SAFE WATER FOR THE COMMUNITY

A Guide for Establishing a Community-Based Safe Water System Program

Edition 1

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Acknowledgments

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Introduction

An estimated 1.1 billion people worldwide do not have access to an improved water supply, and many more drink unsafe, contaminated water from improved sources. Each year, inadequate access to safe drinking water and improper sanitation cause an estimated 4 billion cases of diarrhea and 1.9 million deaths in developing countries, mostly among young children. In addition, waterborne diarrheal diseases lead to decreased food intake and nutrient absorption, malnutrition, reduced resistance to infection, and impaired physical growth and cognitive development.

Factors contributing to this high rate of diarrheal disease incidence include: poor sanitation, poor hand hygiene, contaminated water, and lack of sufficient household water. Programs that provide latrines, education about soap and washing hands, access to microbiologically clean water, and/or enough water all help reduce the incidence of diarrheal disease.

The CDC Safe Water System Program

The Safe Water System (SWS) program is a household water treatment intervention developed by the Centers for Disease Control and Prevention (CDC) and the Pan American Health Organization (PAHO) in response to the cholera epidemics that swept across Latin America in the early 1990s. The Safe Water System consists of three elements:

- Water treatment with hypochlorite solution in the home;
- Storage of water in a safe container; and,
- Education and behavior change communications to improve hygiene and water handling practices.

CDC, in conjunction with partner organizations such as the United States Agency for International Development, Population Services International, and CARE, has established SWS programs in over 30 countries around the world. In addition, CDC has completed a substantial amount of research on the effectiveness of the Safe Water System, and written a handbook that describes how to start an SWS program. The handbook, *Safe Water Systems for the Developing World: A Handbook for*

Implementing Household-Based Water Treatment and Safe Storage Programs, provides a comprehensive guide to treat household water with a hypochlorite solution. The handbook is oriented towards large-scale or national programs. Free copies of the handbook in English, Spanish, French, or Arabic may be obtained by emailing safewater@cdc.gov. PDF versions of the handbook in English, Spanish, and French are included on the accompanying CD.

Purpose of this Guide

Recently, many organizations have expressed an interest in establishing community-based SWS programs on a smaller scale. This guide complements the SWS Handbook by providing specific, detailed information to assist organizations to develop community-based SWS programs.

Developing a Community-Based SWS Program

This guide is organized into seven key steps that are necessary to plan and implement a community-based SWS program. The first step is to assess the community's need for an SWS program, and the feasibility of implementing the program. The second step is to organize the staff necessary to carry out the program. Management of the pilot project is discussed in Steps 3 through 6, from product selection and development of educational materials through implementation and evaluation. The final step is to learn from the experiences of the pilot project how to best expand the program throughout the community and beyond.

Supporting Information

The experiences of the Safe Water for Families program in Jolivert, Haiti, are used throughout this guide to illustrate the development of one successful community-based program.

An CD that contains supporting information necessary to develop a community-based program accompanies this guide. Information on the CD that is referenced throughout this guide can be found by opening the files, organized by step, on the CD. The CD also includes an Excel Spreadsheet for budgeting.

The Safe Water System is an effective, proven intervention that reduces diarrheal disease incidence and is easy for families to use. Please feel free to contact us at safewater@cdc.gov if you have any questions or would like a copy of the SWS handbook. You can also visit our website at www.cdc.gov/safewater for more information.

An SWS User in Madagascar

CDC is a branch of the federal government and does not endorse products from specific companies. Information provided herein is for reference purposes only to describe the Jolivert program experience, and does not represent the full range of available products.

Step 1: Complete Need and Feasibility Assessment

The first step in starting an SWS program is to assess the feasibility of the program based on three factors: 1) the needs and desires of the community; 2) existing water resources; and, 3) the capacity of your organization to implement a program.

