

Knowledge, Attitudes, and Practices Around Peri-Urban and Rural Water Access and  
Sanitation During a Cholera Outbreak: A Comparison of Two Communities in the Puerto  
Plata Region, Dominican Republic

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## ABSTRACT

Many communities in the Dominican Republic have little or no access to safe drinking water or sanitation. The recent introduction of cholera from Haiti further highlights these limitations and their impact on human health. This research focused on two communities; a rural mountainous village and a peri-urban batey, which is a settlement community constructed by sugar cane companies to house primarily Haitian immigrant laborers. The purpose of this project was to examine community attitudes and behaviors surrounding water access and sanitation, barriers to access, and how this impacts cholera control. Research methods included community observations, household interviews, and interviews with local leaders.

The results showed two dramatically different types of water access and sanitation. The mountainous village had regular access to local springs, consistent piped water, functioning latrines, and low population density. Community members voiced no dissatisfaction with their water system or waste disposal and reported no diarrheal disease. In contrast, the batey reported chronic diarrheal disease, high population density, and inconsistent access to safe water or latrines. Residents in the batey voiced frustration with the water infrastructure, with their inability to mobilize as a community, and with government run water services. Local Public Health officials in turn voiced frustration with the community for continuing to engage in behaviors that spread cholera. Overshadowing all of this were issues of anti-Haitian sentiment, poverty, inequality, urbanization, and ineffective decentralized water and sanitation services.

In conclusion, if the sparsely populated mountain community maintains existing water and sanitation practices and current population and watershed levels they should be able to avoid cholera and other waterborne diseases and have consistent access to safe water and sanitation. In contrast, the densely populated peri-urban batey will continue to suffer chronic diarrhea and cholera outbreaks in the face of increasing urbanization, inconsistent water access, poor sanitation, limited community cohesion, discrimination, and poorly managed provincial water systems.

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## LIST OF ACRONYMS AND ABBREVIATIONS

AL	Arroyo de Leche
CHW	Community Health Worker
CORAAPPLATA	Corporation of Aqueducts and Sewers of Puerto Plata
GDP	Gross Domestic Product
HHI	Health Horizons International/ Horizontes de Salud
IDB	Inter-America Development Bank
INAPA	Dominican National Potable Water and Sanitation Authority
MGDs	Millennium Development Goals
NGO	Non-Government Organization
PM	Pancho Mateo
USAID	United States Agency for International Development
UN	United Nations
WASH	Water, Sanitation, and Hygiene

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## **DEDICATION**

To my husband, Christophe, for his tireless encouragement and support.

To the residents of Pancho Mateo and Arroyo de Leche: thank you for sharing your stories.

ACCESS TO SAFE WATER IS A FUNDAMENTAL HUMAN NEED AND, THEREFORE, A  
BASIC HUMAN RIGHT. CONTAMINATED WATER JEOPARDIZES BOTH THE PHYSICAL  
AND SOCIAL HEALTH OF ALL PEOPLE. IT IS AN AFFRONT TO HUMAN DIGNITY.

—*Kofi Annan, former United Nations Secretary-General*

## **Introduction**

Water is a critical component of life on earth, and safe drinking water and sanitation are essential for good public health. An estimated 884 million people lack access to safe drinking water and contaminated water is responsible for 1.6 million deaths per year, primarily in children under age 5 (“Global Water, Sanitation”, 2012; Hrudely & Hrudely, 2007). Approximately 88% of diarrheal diseases are the result of unclean water and poor sanitation (“Global WASH-Related Diseases”, 2012). Increased global urbanization and migration is straining urban water and sanitation infrastructures and inconsistencies and failures of urban and peri-urban water and sanitation delivery systems are a growing problem. Recent data show that the urban population increases by 2 people every second and 141 million urban residents do not have access to safe drinking water (“World Water Day”, 2011). Urban water and sewer systems that may have been functioning at full capacity are now overwhelmed and unable to provide adequate services.

Many infectious diseases are the result poor sanitation and unclean water, and cholera is one of the more virulent. Cholera is a bacterial infection that results in a dehydrating and often fatal diarrheal illness. It is a disease of poverty and inequality and is primarily found in poor communities with limited access to safe drinking water or sanitation. The bacterium is passed from person to person via food and water contaminated with infected feces. The literature reveals a wide range in mortality data indicating that if left untreated, severe cholera is fatal in 25% (Tappero & Tauxe, 2011) to 50% (Farmer et al., 2011) of cases. Treatment consists of aggressive intravenous fluid replacement and antibiotics, if available. Once a consistent system of safe drinking water

and sanitation are established, cases of cholera are virtually eliminated as is demonstrated in most industrialized nations (Talavera & Perez, 2009).

Ensuring access to safe water and sanitation is complicated, but many policymakers and global health organizations around the world are working to address the issue. The millennium development goals (MGDs), which consist of eight global health and development aims, set out by the United Nations (UN) in 2000, highlight water access as a key target in ensuring environmental sustainability. Specifically, the aim is to “halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation” (“Millennium Development Goals”, 2010). In 2005 the UN launched an initiative called the “International Decade for Action ‘Water for Life’ 2005-2015 to further enhance the MDG’s water goals. Water for Life aims to promote sustainable water practices by emphasizing action based programs and policies that encourage long-term water resource management and improved sanitation (“International Decade”, 2012). According to UNICEF’s most recent Water, Sanitation, and Hygiene (WASH) statistics, the MDG water goals are on track. However improvements in sanitation still lag far behind. At least 2.5 billion people still lack access to improved sanitation and over 1 billion have no access to any sanitation facilities and are forced to defecate in the open (“Water, Sanitation and Hygiene”, 2012). For communities without access to sanitation, the introduction of a clean water access point may not be enough to eliminate the spread of disease. As more and more people migrate to urban centers, the need for both safe water access and sanitation will continue to grow.

## Background

### **Research Communities: Location and Context**

This research occurred on the North Slope of the Dominican Republic in the province of Puerto Plata. The study was initiated in conjunction with Health Horizons International (HHI), a small non-government organization (NGO) based in the sugar mill town of Montellano. HHI works closely with four communities in the area and has many dedicated teams of local community health workers (CHW). Research occurred in two of the four communities; Pancho Mateo, a peri-urban slum and the largest community served by HHI, and Arroyo de Leche, a rural, mountainous agricultural village and the smallest community served by HHI. Only two communities were chosen due to the time constraints of the research period. The two chosen were selected because of their difference in geographic location, population size, and differing reports of cholera.

*Figure 1: Map of the Dominican Republic Indicating the Location of Puerto Plata*



Montellano is a 40-minute bus ride from several popular international tourist destinations, which are a key component of the Dominican economy. However, many of the estimated 10,000 Montellano residents are unemployed or under employed, in large part due to the now defunct sugar mill in the center of town. Municipal infrastructure in Montellano and its peri-urban communities also lags behind the neighboring tourist destinations. The Camu River (*Río Camu*) runs along the South side of Montellano and empties into the Caribbean ocean a few miles from town. The river has been the chief source of water access and waste disposal for all of the peri-urban communities around Montellano, most of which are chronically affected by diarrhea and now have confirmed cases of cholera.

*Figure 2: Detailed Map of the Research Area*



Arroyo de Leche is comprised primarily of Dominican agricultural workers and their families. HHI estimates there are about 200 people living in Arroyo de Leche. Households are spread around the mountainous region and are clustered into small groups of 2-4 homes. Most people live within site of only a handful of other homes. Clusters consist of extended family with grandparents in one house and children, grandchildren, aunts, and uncles in the surrounding homes. Arroyo de Leche is about an hour's drive from Montellano via motorcycle on rugged dirt roads. During the rainy season the road and the three river crossings are often impassable. Arroyo de Leche is the most remote community that HHI serves and when the roads are flooded the journey out of town becomes lengthy and difficult.

