this singular cholera epidemic, Haiti, one of the poorest countries in the

world, was devastated by cholera, reporting approximately 779,000 cases and 11,000 deaths between March and November 2011 alone (Poirier et al., 2012). Meanwhile, in the US, there were only 23 imported cases with none resulting in death and no cases of secondary transmission (Newton et al., 2011).

The unfortunate truth is that the prevention and treatment of cholera is fairly simple. The problem, then, becomes the barriers to access that these developing countries face. In the case of cholera, it is the lack of access to healthcare, but most importantly, the lack of access to adequate amounts of potable water.

DISPLACED POPULATIONS

Poverty may be a prerequisite of susceptibility to cholera outbreaks, but the biggest risk factor is poverty combined with conflict or natural disaster. Due to their living conditions, refugees and internally displaced persons (IDPs) are the most vulnerable to outbreaks. Not only do these displaced populations have a higher risk of cholera outbreaks, especially in areas in which cholera is endemic, but they also experience higher rates of attack and higher case fatality rates (CFR) (Brown et al., 2002).

UNDERLYING VULNERABILITY

The ability of cholera to permeate a population is dependent on many risk factors, especially water quality and level of sanitation. For many refugee and IDP camps, there is very limited access to goods, and many of these camps rely on non-governmental organizations (NGOs) and other supportive agencies for very limited implementation of infrastructure and services (Mahamud et al., 2012).

Cholera outbreaks in refugee and IDP camps have a propensity to spread explosively due to their population density—refugee camps are often referred to as “warehousing.” It is this combination of inadequate water supplies, poor sanitation, lack of hygiene, overcrowded camps, and scarce resources that makes patterns of outbreaks so potent.

In the aftermath of the earthquakes that devastated Haiti in January 2010, the country had literally crumbled to the ground. Due to lack of existing infrastructure and resources, 1.5 million Haitians were displaced, seeking refuge in the remnants of cities like Port-au-Prince (Gaestel, 2012). Cholera was introduced to Haiti in October 2010 and in the course of a week, the progression of transmission was truly staggering (See Appendix, Figure 4) (Burgess & Waananen, 2012).

MAJOR GLOBAL HEALTH EMERGENCY

Within the past decade, there has been an observable relationship between cholera outbreaks and conflict or natural disaster. WHO’s Global Alert and Response (GAR), a system that documents cholera outbreaks and cases reported, clearly shows this pattern. Many recent cholera outbreaks have been occurring in places where conflict or natural disaster meet poverty—

Iraq, Afghanistan, Democratic Republic of the Congo, Sudan, Central African Republic, and Haiti among others (WHO, 2012).

This correlation between cholera and conflict or natural disaster presents a major global health emergency. In the past, cholera was often carried along trade routes by merchants and travelers. These displaced populations have the same hazardous potential. Oftentimes, outbreaks within displaced populations do not stay contained and spread outwards, becoming epidemic. In the case of the 2010 cholera outbreak in Haiti, the epidemic swiftly spread to the Dominican Republic (Poirier et al., 2012).

Globalization is partially to blame for the spread of cholera now that distant continents are but a plane ride away. However, it is displaced populations that are at most risk of contracting cholera due to their lack of availability of clean water and sanitation. Because of their lack of resources and barriers to access, they are most vulnerable to the devastating effects of cholera that are no longer relevant in the first world. Also, due to the situation they face—fleeing conflict, oppression, discrimination, or disaster—displaced populations may carry cholera throughout their country, and in the case of refugees, beyond their borders. For this reason, it is important to carefully monitor any displaced populations for symptoms of cholera. Currently, there are two major threats of cholera that must be carefully watched: the re-entry of cholera into the Americas and the possibility of an eighth cholera pandemic.