Collecting Information in the Community

Information on water practices in the community, health knowledge in the community, and resources available in the community is needed before beginning a program. Potential sources for this information include existing reports, medical records at clinics or hospitals, on-site visits to households and institutions in the community, and conversations with community leaders, government officials, and non-governmental organizations (NGOs). Quantitative information can be obtained through a survey of community members. Sample surveys are included on the accompanying CD.

Before developing an SWS program as detailed in subsequent steps, answers to the following sets of questions are needed.

Answers to this first set of questions about the community will help determine the potential size and scope of the program:

- How many people or families are in the community?
- How many families have one or more children under-5 years old?
- How dispersed are the houses in the community?

Answers to the following questions on water resources and water storage will help determine the SWS products that will be needed in the program, including the safe storage container and the hypochlorite solution:

- What sources of water do people in the community use?
    - Is there sufficient water at each of these sources?
    - Do these sources always have water?
    - Is water from these sources turbid (full of solids/dirty looking)?

- What containers do people use to collect water and store water in the home?
    - How many liters do these containers hold?
    - Are they open (like buckets without a lid) or closed (like a jerry can)?
    - What materials are they made of (ceramic, plastic, metal)?

Answers to these questions on community knowledge of disease will help you develop educational materials:

- How frequently do children have diarrhea (defined as 3 or more loose stools per day)?
    - Does diarrhea vary by season?
- Do people perceive diarrhea as a problem in the community?
- Do people understand that diarrhea is an illness that can be transmitted via contaminated water?
- Do people use latrines?
- Do people know to wash hands at critical times, including before preparing or eating food, after changing a baby, and after toileting?
- Is soap available for washing hands?

Answers to these last questions are important for program logistics:

- What material resources are in the community for the program?
    - Is there space to store equipment?
    - Is there electricity?
- What human resources are in the community?
    - Are there trustworthy, respected personnel in the community who are capable of working with the program?
- Is there financial support for the program and ongoing financial planning?

Assessing the Water Resources in a Community

The SWS is most applicable where families have enough water for their daily needs. If a community does not have enough water, a water source intervention, such as the installation of a well, construction of water storage cisterns, or improvements to a

spring, may be more effective at reducing diarrhea than an SWS program. Such an intervention may also be more acceptable to the community. Studies have shown that access to enough water (for drinking, bathing, cooking, and cleaning) is linked to a reduction in diarrheal disease.

Even if there is a reliable source of water for a community, water can become contaminated during collection, transport, and storage in the home. The Safe Water System addresses this issue, by treating water after collection and transport. It can be assumed that all untreated water in developing countries is contaminated at the source or becomes contaminated during handling at the household level. Therefore water quality testing before beginning an SWS program is not needed, although it can be completed if desired.

Sometimes a community has sufficient water, but it may be turbid, meaning cloudy or dirty-looking with solid particles in it. When this is the case, some kind of treatment is preferred before the hypochlorite solution is added. The turbidity can be removed by allowing the dirt to settle to the bottom of the container and then pouring off the clean water; filtering the water through a cloth; or using a natural flocculant; such as *raket*, which is a type of cactus that grows in Haiti, *alum*, a common mineral in Africa, or *moringa seeds.* These mechanisms are further described on the accompanying CD.

Collecting Turbid Water in Ethiopia

It is important to remember that these mechanisms remove large particles; they are not disinfectants, and do not make the water safe to drink. When methods of removing solids are unavailable or not effective, the dose of hypochlorite solution used to treat the water should be doubled. The water in the picture (from Ethiopia) is turbid enough to need a double-dose of hypochlorite solution.

In studies conducted by CDC, household treatment of drinking water with hypochlorite solution reduced diarrheal disease incidence by 22-84%. It is important to note that the use of hypochlorite solution does not reduce diarrhea completely and

does not remove all organisms that cause disease. Hypochlorite solution is effective at removing most bacteria and viruses, but not at removing some protozoa, such as cryptosporidium. Recent research has shown that viruses and bacteria are the most common causes of diarrhea in developing countries. Protozoal disease is often over-diagnosed in developing countries because protozoa are larger and easier to see with a microscope than bacteria and viruses. For example, a person can be shedding cryptosporidium in their stool, even if it is not currently causing the diarrhea.