Pancho Mateo has an HHI estimated population of 1,440 (approximately 1/3 Haitian and 2/3 Dominican) and is known as a batey (pronounced *bat-eh*). Bateyes, which are housing settlements constructed by Dominican sugarcane companies for Haitian workers and their families, are common throughout the Dominican Republic. Infrastructure, such as plumbing for sanitation and running water, was not included in the original construction and these communities have not been able to adequately address basic sanitation needs as they've grown (Tappero & Tauxe, 2011). The "old batey" in Pancho Mateo, as it's sometimes referred to, is primarily comprised of Haitian residents and consists of tightly packed structures with many single-file walkways. New neighborhoods for Dominican families grew around the original old batey. Many of these newer neighborhoods installed water and sewer infrastructure, albeit inconsistently. In the Dominican section of Pancho Mateo, houses are less crowded together and many have electricity, small yards for animals, or *conucos*, which are small agricultural plots.

## **The Dominican Republic and Haiti; A Socioeconomic and Cultural Divide**

The Dominican Republic shares the island of Hispaniola with the country of Haiti. With an estimated 2012 population of 10.09 million people, the Dominican Republic has one of the highest population densities in Latin America (Tappero & Tauxe, 2011; “Dominican Republic Country Profile”, 2012). Roughly half of all Dominicans live in rural communities (“Portada de la Estadísticas, 2011). The Dominican Republic gained independence from Haiti in 1844. Subsequent dictatorships, and the involvement of the United States in the governing structure of the Dominican Republic, provided the framework for the current political and socioeconomic conditions. Compared to its Haitian neighbor, the Dominican Republic has made considerable economic and public health progress in the past 20 years. Health outcomes have greatly improved and the under-5 mortality rate, which was 62/1,000 in 1990, is now 32/1,000 (“Dominican Republic Country Profile”, 2012). Current adult life expectancy is 75 years for men and 79 years for women, much higher than their Haitian neighbors who have an adult life expectancy of 59 years for men, and 62 years for women. The economic numbers show a similar pattern. GDP for the Dominican Republic in 2011 was \$54.4 billion and a per capita GDP of \$5,780. Haiti estimates from 2005 (pre- 2010 earthquake) show a GDP of \$4.3 billion and a per capita GDP of \$1,600 (“Dominican Republic Country Profile”, 2012; “Haiti Country Profile”, 2006).

The main source of industry in the Dominican Republic over the last 100 years was sugar cane. By the early 1920’s U.S. agricultural investment in the Dominican side of the island flourished, while investment in the Haitian side lagged far behind. This prompted the Haitians to begin migrating to the Dominican Republic and the Dominicans

quickly relied on their cheap and readily available labor as a response to the growing worldwide demand for sugar (Orenstein CC., 1995). Because of this workforce need, consistent migration of Haitians across the border was firmly established by the end of the 1920's. Along with this came intense repression of Haitians, despite the Dominican's need for these workers. A brutal massacre along the border in 1937 (led by Raphael Trujillo, the authoritarian dictator of the Dominican Republic from 1930 until his assassination in 1961), and periods of forced, unpaid labor in the cane fields are a few examples (Gregory, 2007). Understanding the influence of the sugar industry on Dominicans and Haitians is important because the two communities involved in this research relied heavily on the jobs and economies created by the sugar boom and are feeling the effects of its decline.

The last sugar boom occurred around 1976 when the global demand for sugar began to decline. Haitians then, as today, were usually illegal and were left with the choice of either returning to Haiti where jobs were nearly non-existent or taking their chances in the Dominican Republic. Many opted to stay and migration to the Dominican Republic continued. This migration intensified after the January 2010 earthquake in Haiti. In response, the Dominican government has stepped up forced deportations via a new law designed to deny residency privileges to Haitian children born in the Dominican Republic (Archibold, 2011).

The current state of the Dominican sugar industry is a mere shadow of its former self. In September 1999, ten publically owned sugar mills in the Dominican Republic were auctioned off to private companies. In return, many of these companies fired all the workers in the name of restructuring and closed their doors for reasons that are still not

understood by most of the workers who lost their jobs (Gregory, 2007). Most have yet to reopen, including the Montellano mill, which provided jobs for the two communities in this study.

### **Safe Water and Sanitation in the Dominican Republic**

The World Health Organization and other major global public health organizations define safe water access as *reasonable access* through an *improved* or an *unimproved* source. This is also true for sanitation. An improved source of safe water consists of one of the following: a piped household connection, public standpipe, borehole, protected dug well or spring, and/or rainwater collection. An unimproved source is considered any of the following: vendors, tanker trucks, surface water, bottled water (due to the inability to confirm source and quality), and unprotected dug wells and/or springs. Reasonable access to an improved source is defined as the availability of at least 20 liters a person a day from a source within one kilometer (.6 miles) of the dwelling (“Improved water source”, 2011; “Global Water, Sanitation, and Hygiene”, 2012).

In 2010, 84% of rural households in the Dominican Republic had reasonable access to an improved water source compared to 1990 when the numbers show that only 76% of rural communities had reasonable access to an improved water source. In contrast, in 2010 only 87% of urban households had reasonable access to an improved water source compared to 98% of the urban population in 1990. This clearly demonstrates that over the past 20 years the rural population has been steadily gaining access to safe water while the urban population has been falling behind (*Table 1*). This is an alarming trend for urban populations in the Dominican Republic.

*Table 1: % of Population with Reasonable access to an Improved Water Source- Dominican Republic* (“Improved water source”, 2011; “Joint Monitoring Programme”, 2012)

	<b>2010</b>	<b>2005</b>	<b>2000</b>	<b>1990</b>
<b>Urban Access</b>	87%	89%	92%	98%
<b>Rural Access</b>	84%	83%	80%	76%

*Table 2: % of Population with Access to an Improved Sanitation Facility- Dominican Republic* (“Improved water source”, 2011; “Joint Monitoring Programme”, 2012)

	<b>2010</b>	<b>2005</b>	<b>2000</b>	<b>1990</b>
<b>Total Access</b>	83%	81%	78%	73%

Improved sanitation facilities are considered those that separate human waste from daily activities and contain, or dispose of, waste in a manner that keeps bacteria permanently separate from daily activities. These include: flush or pour-flush toilets/latrines connected to a piped sewer system (most plumbing systems in fully industrialized nations fall in this category), a septic tank, a pit latrine, a ventilated improved pit (VIP) latrine, a pit latrine with slab, or a composting toilet. Unimproved facilities include a pit latrine without a slab or platform (this allows fluids to seep into the ground water or toward a nearby river or stream), hanging latrine, bucket latrine, or open defecation which includes fields, forests, bushes, bodies of water or other open spaces (“Global Water, Sanitation, and Hygiene”, 2012). In 2010, 83% of the Dominican population had access to an improved sanitation facility compared to only 73% in 1990 (Table 2). This is much better than the current trend for safe water access but more work

needs to be done.

The semi-private company responsible for water and sanitation services in Puerto Plata province, including the two communities in this research, is the Corporation of Aqueducts and Sewers of Puerto Plata and is referred to by the acronym CORAAPPLATA. The system of running water managed by CORAAPPLATA is fragmented and inconsistent, and water delivery varied from town to town. In Montellano, water was pumped into the city water pipes from an underground aquifer via a large electric pump with no generator back up. Pancho Mateo and the surrounding peri-urban communities relied on the water from the Montellano aquifer via these same city pipes. For homes that had electricity and plumbing, water was pumped from the piped city supply to small rooftop cisterns called *tinacos* using small personal pumps called *bombas*. Water was then gravity dispersed into household systems via pipes called *tubería*.

