# Capacity Building for

# IMPROVED WATER QUALITY

## in Aida Refugee Camp

## Prepared for Lajee Center

## Bethlehem, West Bank

by


**Tufts University Graduate Students**
**of the Water: Systems, Science, and Society Program**

Ayah Badran
Jennifer Bogle
Nelly Czajkowski
Amy Hunter
Meg Keegan
Matthew Simon

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Lajee Center

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# Summary

This report describes work completed by the 2013 Water: Systems, Science, and Society (WSSS) Team (the WSSS team) in Aida Refugee Camp (Bethlehem governorate, West Bank, Palestine). The report also makes recommendations for development of a water program at Lajee Center, a community-based organization serving Aida Camp residents. The work was conducted by an interdisciplinary team of Tufts University graduate students to address drinking water quality issues in Aida Camp. The WSSS team travelled to the camp in March 2013 to identify community concerns and assess Lajee's resources, with the goals of building awareness of water quality issues and encouraging residents to work with Lajee on clean water issues.

Water access and water quality are significant, interrelated issues in the camp. Piped water in the Bethlehem governorate is delivered to households on an irregular basis, and as a result, Aida's nearly 6,000 residents must store water in metal or plastic tanks for lengthy periods, which increases the likelihood of infection and associated illness. Additionally, both the water delivery networks and the sewer lines have been classified as poor by the United Nations Relief and Works Agency (UNRWA). In response to concerns that water provided to Aida Camp was causing illness, a team of WSSS students worked with Lajee Center in May 2012 to develop a water quality monitoring program. As part of the program and from the work of the 2013 WSSS team, water samples were collected from >300 homes in Aida and tested for the presence of total coliform and *Escherichia coli (E. coli)* bacteria. Results showed that 36% of the water samples collected (>400 samples) between May 2012 and March 2013 indicated the presence of total coliform bacteria and 5% of samples had *E. coli*.

During the 2013 trip, the WSSS team continued testing for contamination, completed 41 community surveys, and organized three workshops at Lajee Center to generate ideas for how the center can work with camp residents on water quality issues. Based on survey results and discussions with Lajee, the WSSS team directed their efforts to establish a water program at Lajee Center, which will offer technical support and community engagement opportunities around water quality issues. All recommended tasks have been developed from community-based, participatory planning and are based on community participation and input gathered during the March 2013 visit.

The water program will support Aida residents in improving water quality through continued testing and provision of point-of-use interventions. Aida residents may contact Lajee to report suspected contamination, request additional water quality testing, and receive appropriate technical support. The WSSS team assessed a number of point-of-use interventions, including chlorine solution, chlorine tablets, flocculant powders, solar disinfection, filtration, and boiling. Based on social acceptability, cost, and accessibility, the team has recommended the use of chlorine tablets as the primary intervention for Aida residents.

The WSSS team also looked at ways in which Lajee can engage with the community on water issues, particularly by reviewing modes of community outreach and examining school curricula for ways to strengthen water education. This will enable Lajee to increase awareness that water quality problems exist in the camp, as well as help residents take action to improve their drinking water supplies. To advance these goals, the WSSS team prepared informational brochures and learning modules covering a range of topics, including proper use of interventions, the health implications of bacterial contamination in drinking water, and how to test water for bacteria. The team also prepared brochures describing the water program.

This report links key findings of the WSSS team to strategic steps in establishing and implementing a water program at Lajee Center to include water quality investigations to monitor levels of total coliform bacteria in drinking water, point-of-use interventions, public outreach, and education. The implementation plan included in this report describes how Lajee can initiate, manage, and maintain water program tasks recommended

by the 2013 WSSS team. It covers considerations such as staffing for the program, procurement and distribution of water interventions, and mitigation services, costs, and a timeline for implementation.

# Part 1 – Background

The purpose of the project described in this report is to build capacity at Lajee Center, a community-based organization in Aida Refugee Camp (Bethlehem governorate, West Bank), to work with members of the Aida community in addressing water quality issues. Graduate students (referred to as the 2013 WSSS team) in the Water: Systems, Science, and Society (WSSS) certificate program at Tufts University travelled to Aida Camp in March 2013 to identify community concerns and resources at Lajee to determine how best to build awareness of water quality issues and encourage residents to work with Lajee toward a solution.

Water access and water quality are significant, interrelated issues at Aida Refugee Camp. Piped water in the governorate is delivered to households on an inconsistent basis (Hohn et al., 2012). As a result, residents often store water outdoors in large plastic or metal containers for lengthy periods of time. This increases the likelihood of contamination and associated health problems. In May 2012, a team of graduate students in the WSSS program at Tufts University worked on a project at Aida Camp in collaboration with Lajee Center. This work led to the development of a water quality monitoring program to detect sewage indicator bacteria (total coliform and *Escherichia coli* or *E. coli*) in drinking water. Since that time, the monitoring program has been run by a program coordinator at Lajee and supported by volunteers trained by the prior WSSS team during their visit in May 2012.

The 2013 WSSS practicum project, the subject of this report, builds upon the water quality testing program developed by the 2012 WSSS team. Here, the emphasis is on expanding Lajee's capacity to run a water program, which would be equipped to provide water quality testing to monitor levels of total coliform bacteria in drinking water, point-of-use interventions, community outreach, and water education. The 2013 WSSS team traveled to Aida Camp in March 2013 to more precisely determine the scope of water-related support that Lajee could provide to camp residents. The intent of the visit was to expand the existing program by identifying current human and technical resources at Lajee and by gauging community interests, needs, and priorities pertaining to water resources. As part of this process, the 2013 WSSS team also launched a fundraising campaign to leverage additional resources necessary to achieve the joint vision of the Aida community and Lajee Center.

The following report describes work completed through the 2013 WSSS practicum project, and recommends steps for Lajee to implement the water program. Part 1 of the report provides background information on Aida Camp and Lajee, camp water services and infrastructure, the 2012 practicum project, as well as results of bacterial monitoring between May 2012 and March 2013. Part 2 describes the specific goals, scope, and work products of the 2013 practicum. Part 3 presents an implementation plan that describes how Lajee can initiate, manage, and maintain program elements. It covers considerations such as staffing, procurement and distribution of water interventions, costs, and a timeline for implementing recommended tasks within the next year. The report concludes with a series of recommendations that may inform future collaboration between WSSS and Lajee or become projects that Lajee implements as time and resources allow.

## 1-1 Aida Camp

Aida Camp is a Palestinian refugee camp in the West Bank established in 1950. It is located on 0.71-square kilometers of land that was leased by the United Nations Relief and Works Agency (UNRWA) from the Jordanian government at the time (UNRWA, n.d.). It is situated 1.5 kilometers north of the city of Bethlehem and bordered by the city of Beit Jala to the west and south (ARIJ, 2010).

Population estimates for Aida Refugee Camp vary depending upon the source. According to UNRWA, Aida is home to approximately 4,700 registered refugees, while a recent population census by Lajee Center estimates that over 6,000 Aida residents live in the camp. The 2007 Palestinian Central Bureau of Statistics General Census of Population and Housing reported that 38.7% of Aida residents are younger than 15 years old, 57% are between 15 and 64 years old, and 3.7% are 65 years and older.[1] Census data also indicated that males represent 50.1% of the population and females represent 49.9% (as cited in ARIJ, 2010).

According to 2009 data provided by the Directorate of Education in Bethlehem and the Aida Camp Committee, there are 1,196 students and 46 teachers in Aida. The average number of students per class is estimated to be 37 (Directorate of Education, Bethlehem, 2009 & Aida Camp Committee, 2009 as cited in ARIJ, 2010). According to UNRWA statistics, illiteracy is relatively low at 6.8% but is higher among women, and the unemployment rate is quite high at 43% (UNRWA, n.d.). There are no healthcare facilities within the camp; the nearest facility is approximately one kilometer away.

## 1-2 Lajee Center

Lajee Center is a community-based center in Aida that provides cultural, educational, social, and development opportunities to refugee youth. It was established in 2000 and has since hosted hundreds of international volunteers through its summer International Work Program, launched a university scholarship program, run summer camps and programs for refugee youth, and organized human rights workshops, among other initiatives. Lajee's relationship with the Aida community and other Palestinian refugee camps and its focus on skills and knowledge development put Lajee in a good position to help increase awareness of local water quality issues and help prepare community members to take steps to improve their water quality and health.

## 1-3 Water Resources and Infrastructure

Drinking water in the West Bank derives from local aquifers or is purchased from the Israeli national water company, Mekorot. In 2010, the governorate of Bethlehem used a total of approximately 12.1 million cubic meters, of which 4.5 million cubic meters (37%) was from local springs and Palestinian Water Authority (PWA) groundwater wells and 7.6 million cubic meters (63%) was purchased from Mekorot (PWA, 2012).

Currently, Palestinians extract only 15% of the estimated potential of the three aquifers in the West Bank. Palestinians have also reduced their use of local groundwater resources over the past decade as a result of Israeli control of local resources, Palestinian development restrictions set by the Joint Water Committee and Israeli Civil Administration, and drought conditions (PWA, 2012).

The PWA estimates that water is supplied to the West Bank for domestic use at an average per capita rate of 102 liters per day across governorates. However, the average actual consumption is approximately 73 liters per capita per day as a result of losses from leakages from distribution systems, storage facilities, and connection points (PWA, 2012). In the governorate of Bethlehem, the PWA estimates that consumption is 102 liters per capita per day with varying quantities within the governorate (PWA, 2012). Some rural areas have consistent access as they are connected to the same pipe networks that supply Israeli settlements. This raises the Bethlehem-wide reported average use (Galaitsis and Huber-Lee, 2012). The Applied Research Institute – Jerusalem estimates that after accounting for losses, per capita consumption in Aida is 66 liters per day (ARIJ, 2010).

Aida receives water from the PWA through a network established in 1969. The Bethlehem governorate's water supply is managed by the Bethlehem Water and Sewage Authority, municipalities, as well as local and joint service

1 Percents do not add up to 100%.

councils (PWA, 2012). Aida is connected to municipal water and electricity, but UNRWA lists poor water and sewage systems as being among the major problems at the camp (UNRWA, n.d.).

Piped water in the Bethlehem governorate is delivered to homes irregularly, and residents have adapted by storing large volumes of water in metal or plastic tanks in periods when water is not flowing. As reported by the 2012 WSSS team, water is typically delivered to Aida every two weeks. However, there have been times when parts of the network have gone without receiving water for more than a month (Al Azraq, 2012). Shortages are most common in the summer months.

***Figure 1 - Aida Camp Water Storage Tank***

The camp sewer lines were installed in the mid-1990s. This process damaged several branches of the water distribution network. Water mains were replaced several years later (Al Azraq, 2012). Maps of the water distribution system have not been made available to the 2012 or 2013 WSSS teams, but the 2012 WSSS team gathered that two water mains extend from the storage area to service the entire camp (Al Azraq, 2012). An estimated 99.4% of housing units are connected to the water network. The source of water for the other 0.6% of units is unknown (PCBS, 2007 as cited in ARIJ, 2010).

As reported by the 2012 WSSS team, water enters Aida at a distribution center that includes a water storage tank installed in the 1990s (Figure 1), the original tank that is now used only to hold distribution pumps, and a generator and chemical mixing facility for chlorination and fluoridation. Water is delivered to the new tank and then pumped to households through the Aida piping network. There is also a community tap outside the fenced-in distribution center that is available for use by all camp residents (Al Azraq, 2012).

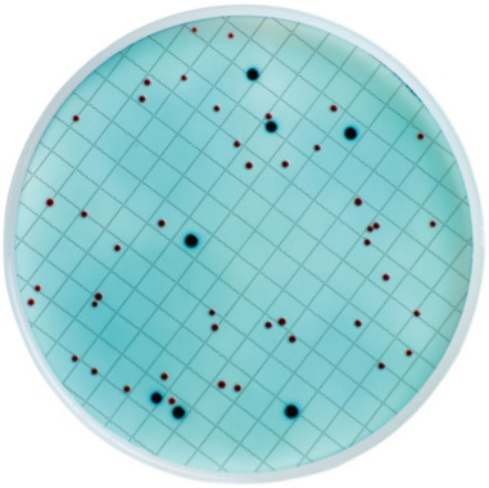


***Figure 2 - Coliform Colonies***

## 1-4 Coliform Bacteria

The water quality testing program established in 2012 showed that coliform bacteria are present in the tap water at many homes throughout Aida Camp (Figure 2). The results of the testing completed to date can be found in Section 2-2.

Coliform bacteria are ubiquitous in the environment and are concentrated in the feces of animals, including humans. Waterborne coliforms are often called indicator organisms because they indicate that a pathway exists between the source of the bacteria and a water supply, and because their presence may mean that harmful (but less abundant) disease-causing organisms are also present in the water supply. Testing can be completed for different types of coliform bacteria, which may indicate different levels of risk. This includes testing for total coliform bacteria and *Escherichia coli (E. coli).*

Total coliform bacteria that are commonly found in the environment are usually harmless (USEPA, 2006). If only total coliform bacteria are in the water, then the source is probably from the environment as opposed to human waste materi-

als. However, they may be used to indicate the effectiveness of water treatment and distribution system integrity (WHO, 2008). *E. coli* is considered the best indicator of recent fecal contamination in the water and that disease-causing bacteria (pathogens) may be present (WHO, 2008). *E. coli* are abundant in the feces of humans and warm-blooded animals, can be found using simple tests, and are not found growing naturally in water (WHO, 2001).

If water does have harmful bacteria, the most common symptoms of illness include vomiting, fever, abdominal cramps, and diarrhea. Children, the elderly, and people with weak immune systems are most vulnerable (Clemens et al., 2007; Washington State Department of Health, 2008). World Health Organization standards are that the *E. coli* and other coliform colonies (i.e., the total coliform count) in a 100 mL sample must not exceed zero when membrane filtration is used (WHO, 2006). Water quality testing (Figure 3) in Aida took place at Lajee Center, the entrance of which is shown is Figure 4.

***Figure 3 - Preparing Water Sampling Equipment***


***Figure 4 - Entrance to Lajee Center***

# Part 2 – Project Information

## 2-1 May 2012 Visit

The WSSS Palestine practicum began in 2012 when members of the Tufts WSSS program, at the invitation of Lajee Center, traveled to Aida Refugee Camp to assess water quality in the community, as there were concerns that their water was causing illness. From discussions with Lajee Center, initiating a water quality testing program was deemed necessary to better measure the community's water concerns. The specific goals of the program were to detect sewage indicator bacteria in drinking water, including *E. coli* and total coliform, and implement a volunteer-based water quality monitoring program directed by a paid program coordinator.

During a weeklong visit to Aida, the 2012 WSSS team conducted surveys and water quality tests at various residences and held discussions with members of the community. Surveys were completed at 29 households, and >65% reported at least one family member was sick during the two weeks prior to the survey (the majority being children under the age of five). The 2012 team also tested water in over 70 households, of which 46.7% had coliform bacteria, and 14.4% tested positive for *E. coli* (Hohn et al., 2012). Preliminary results of the team's efforts were disseminated during a community discussion (18 May 2012) held at Lajee Center, where members of Aida were able to learn about the project and the importance of water quality.

One of the main objectives of the 2012 practicum was to train Lajee staff how to collect samples and perform water quality testing so they could continue to do so beyond the conclusion of the project. Lajee was supplied with all materials and supplies necessary for this effort, including filter units, petri dishes, bacteria growth media, and an incubator. A staff person at Lajee was also hired to lead the water quality testing program after the WSSS team departed (Hohn et al., 2012).

## 2-2 2012-13 Water Quality Results

Using funds raised by the 2012 WSSS team, Lajee has analyzed >290 additional water samples throughout Aida since May 2012. These samples were collected from the primary drinking water supply in each home. A major goal of this effort is to have all Aida homes tested at least once. This will help develop a baseline water quality assessment, work toward identifying areas where there are consistent problems, and determine how to target interventions. Results show that 36% of the water samples collected between May 2012 and March 2013 contained coliform bacteria; 5% of samples contained *E. coli*. Figures 5 and 6 include data collected to

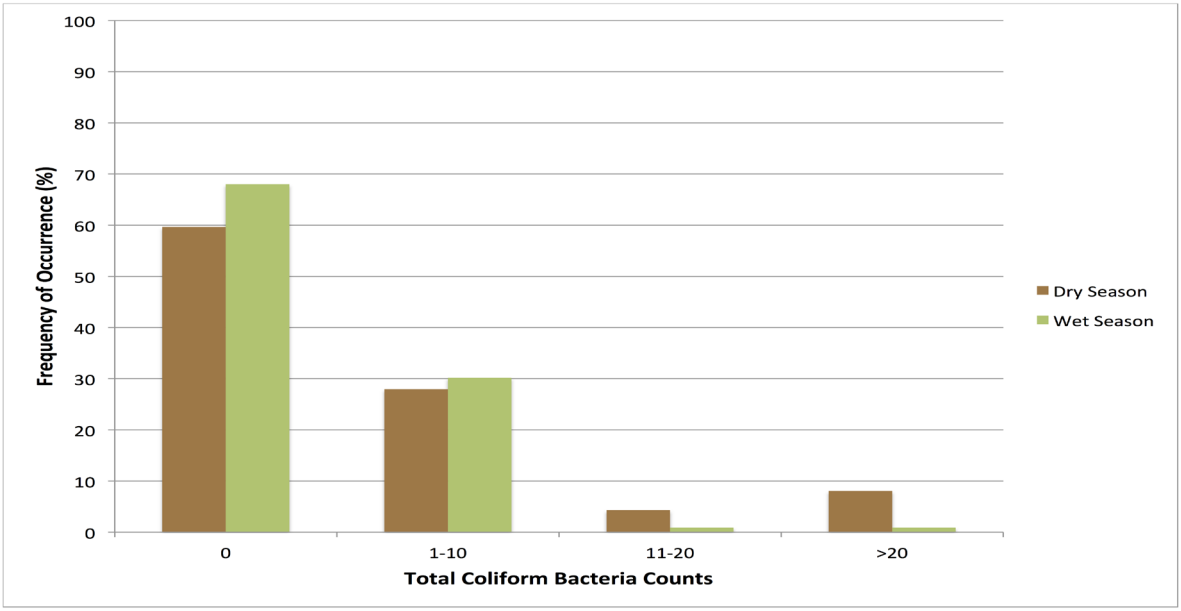



***Figure 5 - Frequency of Coliform Bacteria in 100 mL Water Samples by Season***

Dry season sample size >180. Wet season sample size >220. Data collected from May 2012 to March 2013. The dry season extends from April - September; the wet season extends from October - March.