There is a slight elevation of cancer risk associated with drinking chlorinated water. The World Health Organization (WHO) has established guideline values for exposure to chlorination by-products that are the potential cancer-causing agents. Drinking water with the WHO maximum allowable levels of chlorination by-products leads to an estimated one additional case of bladder or kidney cancer for every 100,000 people who drink 2 liters of chlorinated water per day for 70 years. This slight risk is very small compared to the mortality rates due to diarrhea and other waterborne diseases. Research has shown that water treated with the SWS hypochlorite solution contains concentrations of chlorination by-products that are consistently below the allowed WHO guideline values.

Assessing Your Organization's Ability to Implement an SWS Program

In order to have a successful SWS program, the organization should have a well-established and ongoing relationship with the community or communities where the program is to be established. While the ideal is that SWS programs become self-supporting and locally administered, the reality is that to ensure long-term success, the sponsoring organization should be prepared to furnish limited support and oversight for the program into the foreseeable future. In addition, the sponsoring organization's links to the community should include dependable people from the community who are well respected and who have the background to carry out the necessary technical and record-keeping tasks required by the program.

The organization should have, or be able to secure, the financial, human, and logistic support needed to implement the program. It may take some time after the program is started before any income is generated. During this time the program will need

adequate financial resources to continue. To ensure the program's success in the long-term, it is best to make realistic projections of the resources needed to start and continue the program. The budget spreadsheet provided on the accompanying CD can assist with these projections.

Moving Forward

After collecting the information detailed in this step, based on community needs, water resources, and organizational capacity, your organization is now able to determine if moving forward with an SWS program is appropriate. This is a decision that should be considered carefully, because providing safe water temporarily in a community will not help the community's long-term development. It is also a decision your organization will need to make for itself. There is no formula that can be applied across all situations to determine if it is appropriate to proceed. The following page details the Jolivert Safe Water for Families experience in determining whether to proceed with an SWS program. If your organization decides to establish an SWS program, the subsequent steps in this manual detail how to start a program.

A Focus Group Discussing Water and Sanitation Practices in Ethiopia

The Jolivert Local Program Experience – Step 1

The Jolivert Safe Water for Families program began when Dr. Robert "Bob" Johnson, Director of the Jolivert Medical Clinic in Northern Haiti, invited long-time friend Bill Gallo to establish an in-home water purification program to serve the community surrounding the clinic. Bill, who had been working for several years on water purification in Haiti, was interested in starting a program using the CDC Safe Water System model and agreed to work in Jolivert. Dr. Bob and Bill conducted meetings in September 2001 to educate the community about the program and seek community support.

Bill's experience with water purification in Haiti and Dr. Bob's knowledge of the Jolivert community made it easy to find answers to the questions detailed in Step 1. From clinic records and Dr. Bob's own experience the **need** for an SWS program was clear. **Community interest** in safe water was high since residents suffered frequent bouts of diarrhea, and were well aware of the link between water, diarrhea, and health. Sufficient **water resources** were available from *Trois Riviere,* the river that runs through the community. The river is turbid only when it rains, but when it does rain, families dig a hole next to the river and collect only water that has been filtered through the riverbank. **Resources—financial, human, and logistic—**were all available to the program. The start-up costs were funded by a $5,000 designated gift. Competent staff members who had been associated with the clinic came to work on the program, and space was provided by the clinic for program needs.

Based on all this information, it was determined that an SWS program was appropriate for the area, and program planning was initiated.

