Date: April 22, 2004

To:
Rotary Club: Bob Hildreth, Rob Overly, Jim Bodenner
CDC/FDDB: Rob Quick, Eric Mintz
UNC: Professor Mark Sobsey

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Subject: **Trip Report – Dominican Republic**

I. Dates and Places of Travel

27 February – March 3: Puerto Plata, Dominican Republic

II. Purpose of Travel

A. To assist Rotary Project Teams from Michigan and Florida, specifically around issues of evaluation and comparison of point-of-use treatment options. Specifically, the Michigan groups are supporting implementation of BioSand filtration, and the Florida groups are supporting and implementing the Mission Filter.

III. Principal Persons Contacted

A. Rotary Clubs

Sponsoring and Implementing Biosand Filtration

Bob Hildreth	District Grants Subcommittee Chair District International Projects Coordinator Dominican Republic
Jim & Susan Bodenner	Rotary Michigan US Coordinator and Supporters of Projects
Marisela (Marie) Hernandez	Community Coordinator, Playa Oeste Barrios, Puerto Plata

Sponsoring and Implementing the Mission Filter

Rob Overly	Rotary Florida US Coordinator and Supporters of Projects
Dr. Kate Wilson-Overly	Member of Medical Mission

IV. Presentation to Rotary/Florida, Rotary/Michigan, and Rotary/DR

After all groups arrived in the Dominican, a gathering was held at Bob Hildreth's house to meet, have dinner, and attend a presentation on point-of-use treatment options. The presentation is enclosed as Annex A. The main points stressed in the presentation were: 1) There are a wide variety of options available for point-of-use treatment, 2) Health impact is the gold standard for assessing the efficacy of point-of-use treatments, and 3) A disinfectant step is needed after filtration to ensure that water is not recontaminated in storage. The presentation was well received and many questions were asked.

V. BioSand Filter Project

The history of the BioSand Filter (BSF) project in the Dominican is described in the following paragraphs. Jan Tollefson, MD and Dr. Manz were sponsored by Calgary Chinook Rotary Club and Rotary Foundation to train 10 Dominican technicians to make BSF's. Dr. Tollefson has been primary contact for this project and worked with the technicians on quality control and has returned every 3 months for 3 years to continue working with the project. She has physically gone to most of the areas with BSF's and has developed a significant amount of troubleshooting knowledge. Four of the initial ten technicians are still making BSF's, while the other six have left due to quality control issues, finding other jobs, or the difficulty of the job (which necessitates marketing, organizational, and construction skills).

Dr. Tollefson met the Michigan Rotarians in Mao, Dominican Republic at a Nursing Home project. After this meeting, Dr. Tollefson and Jim and Susan Bodinger from Michigan began communicating. Independently, Bob Hildreth met Dr. Tollefson through mutual friends in the DR. Bob Hildreth had been working on water supply in the Dominican Republic already, and had experience with the installation of institutional 10 gpm systems. Based on the meetings with Dr. Tollefson, the Michigan Rotarians became interested in, and began investing in, the Biosand filter.

A retirement home associated with the Michigan Rotarian group raised an initial amount of 400 USD to bring BSF's to Puerto Plata. Twelve BSF's were installed with people Bob knew directly or indirectly all over Puerto Plata. Initial feedback on these 12 filters was very positive. The Bodinger's then went back to Michigan and raised funding for 170 additional BSF's. Families paid 12 USD to purchase a BSF, which was approximately a 70 percent subsidy at that time. The 170 filters were divided among four barrios and one rural town. Each barrios selected a community coordinator to organize the BSFs, and to promote and troubleshoot the filters. Bob Hildreth designed this model to determine the minimum amount of support necessary for distributing and maintaining filters in the homes in terms of organization and instruction.

The next step in BSF distribution in the DR was when Bob Hildreth and the Bodinger's thought that Peace Corps would be a good organization to work with on BSF installation. A meeting was arranged with the Peace Corps Country Director and the Water & Sanitation Director. Fortuitously, one of the water volunteers had completed an aqueduct project, had extra funding, and the volunteer wanted to do water filtration. The volunteer had decided to go with BSF unaware of the Rotary projects, and installed 80 in a community in a province of Puerto Plata. The volunteer related a favorable review and experience, however the volunteer then left the country. Heather Lukacs and the MIT team went to this location with the Canadian Embassy (SIDA) in January 2004. Rotary