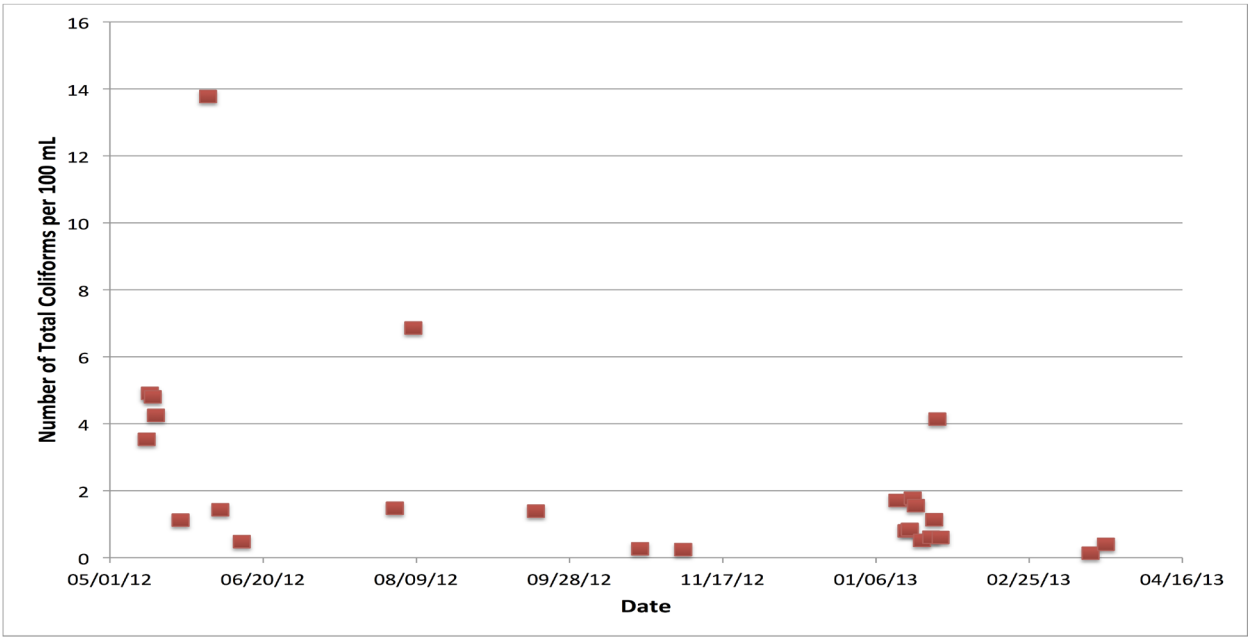



***Figure 6 - Time Series of Daily Mean Total Coliform Bacteria per Sample***
>400 water samples are represented by this plot. Seven samples were classified as too numerous to count and were excluded from this graph.

date, which includes the 2012 and 2013 practica. While the data presented are helpful in characterizing bacterial contamination in the water, there are significant gaps in time between groups of data. For a better representation of how bacteria contamination changes with the season, data would need to be collected more frequently and consistently (on a daily or weekly basis). The inclusion of spatial information would also make the data more useful. It would assist in identifying how elevation and distance away from the main water line affects the incidence of bacterial contamination. While some spatial information is available, it is currently not included in the analysis because the water sampling data have not been superimposed to a geographic location.

## 2-3 March 2013 Visit

The WSSS team spent six days in Aida Camp, from 17-22 March 2013. Upon arrival at the camp, the team met with Salah Ajarma, the Director of Lajee, to discuss the goals of the project and general plans for the week. The team conducted water quality tests for coliform bacteria several times during the visit and spent several hours on four days conducting community surveys with the help of translators from Lajee. By the end of the week, the team had completed 41 surveys. The team organized three workshops at Lajee Center, including two water program planning meetings and a workshop for teachers.Lajee staff members and several community members interested in Aida water quality issues attended the two water program planning meetings. Several teachers from both the girls' and boys' schools attended the teachers' workshop, along with involved mothers from the community. To conclude the trip, the team held a final meeting with Lajee staff members and discussed visions for the future of the project. A detailed schedule for the week is available in Attachment A.

## 2-4 Key Activities and Findings

This section highlights key findings from the three meetings and 41 community surveys conducted during the March 2013 visit. These findings have informed the specific recommendations for the water program to implement in year one, as well as future actions that support expansion of program activities. Recommendations are provided in Section 3-7 of this report.

### *March 2013 Meetings*

#### Methods

The WSSS team ran three meetings with members of the Aida community during the trip, with the primary goal of gathering information on the

***Figure 7 - Water Program Planning Meeting at Lajee***

community's water quality concerns and ideas for how to address them.

The format for each meeting was informed by the positive deviance approach, a strategy that encourages community members to discover successful problem-solving strategies that exist within the community and to develop an action plan for their wider adoption (Positive Deviance Initiative, 2010). In keeping with this approach, the WSSS team did not propose specific ideas for the water program as a means to gather feedback. Rather, the team ran meeting discussions by posing a series of questions intended to encourage brainstorming. The importance of this methodology is that it supports the generation of ideas that are accepted by the community and encourages discovery of current clean water practices within the community.

The items described below represent overall program recommendations for Lajee based on findings from the March 2013 visit. Specific implementation actions and timeframes for the first year of the water program are provided in the roadmap in Section 3-8. Future recommendations for consideration beyond the first year of the program are outlined in Section 3-7.

**Water Program Planning Meeting**

The first full meeting held at Lajee Center 17 March 2013 (Figure 7) was intended to share results from Lajee's water quality testing efforts over the past seven months and to identify the water quality concerns in Aida and ways Lajee could help resolve them. The first half of the second meeting held 18 March 2013 was then used to prioritize the community ideas for water quality improvement to be supported by Lajee. The discussion group consisted of Lajee staff and members from the community interested in water quality.

*Key Findings*

A number of water quality concerns were raised during the discussion, including:

- Tap-water samples from one-third of the houses contained coliform bacteria.
- Residents lack knowledge of water conservation strategies.
- Water quantity provided during the summer is insufficient.
- Solids are sometimes found in the water, such as calcium deposits and rust.

- The source of bacteria contamination in the water is uncertain.

A discussion followed where ideas such as using local media and hosting workshops were suggested as ways to engage the community in addressing these concerns. The remainder of time during the first meeting and the first half of the second meeting were devoted to building and prioritizing ideas of the role Lajee would play in addressing water quality concerns within the community. By the end of the meeting, three main priorities (for Lajee Center) had been identified by attendees: (1) hold workshops, training, and educational outreach regarding water quality and conservation; (2) develop a team to clean tanks within the camp; and (3) continue the water testing program on an as-requested-by-residents basis.

Below is a list of additional key findings from the meetings:

- Attendees were unaware of the extent of the water quality problems in Aida (i.e., 36% of collected water samples showed a presence of total coliform bacteria).
- There was an interest in developing a tank-cleaning team that would offer their services (for payment) to residents of Aida.
- There was interest in expanding Lajee's water quality testing efforts to include in-home interventions and community education and outreach.

**Water Program and Communications Meeting**

The second half of the second water planning meeting on 19 March 2013 focused on ways for Lajee Center to engage the community in its new program. The 10 participants included concerned residents invited by Lajee Center as well as Lajee staff. The purpose of the discussion was to identify appropriate forms of outreach and subject matter to develop a communications strategy for Lajee. The discussion was important for the WSSS team in formulating the communications strategy.

During the meeting, participants were asked how Lajee Center can disseminate information about the new support services, what information is most useful to residents regarding water quality, how the water program can maintain the trust of the community, and what partnerships might be formed with other organizations in the community.

***Figure 8 - Water Quality Testing Activity at the Teachers' Workshop at Lajee***

*Key Findings*

- Print and digital media should be used to reach and educate the residents of Aida Camp.
- Existing avenues of communication should be used to disseminate outreach materials.
- Outreach should focus on women and mothers, as they play an important role in managing water use and treatment in their households.

To address these key findings, the WSSS team developed a Community Outreach and Education Plan, which is outlined in Section 3-4 of the implementation plan. Year one and future components of the outreach plan include brochures, a proposal for educational films, and a list of potential partners (TV stations, schools, mosques, and local organizations).

**Teachers' Workshop**

On 21 March 2013, the WSSS team held a workshop with members of the Aida Camp educational community (Figure 8). The 10 participants included representatives from the mothers' consulate at the girls' school and teachers from the boys' and girls' schools, among which were the UNRWA health coordinator and members of the girls' school environmental club. Attending teachers were primarily focused on science education, while some also taught coursework in social studies and geography. All teachers taught courses for grades four through nine.

The purpose of the workshop was to determine how the Lajee Center can engage local teachers and students in water education. Through the workshop, the WSSS team gathered information about current water-related education and projects in local schools and discussed potential resources for Lajee to provide. The discussion was important for the WSSS team to then formulate teacher and student engagement programs that align with existing resources and initiatives in Aida and address needs and interests expressed by workshop participants.

During the workshop, attendees were introduced to the idea of building water-related educational programs at Lajee; engaged in a discussion of current water education and possibilities for future programs and activities; introduced to Project Earth, an international online student-driven environmental networking site to use to share future projects and search for new ideas; and asked to participate in and assess a possible water quality testing activity to be offered at Lajee.

*Key Findings*

The discussions and activities generated several ideas on how Lajee can support water education in a way that complements existing school curricula and projects. Key findings and next steps are discussed below and have been organized according to the three primary discussion questions posed by the WSSS team during the discussion portion of the workshop.

- There is an interest in having Lajee as a partner in water education.
- There is an interest in expanding water conservation education and projects at local schools.
- School curricula focus on the health implications of fungal infections and pollution in the water supply.
- Students in grades five through nine would be an appropriate group to participate in water quality testing training at Lajee. However, classes are large so students would need to be engaged in a variety of activities in order to accommodate all participants.
- There are concerns among members of the community regarding safe levels of chlorine as well as its impact on the taste and smell of water.
- There is an interest in having students engage in international exchange programs for water and science education.

To address the key findings and conclusions described above, the WSSS team has developed a Water Education Manual, which is provided in Attachment B. The activities referenced above can be administered by the water coordinator using the resources and instructions provided in the manual prepared by the WSSS team.

### *Community Surveys*

#### Methods

During the week in Aida, the WSSS team surveyed a total of 41 households from the four neighborhoods within the camp (Section A, B, C, and D maps in Attachment J). The survey was designed to collect data about general health, water usage, perceptions of water quality, and willingness to adopt and pay for various point-of-use interventions. This survey was largely based on the version designed and administered by the 2012 WSSS team, but has several additional components (a redlined version of the survey is available in attachment C, highlighting additions to the survey prepared by the 2012 WSSS team). New questions in this survey focus on the point-of-use interventions, peoples' willingness to pay for them, and the role of Lajee Center.[2] The survey consisted of a total of 26 questions and can be found in Attachment J, which includes IRB documents.

In designing the new questions that focused on how much Aida Camp residents may be willing to pay for clean water, the WSSS team relied on the method of contingent valuation. Contingent valuation is a tool for economic and community analysis, which is used to determine how much to charge for a good or service (Massachusetts Institute of Technology [MIT], n.d.). However, there are two limitations to note with regard to contingent valuation. First, such survey methods may generate responses that are higher than actual willingness to pay (Murphy & Stevens, 2004). Second, the surveys used in Aida Camp did not provide participants with a specific set of assumptions to inform their responses. As a result, assumptions may differ among respondents, which should be kept in mind when analyzing and using the survey results.

In order to obtain a representative sample of the community, the WSSS team designed a sampling plan to guide selection of the households to be interviewed. Interviews were expected to last approximately 30 minutes, which the WSSS team estimated would allow for up to 60 interviews over the course of the week. The WSSS team randomly selected 15 homes from each of the four sections of the camp (Sections A, B, C, and D as shown on the maps of Aida Camp in Attachment J). In the event that no one was home or the household did not wish to participate, an adjacent household was surveyed.

Before surveys began, Lajee translators were given a brief overview of the survey methodology. The WSSS team then split into groups of three, with each group including two students and one translator. Each translator had a map of one section of the camp (either A, B, C, or D) and was informed as to which houses had been randomly selected in that section. Survey teams conducted interviews at times of the day perceived as being the least likely to inconvenience household members (late morning, late afternoon or early evening). Potential participants were given a brief verbal overview of the study and the opportunity to read the consent form in Arabic. Survey teams addressed any concerns that were raised. Teams began interviews after verbal consent was given.

#### Results

Over the course of the week, the WSSS team surveyed a total of 41 households. Surveys took between 45 and 60 minutes per household to complete, which meant that the Team was not able to complete as many survey as predicted.

2 Several questions in the survey focused on willingness to pay for tank cleaning services and point-of-use interventions. The original intent was to determine whether these services could be provided, and if so, at what price. Workshop discussions revealed different opinions about requesting payment for tank cleaning and point-of-use interventions. Some participants stated they should be free or at a reduced cost, while others were in favor of charging the market rate. Workshop discussions indicated that there were differing opinions regarding whether these services should be provided for free or at a reduced cost. As a result, no recommendations regarding payment are provided as part of this report.

Forty-six percent (46%) of the 41 households surveyed reported they had a child under the age of five, and 27% reported that an adult over the age of 65 resided with them. These population statistics are important, since water contaminated with *E. coli* tends to have more severe impacts on young children and the elderly (CDC, 2012; USEPA, 2012). When asked about the occurrence of illness, 53% of households reported that a member within their household had been sick in the past 15 days. When that period was extended to cover the previous six months, 75% of households reported an illness in their home. Of those sick in the past six months, 41% were children under the age of five, and 17% were adults over 65 (Table 1). The majority of the households surveyed reported that they had run out of water at some point during the year. Eighty-one percent (81%) reported that water had run out during the dry season, while 6% reported this occurred in the wet season. The amount of time that households remained without water (the period between when they ran out of water in their tanks and when water was delivered to Aida) ranged from days to weeks.

| Table 1 - Summary of Households | |
|---|---|
| Average Household Size | 6.85, SD=3.14 |
| ***Households with:*** | |
| Children Under 5 (n=41) | 46% |
| Over 65 (n=41) | 27% |
| Person Sick Within Last 15 Days (n=40) | 53% |
| Person Within Last 6 Months (n=40) | 75% |
| *Person Under 5* (n=29)* | 41% |
| *Person Over 65* (n=29)* | 17% |
| Water Shortages** (n=36) | |
| Wet Season | 6% |
| Dry Season | 81% |

* Percentage of those sick in the last six months.
** At least once per season, all water from household rooftop tanks is used before the next delivery of water.

When asked to describe illnesses within their households in the past 6 months, responses ranged from cold / flu (40%), to diarrhea / vomiting (5%). Over half of the respondents (55%) reported that illnesses occurred during the winter, 20% thought that illnesses occurred during the spring season, and 10% said that the illnesses occurred during the summer months. Some respondents did not specify a season. Most respondents (57%) believed that changes in weather caused the reported illnesses. A much smaller percentage of respondents attributed illnesses to poor sanitation (7%) and water (4%). There were a variety of other causes listed ranging from tear gas to pollen (Table 2).

During periods of water shortage, people often reported that they purchase water to meet their needs. Of the homes surveyed, 44% reported purchasing water to fill their tanks from water trucks, which deliver water from Bethlehem directly to their households. The mean cost of this service was approximately 280 NIS (77 USD) to

***Figure 9 - Plastic Rooftop Storage Tanks at Lajee***

| Table 2 - Summary of Recent Household Illness | |
|---|---|
| ***Seasonality of Illness (n=20)*** | |
| Winter | 55% |
| Summer | 10% |
| Spring | 20% |
| ***Type of Illness (n=20)*** | |
| Cold / Flu | 40% |
| Diarrhea / Vomiting | 5% |
| Fainting | 5% |
| Viruses | 10% |
| Allergies | 10% |
| Chronic | 10% |
| ***Cause of Illness (n=28)*** | |
| Weather | 57% |
| Infection | 4% |
| Viruses | 4% |
| Water | 4% |
| Poor Sanitation | 7% |
| Other | 18% |

fill a household's rooftop tanks; however the actual cost ranged from 250 NIS (69 USD) to 500 NIS (138 USD) depending on the size of the tanks filled.[3] Due to the variation in the number and size of tanks for each household, it was not possible to calculate the cost per cubic meter of water delivered. More than half of the households surveyed (56%) said that they also purchased bottled water at a mean price of about 2.5 NIS (0.69 USD) per 1.5-liter bottle.

The mean number of tanks per household was 5.64. When asked about tank maintenance, a large majority of people surveyed (87.5%) said that they cleaned their tanks.[4] People reported cleaning their tanks in a variety of ways, ranging from cleaning the inside of the tanks with water only, to vacuuming sediments out of the tanks (Table 3). In order to gauge community demand for tank cleaning, people were asked whether they would request tank cleaning services if they were available in the camp. In response to this question, 49% said yes and 51% said no. People who answered affirmatively were then asked how much they would be willing to pay. Although the mean willingness to pay was about 32 NIS (10.67 USD), 59% of households believe these services should be provided free of charge (Table 3).

***Figure 10 - Metal Rooftop Storage Tanks in Aida***

| Table 3 - Tank Cleaning | |
|---|---|
| ***Household That Clean Their Tank (n=40)*** | |
| Yes | 87.5% |
| No | 12.5% |
| ***How Households Clean Their Tank (n=37)*** | |
| Water Only | 32% |
| Chlorine | 35% |
| Soap | 19% |
| Vacuum | 5% |
| ***Households Willing to Request Tank Cleaning (n=39)*** | |
| Yes | 49% |
| No | 51% |
| ***Households Willing to Pay for Tank Cleaning (n=22)*** | 41% |
| ***Average Price Willing to Pay for Tank Cleaning*** | 32 NIS* |

*10.67 USD

Images of the water tanks used in Aida can be seen in Figures 9 and 10; a pump used for moving water into the tanks is shown in Figure 11.

3 Camp residents do not currently pay for water delivered to Aida.

4 This high percentage may be a result of social desirability bias in self-reporting (i.e., tendency to report answers in a way that is viewed favorably by others).

***Figure 11 - Examining a Water Pump***

Twenty-eight percent (28%) of households surveyed reported taking measures to clean their drinking water. Of the 28% who said they cleaned their drinking water, 18% used some form of a homemade filter (cotton or gauze on the tap), 36% used chlorine, 36% boiled their water, and 27% had filtration systems installed in their homes. Survey participants were also asked if they would be willing to take any measures to treat their drinking water in the future using five different treatment options: chlorine, filtration, flocculants, SODIS (solar disinfection), and boiling. There was a preference for filtration, boiling and chlorination, with 63%, 43%, and 35% of respondents stating that they would be willing to use these interventions, respectively (Table 4).

| Table 4 - Measures to Clean Water | |
|---|---|
| ***Households that Take Measures to Treat Drinking Water* (n=40)*** | 28% |
| ***How Those Households Clean Their Water** (n=11)*** | |
| Homemade Filter | 18% |
| Chlorine | 36% |
| Boil | 36% |
| Filtration | 27% |
| ***Willingness to Use Interventions (n=40)*** | |
| Chlorine | 35% |
| Filtration | 63% |
| Flocculants | 23% |
| SODIS | 13% |
| Boiling | 43% |
| Other | 5% |

* Point source interventions only.
** Out of the households that indicate that they take some measure to clean their water.

Of the 41 households surveyed, 80% reported that they had their water tested by Lajee, UNRWA, or a filter company. Households were then asked how they learned about water quality testing services; 90% learned of them when a Lajee staff member came to their house to perform the tests (Table 5).

| Table 5 - Water Quality Testing | |
|---|---|
| ***Households That Had Drinking Water Tested (n=41)*** | 80% |
| ***How Households Learned About Testing (n=29)*** | |
| Lajee Center | 90% |
| UNRWA | 10% |
| Family / Neighbors | 7% |
| Filter Company | 10% |

Interviewees were also asked who they would notify regarding problems with their water and who they believed would take measures to address the issue. More than half of the interviewees (56%) said that they would notify PWA; 37% said they would notify UNRWA. Those numbers dropped when people were asked who they believed would address the issue: 41% believed the PWA would address it; 23% believe it would be UNRWA. Only 2% of respondents said they would go to Lajee Center with a water issue, and 8% thought Lajee would help them deal with it (Table 6).

| Table 6 - Reporting Water Quality Issues | |
|---|---|
| ***To whom would you go with a water quality complaint? (n=41)*** | 37% |
| UNRWA | 18% |
| PWA | 56% |
| Mekorot | 0% |
| Lajee Center | 2% |
| Other | 22% |
| ***Who would you expect to address it?*** | |
| UNRWA | 23% |
| PWA | 41% |
| Mekorot | 0% |
| Lajee Center | 8% |
| Other | 21% |

# Part 3 – Implementation Plan

This section outlines how Lajee will initiate, manage, and maintain recommended water program elements, including water quality testing, point-of-use interventions, community outreach, and water education. It covers specific recommended actions and addresses key considerations such as staffing, costs, and a timeline for implementation.