The water pumped by CORAAPPLATA from the underground aquifer was gas chlorinated at the Montellano city well, but once the water started flowing through the city pipes it was unclear if the water remained safe. Many pipes throughout the system were broken or had leaks, allowing for various forms of contamination. Because of this, those who could afford to purchased bottled water for 40 pesos (\$1.10 USD per 5-gallon container). Private companies sold this water with the claim that it was purified. The Ministry of Public Health tried to keep tabs on these companies as much as possible, but most were completely unregulated so water purity and safety was unverified. When the electricity was out in Montellano and Pancho Mateo, and it was usually out every 12-24 hours for about 12 hours, the system ran dry. When the city water system ran dry, those

who could afford to filled their household *tinaco* by purchasing a truck full of water from yet another private, unregulated company. The cost of one water truck was roughly 500-700 pesos (\$13-\$18 USD). Those who could not afford to purchase water were forced to use the contaminated river.

Running water access in Arroyo de Leche was slightly mysterious, may not have been entirely legal, and was unregulated. Residents repeatedly referenced tapping into an aqueduct which originated in the mountains above Puerto Plata. Many residents told me that they simply call an expert who excavates the main aqueduct pipe and adds a t-joint so that water can be diverted to individual houses through a series of long, plastic pipes. It was not clear if CORAAPPLATA was aware of this process and it seems more likely that this is done “under the table”. Those who could afford to were able to have regular running water in or very near their homes for around 4-5,000 pesos (\$105-132 USD).

Water delivery in other parts of the province varied depending on location. In the capital city of Puerto Plata, water came from a completely different source. Water was pumped to a purification plant on top of a nearby hill from several major rivers north of Montellano. Water was gas chlorinated on site and gravity fed from the plant to Puerto Plata. All water in this plant diverted to Puerto Plata and none was sent to Montellano despite Montellano residing in the watershed. The pipes that brought the water to the Puerto Plata treatment plant were the same that the community of Arroyo de Leche tapped in to for running water. Of note, Arroyo de Leche residents accessed the water before it reached the treatment plant and the gas chlorination process, so their water was untreated. In most tourist towns, water was supplied from an underground source or a

holding tank using an electricity dependent pump with a diesel generator as back up and they rarely experienced the same issues of water inconsistency.

This complexity mirrors the overall organization of water delivery in the Dominican Republic. Water and sanitation delivery underwent a series of centralization and decentralization processes from the 1930's through the 1970's. The National Potable Water and Sanitation Authority (INAPA) was created at the height of the centralization phase and still exists despite the fact that many water and sanitation services are now semi-decentralized according to metropolitan area and province. In 1999 the Inter-America Development Bank (IDB) funded the privatization of five of the largest metropolitan water agencies. The goal was to have each exist as private, commercially operated entities separate from INAPA and without political influence ("DR0123: Drinking Water", 1999). INAPA then gave management responsibility of the smallest rural water boards to their community-based committees.

CORAAPPLATA is considered a small regional water agency and their website states they are decentralized from the central and municipal government. However they, along with several other small regional water organizations, opted to join INAPA after the fall of the Trujillo government in 1961. Since then they have worked closely with INAPA and the IDB on a semi-privatized basis to facilitate water and sanitation projects. This includes the aqueduct and treatment plant described in this research, which was constructed in 1996 ("Un Poco de Historia", 2004).

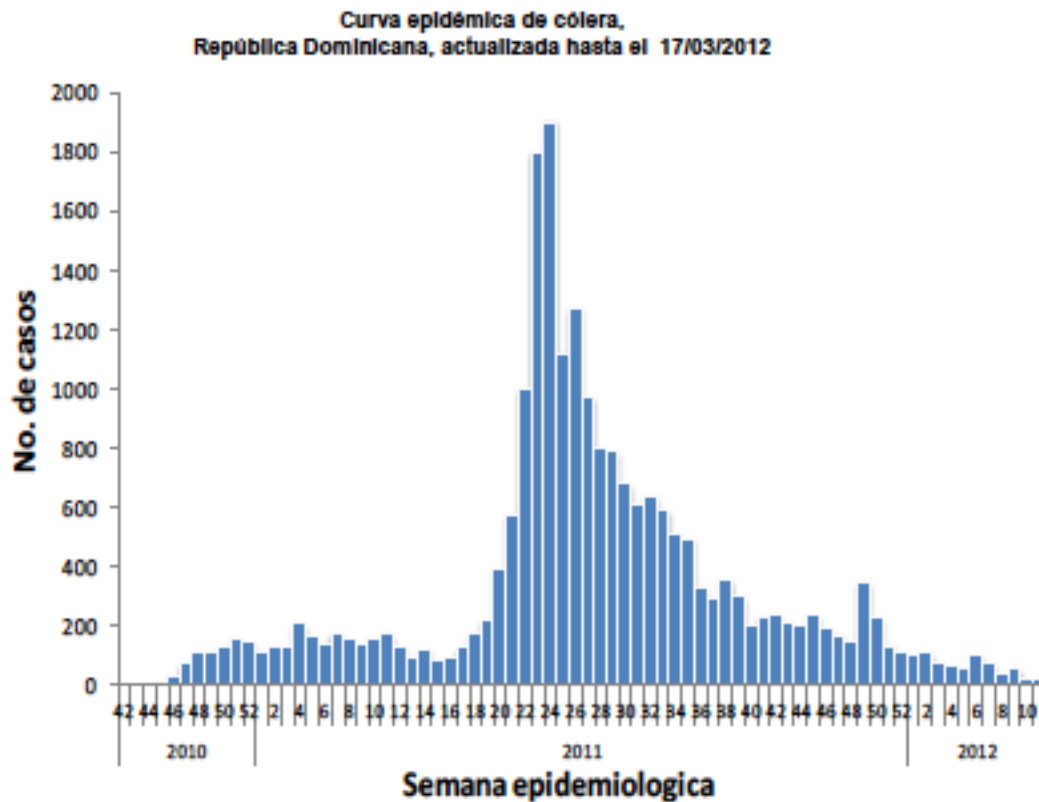
Additionally, USAID provides logistical support and policy advice to INAPA. In 2002, USAID proposed that the Dominican government move toward community based and community managed rural water and sanitation systems and use NGOs to implement

projects (Johnson & Perez, 2002). In the two communities where this research occurred, many NGOs and other aid or faith based groups had an ongoing presence. In Pancho Mateo foreign aid groups had implemented water projects however none had succeeded in sustainably addressing the water and sanitation needs.

### **Cholera in Puerto Plata Province**

Aid workers responding to the January 2010 earthquake in Port-au-Prince, Haiti inadvertently brought cholera to the island of Hispaniola. Haiti's poor sanitation and water infrastructure allowed the disease to spread rapidly throughout the country. The first cases of cholera were confirmed in the Dominican Republic mere months after it was detected in Haiti. Because sanitation and water infrastructure on the Dominican side of the island is better than the Haitian side, the disease did not spread as rapidly in the Dominican Republic. However, cases still emerged in the south near the capitol of Santo Domingo and spread north across the country. They spiked dramatically in the middle of 2011 during the southern rainy season and cholera eventually reached Puerto Plata province toward the end of 2011 (*Figure 3*).