has also obtained an official letter of commitment from the Peace Corps Country Director for the purpose of writing a grant for approximately 1,000,000 USD for 150-160 communities. In addition, Dr. Tollefson and Bob Hildreth trained Peace Corps volunteers on the BSF in the Summer of 2003 and the Fall of 2003. They trained one group during their initial training in country, and another group after they were in the communities. In retrospect, Rotary feels the training is more valuable after the volunteers are established, as opposed to during their initial indoctrination. Twelve Peace Corps volunteers from Haiti were also trained separately. Further work with volunteers will include the development of a brochure and 30-minute orientation for volunteers at their initial training, and then offer quarterly seminars offering training on how to become a community organizer for interested volunteers, and other NGO's or interested parties.

Currently, the project is funded through a Rotary Foundation grant for 25,000 USD, which was supported by the Michigan group. Two others grants are in process from Westhampton (New York) Rotary Club and the Oakville Rotary Club (Toronto suburb). Michigan is also raising soft money to support the project.

Parallel to all of this, the NGO Indinor has funded a fairly large BSF distribution project. In addition, CAWST (The Center for Affordable Water and Sanitation Technology) has been involved by providing instructional material to Dr. Tollefson, and working with Mount Royal College to produce manuals and educational material. Rotary feels there is more practical implementation expertise needed in the CAWST materials. CAWST organized two seminars in the DR, in June and November 2003, to bring together partners working on BioSand in the DR. They did an introduction to water problems and point-of-use technologies, emphasizing the value of BSF, and provided a forum for partners to meet. Mark Sobsey and Heather Lukacs attended the June 2003 meeting, and began discussing conducting a health impact study. In addition, Heather Lukacs and the MIT team visited the DR in January 2004, and Bob Hildreth helped arrange their travel.

Based on all of the work above, Bob Hildreth estimates that there are approximately 3,000 BSF's in the DR, although they are in many locations. The known filters are: Rotary grants (12, 170), Peace Corps (80), and those made by Technicians (1,700).

Lastly, the Michigan Rotary Clubs planned their visit to assess projects for one week in February/March 2004. Bob Hildreth arranged for the Michigan and Florida Rotarians to have dinner together, and for me to give a presentation. I was also able to complete water quality analysis and a short survey at 10 homes with BSFs in the Playa Oeste Barrio in Puerto Plata.

Water quality monitoring results showed that turbidity was low in all filtered water samples, that only 2 of the 10 families were chlorinating post-filtration (and that one of the two families was under-chlorinating), and that all bacterial samples of finished, filtered water were positive for total coliform after 24 hours using the Hach Pathoscreen broth except for the one chlorinated sample. It is important to remember that these samples are from a limited sampling of only 10 homes in one location, and they are not statistically significant, nor intended for scientific analysis. This was a limited survey to ascertain directions for future research, and for gathering of information on usage patterns. A larger study is necessary to determine statistically significant water quality monitoring data.

Table 1: Water Quality Results from BioSand Filter Household Visits, Playa Oeste Barrio

	Turbidity	Conductivity	Free Chlorine	Total Chlorine	Total Coliform	E. coli
1	0.00	330	--	--	+ (24 hrs)	– (24 hrs)
2	0.72	350	--	--	+ (24 hrs)	– (24 hrs)
3	0.34	350	--	--	+ (24 hrs)	– (24 hrs)
4	0.33	370	0.05 / 0.07	0.06 / 0.08	– (24 hrs)	– (24 hrs)
5	0.28	340	--	--	--	--
6	No water					
7	1.57	330	--	--	--	--
8	No water					
9	No water					
10	0.04	380	0.59 / 0.52	0.74 / 0.69	--	--
Marie's	--	--	--	--	+ (18 hrs)	– (24 hrs)

Data obtained from the household visits is detailed below:

- All families collect water from the public tap. Because of it being intermittent, many families store water in large containers (20 – 200 L).
- All BioSand filters were installed between 15-18 months ago.
- 2 families (20%) added chlorine to stored water, although only 1 family (10%) added the correct amount.
    - This 1 family lived next to Marie and had a 7-year old child with HIV contracted from a blood donation at 2 years old. Anecdotally, her health has improved since using filtered water.
- 80% of families store water in open containers, with the majority (70%) storing in white 20 L paint buckets
    - Two families (20%) transfer their water smaller containers to either store it in the fridge, or for ease of storing.
- Two families (20%) store their water in 5-gallon water containers, although both filter water into other containers before pouring it into the water container.
- Two families (20%) cover their filter with a cloth. This metric has been linked in other studies to correct usage of the filter.
- Three families (30%) did not have filtered water at the time of the unannounced visit:
    - One family (10%) clearly does not use the filter regularly.
    - Two families (20%) most likely use the filter regularly, but because it was washing day, were out of water at that point in time.
- The majority of families (60%) use the filter daily.
- No family uses the filter to its capacity – as no family indicated they use the water for drinking, bathing, cooking, juice making, and washing.