## 3-1 Lajee Water Program

The goal of the 2013 WSSS Palestine practicum is to work with Lajee Center in establishing and building a water program for the residents of Aida Camp. This program will include water quality investigations to monitor levels of coliform bacteria in drinking water, provision of point-of-use interventions, community outreach, and water education. Each component was presented to Lajee Center through the planning meetings and workshops described in Part 1 of this report. Community input and participation in these meetings and workshops have directly influenced program objectives and functions.

Based on project meetings and workshops, it was decided that a new staff position at Lajee would be necessary to effectively establish and run a water program at Lajee. This person (the water program coordinator) will have a number of roles and responsibilities to help accomplish all water quality related tasks at Lajee. The water coordinator will be the representative and task manager of the water program. Among the key long-term functions of this program are continued water quality investigations through water quality tests. This will include targeted sampling of drinking water in household taps (specifically in homes that have not yet been tested) as well as water quality testing upon request. In the event that a water sample tests positive for coliform bacteria, point-of-use interventions will be made available to households, along with information on their purpose and proper use. Public education and outreach activities will inform the residents of Aida on the availability of these services. Attachment D includes the recommended protocol for carrying out each component of the water program. Figure 12 depicts the responsibilities of key individuals and groups who will support the water program at Lajee.

An important finding from the workshops was the substantial interest in expanding water quality testing to include interventions for households with contaminated water and to offer outreach and education for Aida community members. While community interests related to both water

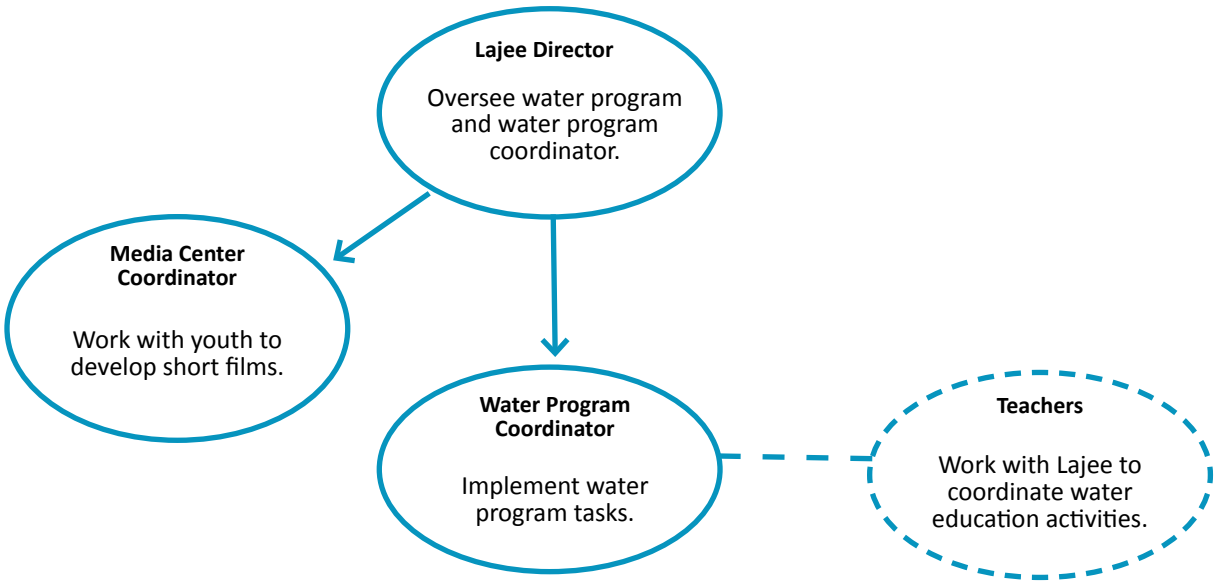



***Figure 12 - Water Program Organizational Chart***

This chart shows the roles and responsibilities of the individuals involved in the water program at Lajee Center. The dotted line shows coordination between the water program coordinator and teachers at local schools.

quality and access, the initial phase (i.e., the first year) of this program will focus on water quality and clean water practices.

One of the key responsibilities of the coordinator will be to continue the water quality testing program currently in place at Lajee, albeit under a modified, more targeted water sampling plan that focuses on residents with water quality concerns. The coordinator, along with well-trained volunteers, would collect the water samples within the homes and complete the already well-established water testing protocol. Figure 13 shows this protocol in action. Data collected (including, but not limited to house location, date, tap location, and number of *E. coli* and total coliform colonies) will need to be saved in an Excel database that can be shared with the WSSS team on a monthly basis. Water samples would mostly be collected at homes of concerned residents, but the coordinator should continue last year's WSSS practicum goal of collecting samples from all households. This serves two purposes: it adds to the water quality dataset and increases awareness of the water quality testing services offered by Lajee. From the surveys within Aida, it was clear that many families (90%) had learned of water testing at Lajee through the random sampling campaign.

Upon completion of the water quality testing, the coordinator should return to the homes to inform the residences of the results. If the results show bacterial contamination, the coordinator should work directly with household members to take measures to disinfect the water and inform UNRWA of the positive result. At present, these activities would likely include providing families with chlorine tablets for disinfection and possibly activated-carbon filters to remove the taste and odor of chlorine after treatment. This also means the coordinator would be responsible for the management of intervention materials. A more detailed explanation of interventions is provided in Section 3-3.

The coordinator may decide to delegate tasks to volunteers to complete water testing and perform community outreach and education. Volunteers could be community members, other Lajee staff, and students (preferably high school age). The more people who are directly involved with this project, the more the community as a whole will learn about water quality and its role in their health and well-being.

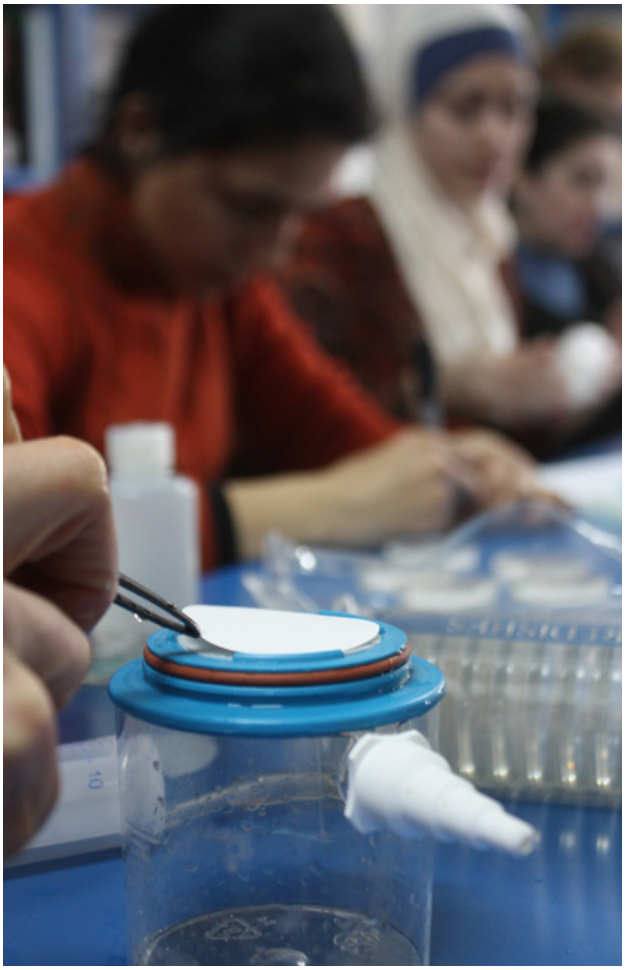


***Figure 13 - Testing Water Samples Collected from Homes in Aida Camp***

Education and outreach will also be an important responsibility of the coordinator, with opportunities for involving available volunteers. The logistics of any education or outreach project or activity would likely be the responsibility of the coordinator. Logistics may include securing space for meetings and inviting participants.

The 2013 WSSS team has prioritized the tasks that should be completed by the water program coordinator. These tasks as well as a detailed description of the job position and necessary skills can be found in Attachment E.

## 3-2 Water Quality Testing

Prior to the 2013 WSSS Palestine practicum, Lajee collected water samples at households throughout Aida with the goal of testing 100% of the residents' homes (Hohn et al., 2012). The 2013 WSSS team suggests continuing to work towards this goal as a way to assist residents with concerns about their personal water supply and inform them of the water testing at Lajee. The education and outreach component of the water program, as discussed in later sections of this report, will also inform Aida residents of water quality testing.

The objective of the 2013 water quality testing is to test remaining (untested) households and conduct sampling upon request. To conserve resources, testing should be limited to taps that families use for drinking water. If a sample tests positive for either *E. coli* or total coliform bacteria, the coordinator should then test a second water sample from the home to confirm the contamination (as is currently practiced). All test results, both positive and negative, need to be reported to the resident as soon as possible. If the second sample is also contaminated, the Coordinator should then provide information on interventions and demonstrate proper use of the intervention. The recommended intervention (chlorine tablets) is described in the following section. The protocol for conducting water quality testing, intervention provision, and data collection and logging is included in Attachment D.

## 3-3 Point-of-Use Interventions

In preparation for the field investigations, the WSSS team evaluated interventions (Attachment F) based on evaluation criteria proposed in the scope of work. Specifically, the WSSS team considered point-of-use interventions that are implementable by community members following simple instructions on proper use, culturally acceptable, low cost, and able to be procured by Lajee as needed. Attachment F shows each treatment option and factors considered in the selection process. The list of interventions was reduced to chlorine tablets (NaDCC tablets) in series with an activated carbon filter for chlorine taste and odor removal.

Chlorine tablets (Aquatabs® by Medentech, or equivalent) were selected as the disinfection treatment option because of the effectiveness of chlorine as a disinfectant for bacteria and viruses, the feasibility and quality control of chlorine in tablet form, and the affordability and accessibility of the tablets. The household survey also concluded that chlorine is considered an acceptable form of water treatment. This method was well received by participants at the second planning meeting and is already being used in homes. Table 4 showed that 36% of the households that already use point-of-use interventions (28% of households surveyed) use chlorine. Thirty-five percent (35%) of household surveys expressed they were willing to do so.

Chlorine is the most common chemical used for disinfection of drinking water (Viessman, 2009). The effectiveness of chlorine is based on the chemical's ability to inactivate most pathogens that cause waterborne diseases (CDC & USAID, 2008). Chlorine is effective for the treatment of bacteria, viruses, and some protozoa when dissolved and mixed in water. This process forms the microbial disinfectant hypochlorous acid (HOCl) as well as the hypochlorite ion ($OCl^-$). Both HOCl and $OCl^-$ are suitable to protect water against reinfection from the point of chlorination to the point of use (WHO, 2011).

Although the main objective is to disinfect water for necessary health reasons, the water source should also meet aesthetic criteria (WHO, 2003). This includes acceptable appearance, taste, and odor. Based on survey data, the aesthetics of the primary water supply are considered acceptable to the community, and many residents expressed concerns regarding the taste of chlorine. To accommodate this concern, activated carbon filters are suggested for the removal of chlorine taste and odor after treatment by chlorine tablets (see below for procurement status). An activated carbon filter is an effective media filter unit for the removal of taste and odor in water. This type of filter

consists of granular activated carbon (GAC), a media created from carbonaceous raw materials. The filtration mechanism is based on the surface phenomenon by which a substance adsorbs to the GAC particle. The effectiveness of this process is based on the large surface area and pore structure of GAC particles (Viessman, 2009). The filters considered for distribution to the residents are Brita® Pitcher Filters by Brita, LP or the equivalent. Product information is included in the Appendix F.

### *Costs*

The costs for the suggested interventions are provided below in Tables 7 and 8, and are estimated for individual households.

| Table 7 - Chlorine Tablet - Medentech, Aquatabs | |
|---|---|
| Capital Cost | 0 NIS (0 USD) |
| Operating Cost | 0.11 NIS (0.03 USD) / 20 Liter tablet* 38.9 NIS (10.95 USD) / year ** |
| Replacement Cost | 0 NIS (0 USD) |

Note: Program, transportation, and education costs are not included. Costs will vary depending on location.
* Medentech (2009).
** Assumed 20 liters / household / day.

| Table 8 - Activated Carboon Filter - Brita®* | |
|---|---|
| Capital Cost | 95.83 NIS (26.99 USD) |
| Operating Cost | 170.92 NIS (USD 47.94) / year** |
| Replacement Cost | 28.37 NIS (7.99 USD) / filter*** |

* Prices based on 2013 U.S. Suggested retail price by Brita®.
** Assumed filter replaced six times per year as suggested by Brita®.
***Based on the price from one-pack quantity.

### *Procurement and Logistics*

Procurement was an important factor in evaluating and selecting household interventions. Procurement of any treatment option is difficult due to the location of Aida Camp. When determining a distribution source, the WSSS team confirmed that the products are supplied from outside of Israel. The team is currently in direct contact with a manufacturer of chlorine tablets (Aquatabs® by Medentech) to discuss provision of their product. As of the last contact (April 2013), Medentech has agreed to supply Aquatabs® to Lajee Center directly from their headquarters located in Wexford, Ireland. The quantity, cost, shipping, and timeline for procuring Aquatabs® is still being discussed with a Medentech representative. Once obtained, Aquatabs® will be provided free of charge to residents that have tested positive for contamination.

At this time, the water program will not provide activated carbon filters to residents. The possibility of providing these filters is contingent upon the final budget allotted to interventions. In the interim, the WSSS team asks the water coordinator to assess the acceptance of chlorine tablets among residents. In the event that the residents show an unwillingness to use chlorine (based on matters of taste and odor) the WSSS team may be able to assist the coordinator in procuring filters (specifically Brita® Pitcher Filters). While Brita® filters can be easily purchased at several U.S. retailers both online and in stores, the team is investigating how to provide these filters to Lajee Center in a sustainable way.

## 3-4 Community Outreach

Building awareness of the program among camp residents is important for its successful implementation. During the second meeting held at Lajee Center, participants ranked education and outreach amongst their top priorities for the water program. Further discussions held at that meeting, a meeting with the media center coordinator at Lajee Center, as well as insights gained from the community surveys resulted in the following recommendations for a community outreach plan.

### *Outreach Material*

In collaboration with Lajee, the WSSS team has developed outreach material for Lajee to disseminate. All material is described below.

**Brochures and Flyers**

Brochures and flyers will be made available at Lajee Center for distribution to increase awareness of the water program at Lajee Center. The

WSSS team developed three brochures and flyers (which are available in Arabic): Improving Drinking Water Quality, Drinking Water Quality and Health Implications, and The Water Program at Lajee Center (Attachment G).

Health topics were selected based on meeting discussions, during which attendees expressed their interest in increased education regarding the health impacts of coliform contamination in water, with a particular focus on concerns for pregnant women and mothers with young children.

The WSSS team also prepared informational brochures on interventions to support their proper use. Lajee should distribute brochures to residents who are interested in using interventions to clean their water before consumption or who have been working with the water coordinator to address confirmed contamination. The intervention brochures explain how to use the interventions as well as the mechanism by which the intervention removes bacteria and other particles from the water. Preliminary survey results and discussions at each meeting indicated that transparency of information is important in maintaining the trust of the Aida community. The brochures focus on chlorine tablets and boiling water.

Lastly, the WSSS team prepared a flyer and brochure describing the water program at Lajee Center, which will include results from the water quality testing conducted over the past year as well as a description of the partnership with Tufts University.

**Digital Media: Short Films and Social Media**

Lajee Center has a well-established media center that will be used to produce short films about the health effects of coliform contamination in water and how to use the different interventions. This effort will be led by the media center coordinator on a schedule that aligns with available time and resources. It is recommended that this be implemented in the first year if feasible. The WSSS team recommends that the films be made through collaboration between Lajee and camp youth as an educational experience that will in turn support community outreach. The informational brochures can be used to guide the production of the films. The intended audience for these films will be community members and students without a technical background. If successful, the films could be shared outside of Aida Camp to continue raising awareness about the need for clean water.

Additionally, Lajee Center should utilize social media networks, particularly Facebook, to disseminate information about the newly available services and keep the youth of the community up to date on water program activities.

***Distribution Strategy***

Once the water program is established, Lajee staff and involved community members should begin disseminating the outreach material described above and use effective avenues through which to inform residents of the water program. With the goal of fostering public interest and engagement, Lajee should reach out to the community by continued sampling throughout Aida Camp (specifically of households that have yet to be tested).

Preliminary results from the community survey suggest that most people became aware of the water quality testing program when a Lajee staff member visited randomly selected households for testing. Some respondents also stated that the visits showed that the Lajee Center cares about water quality at the camp, and that they were supporting the community by offering this service. These reasons form the basis for the WSSS team's recommendation that Lajee Center continue to make door-to-door visits to test water quality, recommend and provide appropriate interventions, and offer material describing the water program and point-of-use interventions.

To reach large audiences within Aida, it is important to use existing and popular congregating areas within the community. Making announcements of the services of the water program at Lajee Center at local gathering places in the

camp will be important to the program's success. Based on discussions with Lajee staff and community members at one of the workshops held at the center, Lajee should make use of existing avenues of communication to provide information about the program to the community. This could include making announcements at the mosque on Fridays before or after the prayer and at schools in Aida, and by providing brochures for the students to bring home. In addition, Lajee could reach out to other organizations in Aida that may be interested in promoting the program.

Lajee Center could also work with local media outlets to prepare a story on water quality concerns in Aida Camp, and the center's efforts to address the issue. Lajee's media center coordinator recommended several news networks that might be interested. This includes:

- Ma'an News Agency - http://www.maan-news.net/eng/
- Bethlehem TV - http://www.beth-tv.com
- Palestine News Network – http://english.pnn.ps/

To support the water coordinator and media center coordinator in carrying out recommended community outreach and engagement tasks, Lajee should consider working with student volunteers or interns.

## 3-5 Water Education

Youth education and engagement is an important component of the water program. Educational programs at Lajee are intended to establish a partnership between Lajee and local schools and educational groups, provide a central location where water is the focus of learning, train students to support water services at Lajee as part of extracurricular volunteerism or internships, encourage students to communicate with their families on water issues, and build youth interest in water issues to develop a new generation of informed residents.

Attachment B includes a manual that provides a basic description of how Lajee may be a partner and supplementary resource for local schools in water education as well as instructions on water activities.

## 3-6 Program Costs

Table 9 shows the anticipated budget for the first year of the water program at Lajee.