RE-ENTRY OF CHOLERA INTO THE AMERICAS

The cholera epidemic in the island of Hispaniola—Haiti and the Dominican Republic—poses a new threat, the re-entry of cholera into the Americas. To understand the danger this presents, it is important to analyze how the 1991 cholera epidemic that began in Peru spread throughout the continent (Poirier et al., 2012). When early outbreaks of cholera in Peru became a full-blown epidemic, the disease was transmitted to Ecuador within two months and to Colombia, Brazil, and Chile within five (Poirier et al., 2012). Throughout the decade, it spread to Mexico and through Central America affecting a total of 21 countries with over 775,000 cases by the end of 1992 (Poirier et al., 2012).

Through phylogenetic analysis of the genomic (DNA) sequences of isolated *V. cholerae* strains, Mutreja et al. were able to trace epidemics of the current and seventh pandemic, classifying them into three separate, but overlapping waves originating from the Bay of Bengal (2011). The 2010 introduction of cholera into Haiti is part of the third wave and is the first introduction of this newer strain into the Western Hemisphere (Mutreja et al., 2011). Reports have uncovered the source to be Nepalese soldiers serving in the United Nations Stabilization Mission in Haiti (MINUSTAH) who dumped their sewage near a stream that led to the contamination of the Artibonite River, a major water source in Haiti (Sontag, 2012).

The strain responsible for the outbreak in Haiti, *V. cholerae* O1 biotype El Tor serotype Ogawa, “has established a new reservoir for the seventh cholera pandemic which threatens to spread to other countries in the Americas” (Poirier et al., 2012, p. 162). Although most of North America—the United States and Canada—has very little risk of cholera outbreak, many countries throughout Central America, South America, and the Caribbean may be susceptible due to lack

of infrastructure. Though most refugees are coming out of Sub-Saharan Africa, the Middle East, and Asia, there are still sources of conflict throughout Latin America that have been or are beginning to produce displaced populations (See Appendix, Figure 5). Not all refugees are fleeing only to the US and Canada where the threat of cholera is not pertinent; many are settling around South and Central America.

AN EIGHTH PANDEMIC

Due to high rate of conflict, oppression, and famine across Africa and Asia, there is a great amount of movement of people throughout these regions, contributing to the high risk of cholera transmission (See Appendix, Figure 5). With the discovery of the new pathogenic strain *V. cholerae* O139 serogroup out of Bangladesh, many fear the rise of an eighth cholera pandemic (Morris, 2008). Bangladesh borders India, a country known to be susceptible to cholera outbreaks (See Appendix, Figure 2). Furthermore, there is also the possibility of the passage of the O139 serogroup into the Middle East, a region ravaged by conflict, with many recent outbreaks of cholera being reported in Iraq, Pakistan, and Afghanistan (WHO 2012). The passage of the O139 serogroup to the Middle East could easily lead to its passage into Africa, a poverty- and conflict-stricken continent where cholera is already endemic and has shown to have devastating effects.

PROPER MANAGEMENT OF CHOLERA OUTBREAKS IN REFUGEE CAMPS

Displaced populations present such a threat because of the role they play in the global transmission of cholera. The cure to end all cholera epidemics would be to ensure the supply of water and sanitation. Unfortunately, the majority of the global population does not have access to this basic right. Because this is a deeper, infrastructural problem that cannot be solved overnight, there needs to be a more attainable solution that can help prevent the spread of cholera. Though there are many factors that place regions at risk for cholera outbreaks, including poverty and environmental factors, addressing cholera outbreaks specifically in refugee camps would be an effective strategy in preventing further development of epidemics or pandemics.

Studies of cholera outbreaks show that there are characteristic higher attack rates and elevated case fatality rates (CFR) which can surpass 5% in refugee camps (Brown et al., 2002). Accordingly, there are two measures that need to be taken to address these two issues. First, there must be a strategy for the proper control of the transmission of cholera within the camp to lower the number of cases, diminishing its ability to spread beyond the borders of the camp. Then, there is also a need for an urgent measure of intervention for any present cases of cholera to reduce mortality.

CONTROL OF TRANSMISSION

In the context of an emergency outbreak in densely populated refugee camps, there are rather simple methods of intervention that can help lower the attack rates of cholera. The biggest obstacle is access, the ability to bring the supplies needed. Funding and provisions necessary for these strategies to control cholera transmission is not great, as there are no wildly expensive medicines to purchase or high-tech instruments needed. The most effective strategies of the management of cholera outbreaks are sufficient potable water, adequate sanitation, and public health education.