Table 2: Use and Storage Practices in Households with Biosand Filter

	Storage Container	Chlorine Added	Filter water?	Use water for?	Store	Notes
1	20 L bucket	No	Daily	Drinking	1 day	
2	~15 L kitchen pot with lid	No	Daily	Drinking, bathing	1 day	
3	20 L bucket	No	Every two days	Drinking	2 days	
4	20 L water container	Yes, 4 drops	Multiple times daily	Drinking	Multiple times daily	Filter covered.
5	20 L bucket	No	Daily	Drinking, cleaning fruit	1 day	
6	20 L bucket	No	Intermittently	Drinking	Intermittent	No water at the time of visit.
7	20 L bucket then 1 gallon jug in fridge	No	Daily	Drinking	1 day	
8	20 L bucket and 5 L juice	No	Daily	Drinking, cooking	1 day	No water because currently washing.
9	20 L bucket	No	Multiple times daily	Drinking, cooking, cleaning kids	Multiple times daily	No water because currently washing. Filter covered.
10	20 L bucket then 20 L water container	Yes, 15 drops	Multiple times daily	Drinking	1 day	

Based on the data obtained above and conversations with Rotarians, the following recommendations are suggested:

- One of the strong benefits of the BSF is the amount of water it can produce. It is recommended that users use BSF water for more than just drinking. Educational materials should stress the use of BSF water for cooking, bathing, cleaning, washing fruit, and washing hands.
- The presence of total coliform in all non-chlorinated finished, stored water is concerning, and it is recommended that users post-chlorinate their water in order to ensure safe storage. A small dropper bottle is an appropriate tool to use to add 3 drops per gallon of 5.25% strength Clorox bleach to the solution.
- Because BSF is an unproven technology in terms of health impact, it is recommended that a health impact study be conducted. Professor Mark Sobsey at UNC would be an ideal person to work on the health impact study, and Jim Bodenner of Rotary/Michigan is willing to look for funding. Daniele will coordinate contact between Mark and Jim.

- While visiting a village with BSF's being installed, we passed by the manufacturing location for the filters, as well as a truck delivering four cement filters to the homes. This transportation was extremely difficult – the truck had four filters with two people holding them to prevent them breaking. This will be difficult to implement on a large scale and it is recommended that Rotary investigate the use of alternate (plastic) containers for the sand.

VI. Mission Filter Project

Concurrent to the Rotary BSF projects in the DR, there is also a Mission Filter Project organized and supported by Rotary/Florida. Rob Overly is the coordinator of this project. Compared with the Rotary/Michigan BSF project where Rotary/Michigan primarily provides the funding for BSF's and Bob Hildreth coordinates the installation of the filters in the DR, the Rotary/Florida project is modeled more like a mission group. Rotary/Florida members raise money to purchase the filters from Eagle Springs Filtration, and then travel to the DR to assemble and distribute them to families. Rob Overly is very knowledgeable about point-of-use interventions, as he had read significant amounts of information on different interventions. He is also responsible for funding and arranging my travel down to the DR.

This Rotary/Florida Mission was conducted jointly with a medical mission that Rob Overly's wife, Dr. Kate Wilson-Overly, is part of, in addition to a construction, bible study, and education mission. During the time spent with Rotary/Florida, the focus was on:

1. Visiting households with the Mission Filter
2. Talking with the medical mission about:
    a. Symptoms seen in the clinic
    b. Helping the medical mission understand the water supply in the area they are working it
    c. Potential of doing a health impact study
3. Thinking about future directions for the Mission Filter Project

Household Visits:

A total of 13 homes in three villages in the area with the Mission Filter were visited. The results are presented in Table 3. The age of the filters visited was 15-18 months old. The majority of the families had not had a change-out of either the cotton or the GAC filter.