**Table 9 - Year One Costs***

| Item | Cost |
|---|---|
| Water Coordinator Salary | USD 6,000 |
| Interventions | USD 2,500 |
| Outreach Material Production** | USD 2,000 |
| Translations*** | USD 1,200 |
| Water Quality Equipment**** | USD 2,000 |
| **Total** | **USD 13,700** |

* The numbers above are based on estimated costs. This is not indicative of the amount of funding available as of May 2013.
** Production includes brochures and film production.
*** Translation costs include outreach material and education manual translation.
**** Equipment includes vacuum pump and testing kits.

The allotted budget for household interventions has been suggested to be $2,500. This budget would allow the water program to provide 34% of households with chlorine tablets free of charge for one year. This percentage is similar to the results of the water quality data in which 36% of the water samples tested positive for the presence of coliform bacteria. Product pricing for tablets was provided by Medentech, the manufacturer of Aquatabs®. The calculated cost of Aqutabs® per year accounts for population size, household size (estimated to be 7 people per household as averaged from the survey), and the standards from drinking water intake per capita per day (WHO, 2003: ~2.4 liters per capita per day under normal conditions).

## 3-7 Recommendations

The 2012 and 2013 WSSS practica represent the initial phases of a program with long term potential for improving water quality and awareness among Aida Camp residents. While the rec-

ommendations and actions undertaken through these two projects are substantial, there are ways to improve upon existing projects and expand the program over time.

### *Summary of Year One Recommendations*

#### General Recommendations

- Develop and fill a new staff position at Lajee (i.e., the water program coordinator) to address the prioritized list of actions expressed during the first two meetings. (One year of funding is available for the creation of this position using funds raised by the WSSS team.) Position tasks include:
    - Informing the Aida community of the water testing available at Lajee;
    - Continuing water testing for bacterial contamination in homes of concerned residents, but also including Aida's community water tap and at the remainder of residences that have yet to be tested;
    - Providing information on interventions (e.g., chlorine tablets and filters);
    - Supplying residents with interventions on an as-needed basis;
    - Hosting workshops for the community to teach best practices in water safety and conservation; and
    - Providing monthly data logs to the WSSS team.

A role guide is provided in Attachment D. Attachment E is a job description for the water program coordinator.

#### Water Quality Testing and Interventions

- Send water quality data to the WSSS team on a monthly basis for further analysis. Both Lajee and the WSSS team should make considerable efforts to keep data private, since the data logs will contain identifiable information of those in the community.
- Distribute interventions for the water program. Interventions include chlorine tablets and possibly activated carbon filters (to remove chlorine after treatment). Chlorine tablets should be a standard size to reduce the potential for incorrect dosing, which could be harmful to those who drink the treated water.
- Disseminate information on the proper dosing of chlorine in drinking water. This could include developing a brochure showing the number of chlorine tablets to use with common household water container sizes.

#### Community Outreach

- Prepare brochures, flyers, and pamphlets on the health effects of bacteria in water, Lajee's water program, proper use of selected interventions, and a summary of last year's water quality testing results. See Attachment G.
- Use social media, such as Facebook, to spread word of the new support systems available.
- Encourage community volunteers to go door-to-door to share information about the program.
- Partner with surrounding schools, mosques, and community organizations to distribute brochures and pamphlets.
- Reach out to local and regional television stations to arrange interviews and story on Lajee and water quality to gain publicity. Refer to Section 3-4 for more information.

#### Education

- Foster a relationship between Lajee and local schools, specifically the environmental club at the girls' school and active, interested groups at other local schools.

***Figure 14 - Learning to Test Water at the Teachers' Workshop***

- Establish Lajee as a field trip destination by developing interactive, educational water-focused activities for local students. Activities may be run using the Water Education Manual in Attachment B. The manual includes a series of activities at Lajee that can be accomplished in a single field trip, including training on water quality testing and activities that focus on the linkage between water quality and health focusing specifically on coliform bacteria, water testing, and filtration of chlorinated water.
- Run a small pilot of the Water Education Manual and make adjustments based on feedback from participating students and teachers before inviting a broader reach of students in Aida and surrounding communities.

### *Future Recommendations*

#### Water Quality Testing and Interventions

- Evaluate the feasibility of implementing tank cleaning methods that would work and cleaning materials that are appropriate to use.
- Consider a more comprehensive diagnostic for determining the source of contamination. This approach would expand testing to all household water taps and rooftop tanks. Each sample would be tested and analyzed for bacteria. Through a process of elimination and retesting, the actual source of contamination could be identified. Depending on the results, it may be recommended that rooftop tanks and / or water pipes and fittings are replaced.

#### Community Outreach

- Seek and recruit new groups or individuals for joint projects.
- Coordinate screenings of educational films at schools and cultural centers outside of Aida Camp.
- Provide bi-annual or annual newsletters to interested members of the community to help keep them up to date on what the water program has accomplished and hopes to accomplish in the future.
- Encourage youth to continue to use media (still photography and film) to document their experiences with water in Aida Camp.
- Provide a brief feedback survey for those who choose to utilize the resources offered by the water program to help the coordinator monitor the successes and failures of the program.
- Explore a partnership with the Bethlehem Ministry of Health to help distribute interventions and provide additional education and outreach materials to those interested in the relationship between water and health.

- Establish a water planning committee as part of a long-term planning strategy. It also is possible that such a committee will form gradually, as the program develops. As Lajee identifies these individuals, a more formal arrangement for a volunteer-based, strategic planning committee should be considered. Ideally, the committee would include several community members of different ages, roles, and occupations; leaders of the environmental club at the girls' school; employees of the UNRWA lab; science teachers from local schools; interested local students; and members of the mothers' consulate at the girls' school.
- Determine whether a website would be a useful tool to inform the community in Aida of the water program at Lajee Center.
- Develop a program for Aida Camp youth to work with the current Lajee media center coordinator to make short, informational films on the relationship between water and health, and on select interventions to promote clean water – and show these at schools and at Lajee.
- Develop workshops on interventions geared towards women, particularly mothers.
- Develop brochures and pamphlets geared towards pregnant women, mothers with young children and older (65+) adults.

**Education**

- Train interested students to assist Lajee's water projects. This may include support for water quality testing services and internship opportunities.
- Work with school environmental clubs to expand programs and projects related to water conservation.
- Seek field trip opportunities related to water, such as visits to the UNRWA lab in Dheisheh Refugee Camp.
- Seek and help facilitate scholarships for high school graduates to study water at an international school. A preliminary list of potential organizations and opportunities is provided in Attachment H.
- Continue to gather feedback from students and teachers regarding the water education modules and possibilities for future activities at Lajee.
- Establish a water internship program to engage young adults at Aida Camp in a capacity-building initiative at Lajee to develop and train water activists among Aida's youth community. The program will grant interested youth a professional opportunity to build water-related skills and knowledge. See Attachment I for a description of potential intern positions.

**Community Surveying**

- Conduct training in interview methods for future WSSS teams prior to visiting Aida Camp (e.g., in February or March 2014), preferably with the guidance and assistance from an experienced faculty member.
- Conduct a similar but brief session with translators upon arrival at the Lajee Center before beginning the survey process. Make sure that all translators have a similar understanding of the survey questions, so as to limit variation in translation, similar to the preparation being done in Figure 15. After the training, have the translators pair up and run through the survey with each other, so they have a better understanding of how the interviewee will experience the survey.
- Ask Lajee Center staff, particularly individuals who are directly involved with the water program, if there is particular information they would like acquire through surveying residents in Aida Camp.
- Pretest the survey in English and Arabic with Lajee staff or other community members, if possible, to gain feedback on the survey content and clarity. This should be done prior to submitting the survey for Institutional Review Board approval.

- If and when relying on contingent valuation, determine appropriate pricing for survey questions. Establishing appropriate prices is helpful in gauging the credibility of results (Gunatilake, 2007). Also, be as specific as possible regarding how funds will be used. For example, in the survey used here, stating that funds would be applied to point-of-use interventions would help clarify the intent of the question and thus the accuracy of responses.
- When revising the survey, design additional questions to collect answers that are more detailed than a simple yes or no. Properly framed questions that permit multiple possible responses, can provide greater in-depth knowledge and also afford opportunity to display results via more visually interesting graphs.
- When devising a coding system for households, build a topographic marker into the codes to explore the potential relationship between topography, water scarcity, water quality and illness.
- For each section add a script explaining the purpose of the section and define key words, like illness, primary supply of water, etc. This will help eliminate confusion among interviewees and variation in translation caused by explanations of questions.
- Record the non-response rate (i.e., the number of households that declined participation). This does not include households without family members at home at the time of the survey.

***Figure 15- Preparations for Surveying***

## 3-8 Year One Implementation Timeline

Table 10 provides the recommended sequence for implementing water program tasks.

| Table 10 - Implementation Timeline | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tasks** | **2013** | | | | | | | **2014** | | | | |
| Hire the water program coordinator. | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
| Begin coordinator training. | x | | | | | | | | | | | |
| Send data to WSSS. | x | x | x | x | x | x | x | x | x | x | x | x |
| Conduct Aida Camp water testing. | x | x | x | x | x | x | x | x | x | x | x | x |
| Disseminate outreach material. | x | | | | | | | | | | | |
| Conduct a pilot of water education modules. | | | | | | | x | | | | | |
| Revise modules based on input from pilot. | | | | | | | x | | | | | |
| Coordinate student field trips to Lajee. | | | | | | | | x | x | x | x | x |

*References*


Al-Azraq, Nidal. Interview by Franklin Crump and Adam Weinberg. In person. Tufts University, September 20, 2012.

Applied Research Institute – Jerusalem (ARIJ). (2012). 'Ayda Camp Profile. Retrieved April 7, 2013 from http://www.ochaopt.org/documents/opt_arij_campprofile_ayda.pdf

Center for Affordable Water and Sanitation Technology (2011). Household Water Treatment and Safe Storage Fact Sheet: Chlorine (NaDCC Tablets). Retrieved April 3, 2012, from http://www.cawst.org/en/resources/pubs

Center for Disease Control and Prevention (CDC) (2012, August 18). Escherichia Coli. Retrieved April 3, 2012, from http://www.cdc.gov/ecoli/general/index.html

CDC & USAID (2008). HWTS Fact Sheets. Centers for Disease Control and Prevention, Atlanta, GA, USA. http://www.ehproject.org/ehkm/pou_bib2.html.

Galaitsis, S. and Huber-Lee, A. (2012). Estimating Domestic Water Demand in the West Bank. Unpublished manuscript.

Gunatilake, H., Yang, J., Pattanayak, S., & Ae Choe, K. (2007). Good Practices for Estimating Reliable Willingness-to-Pay Values in the Water Supply and Sanitation Sector (Asian Development Bank Economics and Research Deartment Technical Note Series No. 23). Retrieved from http://www.ppiaf.org/sites/ppiaf.org/files/documents/toolkits/highwaystoolkit/6/bibliography/pdf/good_practices_for_estimating_reliable_willingness-to-pay.pdf

Hohn, E., Holmesheoran, M., McMahon, K., Galaitsis, S., Morrison, J., Crump, F., & Weinberg, W. (2012). Water Quality in Aida Refugee Camp. Retrieved April 2, 2013 from http://www.tufts.edu/water/pdf/WSSSPalestinePracticumReport2012.pdf

Lajee Center. (2013). About Us. Retrieved April 7, 2013 from http://lajee.org/index.php/lajee-center/about-us

Massachusetts Institute of Technology (MIT). (n.d.). Contingent Valuation. Retrieved April 16, 2013 from the MIT Web site: http://web.mit.edu/urbanupgrading/urbanenvironment/tools/contingent-valuation.html

Murphy. J. J., & Stevens, T.H. (2004). Contingent Valuation, Hypothetical Bias and Experimental Economics (prepared for the NAREA-CAES Conference, Nova Scotia). Retrieved from http://www.clt.astate.edu/gguha/Courses/EVSCore/CV%20bias.pdf

Palestinian Central Bureau of Statistics (PCBS). (n.d.). 'Ayda Camp. Retrieved April 7, 2013 from http://www.pcbs.gov.ps/pcbs_2012/CommunityProfile.aspx

Palestinian Water Authority (PWA). (2012). Water Supply Report 2010. Retrieved April 9, 2013 from http://www.pwa.ps/Portals/_PWA/Supply%20water%20report%20to%20print%20(2).pdf

Positive Deviance Initiative. (2010). About PD. Retrieved May 3, 2013 from the Positive Deviance Website: http://www.positivedeviance.org/about_pd/index.html

United Nations Relief and Works Agency (UNRWA). Aida refugee camp. Retrieved April 3, 2013 from the UNRWA Web site: http://www.unrwa.org/etemplate.php?id=104

United States Environmental Protection Agency (USEPA). (2012). Basic Information about E. coli in Drinking Water. Retrieved April 3, 2012, from http://water.epa.gov/drink/contaminants/basicinformation/ecoli.cfm

USEPA. (2006). Total Coliform Rule: A Handbook for Small Noncommunity Water Systems serving less than 3,300 persons. Retrieved from http://www.epa.gov/ogwdw/disinfection/tcr/pdfs/stepguide_tcr_smallsys-3300.pdf

Viessman, W, Hammer, MJ, Perez, EM, Chadik, PA. (2009) Water Supply & Pollution Control, 8th ed.. Pearson Prentice Hall, Upper Saddle River, NJ

World Health Organization (WHO). (2003). Domestic Water Quantity, Service Level and Health. Geneva, Switzerland. http://www.who.int/water_sanitation_health/diseases/WSH03.02.pdf

World Health Organization (WHO). (2011). Guidelines for drinking-water quality, 4th Edition; Volume 1: Recommendations. Geneva, Switzerland. www.who.int/water_sanitation_health/dwq/gdwq3rev/en/

# Attachments

## Attachment A – Schedule for March Trip to West Bank

| WSSS 2013 West Bank Trip Schedule | | |
|---|---|---|
| Friday, March 15 | 7:30 PM | Depart Boston for Tel Aviv via Newark |
| Saturday, March 16 | 3:30 PM<br>Evening | Arrive in Tel Aviv<br>Travel to Jerusalem |
| Sunday, March 17 | 9:30 AM<br>10 AM-Noon<br>2PM-6 PM | Depart for Aida<br>Meet with Salah to discuss plans and logistics for the week<br>Water Quality Testing |
| Monday, March 18 | 9:30 AM-Noon<br>2 PM-6 PM | Community Surveys<br>Water Quality/ Outreach Meeting & Community Surveys |
| Tuesday, March 19 | 9 AM-11:30 AM<br>2 PM-6 PM | Community Surveys and Water Quality Testing<br>Water Quality/Outreach Meeting & Community Surveys |
| Wednesday, March 20 | Day Trip / Tour of Hebron | |
| Thursday, March 21 | 10 AM-1 PM<br>2 PM-6 PM | Education Workshop<br>Community Surveys |
| Friday, March 22 | 9:30 AM-11:30 AM<br>1 PM-2 PM<br>3:30 PM | Community Surveys<br>Debrief with Lajee<br>Travel to Jerusalem |
| Saturday, March 23 | Day in Jerusalem | |
| Sunday, March 24 | 7 AM<br>9 PM | Depart for Tel Aviv Airport<br>Arrive in Boston |

## Attachment B - Manual for Water Education at Lajee

*A fully formatted version for Lajee has been created separately.*

This manual offers guidance for water education at Lajee. Based on input from the March 2013 WSSS practicum meeting and workshop participants, the WSSS team recommends that Lajee become a center for water education where students visit and engage in activities that make use of unique resources, such as the water quality testing equipment, available at Lajee. It is hoped that designating Lajee as a field trip destination brings water issues to the forefront of education and develops a cohort of informed and engaged youth.

The following text describes three activities that Lajee can implement after coordinating with local schools. The WSSS team recommends that these activities be viewed as short term educational goals and that Lajee and local schools form a partnership through which Lajee may expand its role. It is important that the educational resources at Lajee reflect the needs and interests of the local educational community, which includes administrative staff, teachers, and, importantly, the students themselves.

### Water Education Activities

The following three activates may be organized as stations to be completed by students during one school field trip visit to the Lajee Center. Students will break into groups to cycle through activities. With this format, it is anticipated that these three activities will take a total of two hours. Students are encouraged to take the activity handouts home to share with their families.

The exercises are intended to target grades 5 through 9.

### Activity 1 - Chlorine and Taste

*Learning Objectives*

Through this activity students will learn:

- Adding chlorine to drinking water kills bacteria;
- How to treat water with chlorine tablets;
- How to use filters to remove the smell and taste of chlorine from water; and
- Some basic science behind chlorine as a drinking water disinfectant.

*Materials*

- Chlorine tablets
- Filters
- Student Activity Handout
- Pens

*Facilitation*
No formal facilitation is required.

*Procedure*

1. Students break into groups of two to four, depending on the size of the student group and the number of chlorine tablets and filters available.
2. Students read the activity handout to learn more about the science of chlorine disinfection and carbon filters.
3. Students use chlorine tablets to disinfect the water and the filters to remove the taste from some of the chlorine-treated water.
4. After treatment, students compare the taste of the unfiltered and filtered chlorine-treated water and answer questions about the reading material and their reactions to using the filters.

**STUDENT ACTIVITY HANDOUT**

Please read the Student Activity Handout to learn about the chlorine tablets and carbon filters you will use for this activity.

You can then follow the instructions on the handout titled Improving Water Quality. It will show you how to use the chlorine tablets and filters.

Afterwards, you will do a taste test and answer a few questions.

*Background Information*

What is chlorine? Chlorine is a common household cleaner and disinfectant that is added to drinking water and swimming pools to remove harmful bacteria, such as some types of coliform bacteria. It is relatively inexpensive and commonly used to disinfect water supplies (USEPA, 2012; WHO, 2013).

*Coliform Bacteria*

What are coliform bacteria? Coliform bacteria are ubiquitous in the environment and are concentrated in the feces of animals, including humans. Waterborne coliforms are often called indicator organisms because they indicate that a pathway exists between the source of the bacteria and a water supply, and because their presence may mean that harmful (but less abundant) disease-causing organisms are also present in the water supply. Testing can be completed for different types of coliform bacteria, which may indicate different levels of risk. This includes testing for total coliform bacteria and *Escherichia coli (E. coli).*

This activity focuses on using chlorine to disinfect water, but there is more than one way to get rid of coliform bacteria. Lajee has information available on a number of different methods.

What does chlorine do? Chlorine destroys the membranes, or protective barrier, of microorganisms in the water and kills them. However, it only works if the chlorine comes into direct contact with organisms. It cannot make contact and destroy the microorganisms through silt or particles of organic material (WHO, 2011).

How long does it take chlorine to do its job? To kill harmful microorganisms, chlorine should be in the water for at least 30 minutes when the temperature is 18 degrees Celcius or above. This recommended time becomes longer as the water becomes colder. As a result, it is normal for chlorine to be added to water as it enters the main storage tank, like the one shown below, or before it goes through a long piping system (WHO, 2011).

How much chlorine should be in the water? The Palestinian Water Standard is that free chlorine should not be less than 0.2 milligrams per liter or more than 0.8 milligrams per liter where it is consumed (WHO, 2006).

How does chlorine disinfect water? Some of the chlorine reacts with and destroys organic material and metals in the water, which means the chlorine attacks them to get rid of them. The amount of chlorine used up in this process is called the chlorine demand. This chlorine is no longer able to disinfect the water.

The remaining chlorine, called total chlorine, is either combined or free.

Free chlorine is available to inactivate, or destroy, harmful organisms.

Combined chlorine already combined with other compounds in the water, called nitrates. It is not available for disinfection.

Nitrates for a combined chlorine in water, so the amount of free chlorine is less than the amount of chlorine first added to the water.