*Figure 3: National Epidemiology Data- Cholera Disease Burden in the Dominican Republic (“Curva Epidémica de Cólera”, 2011)*



The week prior to the start of this research, the first confirmed death from cholera occurred in Pancho Mateo. The victim was an infant who had recently traveled to Haiti with her mother. Childhood diarrhea is common in Pancho Mateo, so it’s not clear if she was ill while en route from Haiti or became ill after returning home. However, due to her recent trip to Haiti, Pancho Mateo community members immediately identified that as the cause of the local outbreak. Soon the hospitals in Montellano and Puerto Plata were filling with patients with severe, watery diarrhea. Within a few weeks a second death of an elderly man living in the old batey was attributed to suspected cholera. Despite the surge in acute diarrheal illness and cholera-like symptoms, many suspected cholera cases

went undiagnosed. This was due to the complicated laboratory systems that required all samples to be sent to Santo Domingo for confirmation of cholera. Some Puerto Plata hospitals provided this service free of charge. Others, including the Montellano hospital referenced in this research, required patients to pay 500 pesos (\$13 USD) for the confirmatory test. Many could not afford this and elected not to order the test despite severe cholera-like symptoms.

### **Purpose of this Research**

The purpose of this research was to compare two communities and their attitudes and practices surrounding water access and sanitation during a cholera outbreak. This research aimed to understand the behaviors and feelings surrounding water access and sanitation, barriers or perceived barriers to water access, and how each community addressed these barriers. This study coincided with the first reported cholera cases in Montellano and Pancho Mateo.

### **Research Questions**

1. What are the behaviors and barriers, or perceived barriers, surrounding water access?
2. What factors influence the ability to prevent cholera and diarrheal disease?

## **Methods**

### **Selection of Communities and Subjects**

This descriptive study occurred in October and November 2011 and was conducted in conjunction with Health Horizons International/Horizontes de Salud (HHI), an American NGO based in Montellano. The research also involved HHI's network of local Dominican and Haitian community health workers (CHWs). Communities were selected from among the four served by HHI. Two of the four communities were chosen due to the in-country time constraints of the data collection period. Pancho Mateo was specifically chosen because of its close proximity and dependence on the contaminated river, and the growing number of cholera/diarrhea cases reported there. Arroyo de Leche, one of the smallest communities served by HHI, was selected as a comparison community because of the difference in location, population size, and access to natural resources.

Subjects were purposefully selected and interviewed based entirely on their willingness to participate and provide verbal consent. An attempt was made to ensure that an equal number of households in both the Haitian and Dominican sections of Pancho Mateo were included. Community leaders were chosen based on word-of-mouth recommendation from the community and/or their obvious leadership roles.

### **Methods Used**

Research methods included community observation, household interviews, interviews with community leaders and community health workers, and interviews with officials in the local hospital in Montellano, and the Ministry of Public Health in Puerto

Plata. Additional observations included a tour of the CORAAPPLATA water treatment plant that serves Puerto Plata, the Montellano city well, and a door-to-door census of household cisterns in Pancho Mateo. Interviews took place in 6 households in Arroyo de Leche, and 16 households in Pancho Mateo.

### **Data Collection**

Participants in both communities were approached during the day. Due to high levels of unemployment, many residents were home and therefore the respondents were a fairly equal mix of adult men and women. Participants were approached initially with general conversation about life and daily activities. An explanation of the study was then provided and subjects were asked if they would be willing to answer a few questions about water and sanitation and have their interviews audio recorded. Participants also gave permission to have photos taken of their water access and water storage methods and sanitation facilities. Verbal permission was also obtained for other observations such as the tour of the water treatment plant. Audio recordings of any public events were considered public behavior and were recorded as such, therefore permission was not obtained. A research assistant from the Dominican neighborhood in Pancho Mateo gathered a subset of the Pancho Mateo household information

This study was approved by the University of Washington Human Subjects Division (IRB).

### **Data Analysis**

Interviews and most community interactions were audio recorded in Spanish or Haitian Kreyole. Other community interactions and interviews were hand written.

Kreyole was translated into Spanish through a local interpreter and research assistant who was also a CHW and resident of the batey. Local translators helped with some transcriptions and the principal investigator transcribed all other audio files.

Transcriptions were recorded and analyzed in Spanish and hand written field notes were recorded and analyzed in English. All transcriptions were analyzed and coded for recurring themes and key words. Codes were divided into 49 categories and sub-categories and the most frequently occurring themes or key words served as the basis for the results and discussion. A CHW from Pancho Mateo provided insights on important local context and relevant Dominican and Haitian cultural issues in the recorded interviews and field notes.

The decision to hand write some field notes instead of audio recording was decided on a case-by-case basis determined by the comfort level of the interaction. For reporting purposes I have also distinguished between Dominican and Haitian respondents where I think it's important to the conversation. Many Haitians in Pancho Mateo were born in the Dominican Republic and have never been to Haiti. However, they are not formally recognized by the Dominican government which leaves them essentially stateless. The identifier of Haitian or Dominican was assigned based on the location of the respondent's house or respondent self-identification.

## Results

Four major themes and twelve sub-themes emerged from the data. The four major themes were water and sanitation infrastructure, attitudes and behaviors around water access, interactions between public health officials, CORAAPPLATA and the communities, and discrimination and marginalized populations (*Table 3*). The majority of the results focus on Pancho Mateo due to the larger number of household interviews completed in that community and the complex factors surrounding water access, sanitation, and cholera.

*Table 3: Research Themes and Subthemes*

Major Themes	Sub-themes by Community	
Water & Sanitation Infrastructure	Arroyo de Leche	<ul style="list-style-type: none"> <li>• Consistent &amp; Well-maintained</li> </ul>
	Pancho Mateo	<ul style="list-style-type: none"> <li>• Inconsistent &amp; Overburdened</li> </ul>
Attitudes & Behaviors Around Water Access	Arroyo de Leche	<ul style="list-style-type: none"> <li>• Content &amp; Satisfied</li> <li>• Ability to Self-Determine</li> <li>• Positive Community Engagement</li> </ul>
	Pancho Mateo	<ul style="list-style-type: none"> <li>• Frustration &amp; Community Disengagement</li> <li>• Distrust &amp; Suspicion</li> <li>• Blame</li> <li>• Limited Self-determination &amp; Positive Community Engagement</li> </ul>
Interactions Between Public Health Officials, CORAAPPLATA & the Communities	Arroyo de Leche	<ul style="list-style-type: none"> <li>• Little Need for Interaction</li> </ul>
	Pancho Mateo	<ul style="list-style-type: none"> <li>• Problems with Public Health Messaging</li> <li>• Frustration with CORAAPPLATA</li> </ul>
Discrimination & Marginalized Populations	Arroyo de Leche	<ul style="list-style-type: none"> <li>• Evident in Both Communities</li> </ul>
	Pancho Mateo	

## Water Access and Sanitation Overview

Three methods of water access were recorded in Arroyo de Leche. Two unimproved sources; spring water and river water (via the *Río Arroyo de Leche*), and one improved source; water via *tubería* which was accessed from the aqueduct. Households reported using unimproved water sources for drinking, cooking, bathing, and cleaning. Four of the six houses had an improved source of running water piped directly to their homes, although the integrity of the piping system could not be verified. Respondents reported drinking almost exclusively from the unimproved local springs and said they liked the taste of the spring water best and felt that this was the most natural way to obtain drinking water. All residents reported water access reasonable (defined as 20 liters a person a day from a source within one kilometer) and four out of six households reported unlimited daily water access at their doorstep. Unimproved sanitation methods were observed in five out of six households in Arroyo de Leche. One household had an indoor bathroom complete with a ceramic toilet and an indoor kitchen sink, both of which used water from the *tubería*. All other houses had outdoor pit latrines without a slab or platform.

Five methods of water access were reported in Pancho Mateo. Two improved sources; rainwater collection and *tubería* water, and three unimproved sources; river water (via the Río Camu), purchasing “purified” bottled water, and purchasing or receiving water from a private water truck. Six household interviews took place in the Haitian batey and ten took place in the predominantly Dominican section of Pancho Mateo. Thirteen of the sixteen houses interviewed reported collecting rainwater for drinking and no households reported receiving daily *tubería* water despite some having

the infrastructure in place. Of the unimproved sources documented, seven households reported buying bottled water or *camion* water and all sixteen households utilized water from the Río Camu for washing, cooking, and bathing.