Table 3: Findings from Household Visits in Three Communities, Mission Filter

	Free Chlorine Top Bucket	**Free Chlorine** Bottom Bucket	**Free Chlorine** Refrigerated Water	**Notes**
Isla Bon 1	0.06	0.02 / 0.04	> 2.20	This family appeared to chlorinate their water (there was a bucket with > 2.2 mg/L free chlorine in it) but then not use the filter and store the finished water in the refrigerator.
2	Cracked bottom bucket.			
3	Cracked bottom bucket.			
4	Cracked bottom bucket.			
La Pina 1	1.61	0.00	0.00	Use water for drinking only.
2	2.20	0.05 / 0.07	0.09 / 0.06	Use water for drinking only.
3	Loose, unfixed spigot. Tightened while there.			
4	Cracked bottom bucket.			
Rincon 1	> 2.20	0.07 / 0.05	-	Use filter watered to sell juice and for drinking.
2	Use water for bathing only. Use purchased water for drinking. No water in filter. Has dirty cotton filter.			
3	Tap broken. Uses bottled water for drinking (30 pesos for 5 gallons).			
4	Cracked bottom bucket.			
5	Broken tap. Family said they use the system, but not at this point in time. Fixed while there.			

As can be seen from Table 3, there were a significant number of broken filters within the 15-18 month time frame. 8 of the 13 (62%) of the filters were broken. In addition, another household appeared not to be using their filter (8%) for a total of 70% of filters not in use at the time of the unannounced visit. This is problematic for the sustainability of the program. Families did use the buckets with spigots for storing of water when the buckets cracked.

Also of note is the common storage practice of filtering water, and pouring it into another container to store in the refrigerator. This raises questions about the fact that there is little residual in the water in the bottom bucket, and that this residual may not be protective when transferred into another container.

Medical Mission:

Symptoms:

The medical mission has been ongoing for 16 years in the Sabanetta area. Past pharmaceutical records have indicated a preponderance of waterborne illnesses, and the first year Dr. Kate Wilson-Overly participated in the mission, Rob Overly investigated the water issues. He had also found the Mission Filter via the internet, and Mission Filters were distributed based on need identified through the pharmaceutical records. During the 2004 mission, Dr. Kate Wilson-Overly was targeting questions on waterborne complaints based on knowledge of the filter project. Dr. Wilson-Overly was noting a large variety of parasitic worms in patients. Mission doctors were asking patients to describe the worms in order to provide the best diagnosis and treatment. Patients described small black, small white, and large red worms. Mebendazole was given to patients with worms. The first two days the whole family was treated if a patient presented with worms, and subsequent to that only the patients was treated. The was due to the fact that supplies were low and it was determined to be unfair to patients who paid to treat patients who had not paid.

Water Supply:

Because of the amount of worms in the patients, the medical mission was interested in determining the water supply of the families. A document to determine the water supply system in a village, specifically for medical missions, has been attached as Annex B.

Health Impact:

The medical mission and local doctors are interested in conducting a health impact study to follow-up on what is already known about the water supply, filter project, and medical status of the community. Dr. Kate Wilson-Overly, Dr. Olga, Alerigo, and myself met about the possibility of doing a health impact study. They are very interested and have the funding and staff to supervise and visit homes weekly if they receive technical assistance from the US. Professor Mark Sobsey of the University of North Carolina was contacted about his potential interest in this study, and is willing to be a contact person for the Rotary/Florida groups on this issue.

Future of Mission Filter Project:

Recent changes to the project include the hiring of a Technician and the purchase of a motorcycle for him to service the filters. The following recommendations for future work are:

- Visit every household with a filter and perform maintenance and administer the survey attached as Annex C.
- Investigate selling replacement parts in stores in villages.
- Discontinue the use of the DR buckets that break.
- If possible, conduct a health impact study.

Summary Statement:

Rotary groups are currently promoting two unproven point-of-use treatment technologies in the Dominican Republic. A significant amount of effort, volunteer time, and expense has gone into these two projects. The BSF project is at an ideal location to conduct a health impact study. The Mission Filter project needs to address the sustainability issue in terms of broken hardware before a health impact study can be completed. The goals of both projects is to provide safe drinking water to families and to provide a model to Rotary and Rotary International clubs doing an international water project. It is unclear to me that either of these projects is yet at the stage that it could be an appropriate model for promotion to Rotary International.

Annex B: A How-to on Investigating Water Sources (Designed for Medical Mission Teams)

Medical mission teams that note a large amount of waterborne disease in patients are often curious about the water supply system in the local area and wish to investigate it. This document is a brief overview of how to investigate the local water system in communities.