Chlorine Added – Chlorine Demand = Total Chlorine
Total Chlorine = Free Chlorine + Combined Chlorine

As a result of these processes, the amount of free chlorine is less than the amount of chlorine first added to the water (CDC, 2012).

Why do people add chlorine to the water if it is already in the supply?

The amount of chlorine added to the water supply will not always be the same when people are ready to drink it at homes or in school.

The CDC explains that 0.5 milligrams per liter of free chlorine might maintain a good water supply as it moves through the pipes but is probably not enough to keep the water clean when people store the water for 24 hours (CDC, 2012). It important to be aware that even though the chlorine destroys microorganisms, the water may not be clear of sediment, rust, or other contaminants.

Chlorine also volatilizes, or evaporates, from the water. Chlorine volatilizes more quickly when water is warmer (Suslow, 1997).

When do people start to smell and taste chlorine in their water?

People start to notice the taste of chlorine when levels are 5 milligrams per liter. People begin to notice the smell at 2 milligrams per liter (WHO, 2003).

What can people do to get rid of the smell and taste of chlorine?

Activated carbon filters can help lessen the smell and taste of chlorine in the water (Michigan State University, 2003).

*Questions*

Please answer these questions after you use the chlorine tablets and filters.

1. Did you notice a taste difference between the unfiltered and filtered water?
2. Think about chlorine in your own home. What do you think might happen to chlorine in the water that has been sitting in your storage tanks for several days or weeks?
3. Do you think you and your family would use the chlorine tablets at home? Why or why not?

**Activity 2 - Water Quality Testing**

*Learning Objectives*

Through this activity students will learn:

- How to analyze water samples for total coliform bacteria and *Eschericia coli (E. coli)* using the membrane filtration technique;
- How to count and record bacterial colonies; and
- The importance of positive and negative controls in lab experiments.

*Materials*

- Water samples
- Petri dishes with absorbent pads (1 dish and pad combination per water sample)
- Fully incubated Petri dish with visible coliform
- Permanent markers
- Media – 2 mL plastic ampoule of m-Coliblue24® Broth (1 per sample)
- Filters (1 per sample)
- Box of gloves
- Plastic pipettes for dilutions if necessary
- Plastic filtration unit and syringe
- Chlorine disinfectant (bleach)
- Tweezers
- Buckets (1 for disinfecting the sample bottles and filtration unit and 1 for rinse water)
- Data entry sheets

*Facilitation*
Facilitation by one instructor will be required in the lab activity. Students will first retrieve samples from their own homes in Aida or a tap near Lajee to run the tests. Through this activity, the Lajee staff or facilitator may be able to identify interested and engaged students as possible internship candidates.

*Procedure*

1. Students break into groups of two to four, depending on the size of the student group and the testing equipment available.
2. Students read through the Student Activity Handout and follow its instructions to learn how to take water samples on their own.

**STUDENT ACTIVITY HANDOUT**

*Preliminary Information*

*Media*
Shelf life of media is 12 months from date of manufacture. Media should always be stored in a refrigerator when not in use. A standard kitchen refrigerator maintained at < 4º Celsius is sufficient. Ampoules should be stored in plastic bag or container to keep them separated from other items in the refrigerator.

*Quality Control*
It is important to have quality control samples to ensure that our data is consistent and good quality. We will prepare and process both a negative control and a positive control with the same procedure as the other samples.

Negative Control – Negative controls are used to ensure that bacteria are not present in the testing materials. No colonies should be found in the negative control. Use bottled water for this control.

Positive Control – Positive controls are used to ensure that bacteria will grow in the media under the lab conditions if they are indeed present. If the media expires, the samples will not grow bacteria even if it is present. Positive controls should be routinely completed. The positive control should be processed with the group of water samples to be analyzed. Water for this sample should be collected where total coliform and *E. coli* bacteria are known to be high (e.g., toilet water after someone has used the toilet). After defecating, flush the toilet once and then, wearing clean latex gloves, collect your sample from the toilet bowl as you would with any other sample. Begin by triple rinsing your bottle, dumping the rinse water in the sink. Then collect your sample from the toilet bowl. Plate 1 mL of positive control water diluted with tap water from the Lajee Center for a total of 100 mL of liquid. The positive control should be the last sample of the day to minimize the potential for cross-contamination, as it will likely have the highest concentrations of coliform bacteria. Sometimes the growth on the positive control will be pink, most likely because the bacteria are too numerous for the volume of media.

*Procedure*

It is important that analysis procedures in the lab be performed the same way each time to ensure consistency of the results.

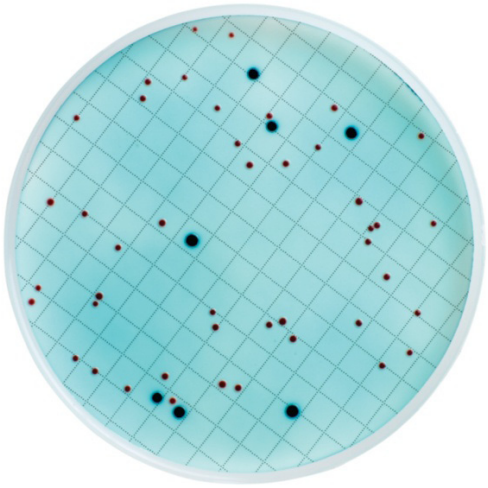
*Plating the Samples*

1. Plating should begin as soon as the samples arrive in the lab. Samples should be placed in the refrigerator until plating begins.
2. Turn on the incubator. Set to 35° Celsius.
3. Put on rubber gloves.
4. Sterilize the upper chamber of the filtration unit and tweezers in a bucket of water with chlorine bleach. Use 1 capful (~10 mL) of bleach per four liters of water (approximately ½ bucket). Soak in bucket for at least 30 minutes. Thoroughly rinse with tap water from Lajee Center. After rinsing, there should be no chlorine odor on the sample bottles or equipment. If the sterilized filtration equipment touches any unclean surface, re-sterilize.
5. Label both sides of each Petri dish in permanent marker with the location and date of each sample. Label one dish per sample.
6. Place the Petri dish on the table with the side that says “Millipore” face down.
7. Remove the cap from the media ampoule. Remove the cover of the Petri dish, holding it only by the outer edge. Do not place the Petri dish cover on the table. Squeeze the media evenly over the pad inside of the Petri dish without touching the pad. Place the Petri dish cover back on.
8. Remove the upper chamber of the filtration unit and place it on a clean surface such as a cleaned area on the table or sheet of paper.
9. Take a filter and open the packaging, being sure to touch only the outside of the package. Using your sterilized tweezers, gently separate the blue cover from the white filter. Try to touch only the edge of the filter with the tweezers. Remove the filter from the sterile packaging. Center the filter, grid side up, on the white pad on the base of the filtration unit.
10. Place the upper chamber of the filtration unit on top of the filter, and snap into place. Be sure to push the top on tightly, so that there is no leakage once the sample is poured into the upper chamber.
11. Attach the vacuum pump (syringe) to the side spout of the filtration unit.
12. Pour the entire water sample (125 mL) into the upper chamber of the filtration unit.
13. Slowly pull the plunger back so that the sample water drips through the filter. As needed, detach the syringe, push the plunger back in, and reattach the syringe to the spout. Pump until all of the water has dripped into the bottom of the filtration unit.
14. Remove the vacuum syringe from the filtration unit.
15. Remove the upper chamber of the filtration unit and place it upside down on a clean surface.
16. Secure the edge of the filter with the tweezers and lift the filter off of the filtration unit. Be careful not to tear the filter or touch the center of the filter.
17. Remove the lid of the Petri dish and gently lay the filter flat -- grid-side up -- and centered on the pad inside the Petri dish. Place the Petri dish cover back on the dish.
18. Place the Petri dish in the incubator, keeping the “Millipore” side up, and incubate for 22 ± 2 hours. Note that for the purpose of this exercise, you will be looking at the result from already incubated samples. Typically, you would wait 22 ± 2 hours before analyzing your results.

19. Sterilize equipment, including tweezers, between each sample by placing the equipment in a bucket of water with chlorine bleach. Use 1 capful of bleach per four liters of water (approximately ½ bucket). Soak bottles in bucket for at least 30 seconds. Rinse with tap water from Lajee Center. If sampling equipment becomes unclean again, re-sterilize.
20. Repeat steps 5 through 19 for each remaining sample.
21. Refrigerate remaining ampoules of media. Clean up and put all other materials back where they belong.
22. Place the sample bottles and caps in the bucket containing the chlorine bleach and let soak for 24 hours before rinsing.

*Counting the Bacteria Colonies*

1. In the prepared plated samples, count the blue (*E. coli*) and red (other coliforms) colonies. Total coliform is the sum of the blue and red colonies. Use the grids on the filter to keep track of which colonies you have already counted. For example, you can count all colonies above a line (including the ones directly on the line) and continue this as you move from top to bottom. Remember the three key things to look for when counting colonies – color and shine. The colonies should be dark red or blue in color and exhibit a shine. Observing the colonies under direct light or sunlight can help determine if the colony exhibits shine. Colonies will look similar to the following:



Source: Millipore m-ColiBlue24® Broth website
http://www.millipore.com/catalogue/item/m00pmcb2

*Recording the Data*

1. When colonies for each sample are counted, the results should be recorded on the corresponding data sheet.
2. If you make a mistake on a data sheet, cross out the mistake and write the correct text next to it. Do not erase anything.
3. If any data needs to be discarded, write the reason why the data is being discarded on the data sheet. Some examples of reasons to discard a sample are: analytical errors, the filter turned pink because there was not enough media in the Petri dish, and power outages that shut off the incubator for more than 30 minutes.
4. Filters and Petri dishes can be thrown out in the trash. First place them in a plastic bag so that no one comes in direct contact with the dirty filters.

**Activity 3 - Water, Bacteria, and Illness**

*Learning Objectives*

Through this activity students will learn:

- Basic facts about coliform bacteria;
- Sources of coliform bacteria;
- How coliform bacteria enters the water system; and
- The health impact of coliform bacteria.

*Materials*

- Student Activity Handout
- Pens

*Facilitation*
No formal facilitation is required.

*Procedure*
Students read the Student Activity Handout and answer questions about the reading.

**STUDENT ACTIVITY HANDOUT**

Please read the information below and answer the questions that follow.

What are coliform bacteria? Coliform bacteria are ubiquitous in the environment and are concentrated in the feces of animals, including humans. Waterborne coliforms are often called indicator organisms because they indicate that a pathway exists between the source of the bacteria and a water supply, and because their presence may mean that harmful (but less abundant) disease-causing organisms

are also present in the water supply. Testing can be completed for different types of coliform bacteria, which may indicate different levels of risk. This includes testing for total coliform bacteria and *Escherichia coli* (*E. coli*).

Total coliform bacteria that are commonly found in the environment are usually harmless (USEPA, 2006). If only total coliform bacteria are in the water, then the source is probably from the environment as opposed to human waste materials. However, they may be used to indicate the effectiveness of water treatment and distribution system integrity (WHO, 2008). *E. coli* is considered the best indicator of recent fecal contamination in the water and that disease-causing bacteria (pathogens) may be present (WHO, 2008). *E. coli* are abundant in the feces of humans and warm-blooded animals, can be found using simple tests, and are not found growing naturally in water (WHO, 2001).

If water does have harmful bacteria, the most common symptoms of illness include vomiting, fever, abdominal cramps, and diarrhea. Children, the elderly, and people with weak immune systems are most vulnerable (Clemens et al., 2007; Washington State Department of Health, 2008). World Health Organization (WHO) standards are that the *E. coli* and other coliform colonies (i.e., the total coliform count) in a 100 mL sample must not exceed zero when membrane filtration is used (WHO, 2006).

What are sources of fecal coliform bacteria?

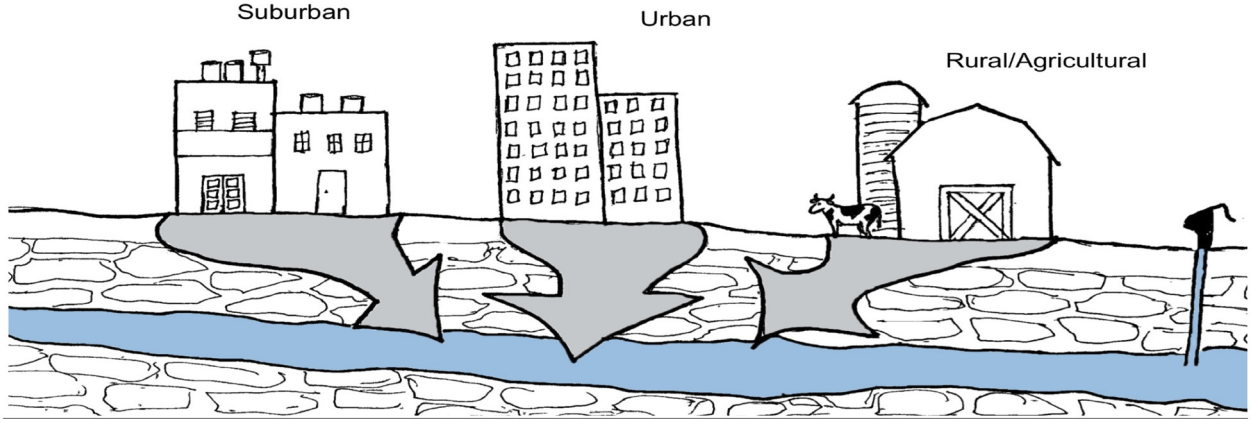
Human Waste

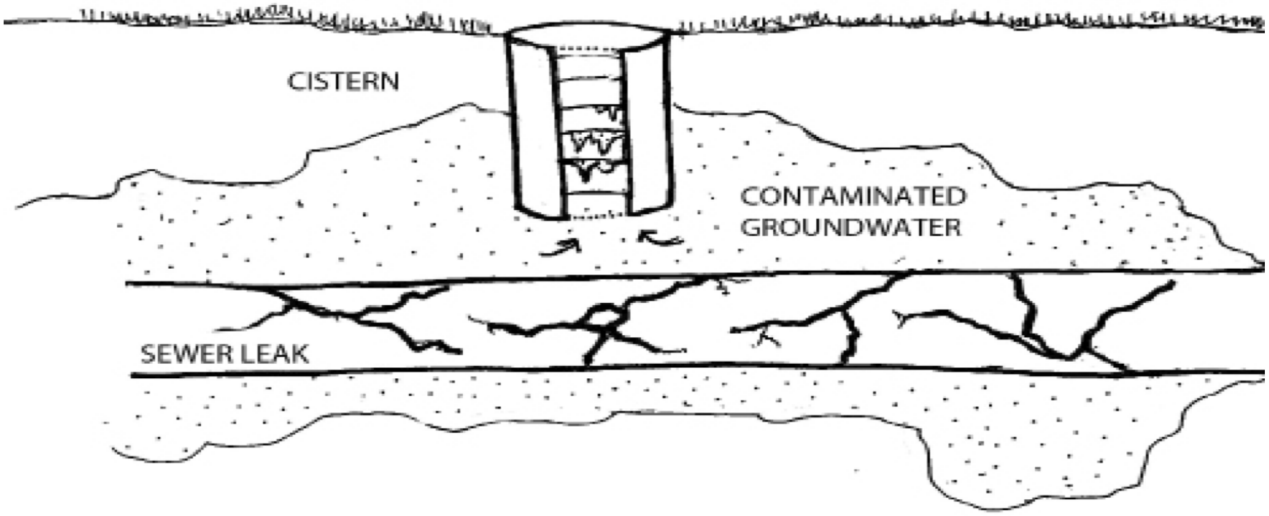
- Sewer Pipe Leaks
- Septic System Discharge
- Sewage Plant Discharge

Animal Waste

- Feedlot Runoff
- Pastureland Runoff
- Agricultural Runoff After Manure Fertilizer Application
- Infiltration of Domestic or Wild Animal Feces

Remember that coliform bacteria are naturally in the environment, so runoff from areas without human or animal waste may have coliform but from a fecal source.






How can coliform bacteria get into the water system?

Ideally, our water system will be able to keep out coliforms, but if the bacteria are able to enter, it may happen in a number of ways:

- Open Storage Tanks
- Poorly Constructed, Poorly Maintained, or Open Wells
- Cross Contamination of Water and Sewer Lines

What helps bacteria grow? Sediment particles in the water system can create a place for coliform to grow and be protected from disinfectants like chlorine. Biofilms, or layers of bacteria, growing on the walls of water pipes can also be a place where coliforms attach and grow (USEPA, 2007). Temperature is also an important factor in bacterial growth. In warm climates, bacteria may grow very quickly (WHO, 2003).

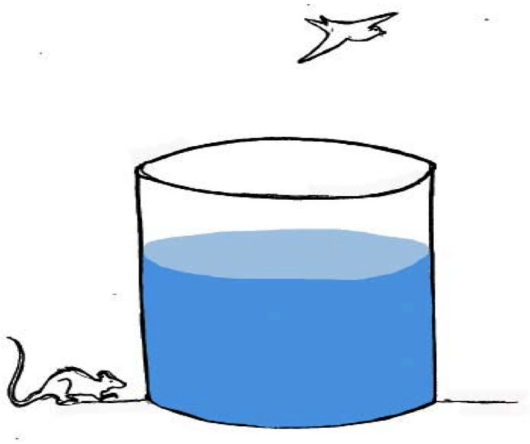
Can I spread coliform bacteria? Bacteria can easily travel between people, especially when adults and children do not properly wash their hands (Mayo Clinic, 2011).

What happens when people drink water with disease-causing bacteria? If water does have harmful bacteria, the most common symptoms are an upset stomach and flu-like symptoms such as fever, abdominal cramps, and diarrhea. Children, the elderly, and people with weak immune systems are most vulnerable (Clemens et al., 2007; Washington State Department of Health, 2008).

*Questions*

1. Which type of coliform bacteria is considered to be the best indicator of fecal contamination in the water supply?
2. Do all types of coliform make people sick?
3. Circle your answer. Yes  No
4. Based on what you just learned, list some ideas you have to minimize the amount of bacteria in your water.
5. If you would like some ideas, please ask Lajee for information on household clean water resources and practices.

6. Are coliform bacteria more likely to grow in the summer or the winter?
7. Give an example of a source of fecal coliform bacteria in a rural setting and an urban setting.
8. Explain how broken or cracked sewer pipes can lead to bacteria in the drinking water supply.