Unimproved sanitation methods were recorded for almost all households in Pancho Mateo. One Haitian household reported having access to a ceramic flush toilet, which was in a shared building separate from the house and was flushed using a bucket of river water. All other Haitian households reported no regular access to a latrine and some reported open defecation in the cane fields or in the river. Seven of the ten Dominican households reported access to a pit latrine or household ceramic toilet that was flushed with buckets of water from the river.

### **Theme 1: Water and Sanitation Infrastructure**

#### *Consistent and Well-Maintained – Arroyo de Leche*

Arroyo de Leche reported abundant and consistent water access and limited population vying for the same resources. Five out of six households told me that they regularly had water via *tubería* and almost never went to the river for water. Only two out of the six households had to carry water from the nearby spring in buckets; all other households reported regular running water at their doorstep. Although all households utilized unimproved sanitation, latrines were well constructed and maintained and were at a distance from the living areas and water sources.

*Inconsistent and Overburdened – Pancho Mateo*

The most common infrastructure problem repeated by many respondents was broken or non-existent *tubería*. Residents explained how some of the pipes, which had been installed by an NGO, were not meant to carry water.

*“The pipe here isn’t a water pipe because it can’t handle the pressure, so when the water comes with pressure [the pipe] bursts. It’s because this pipe is basic. The water pipes have to be a special type of pipe for this and this pipe doesn’t work at all. This was the work of others.” (PM Community member, Dominican section)*

This respondent told me the NGO had installed plastic pipes meant to carry electrical lines and they were not sufficient in diameter or strength.

Overburdened and poorly constructed sanitation systems in neighboring towns also affected the public health of Pancho Mateo. The river was the common water source for many communities around Montellano and was also the major mechanism of disease transmission.

*“But you haven’t seen what we’ve seen there... We saw in Tamarindo (the community next to Puerto Plata), a cement latrine drain that was open from the houses, around probably 10 houses, discharging black water directly into the river. Have you seen this?” (Public Health Official #1)*

Neighboring communities’ gaps in infrastructure affected Pancho Mateo’s to control river contamination and the spread of disease.

## **Theme 2: Attitudes and Behaviors Around Water Access**

### *Content and Satisfied- Arroyo de Leche*

Individual attitudes and feelings about water access were dramatically different between the two communities. Attitudes and feelings about water access in Arroyo de Leche did not relay frustration, and for most households accessing daily water was not burdensome. Residents here expressed happiness and satisfaction with water access and found it to be a relatively easy and stress free process. Many seemed surprised or amused by my questions about their water and sanitation. I regularly heard, “*there is always water here!*” as a respondent readily demonstrated how their running water system worked.

### *Self-Determination and Positive Community Engagement – Arroyo de Leche*

Feelings of self-determination and a “take charge” attitude were apparent, and residents in both communities demonstrated a desire to manage their own circumstances surrounding safe water access. One young respondent in Arroyo de Leche reported meticulously boiling water for her 4-month-old daughter.

*“When I prepare [water] for my baby, I boil it. I’m very careful with the bottles. I boil the water. I’m always very careful with this.” (AL House #2)*

Easy access to household running water was available in Arroyo de Leche to those who could afford it and were willing to put in the extra work to obtain it. Community members reported gathering together to help each other construct a household water system.

*Respondent: “We have to buy, at least 6 tubes. Then, cement...”*

*Interviewer: “You construct it on your own?”*

*Respondent: “Exactly! God willing, we’re going to make one at my house!”(AL House #4)*

The community collectively benefited from installing running water in one household, particularly in close family groups. Family members would often share water points and divide chores between households, focusing water intensive chores like clothes washing around houses with consistent water access.

#### *Frustration and Community Disengagement- Pancho Mateo*

In contrast, respondents in Pancho Mateo reported inconsistent or non-existent water access and feelings of frustration and discouragement with their ability to access water. Residents also reported disengagement from community efforts to solve the water and sanitation problems and many feelings of individual frustration also corresponded with feelings of frustration toward other members of the community. Individual resources were often a contentious topic particularly in a community with a wide range of socioeconomic backgrounds. Several observations revealed a constant discussion about the price of the materials needed to fix the pipes, who was going to pay, and why the community couldn’t come together and resolve the issues. Everyone I spoke to in Pancho Mateo agreed there was a problem, but if someone called for collective funds to repair a broken pipe, no one was willing to pay. The repair costs quoted ranged from 20 pesos (less than \$1USD) to several hundred pesos.

One man in the Dominican section pointed to a broken pipe emerging from the ground with water seeping out on the dirt road and complained:

*“This little problem [of the broken water pipes] has been here for 6 months. The community, among ourselves we need to get together and do this, but no one wants to do it. Here there isn’t a neighborhood council, here we... I don’t know...” (PM Community Member, Dominican section)*

His neighbors concurred or watched without comment. It was not clear who had originally installed the *tubería* referenced in this quote. Some residents said the sugar cane company that constructed the batey had installed it; others said it had been installed by foreign NGOs. During this exchange, residents from the Haitian batey and the Dominican section argued over who should pay and why the community wasn’t organizing to share the cost burden. One Dominican resident made a point of mentioning that the Haitian section doesn’t even have plumbing for water delivery and that they (the Haitians) have limited resources, financial or otherwise. Others implored their Dominican neighbors to chip in. In the midst of this small community argument about collective responsibility around broken water pipes, the individual quoted above became so frustrated that he got his own tools and plugged the leaking pipe using a plastic soda bottle and part of an old tire. This solved the problem of the leaking water, however it did nothing to solve the overall problem and rendered the pipe useless.

#### *Distrust and Suspicion- Pancho Mateo*

A common topic in Pancho Mateo that elicited strong feelings of distrust and suspicion was the collection of rainwater. Rain is fairly constant throughout the year on

the north slope of the Dominican Republic. Although many residents gathered rainwater for daily use, some had strong opinions against the use of rainwater.

*“You know that the atmosphere consumes and takes everything. All of this poop and all of this rises above and returns in the rainwater. The rainwater is bad. Here [Pancho Mateo] they burn trash and everything, the pee, the poop, everything together and they burn that trash and then this rises up into the atmosphere and it returns as rainwater. It’s all contaminated.” (PM CHW, Dominican section)*

A Pancho Mateo community leader in the Haitian batey also disliked rainwater collection and said he had learned from a biology teacher that it wasn’t good to drink rainwater. He also disliked the taste of it after it was purified with chlorine and as a result had not had any water to drink for several days. These feelings about rainwater often resulted in people not drinking water either because they didn’t like the taste of the chlorinated water or they just felt too afraid to drink water in general due to the cholera outbreak.

Respondents often concurrently complained of low back pain, kidney stones, or constant stomachaches.

### Blame – Pancho Mateo

Inter-community blame was observed toward residents in Pancho Mateo who could afford to buy their own personal pumps. These pumps were nicknamed “*ladronas*” (which translates as thief). *Ladronas* would run as soon as the electricity came on and the water started flowing through the piped system. The *ladrona* owners would then fill their own rooftop *tinacos* or any other water container they could find. Other residents claimed

that this used up all the water in the system and left none for those who didn't have access to a *ladrona*, particularly in the Haitian batey.

Attitudes of blame were also aimed at the community from government officials, which was evident from interviews with the Ministry of Public Health workers.