WATER

Water, so essential for survival, is the major vector for the transmission of cholera. In refugee camps, water supplies are often scarce and unprotected. Water sources in refugee camps are vulnerable to contamination which could lead to disastrous effects because they are so limited. Thus, it is vital to carefully monitor the water supply and its distribution in order to prevent contamination as well as eliminating the source in the case of a cholera outbreak. Obviously, in the chaos of a refugee camp, careful supervision is not always possible. However, during an outbreak a general scheme of the camp should be sufficient in determining the specific site where the cholera may have originated from by mapping the patients' reported source of water.

The most comprehensive approach to transmission management would be to assure both quality and quantity of water. Assuring the quality of water is more easily manageable and, most importantly, cheap. For individual household use, there are two simple and effective ways of maintaining water quality: proper water storage and point-of-use water treatment. A study found that there is limited availability of water storage containers among refugee and IDP camp residents and that widespread use of proper water storage can help improve water quality at the household level (Doocy & Burnham, 2006). The second tactic is the distribution of point-of-use water treatment such as chlorine tablets or flocculant-disinfectant power (PUR™) which are not only cheap, but also highly effective, “the World Health Organization found that point-of-use water disinfection was the most cost-effective method to reduce disease burden associated with risks of unsafe water supply and sanitation” (Doocy & Burnham, 2006). PUR™ is not only cheap, sold to NGOs at 3.5 US cents per sachet, but it is also effective, reducing incidence of diarrhea by 90% (CDC, 2012).

Supplying an adequate amount of potable water is a bit more complicated, especially in regions where water is scarce. Shipping large amounts of water could be expensive and many refugee camps may be inaccessible as many of these areas may not even have paved roads. The most sustainable, cost-effective solution would be to build carefully constructed wells or boreholes to provide water for the camp.

SANITATION

Another measure to control the spread of cholera in refugee or IDP camps is the availability of proper sanitation. Systematic distribution of soap is a major part of improving the general sanitation and hygiene in these camps, but there is also the necessity of the appropriate

elimination of excreta. In these camps there is usually an insufficient number of latrines and the few latrines that exist, are shared between a large number of people in the collective area, which favors contamination (Brown et al., 2002). In an ideal situation, there would be a single latrine shared amongst one family, which is hardly a realistic goal in this type of situation. However, building more latrines, thereby lowering the amount of people sharing each, can reduce the risk of transmission of cholera.

PUBLIC HEALTH EDUCATION

However, all these measures—the distribution of point-of-use water treatment and soap—are only as powerful as the rate at which they are employed to their full potential. A general education of the displaced population in hygiene and sanitation must accompany these measures. Fortunately, public health campaigns are perhaps one of the simplest and cheapest forms of intervention. This would consist of the distribution of flyers, pamphlets, and posters with simple descriptive and informative images and diagrams, taking into account the high rate of illiteracy in these camps (See Appendix, Figure 5).

In the event of a cholera outbreak, the most important public health message would be: (1) hand washing especially before eating, cooking, and after defecating, (2) cooking food thoroughly and serving it hot, and (3) proper treatment of drinking water. Distributing soap throughout the camp will only be effective if members are using it. Promoting hand washing is especially imperative amongst populations where it may not be a common practice. A case-control study in the Kakuma Refugee Camp in Kenya during the cholera outbreak in 2009 showed that those who ate cooked food had much lower odds of contracting cholera (Mahamud et al., 2012).

Education on the proper treatment of drinking water should be stressed. There are different ways in which to treat drinking water: boiling, chlorination, solar disinfection, use of PUR™ sachets, etc. It is important to ensure that people understand the correct instructions for these methods to be most effective. In a study done on the knowledge and attitudes on prevention practices in Haiti during the 2010 outbreak, self-reported household water treatment practices increased from 30.3% to 73.9% (Beau De Rochars et al., 2011). Between the two time points at which questionnaires were distributed and collected, there was not a sudden increase in the distribution of point-of-use water treatments. In fact, the study was focused around a public-health campaign in the capitol Port-au-Prince (Beau De Rochars et al., 2011). This study shows the monumental importance of public health education as a supplement to the distribution of preventative measures in efficient prevention of cholera transmission.