*References*


British Columbia Ministry of the Environment. (2007). Total, Fecal, & E. coli Bacteria in Groundwater. Retrieved from http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/library/ground_fact_sheets/pdfs/coliform(020715)_fin2.pdf

Clemens, S., Bryan R. Swistock, B.R., & Sharpe, W. (2007). Water Facts #13: Coliform Bacteria. Retrieved from http://www.aasl.psu.edu/coliform.pdf

Centers for Disease Control and Prevention. (2006). Facts about Chlorine. Retrieved April 8, 2013 from http://www.bt.cdc.gov/agent/chlorine/basics/facts.asp

Centers for Disease Control and Prevention. (2012). Chlorine Residual Testing Fact Sheet. Retrieved April 8, 2013 from http://www.cdc.gov/safewater/publications_pages/chlorineresidual.pdf

Washington State Department of Health. (n.d.). Coliform Bacteria in Drinking Water. Retrieved April 11, 2013 from the Washington State Department of Health Web site: http://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Coliform.asp

Mayo Clinic. (2011). E. Coli: Causes. Retrieved April 12, 2013 from http://www.mayoclinic.com/health/e-coli/DS01007/DSECTION=causes

Michigan State University. (2003). Activated Carbon Water Treatment. Retrieved April 9, 2013 from http://www.msue.msu.edu/objects/content_revision/download.cfm/revision_id.499668/workspace_id.-4/01500610.html/

New York State Department of Health. (2011). Coliform Bacteria in Drinking Water Supplies. Retrieved April 11, 2013 from the New York State Department of Health Web site: http://www.health.ny.gov/environmental/water/drinking/coliform_bacteria.htm

Rhode Island Department of Health & University of Road Island. (2003). Healthy Drinking Waters for Rhode Islanders. Retrieved from http://www.uri.edu/ce/wq/has/PDFs/Bacteria_handout_revised.pdf

Suslow, T. Davis. (1997). Postharvest Chlorination (ISBN 978-1-60107-183-5). Retrieved April 9, 2013 from http://anrcatalog.ucdavis.edu/pdf/8003.pdf

Treyens, C. (2009). Bacteria and Private Wells: Information Every Well Owner Should Know. Retrieved from http://www.nesc.wvu.edu/pdf/dw/publications/ontap/magazine/OTWI09_features/BacteriaAndPrivateWells.pdf

United States Environmental Protection Agency. (2006). Causes of Total Coliform-Positive Occurrences in Distribution Systems. Retrieved from http://www.epa.gov/ogwdw/disinfection/tcr/pdfs/issuepaper_tcr_causes.pdf

United States Environmental Protection Agency. (2007). Chlorine. Retrieved April 8, 2013 from http://www.epa.gov/ttnatw01/hlthef/chlorine.html

United States Environmental Protection Agency. (2012). Basic Information about Disinfectants in Drinking Water: Chloramine, Chlorine and Chlorine Dioxide. Retrieved April 8, 2013 from http://water.epa.gov/drink/contaminants/basicinformation/disinfectants.cfm

United States Environmental Protection Agency. (2012). 5.11 Fecal Bacteria. Retrieved April 12, 2013 from the United States Environmental Protection Agency Web site: http://water.epa.gov/type/rsl/monitoring/vms511.cfm

United States Environmental Protection Agency. (2013). Basic Information about Pathogens and Indicators in Drinking Water. Retrieved April 12, 2013 from http://water.epa.gov/drink/contaminants/basicinformation/pathogens.cfm

Washington State Department of Health. (n.d.). Coliform Bacteria in Drinking Water. Retrieved April 11, 2013 from the Washington State Department of Health Web site: http://www.doh.wa.gov/CommunityandEnvironment/DrinkingWater/Contaminants/Coliform.aspx

Washington State Department of Health. (2008). Public Health Advisory: Coliform. Retrieved from http://www.doh.wa.gov/Portals/1/Documents/Pubs/331-179.pdf

World Health Organization. (2001). Water Quality: Guidelines, Standards and Health. Retrieved from http://www.who.int/water_sanitation_health/dwq/iwachap2.pdf

World Health Organization. (2003). Conditions favouring coliform and HPC bacterial growth in drinking-water and on water contact surfaces. Retrieved from http://www.who.int/water_sanitation_health/dwq/HPC10.pdf

World Health Organization. (2003). Chlorine in Drinking-water: Background document for development of WHO Guidelines for Drinking-water Quality. Retrieved April 8, 2013 from http://www.who.int/water_sanitation_health/dwq/chlorine.pdf

World Health Organization. (2006). A compendium of drinking-water quality standards in the Eastern Mediterranean Region. Retrieved from http://applications.emro.who.int/dsaf/dsa1183.pdf

World Health Organization (2011). Measuring chlorine levels in water supplies. http://www.who.int/water_sanitation_health/publications/2011/tn11_chlorine_levels_en.pdf

## Attachment C - Survey Questions and Detailed Results

### Survey Questions

### Section 1 – Household Health

1. How many people live in this household?
2. How many are children under the age of 5? Adults over the age of 65?
3. a) Has anyone in your family been sick in the last 15 days?

   b) In the last 6 months?

   c) Who (no names-categorize by age)?

   d) What was the nature of the illness?
4. Check all symptoms associated with illness:

   - Diarrhea
   - Vomiting
   - Fever
   - Intestinal Discomfort
   - Coughing
   - Runny Nose
   - Other

5. How frequently does an illness like this occur in your household?

   - Less than once a year
   - 1-2 times a year
   - More than twice a year
   - Once a month

6. Are there types of illnesses that happen at a specific time of the year in the camp? If so, what are they and when do they occur?
7. What causes the sickness described above?

### Section 2 – Water Usage and Storage

1. How do you store your water?

| | |
|---|---|
| Tank (Plastic or Metal): | Quantity: |
| Cistern: | Quantity: |
| Dubba: | Quantity: |
| Other: | Quantity: |

2. How often do you run out of water in your tank (wet season/dry season)?
3. Do you ever take any measures to clean your water? What are these measures?
4. If you do take any measures, how did you learn about these measures?

5. a) If you do not take any of these measures, would you be willing to do so in the future?

   b) Which interventions would you be more likely to use?

   - Adding chlorine to water
   - Using a filtration system (ceramic filters)
   - Using flocculant/disinfectant powders (PUR Purifier of Water)
   - Placing water bottles in the sun for 6 hours (Solar disinfection)
   - Boiling Water

6. Do you clean your water storage vessels?

   Yes How?
   No Why not?

7. Would you request tank cleaning services if they were available? How much would you be willing to pay for these services?
8. How often does your primary water supply run out (wet and dry season)?
9. a) Do you ever buy water? Yes No

   b) How much does it cost?

   c) Where do you get it?

   - Water truck
   - Water bottles or other water based drinks
   - Other

**Section 3 – Water Quality**

1. What do you think of the quality of water delivered (taste, smell, color)?

   Primary Supply

   a) Taste
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

   b) Smell
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

   c) Color
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

   Secondary Supply

   a) Taste
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

   b) Smell
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

   c) Color
   - Very bad
   - Bad
   - Normal
   - Good
   - Very good

2. a) Have you had your water tested recently?

   b) If yes, when?

   c) How did you learn about the water quality testing services?

   d) If you didn't have your water tested, are you aware these services are available?

3. Did your water contain coliform bacteria when it was tested?

   a) Did you take any measures to treat your water if it was contaminated?

   b) What were those measures and how did you find out about them?

   c) If you didn't take any measures, why not?

4. Is your household connected to a sewer? Yes No

5. If a water quality issue were identifid, who would you go to with your complain?

   UNRWA PWA Mekorot Lajee Center Lajee Other

6. Who would you expect to deal with it?

   UNRWA PWA Mekorot Lajee Center Lajee Other

7. How do you think Lajee could encourage the implementation of clean water practices in households throughout the camp?

8. Would you be willing to pay $3 / month for clean water?

8. Would you be willing to pay $5 / month for clean water?

8. Would you be willing to pay $10 / month for clean water?

**Survey Results**

| Household Water Purchases | |
|---|---|
| Households that purchase water | 63% |
| ***Type of Purchase*** | |
| Water Truck | 44% |
| Water Bottles | 56% |
| Average Cost of Water Bottle | 2.46 NIS (0.69 USD) |
| Cost of Water Delivered by Truck | 280 NIS (79.93 USD) |

| Tank Cleaning | |
|---|---|
| ***Household That Clean Their Tank (n=40)*** | |
| Yes | 87.5% |
| No | 12.5% |
| ***How Households Clean Their Tank (n=37)*** | |
| Water Only | 32% |
| Chlorine | 35% |
| Soap | 19% |
| Vacuum | 5% |

| Tank Cleaning | |
|---|---|
| ***Households Willing to Request Tank Cleaning (n=39)*** | |
| Yes | 49% |
| No | 51% |
| ***Households Willing to Pay for Tank Cleaning (n=22)*** | 41% |
| ***Average Price Willing to Pay for Tank Cleaning*** | 32 NIS* |

*10.67 USD

| Measures to Clean Water | |
|---|---|
| ***Households that Take Measures to Treat Drinking Water* (n=40)*** | 28% |
| ***How Those Households Clean Their Water** (n=11)*** | |
| Homemade Filter | 18% |
| Chlorine | 36% |
| Boil | 36% |
| Filtration | 27% |
| ***Willingness to Use Interventions (n=40)*** | |
| Chlorine | 35% |
| Filtration | 63% |
| Flocculants | 23% |
| SODIS | 13% |
| Boiling | 43% |
| Other | 5% |

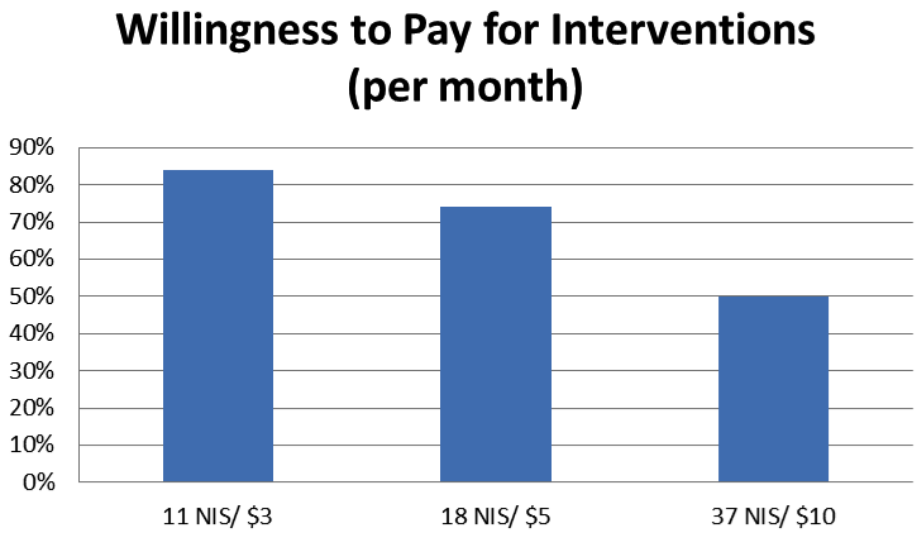
* Point source interventions only

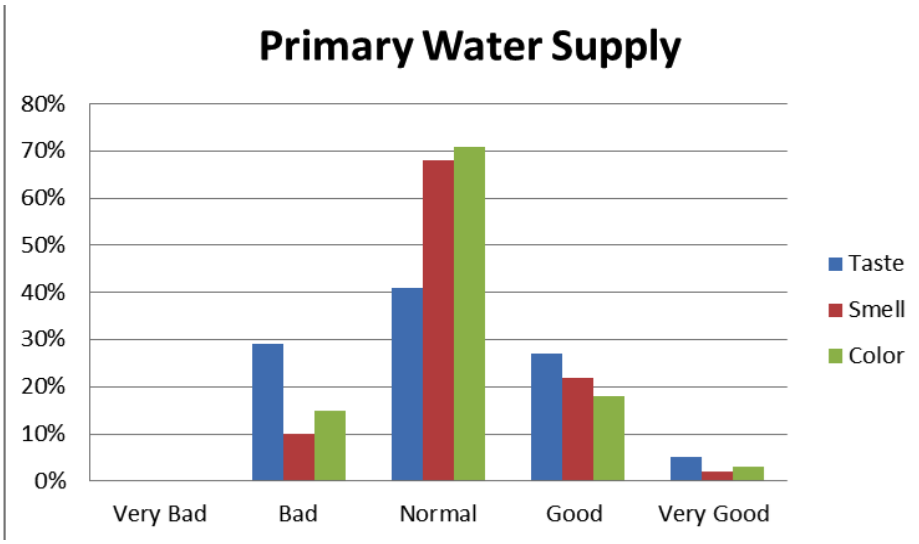
** Out of the households that indicate that they take some measure to clean their water

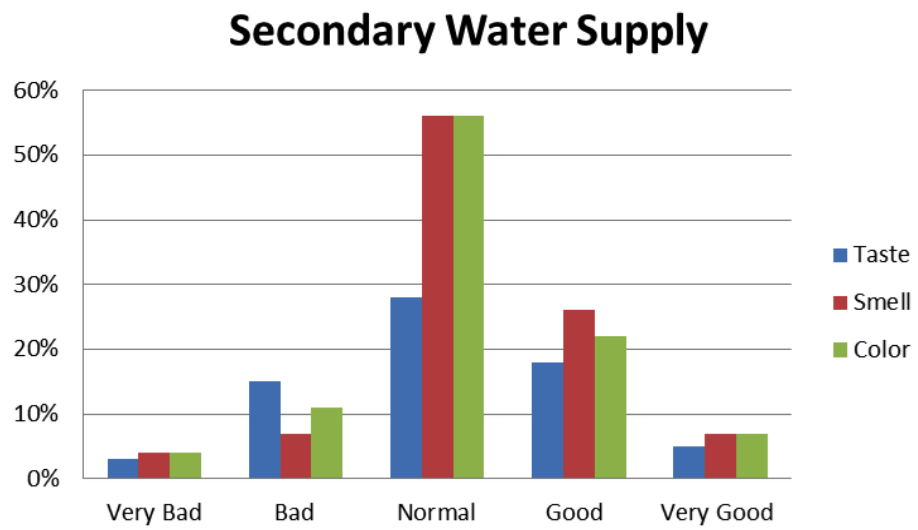
| Summary of Recent Household Illness | |
|---|---|
| ***Seasonality of Illness (n=20)*** | |
| Winter | 55% |
| Summer | 10% |
| Spring | 20% |
| ***Type of Illness (n=20)*** | |
| Cold / Flu | 40% |
| Diarrhea / Vomiting | 5% |
| Fainting | 5% |
| Viruses | 10% |
| Allergies | 10% |
| Chronic | 10% |
| ***Cause of Illness (n=28)*** | |
| Weather | 57% |
| Infection | 4% |
| Viruses | 4% |
| Water | 4% |
| Poor Sanitation | 7% |
| Other | 18% |

| Water Quality Testing | |
|---|---|
| ***Households That Had Drinking Water Tested (n=41)*** | 80% |
| ***How Households Learned About Testing (n=29)*** | |
| Lajee Center | 90% |
| UNRWA | 10% |
| Family / Neighbors | 7% |
| Filter Company | 10% |

| Reporting Water Quality Issues | |
|---|---|
| ***To whom would you go with a water quality complaint? (n=41)*** | 37% |
| UNRWA | 18% |
| PWA | 56% |
| Mekorot | 0% |
| Lajee Center | 2% |
| Other | 22% |
| ***Who would you expect to address it?*** | |
| UNRWA | 23% |
| PWA | 41% |
| Mekorot | 0% |
| Lajee Center | 8% |
| Other | 21% |




Primary Water Supply
80%
70%
60%
50%
40%
30%
20%
10%
0%
Very Bad
Bad
Normal
Good
Very Good
Taste
Smell
Color


Secondary Water Supply
60%
50%
40%
30%
20%
10%
0%
Very Bad
Bad
Normal
Good
Very Good
Taste
Smell
Color

## Attachment D - Water Quality Testing and Intervention Protocol

*These protocols are current as of May 2013. The signed Memorandum of Understanding may include more up-to-date protocols that supersede this text.*

**Sampling**

- Collect 10-20 samples per week including requested and random sampling.

  * Workshops and other educational activities that include sampling do not count toward this protocol.

- Community tap sampling
  - Test the community tap on the same day that any household testing is conducted.
  - Conduct sampling as specified on BACTERIA ANALYSIS PROTOCOL.
  - Use community tap results for comparison to household testing.
- Targeted Sampling
  - Household selection – Continue sampling remaining households in Aida as a continuation of the 2012 practicum goal to test 100% of households.
  - Hand out informational brochures upon entering house.
  - Conduct sampling as specified on BACTERIA ANALYSIS PROTOCOL.
- Requested Sampling

  * Includes sampling conducted upon request from resident.
  - Provide information about water program if necessary.
  - Conduct sampling as specified on BACTERIA ANALYSIS PROTOCOL.
- Retest Sampling

  * If a household tests positive for the presence of indicator bacteria.
  - Inform resident of positive test as soon as possible.
  - Provide information about water program if necessary.
  - Conduct sampling as specified on BACTERIA ANALYSIS PROTOCOL.
- All residents should be informed of water testing results as soon as possible.

**Intervention Provision**

**Contingent upon household testing positive for bacterial contamination.*

- Provide intervention brochures and other informational material to residents.
- Demonstrate the proper use of chlorine tablets (e.g., Aquatabs®)

- Note residents who express dislike for the taste of chlorine.
- If residents oppose using chlorine tablets due to the taste and smell, suggest activate carbon filters (e.g. Brita® filters).

**Data Logging**

- Water Quality Test Data
  - Log all water sample data in the Water Quality Data spreadsheet (WQ_Data_Template_xlsx).
  - Compile data within the Water Quality Data spreadsheet by month.
  - See example at top of data sheet for proper method of data entry.
- Intervention Provision Data
  - Log information on households that received interventions in the Intervention spreadsheet (Intervention_Distribution.xls).

**Data Sharing**

- Water Quality Test Data
  - Send data to the WSSS team at the end of each month.

| Water Quality Data (WQD) - Month 20XX | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | No. of Colonies | | |
| Sample No. | Date (d/m/y) | House No. | Household Name | No Water Available for Testing ("x" if yes) | Retest ("x" if yes) | Invervention ("x" if yes) | Sampler's Name | Volume Plated (mL) | Time of Incubation Start (hh:mm) | Other Coliforms (red) | *E. coli* (blue) | Total Coliform (red + blue) |
| Ex. 1 | 22/3/2013 | A43 | Family 1 | | | | Sampler | 125 | 18:00 | 5 | 2 | 7 |
| Ex. 2 | 23/4/2013 | B03 | Family 2 | x | | | Sampler | - | - | - | - | 0 |
| Ex. 3 | 23/4/2013 | A43 | Family 1 | | x | x | Sampler | 125 | 18:30 | 3 | 1 | 4 |
| | | | | | | | | | | | | 0 |
| | | | | | | | | | | | | 0 |
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| | | | | | | | | | | | | 0 |

| Water Quality Intervention Tracker | | | | | |
|---|---|---|---|---|---|
| House No. | Household Name | Intervention Being Used | Date Started (d/m/y) | Date Ended (d/m/y) | Reason for Stopping Use of Intervention |
| A43 | Family 1 | boiling | 22/3/2013 | 22/4/2013 | chose to stop |
| C21 | Family 2 | chlorine + filter | 30/3/2013 | 15/5/2013 | water tested clean |
| D03 | Family 3 | chlorine | 13/4/2013 | | |
| | | | | | |
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## Attachment E - Water Program Coordinator Job Description

*This description is current as of May 2013. The signed Memorandum of Understanding may include a more up-to-date list of job tasks that supersede this text.*

**Description and Skills**

The water program coordinator will work quarter time from June 2013 through June 2014 to assist residents of Aida Refugee Camp with their concerns regarding water quality in their homes. Position tasks include continued targeted water sampling at households that have not yet been tested and water sampling at households as requested by residents. When there are positive results, the water program coordinator will work with the residents to determine the best way to provide clean drinking water. The coordinator will also be responsible for keeping records of all interactions with residents as well as records of water testing results. The water program coordinator will also interact with community members and respond to inquires about water quality and work with other Lajee staff members to sustain community engagement and student educational activities. Key responsibilities include:

- Advertising the water program at Lajee to the Aida community;
- Performing water testing for bacterial contamination and logging data;
- Managing the intervention inventory (chlorine tablets) and supplying residents as needed;
- Providing quarterly status updates (water quality data) to the WSSS team; and
- Hosting student field trips to Lajee for water education in collaboration with local schools.