*“You know the last time we went to Pancho Mateo we saw many people drinking water from the river and still bathing themselves in the river.” (Public Health Official #1)*

The issue of using the river was one of the most contentious. The Dominican military had declared a ban on the river, yet there was no visible enforcement of this ban and many residents continued to go to the river out of necessity. Most of the residents I spoke to at the river understood that they should not drink the water, but they still needed to bathe and gather water to clean their house. Although some did understand that this potentially increased their chances of spreading disease, most told me they had no choice and no other way to obtain water.

#### *Self-Determination and Positive Community Engagement – Pancho Mateo*

Inability to work together as a community was not true for all of Pancho Mateo. On a more affluent street in the Dominican section, one respondent told me he and his neighbors had successfully pooled their money and had installed new water pipes. They even purchased a truck of water to flush the pipes to ensure that they could carry enough water. In the end, despite their hard work, regular water did not arrive due to the larger

failures of CORRAAPLATA management and the faulty Montellano city pump that relied on consistent electricity in order to pump sufficient water through the system.

Other respondents also reported positive examples of collaboration, particularly with so many extended families living in the same, dense community. A woman in the Haitian batey stated she was too old and weak to make her way to the river for the water she needed to wash her clothes, however she was able to gather buckets of rainwater for her neighbors. In return, her neighbors helped with the rent payments on her one-room house. Residents also looked after one another in the wake of the growing number of suspected cholera cases. A respondent in the Dominican neighborhood described how there were many people on her street that had recently been taken to the hospital with cholera symptoms; her neighbor had just gone in that morning.

*“She told me that she [had diarrhea] like 6 times in less than an hour and I said ‘no’, she has to go to La Maternidad (the local hospital) and she agreed.” (PM CHW, Dominican section)*

### **Theme 3: Interactions Between Public Health Officials, CORAAPPLATA, and the Communities**

#### *Limited Interaction- Arroyo de Leche*

Arroyo de Leche residents expressed little knowledge or understanding of CORAAPPLATA and the politics surrounding the semi-private water agency. Residents also, quite frankly, didn’t seem to care. They believed that they accessed their water from an aqueduct managed by a government organization, but they expressed little understanding or interest in knowing exactly who or what that organization was. Cholera

was also something they hadn't experienced in Arroyo de Leche and the ubiquitous cholera prevention posters that the Ministry of Public health had distributed throughout the urban centers were not found here. Residents were aware of cholera and understood they needed to avoid contaminated water, but none felt the need to change their current habits surrounding water access and sanitation and were very grateful that cholera was not in their community.

#### Public Health Messaging- Pancho Mateo

Public Health officials continued to focus primarily on the messages of hand washing and prevention.

*“Because the work doesn't end and [patients] are treated based on prevention measures so you need to teach them. Talk to the people about the many habits that they need to modify and the others that they need to eliminate completely. Over all, frequent hand washing is very important after going to the bathroom. This is one of the habits to accentuate. Over all it's good for you to remember that you're working for the community and tell them that they can't go to the bathroom [without washing their hands], and should wash their hands after they prepare food or change a diaper.” (Public Health Official #2)*

Yet despite the Ministry of Health radio broadcasts and informational posters about hand washing and cholera prevention, many community members said they didn't have the extra water or soap to wash their hands. Some relied on donated hand sanitizer which they applied after using the toilet, but because few had running water or an easy way to wash their hands (such as a hand washing station or a sink with running water) most did not incorporate this into their daily activities. Many residents told me they had no other

choice but to use the river for water, even if it was just to gather water for washing. However, even this seemingly benign use of the river could easily transmit bacteria to their household.

Some respondents did not trust the public health messaging, particularly with the uncertainty around the new cholera cases. A Haitian respondent living in the batey said he relied on chlorine tablets brought to him from his sister in Haiti instead of the liquid chlorine that had been certified by the Ministry of Public Health for water purification and cholera prevention. He felt that the tablets from Haiti were the best option for preventing cholera because the epidemic had started there and he trusted the advice of his family members more than the advice of Public Health officials.

In extreme cholera cases, which the Ministry of Public Health defined as several days of watery diarrhea, fever, and vomiting, they recommended going to the hospital. Those who did seek treatment in the hospital were released when their symptoms were under control, which usually involved antibiotics and high amounts of intravenous fluid replacement. Yet the messaging to prevent the spread of bacteria didn't seem to be working.

*“And people also leave the hospital with antibiotics and things like that and they know they should continue taking them and continue being careful with their water and putting chlorine in it and everything, yet I think that maybe they think that ‘ok, I took an antibiotic and now I’m ok’.” (Public Health official #2)*

In another example of inconsistent messaging, a doctor in the Montellano hospital told me once someone has cholera they are thereafter naturally immune. I did not hear this repeated by the Ministry of Public Health.

*Frustration with CORAAPPLATA – Pancho Mateo*

In contrast, Pancho Mateo residents were well aware of CORAAPPLATA and its role or perceived role in their community. Despite the fact that some residents in Pancho Mateo had the necessary *tubería* to bring running water to their house, CORAAPPLATA had not addressed the larger issues of the electricity dependent city pump and broken or inconsistent *tubería*. Immediately after the cholera outbreak when the military placed a ban (albeit unenforced) on the river, CORAAPPLATA vowed they would send water on a daily basis to Pancho Mateo. For a few days, water arrived in the city pipes nearly every day in some parts of Pancho Mateo. However, for most, water arrived every three to four days and only in the middle of the night. Residents would hear the water coming through the system and jump out of bed to make sure they had everything in place to collect the water. This only applied to those with *tubería* or a nearby water access point. For most of the Haitian batey this did not apply. For still others in Pancho Mateo, water simply never arrived. The result was continued use of the river and continued cases of suspected cholera. Residents regularly said things like “*they only send water once a year*” in reference to CORAAPPLATA, or “*they said they would send it [the water] but they never did*”.

In other parts of town, pipes appeared to have been deliberately severed. One resident told me that if someone doesn't pay their water bill CORAAPPLATA would come and cut the pipe. It's not clear if and when they would then repair the pipe, but most of the pipes were interconnected so cutting access to one household severs access to many others. The process of paying for water was not well understood because many

people, particularly in the batey, did not even have infrastructure for running water so it wasn't clear what they would be paying for.

The Ministry of Public Health also voiced frustration with the provincial water company and were very interested in understanding the complex water infrastructure system. Public Health officials were a valuable ally for this research and helped to make the necessary contacts and facilitate access to the water treatment plant and the Montellano city well. As a result, a clear pattern of shifting responsibility was evident in the attitudes and behaviors from CORAAPPLATA officials toward the inquiring Public Health officials. In conversations with Public Health officials, CORAAPPLATA representatives repeatedly referred to a broken valve somewhere in the system and several times said it would be repaired "*tomorrow*", but this never occurred and consistent water delivery was not established during the time of this research and has yet to be established at the time of this writing.

#### **Theme 4: Discrimination and Marginalized Populations**

The underlying issue that cuts across all themes is the discrimination and marginalized populations. Many residents in Pancho Mateo were marginalized due to their impoverished status and Haitians are openly discriminated against in the Dominican Republic. Because many Haitians in Pancho Mateo were undocumented, they often felt uncomfortable or even unsafe advocating for change in their community. Residents of the batey told me that the land they lived on was still owned by the sugar mill, even though the company had folded years before. Few felt as if they had any agency to push for better infrastructure and basic levels of sanitation. Some Dominicans I spoke to,

especially in light of the current economic climate and recession, felt that Haitians were further limiting Dominican job prospects by competing with Dominicans for labor positions. Although none of the Dominicans I spoke to voiced direct interest in working the cane fields, all those living near the Montellano sugar factory hoped it would re-open because of the management positions available in the factory and the boost in customers for surrounding corner stores, food vendors, and other spin-off economies.