URGENT INTERVENTION

Refugee and IDP camps also experience abnormally high case fatality rates (CFR). There is an urgent need to alleviate this issue not only for the social disparity it poses, but also because by quickly and efficiently addressing cholera cases that have occurred, the rate of transmission is also reduced. Another advantage with the treatment of cholera is that it is very inexpensive. The cure for cholera is simply rehydration, though antibiotics may be used as an ancillary treatment.

The problem is access. The availability of treatment, oral rehydration salts (ORS), intravenous fluids, potable drinking water, and antibiotics must quickly be dispatched to refugee camps.

There also needs to be a quick response of urgent medical intervention. NGOs like the Red Cross and Médecins Sans Frontières are adept at handling medical emergencies and would be well-suited for exactly this type of crisis. Medical humanitarians working in a cholera outbreak in refugee camps must establish guidelines for swift and proficient treatment for patients, as conditions allow, as well as proper management of the disposal of waste to prevent further contamination. It is also important for any medical presence to foster collaboration between medics, logisticians, and community members to ensure rapid intervention.

While in these camps, these medical NGOs must also establish a sustainable solution for ongoing treatment of cholera. This can be done through the foundation of cholera treatment centers (CTC) (Brown et al., 2002). The CTC would specialize in lowering fatality rates as well as reducing risk of resurgence. While NGOs would still be responsible in continuing a supply of treatment and clinicians, they could also train local community members. These community health workers would be essential in maintaining a relationship with the refugee camp as well as perpetuating ongoing preventative measures.

Appendix

Figure 1: The fecal-oral route of transmission (Finkelstein, R. A. (1996). Chapter 24: Cholera, *Vibrio cholerae* O1 and O139, and Other Pathogenic Vibrios. In: Baron, S. (Ed.), *Medical Microbiology*, 4th Edition [National Center for Biotechnology Information online bookshelf]. Galveston, TX: University of Texas Medical Branch at Galveston. Retrieved from <http://www.ncbi.nlm.nih.gov/books>)