**Preferred Skills**

- Able to use data management software (e.g., Microsoft Excel).
- Able to follow protocols consistently.
- Able to perform water quality testing on a regular basis.
- Communicates well with others.
- Interest in continuing this work beyond 6 months (suggested).
- Interest in water quality issues and community engagement.

| Intervention | Benefits[1] | Drawbacks[1] | User Feasibility[2] | Accepted by Community[3] | Cost[1] |
|---|---|---|---|---|---|
| *Chlorine Solution (sodium hypochlorite solution)* | • Reduction of most bacteria and viruses<br>• Residual protection agains contamination<br>• User acceptability- ease of use<br>• Proven health impact<br>• Scalability<br>• Low cost | • Low pretection against parasitic cysts<br>• Decreased effectiveness in turbid waters contaminated with organic and some inorganic compounds<br>• User objections to taste and odor<br>• Quality control of solution<br>• Chlorination by-products | • Add one full bottle cap of solution to clear water to "standard size container"<br>• Agitate<br>• Wait 30 minutes before drinking | • 35% of surveyed Aida population would be willing to use chlorine as a household intervention (this percentage includes both chlorine solution and chlorine tablets) | • Product Cost: 0.33 USD<br>• Per Liter: 0.0003 USD<br>• Per Month at Household: 0.20 USD |
| *Chlorine tablets (NaDCC)* | • Reduction of most bacteria and viruses<br>• Residual protection against contamination<br>• User acceptability- ease of use<br>• Proven health impact<br>• Scalability<br>• Low cost | • Low pretection against parasitic cysts<br>• Decreased effectiveness in turbid waters contaminated with organic and some inorganic compounds<br>• User objections to taste and odor<br>• Quality control of solution<br>• Chlorination by-products | • Add one full bottle cap of solution to clear water to "standard size container"<br>• Agitate<br>• Wait 30 minutes before drinking | • 35% of surveyed Aida population would be willing to use chlorine as a household intervention (this percentage includes both chlorine solution and chlorine tablets) | • Product Cost: 0.01 USD<br>• Per Liter: 0.0005 USD<br>• Per Month at Household: 0.30 USD |
| *Flocculant/disinfectant powders (i.e. PuR Purifier of Water)* | • Reduction of bacteria, viruses, and protozoa<br>• Reduction of some heavy metals and pesticides<br>• Residual protection against contamination<br>• User acceptability- visual improvement<br>• Proven health impact<br>• Easily transported and long shelf life | • Multiple step use which requires demonstration<br>• Users must have and maintain two buckets, a cloth, and a stirring device<br>• Higher relative cost per liter of water as compared to other treatment options | • Open sachet and add contents to bucket with 10 liters of water<br>• Stir for 5 minutes<br>• Let solids settle to the bottom<br>• Straing water through a cotton cloth and into a second bucket<br>• Wait 20 minutes for hypochlorite to inactivate microorganisms | • 23% of surveyed Aida population would be willing to use a flocculant as a household intervention | • Product Cost: 0.035 USD<br>• Per Liter: 0.035 USD<br>• Per Month at Household: 2.10 |
| *Solar Disinfection (SODIS)* | • Reduction of bacteria, viruses, and protozoa<br>• No cost to the user after obtaining the plastic bottles<br>• Minimal change to taste of the water<br>• Proven health impact<br>• Not likely recontaminated due to safe storage | • Need for pretreatment of high turbidity water<br>• Users concerns due to limited volume of treatement (based on amount of bottles)<br>• Length of time required to treat<br>• Need large supply of intact, clean, suitable plastic bottles | • Fill a 0.3-2.0 liter plastic soda bottle<br>• Shake to oxygenate<br>• Place bottles on a roof or rach for 6 hours if sunny / 2 days if cloudy | • 13% of surveyed Aida population would be willing to use SODIS as a household intervention | • Product Cost: 0.45 USD/year<br>• Per Liter: 0.0006 USD<br>• Per Month at Household: 0.04 USD |
| *Filtration (Ceramic)* | • Reduction of bacteria and protozoa<br>• User acceptablility- simple to use<br>• Proven health impact<br>• Long life of filter if remains unbroken<br>• One-time initial cost | • Low effectiveness against viruses<br>• No residual protection if not safely stored<br>• Variability in quality control of filters<br>• Filter breakage and need for spare parts<br>• Regular cleaning required<br>• Length of time required to treat (low flow rate of 1-3 liters per hour) | • Filter/receptacle model<br>• Fill top of receptacle with water<br>• Allow water to filter through to storage receptacle<br>• Access water via a spigot within storage receptacle | • 63% of surveyed Aida population would be willing to use filtration as a household intervention | • Product Cost: ~7.50-30.00 USD<br>• Per Liter: 0.001-0.004 USD (10 L/d)<br>• Per Month at Household: 0.31-1.25 USD |
| *Boiling* | • Reduction of all bacteria, viruses, and protozoa, including for turbid water<br>• Materials needed for use are likely already present in household<br>• Socio-cultural acceptance of boiling, particualarly in tea-consuming cultures | • No residual protection if not safely stored<br>• Not scientifically proven to reduce diarrheal disease<br>• Potential for burn injuries<br>• Potentially high cost of carbon-based fuel<br>• Possible user taste objections<br>• Potential for incomplete water treatment if not fully boiled | • Bring water to a boil (100°C / 212°F at sea level)<br>•CDC recommendation: rolling boil for 1 minute<br>• Water should be stored in same container to prevent recontamination | • 43% of surveyed Aida population would be willing to use boiling water as a household intervention | • Product Cost: N/A<br>• Per Liter: N/A<br>• Per Month at Household: 0.272-1.68 USD |

[1]PoUWT Table 3

[2]From WSSS 2013 Practicum Household survey

# Attachment G - Community Outreach Material

**The Lajee Center** is a community-based cultural center in Aida that provides cultural, educational, social, and developmental opportunities to refugee youth.

The primary goal of **The Water Program** at Lajee Center is to help the residents of Aida Camp improve drinking water quality through water quality monitoring, provision of necessary interventions and increased education and outreach on water-related issues.

For more information contact Lajee Center
Email: info@lajee.org
Website: www.lajee.org
Phone: +970 2 275 0789

**IMPROVING WATER QUALITY:**
**Recommendations on cleaning your drinking water**

Recommended Interventions*:

CHLORINE TABLETS

BOILING WATER

*Recommended Interventions are mutually exclusive and not intended to be used together.

## How It Works:

**Chlorine** is a common chemical used for the disinfection of drinking water. The effectiveness of chlorine is based on the chemical's ability to inactivate most pathogens that cause waterborne diseases.[1] Chlorine is effective for the treatment of bacteria, viruses, and some protozoa when dissolved and mixed in water. This process forms the microbial disinfectant hypochlorous acid (HOCl) as well as the hypochlorite ion ($OCl^-$). These two compounds protect the water from recontamination.

**Boiling** is one of the most effective and common methods for household water treatment in the world. When water reaches the boiling point, 100°C (212°F) at sea level, all bacteria, viruses, and protozoa are inactivated. One advantage of this method of treatment over chlorine use is it can effectively treat turbid water.[2]

[1] Center for Disease Control (CDC)
[2] CDC

## Steps to Using Chlorine Tablets:

*See Water Program coordinator for amount of water needed for the dosage of the chlorine tablet.

**1.** At least 30 minutes before consumption fill appropriately sized container with water from **tap.**

**2.** Place correct number of tablets in the container and mix until chlorine is fully dissolved.

**3.** Let the water sit for 30 minutes to kill any bacteria and viruses present.

If you do not like the flavor of chlorine in your drinking water you have two options:

**1.** Let the water sit out for 24 hours before consumption to allow the chlorine taste and smell to dissipate.
**2.** Run water through a carbon activated filter* to remove the taste and smell.

*Ask Water Program Coordinator at Lajee about where to purchase

## Steps to Boiling Water:

**1.** Fill pot with water from tap.

**2.** Bring water to a rolling boil and leave boiling for 1 minute.

**3.** Remove pot from heat. Set aside and let cool.

**4.** Before transferring cooled water to a bottle for storage, **clean container with anti-bacterial cleaners** and previously boiled water to kill any bacteria present.

If you do not like the taste of water after boiling you have two options:

1. After water has cooled and been transferred to new container, shake the new container for 10 seconds to add air back into the water.
2. Let water sit for 24 hours before consumption to allow for the reintegration of air.

**IMPORTANT:** After using chosen intervention keep water in clean and covered containers to avoid recontamination.

For more information contact Lajee Center
Email: info@lajee.org
Website: www.lajee.org
Phone: +970 2 275 0789

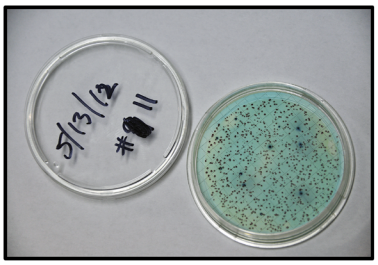
**DRINKING WATER QUALITY AND HEALTH IMPLICATIONS**

**Lajee Center** is a community-based cultural center in Aida that provides cultural, educational, social, and developmental opportunities to refugee youth.

The primary goal of **The Water Program** at Lajee Center is to help the residents of Aida Camp improve drinking water quality through water quality monitoring, provision of necessary interventions and increased education and outreach on water-related issues.

## What could be in your water?

Coliforms are a group of bacteria present in the digestive tracts and waste of humans and animals, which can survive in water under the right conditions.[1] *E. coli* is a strain of coliform bacteria, which can make you sick if consumed unknowingly. Coliform bacteria are not always harmful but indicate water quality may be compromised and other harmful pathogens may be present.



Source: Rusty Russell

## Where is it coming from?

Improperly sealed tanks can allow animals or other living organisms to enter the water supply.

When water sits in the tanks for longer periods of time, the chlorine already in the water dissipates allowing water to become recontaminated if the source of contamination is still present.

High temperatures lead to high rates of bacterial growth. Temperatures above 15°C promote higher occurrences of coliform colonies.[2]

## What does it mean for your health?

Coliform bacteria are indicators of bacterial pathogens that can lead to varying levels of gastrointestinal stress, including vomiting, diarrhea, abdominal cramps and flu-like symptoms. If untreated, diarrhea can lead to dehydration and in severe cases, death.

Children under five, adults over 65, and those with weakened immune systems are at an elevated risk for these water-related diseases.

## What can you do to protect yourself and your family?

- Get your water tested once in the wet season and once every two months during the summer or if water appears visibly dirty.
- If the test comes back positive or you notice visible levels of sediment in your water, use an appropriate intervention like chlorine tablets or boiling.
- Clean tanks on a regular basis and make sure they are sealed against outside elements.
- If someone in your family is sick and experiencing severe symptoms, see a doctor immediately.

[1] Center for Disease Control (CDC)

[2] World Health Organization (WHO)

For the past two years, Lajee Center has partnered with Tufts University to test the quality of drinking water in households in Aida Camp and to find suitable interventions to help residents address poor water quality. **The Water Program** is part of an on-going collaboration between Lajee Center and Tufts University.

Since May 2012 Lajee Center, in collaboration with Tufts University has tested the drinking water in over 300 homes in Aida Camp for total coliform bacteria, which includes *E. coli*. 40% of the water samples tested positive for total coliform bacteria during the dry season and 32% of the samples tested positive during the wet season. 5% of the samples tested positive for *E. coli.*

**Lajee Center** is a community-based cultural center in Aida that provides cultural, educational, social, and developmental opportunities to refugee youth.

The primary goal of **The Water Program** at Lajee Center is to help the residents of Aida Camp improve drinking water quality through water quality monitoring, provision of necessary interventions and increased education and outreach on water-related issues.

**THE WATER PROGRAM AT THE LAJEE CENTER**

**Water Quality Monitoring**

**Household Intervention Guidance**

**Water Education**

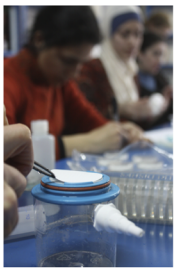
For more information contact the Lajee Center
Email: info@lajee.org
Website: www.lajee.org
Phone: +970 2 275 0789

## Water Quality Monitoring

Concerned residents can request for Water Program staff to test their water free of charge. Households will also be randomly sampled throughout the year to have the water tested to contribute to expanding data on the extent of contamination within the camp.

If a sample tests positive for *E. coli* or other coliform bacteria, Lajee will retest a second water sample from the home to confirm the contamination. A contaminated retest sample will prompt Lajee to work with the resident on possible mitigation strategies and interventions, as described in the following section.

Residents will be notified of the outcome of the sample, even in the case of a negative result.



## Household Intervention Guidance

The Water Program coordinator and staff will be available, in the case of a positive result, to help residents find the best intervention for their situation.

Instructional sessions will be offered on how to properly use each recommended intervention. Staff and volunteers will be available at Lajee Center to address help ensure the proper maintenance and continuation of the chosen intervention.

For more information on the recommended interventions, see the brochure titled *Improving Water Quality*.

## Water Education

The Water Program will provide educational modules for children and teenagers, 10 to 15 years old. Modules will include:

- Chlorine and Taste
- Water Quality Testing
- Water, Bacteria and Illness

The Water Program will also have opportunities for older students hoping to gair knowledge and experience working with water. Interested students can gain skills in water quality monitoring and media production. For more details speak to the Water Program Coordinator.

## Attachment H - Scholarship Resources

*Scholarship Name:* United Nations University Scholarships for Developing Country Students
*Field of Study:* MSc in Sustainability, Development, and Peace
*Requirements and Eligibility:*

- Bachelor's degree or equivalent;
- Particular interest and career aspiration in at least one of the following areas: global change and sustainability, peace and security, international cooperation and development; and
- English language proficiency.

More information is available at http://isp.unu.edu/grad/degrees/masters/admissions.html

*Scholarship Name:* Netherlands Fellowship Program for Master's, PhD, and Short Courses
*Field of Study:* Agriculture, Forestry & Fisheries; Education; Engineering; Environmental Science; Law; Medical and Health Science; Natural Science
*Requirements and Eligibility:*
*Preference given to females.

- Be a professional with at least three years' relevant work experience;
- Be nominated by your employer, who pledges to continue paying your salary and guarantees that you will be able to return to the same or an equivalent position at the end of your fellowship period;
- Have been unconditionally admitted by a Dutch institution to one of the Master's degree programmes or Short courses on the course list, or have agreed upon a PhD research proposal with the Dutch institution;
- Have completed and submitted an NFP PhD study, master's degree programme or short course fellowship application, including all the required documentation, before the applicable fellowship application deadline; and
- Be employed in a subject area to which endorses the objective and the aim of the NFP and use your new knowledge and skills to support your employing organisation and your country.

More information is available at http://www.studyinholland.nl/scholarships/scholarships-administered-by-nuffic/netherlands-fellowship-programmes

*Scholarship Name:* VLIR-UOS Training Scholarships for Developing Countries
*Field of Study:* Training Programs: Human Rights for Development; Technology for Integrated Water Management
*Requirements and Eligibility:* Specific eligibility and admission requirements available on the official scholarship webpage.
More information is available at http://www.scholarships.vliruos.be/index.php?language=EN&navid=244&direct_to=Home

*Scholarship Name:* VLIR-UOS Scholarships for Developing Countries
*Field of Study:* Development-related Masters Degree

*Requirements and Eligibility:*

- English proficiency - TOEFL may be required;
- Under 40 years of age; and
- Professional experience not required but considered a competitive advantage.

More information is available at http://www.scholarships.vliruos.be/index.php?language=EN&navid=489&direct_to=Masters%20Programmes

*Scholarship Name:* CUD Scholarships in Belgium for Developing Countries
*Field of Study:*

Graduate Degrees

- Master in Aquaculture
- Master in Public Health – Guidance Health and Development
- Master in Science and Environmental Management in Developing Countries
- Master in International Economics and Development
- Master in Development, Environment and Societies
- Master in Public Health Methodology

Training Courses

- Internship in GIS
- Internship in Management Systems Health Services
- Methodological Stage in Supporting Innovation in Family Agriculture
- Internship in Environment and Sustainable Management of Mineral Resources

*Requirements and Eligibility:*

- Candidates must be less than 40 years old for courses, and less than 45 years old for training programs.
- Candidates must be holders of a degree that is comparable to a Belgian University graduate degree
- Candidates must show professional experience of at least two years upon termination of their studies. Where candidates are holders of a postgraduate degree delivered by an university of an industrial country, they must show professional experience of at least three years upon termination of their studies.
- Candidates must have a good knowledge of written and spoken French; for programmes organised in another language, good knowledge, in writing and speaking, of this language, is required. Moreover, the candidate will be asked to commit himself to study French in order to be able to participate in daily life in Belgium.

More information is available at http://www.cud.be/content/view/340/209/lang,/

*Scholarship Name:* Erasmus Mundus Scholarships for Developing Countries
*Field of Study:* Masters or Joint Doctorate Programs: Agriculture and Veterinary, Engineering, Manufacture and Construction, Health and Welfare, Humanities and Arts, Science, Mathematics and Computing, and Social Sciences, Business and Law
*Requirements and Eligibility:* Program-specific
More information available at http://eacea.ec.europa.eu/erasmus_mundus/funding/scholarships_students_academics_en.php#1
Program guide is available at http://eacea.ec.europa.eu/erasmus_mundus/programme/documents/guide_emdec09_%20en.pdf

*Scholarship Name:* Diversity in Engineering PhD Scholarship – University of Edinburgh
*Field of Study:* PhD Engineering; Sciences
*Requirements and Eligibility:*

- A background in environmental/ process/chemical/energy engineering, physics, chemistry or environmental science (or equivalent) interested in water treatment and renewable energy; and
- Strong academic standing.

More information is available at http://www.ed.ac.uk/schools-departments/student-funding/postgraduate/international/science-engineering/diversity.

## Attachment I - Internship Descriptions

**Water Quality Intern**

The water quality intern will support the water program coordinator with ongoing water testing services provided by Lajee. There may be more than onewater quality intern working with Lajee in a given period. The number may largely depend upon the volume of work available to engage interns and support their continued learning as well as the capacity and availability of the coordinator to offer initial training. As an alternative, more experienced or former interns may help train new interns.

It is recommended that interns gain three months of experience at Lajee.

*Training*

The intern should receive training on water sample collection, plating, counting, and documenting and communicating results. Training may be accomplished as the intern shadows the Crisis Water Services Coordinator while he or she completes these tasks.

Interns will be encouraged to work independently following one to two weeks training. Ultimately, the intern should be capable of independently carrying out each aspects of the water quality testing program.

*Tasks*

- Conduct routine water sampling at Aida Camp schools and households.
- Plate samples and count colonies from each.
- Record water results into the Excel tracking sheet.
- Provide a summary of water quality results at the close of the internship through basic graphs and descriptions.
- Deliver a brief presentation to Lajee staff on sampling results.

**Media and Communications Interns**

The media intern will be support the media center coordinator at Lajee in the production and distribution of the various forms of media to be produced by the center (brochures, pamphlets, flyers and short films previously describe). The media center coordinator may choose to have more than one intern, and the duration of the internship will depend on the amount of time needed to complete the films. At least one of the interns should have previous experience working with the coordinator at the media center, as he or she may be working independently on assigned tasks at various points in the internship.