Anti-Haitian sentiment, both in connection to the cholera epidemic and in general, was also readily apparent. Casual conversations often revealed clear discrimination against Haitians. The Dominicans I interviewed in Pancho Mateo made reference to the Haitian community as being poor and having fewer resources but did not openly blame them for the cholera epidemic. However, some residents in Arroyo de Leche were quick to disparage and blame Haitians. One resident described the Haitians as dirty and primitive and said the Haitian community was unwilling to care for themselves and the environment. He supported his opinion by explaining how Haiti had cut down all its trees and now they had nothing. This opinion about Haitian's lack of environmental concern was heard from several different individuals.

The spread of cholera was also routinely attributed Haitians living in the Dominican Republic. An official in a Montellano hospital blamed the Haitian's cultural practices for the spread of cholera in Pancho Mateo.

*“The problem is also the Haitians. There is a type of Haitian and their lifestyle is a problem. It's cultural. They don't like to go to the doctor. They have their own beliefs*

*and their magic [when it comes to] sickness. It's basically a problem of education."* (La Maternidad, Montellano, official #2)

He went on to explain how they use these cultural practices to cure cholera but instead they only spread it in their household and then to others. Haitians I spoke to did regularly gather plants and brew teas for illness, but many had also sought treatment in the local hospitals. In addition, Haitians living in the batey shared stories of forced deportation. A respondent explained how his mother had been forcibly deported directly from the hospital as she was receiving care. This occurred over 10 years ago, however he was still less inclined to go to the hospital because of this.

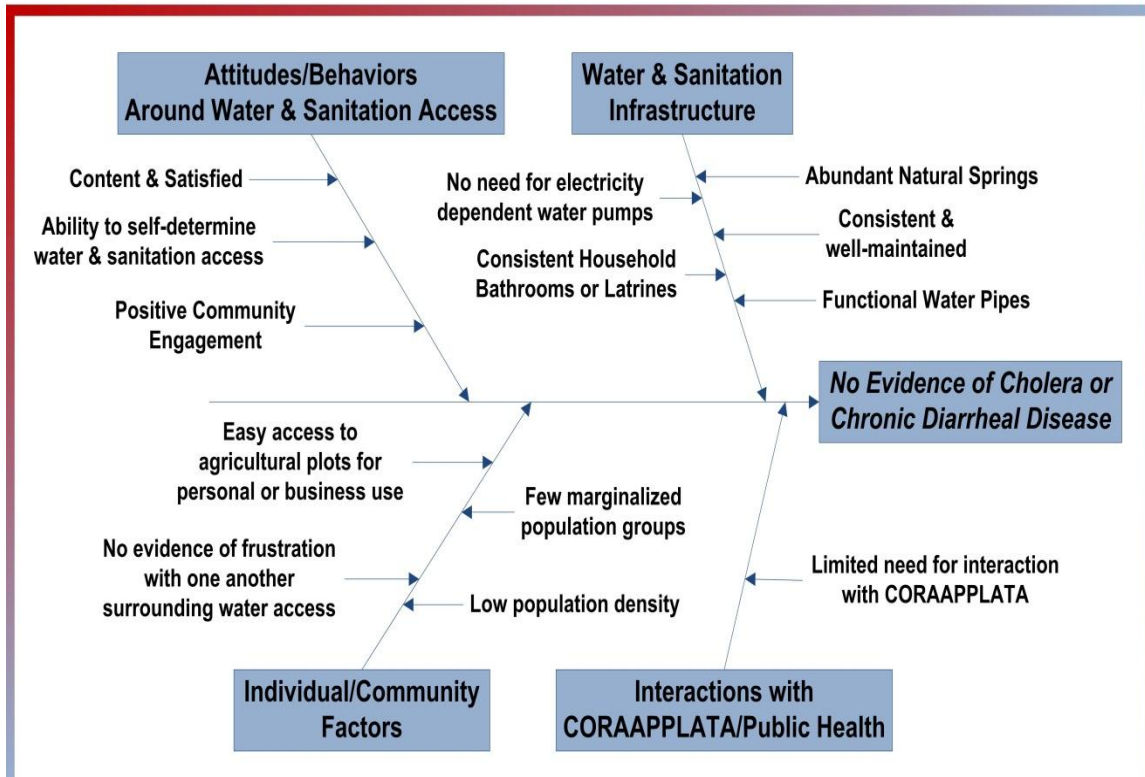
Other officials were frustrated with the Haitians' and poor Dominicans' inability to *"pull themselves up by their bootstraps"*. The director of the local hospital in Montellano was clearly frustrated when we started discussing the problem of inadequate sanitation in Pancho Mateo. *"There are six houses. Why don't they just get together and build a latrine between these six houses?!"* When I asked who would pay for this, his response was *"Well, what are they doing?"*, meaning why aren't they working to pay for it themselves. I went on to remind him that many Haitians are undocumented and struggle to find and keep jobs, which makes it hard for them to afford something like a major community construction project. He seemed to be unaffected by this response and went on to talk about how everyone should stop waiting around for the government to intervene and start helping themselves. This clear disconnection from the real lives of those living in the batey and in poverty was readily apparent in other observations and interactions.

## Discussion

This descriptive study highlights the factors involved in water access, sanitation, and disease prevention in two communities in the Dominican Republic and how two communities in the same region can have dramatically different water access and sanitation problems. Despite having few improved sources of water access and sanitation, respondents in Arroyo de Leche were happy with their water supply. Community members did not express frustration with one another or with their water situation and respondents here reported no diarrheal disease (*figure 4*).