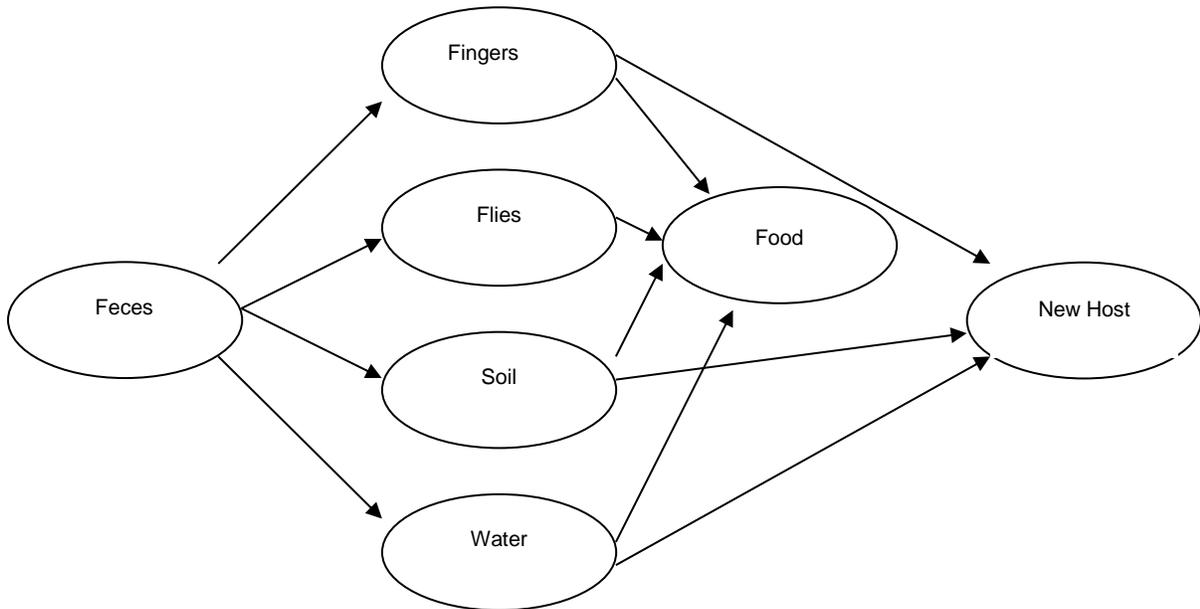
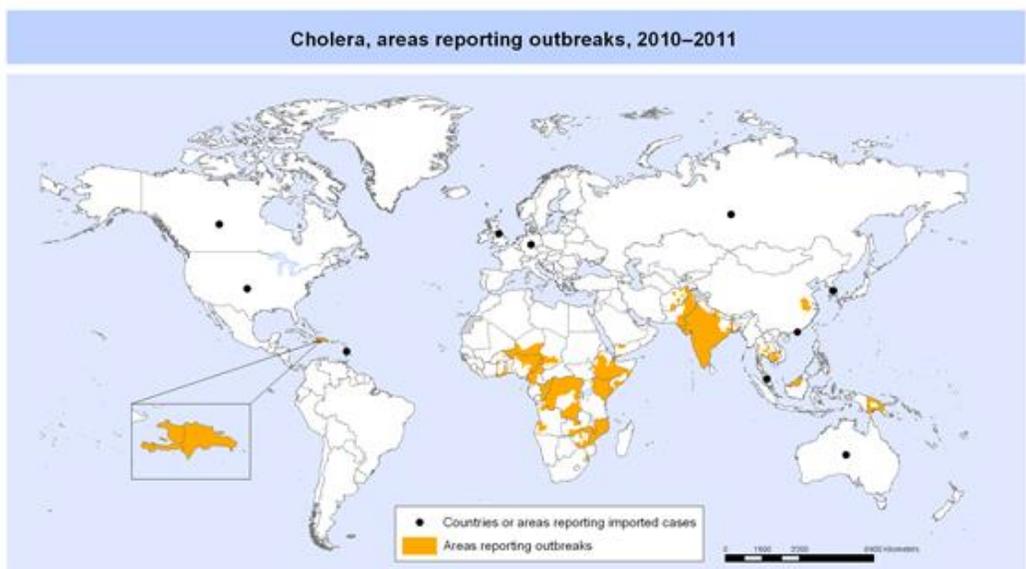


Figure 2: World Health Organization. (2012). Global Health Observatory Map Gallery. Retrieved from <http://gamapservr.who.int/mapLibrary/>



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

 World Health Organization
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Figure 3: World Bank. (2012). Poverty & Equity Data. Retrieved from <http://www.worldbank.org>