*Training*

Media and communication interns will be trained to use digital and film cameras. Dedicated interns may be trained in film editing software as well. The specific training the interns receive will be left to the discretion of the media center coordinator.

Prior experience in filmmaking and editing is preferred for at least one of the interns. If multiple interns are needed, the more experienced intern can aid in training the others.

Interns should feel comfortable working closely with the community to distribute education material and help organize workshops and film screenings.

*Tasks*

Film

- Help develop storyline for short films.
- Assist in shooting footage for short film.
- Aid the media center coordinator in editing the short films and any other water-related film projects.

Community Outreach

- Work with the WSP Coordinator to ensure brochures are ready to be distributed to the public.
- Distribute flyers to schools, mosques and other appropriate social gathering places in Aida Camp.
- Help identify local media outlets (such as TV and radio stations) that would be interested in what the Lajee Center is doing.
- Assist in organizing events at the Lajee Center (and other appropriate locations) to screen the short films produced.

Tufts UNIVERSITY

Office of the Vice Provost for Research

Social, Behavioral, and Educational Research
Institutional Review Board
FWA00002263

March 14, 2013 | Notice of Action

IRB Study # 1302031 | Status: ACTIVE

**ATTENTION: BEFORE CONDUCTING ANY RESEARCH, PLEASE READ THE ENTIRETY OF THIS NOTICE AS IT CONTAINS IMPORTANT INFORMATION ABOUT PROPER STUDY PROCEDURES.**

Title: Bringing Clean Water to Aida Refugee Camp

PI: John Durant
Co-Investigator(s): Margaret Holmes (Holmesheoran), Ayah Badran

The PI is responsible for all information contained in both this notice of action and on the following **Investigator Responsibilities Sheet.**

**Only copies of approved stamped consent forms and other study materials may be utilized when conducting your study.**

This research protocol now meets the requirements set forth by the Office for Human Research Protections in 45 CFR 46 under Expedited Category 7.

Reviewed 3/13/2013 – Expires 3/12/2014

- Approved for 50 participants for the duration of the study.

Protocol Management:
- For all changes to the protocol, submit: *Request for Protocol Modification* form
- All Adverse Events and Unanticipated Problems must be reported to the Office of the IRB promptly (no later than no later than 7 calendar days after first awareness of the problem) using the appropriate forms.
- Six weeks prior to the expiration of the protocol on 3/12/2014, investigators must submit either a *Request for Continuing Review* or a *Request for Study Closure*
- All forms can be found at: **http://www.tufts.edu/central/research/IRB/Forms.htm**

IRB Administrative Representative Initials: _____

20 Professors Row, Medford, MA 02155 | TEL: 617.627.3417 | FAX: 617.627.3673 | EMAIL: SBER@tufts.edu

***IN THE KNOW***

**BULLETIN OF THE TUFTS SBER IRB MEDFORD CAMPUS**

# UPDATES TO IRB FORMS

All IRB forms have been updated to expedite the approval process.

The revisions include the addition of information on the following:

- Applicability and receipt of local IRB approval for international research protocols
- Tufts University's Participant Payment Policy
- Tufts University's Human Record Retention Policy

The updated forms can be found on our website:
http://www.tufts.edu/central/research/IRB/Forms.htm.

*** AS OF NOVEMBER 5, 2012, ONLY REVISED FORMS WILL BE ACCEPTED ***

Avoid using previously saved templates of outdated forms. Please go to the forms webpage every time you submit. This will ensure that only the latest version of the form is being used. These forms are identified as version 11/2012.

All revisions to the forms are intended to ensure that researchers are well-informed of all applicable university and federal policies. If you have any questions regarding these policies, please contact the SBER IRB Office at 617-627-3417.

Feedback and suggestions are also always welcome. To do so, please email sber@tufts.edu.

On behalf of the SBER IRB Office, thank you.

**Tufts University Office of the Vice Provost for Research**
Social, Behavioral, and Educational Research Institutional Review Board (SBER IRB)
**Program for the Protection of Human Participants in Research**

## Investigator Responsibilities

Research involving human participants involves a myriad of responsibilities.

**General Responsibilities:**

- To comply with the Code of Federal Regulations regarding the protection of human subjects http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm
- To protect the rights and welfare of all human subjects and to conduct all research according the IRB approved protocol.
- To retain all data and signed consent documents for at least 3 years beyond the completion of the research.

**Consent Responsibilities:**

- To ensure that each potential participant understands the nature of the research.
- To ensure that the correct procedures are followed to gain *informed* consent from each person prior to participation.
- To provide each participant with a copy of the IRB approved consent document unless waived by the IRB.

**Education Responsibilities:**

- To ensure that all researchers, research assistants and faculty advisors have completed the required CITI training and that the certification is current. Certification is valid for a period of 5 years.

**Procedural Responsibilities:**

- When submitting to the SBER IRB, be sure to only use the most updated version of the required forms. They will always be posted on the website under 'forms'.
- To not initiate any changes to the protocol without IRB review and approval, unless it is necessary to eliminate an immediate hazard. Submit the *Request for Protocol Modification* form.
- To submit to the IRB for continuing review (*Request for Continuing Review* form) at least 6 weeks prior to the expiration date of the protocol if the research is going to continue past the expiration date.
- To promptly report any unanticipated problems to the IRB. Submit *Unanticipated Problem Report* form.
- To promptly report any adverse events to the IRB. Submit the *Adverse Event Report* form.
- To officially close the study once completed. Submit the *Request for Study Closure* form.

**Please refer to the website for additional information:**
**http://www.tufts.edu/central/research/IRB/main.htm**

**Feel free to contact us at SBER@tufts.edu or 617-627-3417 for any assistance.**

Revised January 2013

**Tufts University Office of the Vice Provost for Research**
Social, Behavioral, and Educational Research Institutional Review Board (SBER IRB)
**Program for the Protection of Human Participants in Research**

## Faculty Advisor Responsibilities

All faculty advisors who oversee undergraduate and graduate student research have the following responsibilities:

- To complete the required CITI training.
- To ensure that the principal investigator and additional research staff abide by the *Investigator Responsibilities*.
- To meet with the principal investigator to monitor study progress and ensure that the procedures outlined in the IRB protocol are followed.
- To be available to the principal investigator to supervise and address problems should they arise.
- To arrange for an alternate faculty advisor to assume these duties when unavailable (vacation or sabbatical).
- To oversee the prompt reporting of any adverse events or unanticipated problems to the IRB.

**Household Survey Recruitment Script**

When the house is approached for survey, the following will be read to the adult who comes to the door (and verbally translated by the translator for the Lajee Center on the survey team if necessary):

Hello. We are members of a group of students working with the Lajee Center on a project about water in your community. The Lajee Center is an organization in Aida Camp which provides refugee youth with cultural, educational, social and developmental opportunities. Would you be willing to spend about 30 minutes with us answering some questions about your personal experiences with water? Your participation in this study is strictly voluntary. The questions are about general health, water storage, and water quality in your household.



**Lajee Center Script – Notification to the Community**

A group of students from Tufts University in the United States will be working with the Lajee Center on a project about water in our community. The will be visiting households from 03/17/2013-03/22/2013, asking residents to talk about their experiences with water in Aida Camp. Participation in this study is strictly voluntary. The questions are about general health, water storage, and water quality in your household.

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**Verbal Consent Script**

**Background and Purpose:**

You are being asked to participate in a research project organized by a group of Tufts University students and professors in the Water: Systems, Science and Society (WSSS) program. Tufts is a research university located near Boston in the United States. The purpose of the project, building upon the water quality testing program set up by the team of students that visited from Tufts last year, is to provide members of the Aida Camp community with the skills necessary to continue to test water quality in Aida Camp, and to expand Lajee's capacity as a water service provider and educator on water quality issues in Aida Camp. As a member of the community, you are in a position to provide insight into water quality at the camp. I would appreciate it if I could ask you some questions, in the form of a verbal survey, about these issues.

**Procedures:**

If you agree to participate, one of our group members, through a translator, will ask you some questions. Our survey should take about thirty minutes to complete. One of my colleagues will take notes. We ask that you keep your responses relevant to the questions asked during the survey, and would like you to know that anything discussed that is not relevant to the survey will not be recorded as part of our study.

**Risk and Confidentiality:**

There are no physical risks arising from your participation in this project. We will not record your name, and have designed the questions to avoid obtaining information that can be used to identify you. Please be aware that, although your responses will be maintained in complete confidentiality, there is a chance that someone may discover that you participated in this study.

We believe that the risk of harm to you and your family by participation in this survey is minimal. However, you should consider whether you want to be associated with this study prior to providing your consent.

**Voluntary Participation:**

Participation in this study is strictly voluntary – there are no consequences if you do not wish to be surveyed. Furthermore, if you decide at any time during the survey that you no longer wish to participate, you may withdraw your consent without consequence and we will not incorporate any of your responses into our research.

**Benefits:**

There are no specific direct benefits to you for participation in this project. However, your participation will help inform our efforts to set up the Lajee Center as water service provider and educator in this community. The goal of this project is for the Lajee Center to be able to assist community members in properly treating their household water supplies before use. You may be able to take advantage of these



services when they become available, and through participation in this study would have assisted in making these services available to your community.

**Request for More Information:**

If you have any questions or concerns about this project or your participation in it, do not hesitate to contact Ayah Badran at Ayah.Badran@tufts.edu or +1 (617) 901-1237, or at the Lajee Center at +972 2 275 0789 (March 17 – March 22) . If you have any questions or concerns about your rights as a participant, you are encouraged to contact the Institutional Review Board (IRB) Administrator, Lara Sloboda (in the USA) at: +1 (617) 627-3417. We will provide you with an Information sheet with this contact information to keep after we leave.

**Permission:**

Now that I've explained the purpose of the survey, would you be willing to participate in it?

**Signature:**

I confirm that the purpose of the research, the study procedures, the possible risks and discomforts as well as benefits have been explained to the participant. All questions have been answered. The participant has agreed to participate in the study.

Signature of Person Obtaining Consent _____ Date _____

**All households will receive a unique identification number at enrollment when consent is provided.** These interview numbers will be used (with the data) on all study documents.

This study uses Oral Consent Scripts – this method further ensures the confidentiality of the participant because no participant is required to sign their name for consent, but must provide verbal agreement. **It is important to note that although signed consent is waived, the consent process is still required and the interviewer/translator is responsible for documenting that consent was obtained.** Consent will be documented by entering the following information: Household identification number, date, and whether consent was provided by the participant.

3. Conducting the Interview

A. Roles Responsibilities of Interviewers:

- Bring all materials needed (surveys, notebook, pens, interview guide, consent scripts, sample interventions).
- Keep participants focused, engaged, and interested.
- Monitor time and use limited time effectively.
- Be prepared to explain or restate questions- a list of key phrases or local/commonly used terms may be helpful.
- Kindly remind participants to keep the conversation relevant to the survey, and if they go off topic making sure they know that what they are saying won't be recorded unless it is specifically relevant to the survey questions.
- Ensure confidentiality.

B. Leading the Discussion

Often participants do not know what to expect from survey questions and interview discussion. To set the participants at ease, the interviewer should describe the purpose and format of the discussion at the beginning of the session. Participants should be told that the survey questions are standardized, and that discussion is informal. Participants are not required to provide their personal experiences. Participants should be reminded that they are sharing their expertise and opinions, so there are no right or wrong answers.

C. Protecting participants during interview and discussions

It is important that project staff remember the communities in which participants reside are small, people often know each other, and unintentional disclosure of participation or experience can place a participant at social or physical risk. The interviewer/coordinator should develop a contingency plan to prevent unintentional disclosure of the individual's participation. The contingency plan should include 1) a topic to which the interview should change if someone enters the room during the interview and 2) fake titles of the interviewer/translator. It is the responsibility of the project team to continuously assess the environment and stop project activities to avoid placing the participant and/or project team at risk.



## Public Health & Water Quality Survey

**Section 1 – Household Health**

1. How many people live in this household?
2. How many are children under the age of 5? Adults over the age of 65?
3. a) Has anyone in your family been sick in the last 15 days?
   b) In the last 6 months?
   c) Who (no names-categorize by age)?
   d) What was the nature of the illness?
   Check all symptoms associated with illness:
   - Diarrhea
   - Vomiting
   - Fever
   - Intestinal Discomfort
   - Coughing
   - Runny Nose
   - **Other** _____
4. How frequently does an illness like this occur in your household?
   - Less than once a year
   - 1-2 times a year
   - More than twice a year
   - Once a month
5. Are there types of illnesses that happen at a specific time of the year in the camp? If so, what are they and when do they occur?
6. What causes the sickness described above?

**Section 2 – Water Usage and Storage**

1. How do you store your water?
   Tank (Plastic or Metal): Quantity:
   Cistern: Quantity:
   Dubba: Quantity:
   Other: Quantity:
2. How often do you run out of water in your tank (wet season/dry season)?
3. Do you ever take any measures to clean your water? What are these measures?
4. If you do take any measures, how did you learn about these measures?
5. a) If you do not take any of these measures, would you be willing to do so in the future?
   b) Which interventions would you be more likely to use?
   - Adding chlorine to water
   - Using a filtration system (ceramic filters)
   - Using flocculant/disinfectant powders (PUR Purifier of Water)
   - Placing water bottles in the sun for 6 hours (Solar disinfection)

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- Boiling Water

6. Do you clean your water storage vessels?
   Yes How?
   No Why not?
7. Would you request tank cleaning services if they were available? How much would you be willing to pay for these services?
8. How often does your primary water supply run out (wet and dry season)?
9. a) Do you ever buy water?
   Yes
   No
   b) How much does it cost?
   c) Where do you get it?
   - Water truck
   - Water bottles or other water based drinks
   - Other _____

**Section 3 – Water Quality**

1. What do you think of the quality of water delivered (taste, smell, color)?
   Primary Supply

| a) Taste | b) Smell | c) Color |
|---|---|---|
| - Very bad | - Very bad | - Very bad |
| - Bad | - Bad | - Bad |
| - Normal | - Normal | - Normal |
| - Good | - Good | - Good |
| - Very good | - Very good | - Very good |

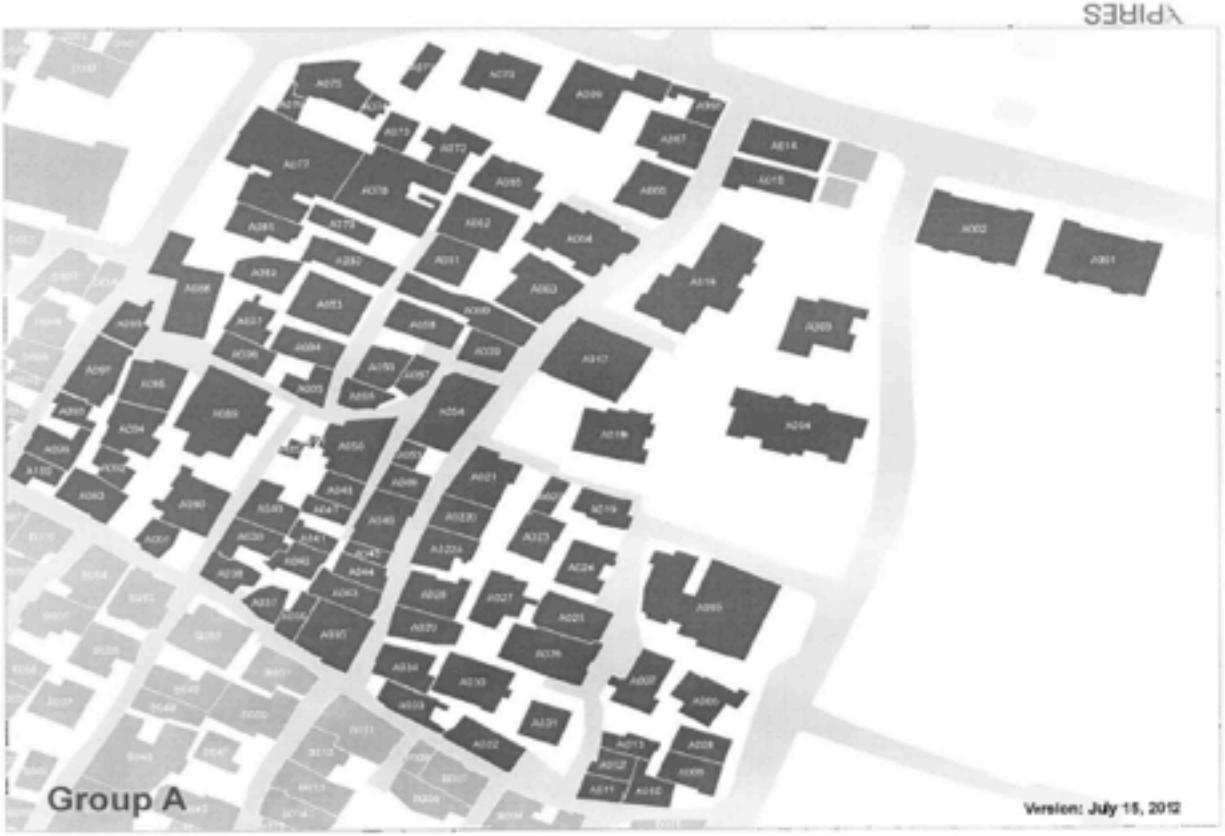
   Secondary Supply

| a)Taste | b) Smell | c) Color |
|---|---|---|
| - Very bad | - Very bad | - Very bad |
| - Bad | - Bad | - Bad |
| - Normal | - Normal | - Normal |
| - Good | - Good | - Good |
| - Very good | - Very good | - Very good |

2. a) Have you had your water tested recently?
   b) If yes, when?
   c) How did you learn about the water quality testing services?
   d) If you didn't have your water tested, are you aware these services are available?
3. Did your water contain coliform bacteria when it was tested?
4. a) Did you take any measures to treat your water if it was contaminated?
   b) What were those measures and how did you find out about them?
   c) If you didn't take any measures, why not?



5. Is your household connected to a sewer?
   Yes
   No
6. If a water quality issue were identified, who would you go to with your complaint?
   UNRWA
   PWA
   Mekorot
   Lajee Center
   Other
7. Who would you expect to deal with it?
   UNRWA
   PWA
   Mekorot
   Lajee
   Other
8. How do you think Lajee could encourage the implementation of clean water practices in households throughout the camp?
9. Would you be willing to pay $3/month for clean water?
10. Would you be willing to pay $5/month for clean water?
11. Would you be willing to pay $10/month for clean water?


Group A
Version: July 15, 2012


APPROVED
MAR 13 2013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MAR 13 2013

## Attachment K - Photo Credits

Cover page – Matthew Simon

Acknowledgement page – Mohammed Alazza

Figure 1 – Jen Bogle

Figure 2 – Millipore m-ColiBlue24© website;
http://www.millipore.com/catalogue/item/m00pmcb2

Figure 3 – Jen Bogle

Figure 4 – Jen Bogle

Figure 7 – Mohammed Alazza

Figure 8 – Jen Bogle

Figure 9 – Jen Bogle

Figure 10 – Jen Bogle

Figure 11 – Matthew Simon

Figure 13 – Mohammed Alazza

Figure 14 – Jen Bogle

Figure 15 – Matthew Simon

Attachment B, Activity 3 (drawings) – Meg Keegan