First, it is **not** recommended that medical missions ask each patient that visits the clinic where their water comes from. This will result in a large variety of answers that will be difficult to interpret without having a sense of the larger scale system. For example, if the water in a community is from a river, but treated in a central location, and then piped to each home, a patient could correctly respond to this question by saying "river", "treatment plant", "pipe", or "tap". Thus, an understanding of the larger system is important to understand the answers given by patients.

Second, to assess the system, a basic knowledge of water treatment practices and their impact on human health is necessary. Essentially, there are two ways water is treated: 1) Mechanisms to remove large material in the water, and 2) Disinfection to inactivate disease-causing organisms. Mechanisms to remove large material in water include filtration through sand, ceramic, membranes, or another medium, and/or coagulation and settling of material to the bottom of the tank or bucket. Disinfection includes chlorination, or a more advanced process such as ozonation or exposure to UV-light. The general relationship between water treatment processes and their effectiveness at removing waterborne disease-causing agents is depicted in the table below.

Effectiveness of Water Treatment Processes at Removing Waterborne Disease-causing Agents

Disease-causing Agent	Removal of agent by Filtration	Inactivation of agent by Disinfectants
Helminths	Significant	Minor
Protozoa	Significant	Minor
Bacteria	Minor – Signficant[1]	Significant
Viruses	Minor	Significant

1: Depending on pore size of the filter.

Generally, water supply in developing countries comes from the following sources:

- Surface water
- Unprotected open wells
- Protected wells
- Community systems, such as:
    - Reservoir flowing to community tap
    - Sand filter flowing to community tap
    - Reservoir flowing to household taps
- Infrastructure systems, such as:
    - Water treatment plant to community tap
    - Water treatment plant to household taps

During the assessment process, it is important to consider what treatment processes water from each different source is receiving. For example, water from a protected well may be filtered by the soil, removing many helminthes and protozoa, but not disinfected, leading users to be potentially exposed to bacteria and viruses, especially if water is stored and transported in unsafe containers. Water from a chlorinated community reservoir may be stored, unfiltered surface water, potentially exposing users to helminthes and protozoa.

To conduct a water supply system assessment, complete the following steps:

- Designate one person who will investigate the water supply system (this activity would take approximately ½ - 1 day).
- Talk with knowledgeable residents about the different options for water in the community.
- Visit each option, particularly noting the downstream and upstream points along the supply chain. For example,
    - If there are wells in the community, visit the well and then walk with a family collecting water and note how they store the water in their home.
    - If the water is treated centrally, visit the intake to the treatment system, the treatment system, and then follow the pipes to the end point. The end point is always the glass that is used to put drinking water into a child's mouth. Pay particular attention to homes at the outer reaches of the system.
    - Pay especial note to potential lapses in the system, such as a lack of chlorine at the water treatment plant, or intermittent supply that necessitates a large volume of stored water, or dirty buckets used to carry water from a well.
- Draw a map of the community with water supply points and potential lapses clearly noted.
- Present the map to all health workers interacting with patients.
- Ask patients presenting with suspected waterborne disease where they obtain their drinking water and correlate that information with the map created. Specifically ask questions that allow you as the health care provider to understand their drinking water source within the community context. This approach prevents the need for individual household visits to those presenting with suspected waterborne disease.

If trends are noted regarding water supply and waterborne disease, then water supply improvements can be considered. For example, areas of high need for intervention can be identified and improvements completed. For more information on water supply improvements, please visit www.cdc.gov/safewater or email safewater@cdc.gov.

Annex C: Mission Filter Household Survey

Community Name: _____ Household Number: _____

Date of survey: _____

Where do you obtain your water that you use in the filter? _____

Do you always have access to enough water? _____

What is the estimated color of the untreated water? _____

Age of Mission Filter: _____

Age of GAC Filter: _____ Age of String Filter: _____

Is the filter in operational order? _____

If NO, what is broken? _____

How long has it been broken? _____

Is there filtered water in the home for drinking? _____

If NO, why not? _____

What is the current drinking water in the home? _____

If YES, how many hours ago was it prepared? _____

Where is drinking water taken from? _____

Free chlorine residual in drinking water: _____

What do you like about using the Mission Filter? _____

What is difficult about using the Mission Filter? _____

Have you had any problems with the Mission Filter? _____

Would you be willing to participate in a study to determine the health impact of the Mission Filter. This study would ask you to provide information about diarrhea in every member of your family once per week for a few months? _____