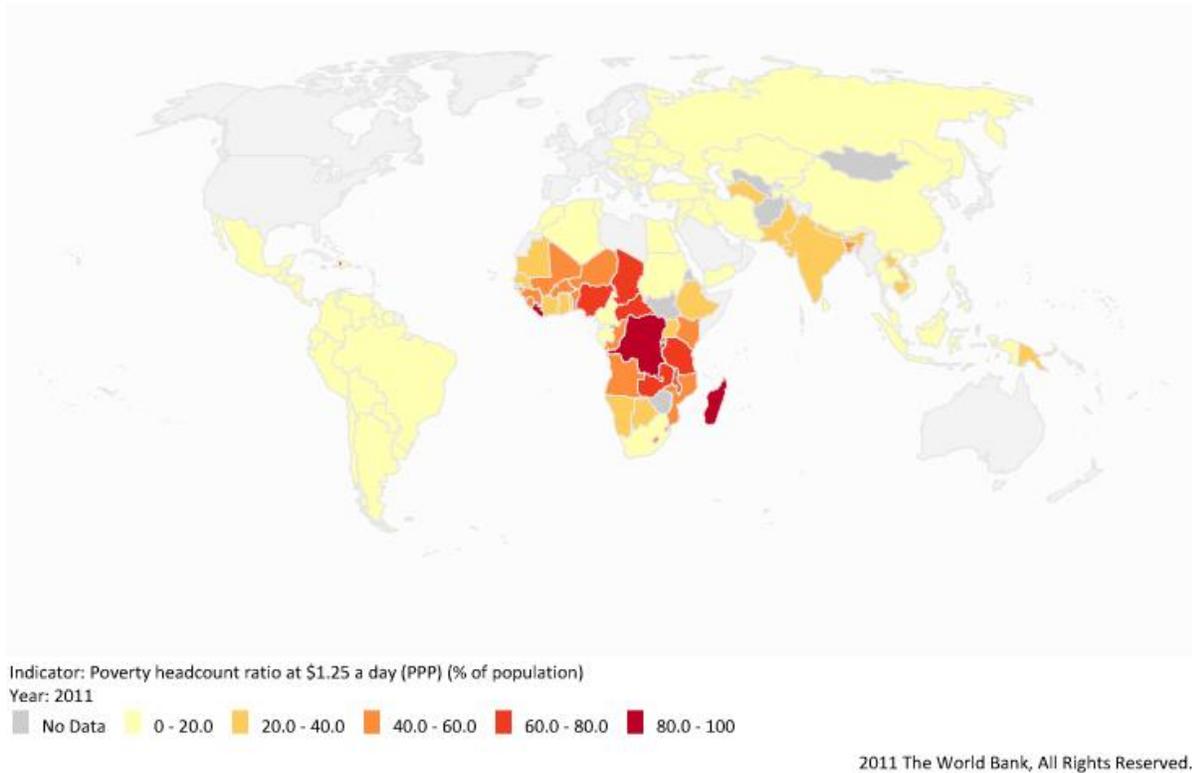


Figure 4: Progression of cholera in Haiti in the first week of the October 2010 outbreak. Burgess, J. & Waanen, L. (2012, March 31). How the cholera epidemic spread. *The New York Times*. Retrieved from <http://www.nytimes.com>.

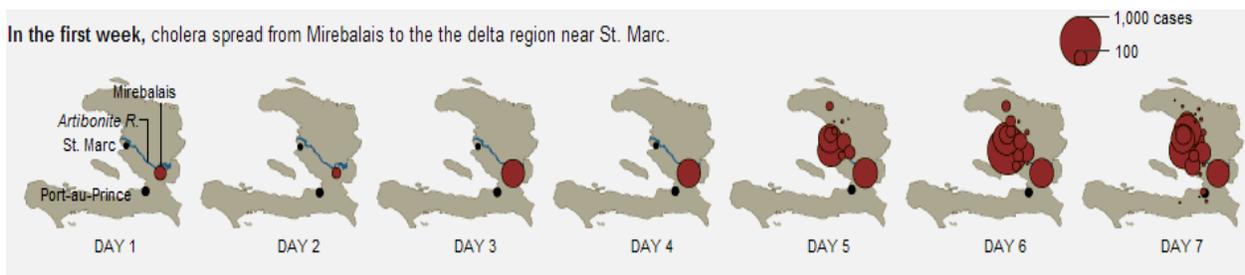


Figure 5: Maps of countries producing refugees (left) & where they are going (right) (Rogers, S. (2011, June 20). Refugee statistics mapped. The Guardian. Retrieved from <http://www.guardian.co.uk>