*Figure 4: Factors influencing Cholera/Diarrheal disease in Arroyo de Leche*

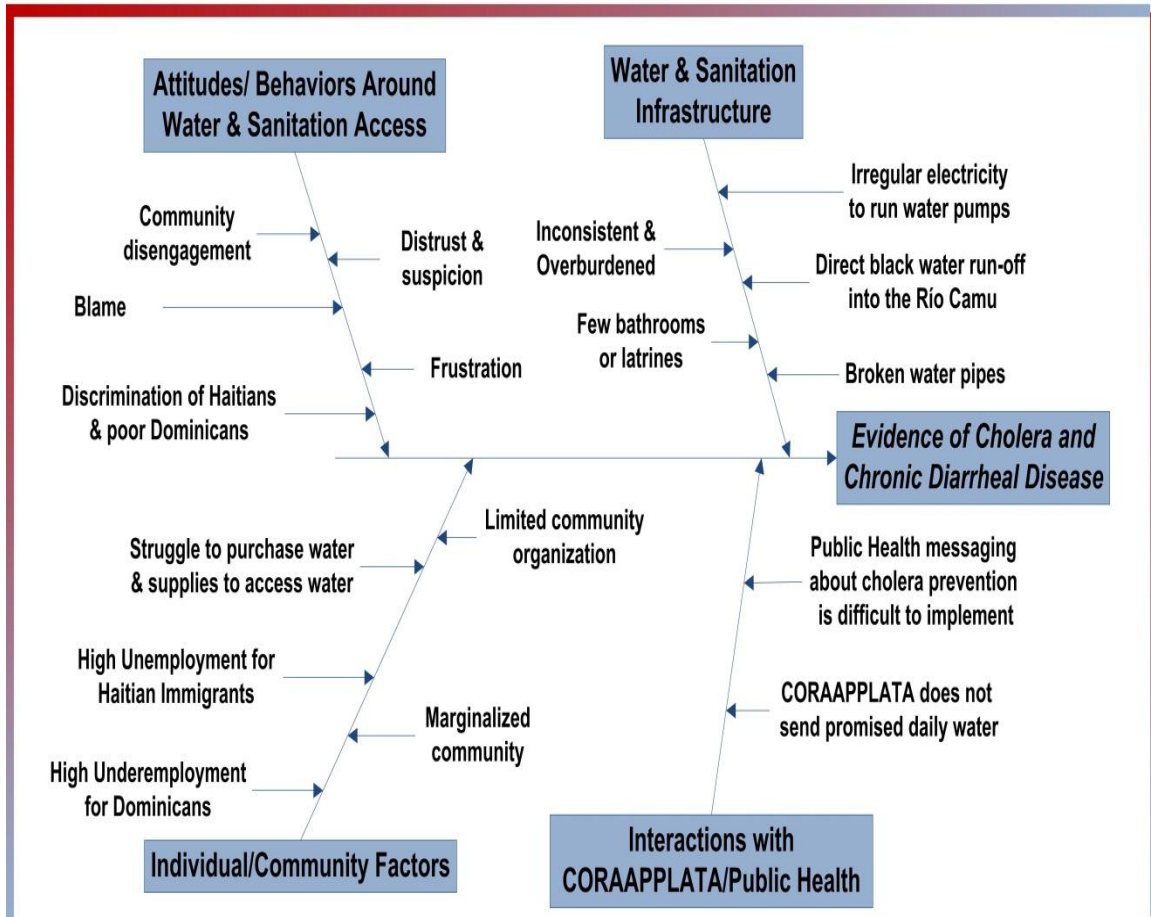
## Arroyo de Leche



In contrast Pancho Mateo struggled for resources and experienced chronic diarrhea and cases of cholera. Community cohesion was inconsistent and when successful, only brought small, short-term changes for a few residents. Respondents voiced uniform frustration toward CORAAPPLATA and their ineffective operations and in turn officials voiced frustration with the community (figure 5).

*Figure 5: Factors influencing Cholera/Diarrheal disease in Pancho Mateo*

## Pancho Mateo



There was a marked disconnect between officials' understanding of life in the communities, particularly in the Haitian batey and poor Dominican in Pancho Mateo. The response of the officials in the Montellano hospital highlights the problem of marginalized populations. By making patients pay for their cholera lab tests, the true magnitude of the disease was unknown as many patients were unable to afford the 500-peso cost. Instead they were sent home without a real understanding of their disease and the importance of prevention. In failing to understand the economic and cultural realities of the Haitian communities, officials were more inclined to dismiss the Haitian population instead of working with them to prevent the spread of cholera. Health officials also failed to recognize and respond to unanticipated negative health outcomes such as severe dehydration. Residents often refused to drink water, sometimes for days, because of their fear of drinking contaminated water and distaste or distrust of water. These were often the same residents who complained of lower back pain, stomach aches, and kidney problems.

At the same time the Ministry of Public Health was left with few options other than promoting hand-washing and proper waste disposal. Because CORAAPPLATA is semi-private and separate from the Ministry of Public health, the two institutions struggled to work together to prevent the spread of cholera. Public Health officials were left feeling just as frustrated as the communities were at the lack of infrastructure, oversight, and attention CORAAPPLATA devoted to really solving the problem of water and sanitation delivery in Pancho Mateo. By giving Pancho Mateo no other real option but to use the river when the water system ran dry, CORAAPPLATA was enabling the spread of cholera and other diarrheal disease.

It's not clear if a more centralized system would have been any more effective than CORAAPPLATA in its current semi-private formation. Montellano, the defunct sugar factory town, did not receive the same attention and resources from the Dominican government as the near-by tourist towns because it is not seen as a source of economic stimulus. Although recent presidential elections instigated a wave of public service projects like paving and other construction projects, Montellano and subsequently Pancho Mateo are not high priority. However, by failing to recognize the closely linked public health issues of cholera, safe water, and sanitation infrastructure, the well-being of these marginalized communities will affect the health of surrounding towns including the popular tourist destinations and the economic engine of the Dominican Republic.

As urban and peri-urban populations in the Dominican Republic continue to grow, good public health means an overhaul of the water and sanitation infrastructure. This is no small task, particularly in a country with a fragmented water delivery and sanitation system. Data earlier in this report show that the percent of the urban population with reasonable water access in the Dominican Republic has declined over the past 20 years (*Tables 1 & 2*). This is a stark wake-up call for the Dominican government and other governments with similar social demographic and socioeconomic landscapes. Government decentralization and privatization of the delivery of water and sewer services is a common theme in many countries, yet examples demonstrated here show that this fractured system results in limited oversight and accountability. By delegating authority for infrastructure projects to foreign NGOs, the system becomes even more fractured. NGOs are beholden to their own donors who may have little incentive to fund a system that is sustainably integrated with other systems throughout the country.

The contrast between Arroyo de Leche and Pancho Mateo is a great example of the rural/urban divide surrounding sustainable water access and sanitation. Rural Arroyo de Leche is not impacted by urban sprawl and is able to work together to successfully access water and maintain sanitation. The long-term sustainability of this practice is questionable, but for now it serves them well. Future levels of water in the main supply aqueduct may decrease or CORAAPPLATA may decide to regulate water access in Arroyo de Leche as demand downstream in Puerto Plata grows. Increased population growth, particularly if the Montellano sugar mill should ever re-open, could also put a strain on the resources available to residents of Arroyo de Leche.

The opposite is true in Pancho Mateo where too many people vie for too few resources. Because of its origin as a community for an already marginalized population, Haitian cane workers, the sanitation infrastructure was never installed in the first place. Pancho Mateo started a few steps behind. As the economy in Haiti continues to falter, more immigrants are making their way to the Dominican Republic and the batey communities where they have friends or family. Most of these new immigrants will remain jobless but will attempt to compete for Dominican jobs, frustrating many Dominicans who are also jobless and adding to the already heightened anti-Haitian sentiment and discrimination. Haitian immigration will continue the trend of increased urbanization to areas with decreasing water and sanitation services like Pancho Mateo and further strain the system. It will also continue the trend and spread of diseases of poverty and inequality like cholera.

As the global migration from rural to urban continues, this trend will be reflected in communities across the Dominican Republic. Previously peri-urban areas will become

fully urban with impossible demands on existing water resources and sanitation infrastructure. In Pancho Mateo, the Ministry of Public Health continued to spread the message of hand washing and chlorinating drinking water in an attempt to mitigate the spread of cholera, yet residents were without consistent water and sanitation and had little choice but to continue to access the contaminated river and continue the bacterial cycle of cholera. In Arroyo de Leche, residents were happy with their consistent water access and well-maintained system of latrines. Yet it's questionable how long they and other mountain communities will be able to sustain this type of existence. The Dominican government, and others like it, will need to make water and sanitation a priority, particularly in historically marginalized and densely populated peri-urban areas like Pancho Mateo, if they desire to eliminate cholera and improve national public health.

## **Limitations**

The main limitation of this research was the short data collection period. Additionally, although the interviewer speaks Spanish, a true understanding of cultural norms and respondent comfort with the interviewer are hard to achieve in such a short time period, if at all. Finally, a potential confounder may be the timing of the research trip, which coincided with the very first confirmed cases of cholera in Pancho Mateo when community tensions were high and fear around cholera was rampant.

## **Conclusion**

This research highlighted the complex community behaviors, attitudes and practices around water access and sanitation. It also highlights the larger issues of decentralized water and sanitation agencies, increasing urbanization, and the plight of marginalized populations in the midst of these growing problems. This research demonstrates how one rural community can have consistent, safe water at their doorstep while a peri-urban community in the same region can have little or no water access, unsafe sanitary conditions, and a cholera epidemic. The growing global population shift from rural to urban is placing a great strain on water and sanitation infrastructures, and many government or privatized water and sanitation agencies will be unable to withstand these new demands. Safe water access and sanitation should continue to be a major concern for global public health advocates and polity makers with particular attention toward growing urban and peri-urban communities and the marginalized populations within them. Regional and national governments need to make urban water and sanitation a top priority to ensure good public health for all.

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