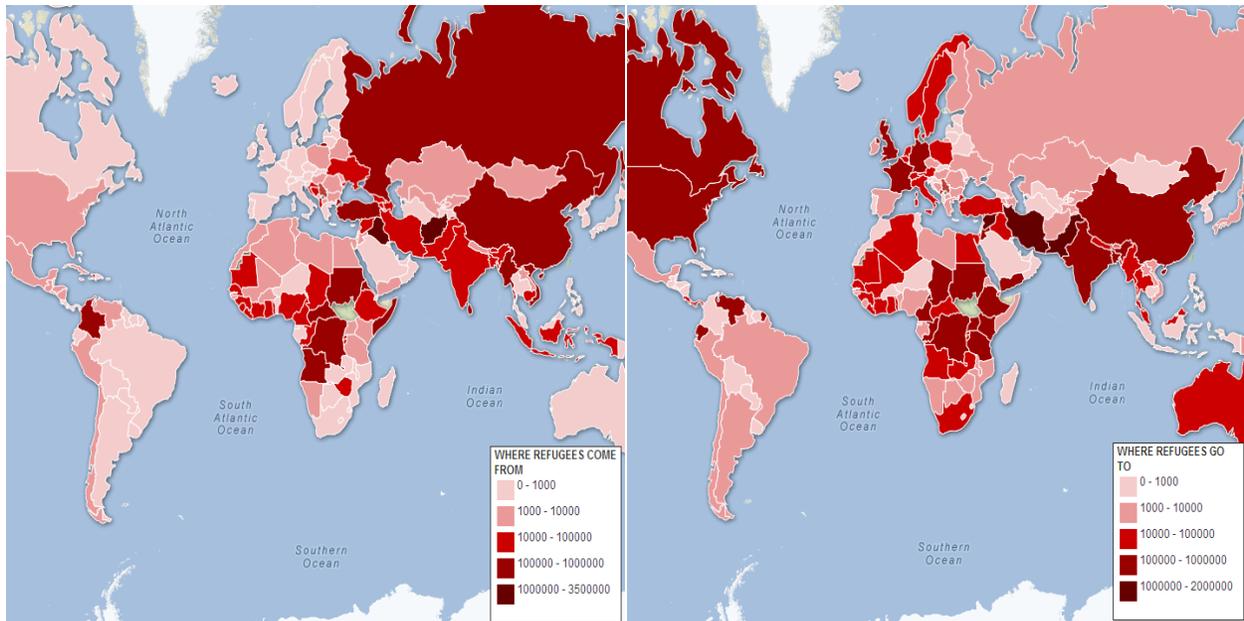


Figure 6: A public health campaign poster from Haiti during the cholera outbreak of 2010. (Steinlechner, B. (2010, November 23). UNICEF-supported campaign raises awareness about cholera prevention in Haiti. UNICEF. Retrieved from <http://www.unicef.org>)



Men sa pou nou fè lè yon moun gen dyare ak vomisman

Ba li sewòm oral pou ka ranplase dlo lap pèdi

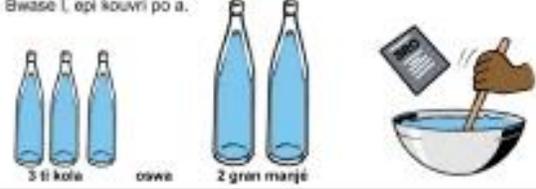


Si yon tibebe trape dyare kontinye ba li tete epi ale nan yon sant sante. Toujou bay tibebe yo tete menm si yo gen dyare pandan nap swiv règ ijyèn yo.

Mennen l nan sant sante san pèditan



Kijan pou prepare sewòm oral
Lave man, po, kiyè, boutèy. Masine yon lit dlo (valè 3 li boutèy kola oswa 2 boutèy gran manjè). Vide dlo nan po a. Vide li sachè sewòm oral la nan dlo a. Bwase l, epi kouvi po a.



3 li kola oswa 2 gran manjè

Pa manyen vomisman, mete yo nan latrin oswa nan yon trou byen fon.



Dyen lave latrin yo ak dlo ak klorwèn epi kenbe yo pwòp.

Kijan pou nou fè sewòm lakay si pa gen sachè sewòm
Mete nan yon galon dlo tretè 6 kiyè sik ak demi kiyè sel. Sèvi ak kiyè nou abityè manje.



demi sel + 6 sik

Lave men nou ak dlo ak savon lè nou sot manyen moun ki malad





Oktòb 2010

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