A Woman Filling her Water Container Using Riverbank Filtration after Rainfall

Step 2: Organize the SWS Program and Select Staff

Many community-based programs are sponsored by organizations that work in the community, but are based in another country. Local program staff hired within the community are the key to a successful program because they provide day-to-day supervision, problem solving abilities, and program promotion. Although specific staff positions will vary with the size and scope of each SWS program, sample positions and responsibilities are detailed below.

Sponsoring Organization and Community Advisory Committee

The sponsoring organization is usually associated with, or working in, the community, and assumes ultimate responsibility for the SWS Program. The sponsoring organization could be a non-governmental organization (NGO) or faith-based organization (FBO) headquartered outside the country, or a community-based organization (CBO) located in the community. In any case, a Community Advisory Committee ('Water Committee') may be selected from respected community members by the sponsoring organization to assist in program development, and provide guidance on what is best for the community. While a Water Committee is not a requirement for an SWS program, it often helps smooth the way for a successful program.

Program Director

The Program Director, often selected from the ranks of the sponsoring organization, is responsible for seeing that the long-term needs of the program are met. These include ensuring adequate funds for the program, overseeing staff selection, communicating with the sponsoring organization, and trouble-shooting problems. The Program Director may or may not be a local resident, and may or may not spend significant time at the site of the program after it has been implemented.

Program Administrator

The Program Administrator supervises the day-to-day activities of the program, and most often lives in the community. He or she is responsible for managing the budget, supervising the employees, and reporting on the progress of the SWS program to the Program Director. The Program Administrator should be able to read, write, and have the skills to keep local financial and program records. Basic computer skills are an advantage for this position. The Program Administrator also supervises, trains, and coordinates the Technicians/Community Health Workers.

Technician/Community Health Worker

The Technician/Community Health Worker takes care of the day-to-day activities of the program. The following are some of the duties normally carried out by the Technician/Community Health Worker:

- Preparing or purchasing the SWS products, including the hypochlorite solution and safe water storage containers;
- Selling and distributing the hypochlorite solution and safe water storage containers;
- Educating groups and individuals on the SWS and on healthy water and sanitation practices;
- Visiting SWS users' households on a regular basis to test for chlorine residual, solve any problems the users are having with the SWS, and encourage the correct and consistent use of the SWS; and,
- Maintaining clear and complete records of sales and test results.

In larger programs, it may be useful to designate a Chief Technician/Community Health Worker to co-ordinate the activities of a group of Technicians/Community Health Workers.

Staff Training and Management

The Technicians/Community Health Workers will need to be trained to carry out their duties. Generally, the Program Administrator is responsible for the trainings, which include the following topics:

- Preparing the hypochlorite solution. Technicians/Community Health Workers need to be taught how to prepare the solution using safe procedures and the necessary safety equipment, and to follow specifications to ensure the solution is the proper strength and the equipment is maintained correctly.

- Distributing and selling the hypochlorite solution and containers. Technicians/Community Health Workers will need to be taught how to develop and maintain supply chains for the products that are appropriate within the community.

- Teaching users to purify water with the hypochlorite solution and motivating them to use the SWS consistently and correctly. To do this, Technicians/Community Health Workers need to be able to make educational and motivational presentations to individuals and groups about the use of the SWS and water and sanitation issues in general.

- Testing household water in homes for the presence of free chlorine to ensure that the users are using the SWS correctly. This is accomplished through the use of simple test kits that are described on the accompanying CD.

- Keeping the necessary records for the program, including sales of hypochlorite solution, test results, and inventories of supplies.

The Program Director and Project Administer can organize the training in conjunction with local medical facilities, NGOs, or educational institutions to help Technicians/Community Health Workers carry out the activities required by the position. Training materials can be developed by adapting existing materials that are included on the accompanying CD or by using materials already available within the community.

Formal, written contracts or letters of agreement of work duties should be established with local employees, and job evaluations should occur regularly. This validates their role as important employees, and allows the organization recourse in the event of unforeseen problems. Sample contracts are included on the accompanying CD.

SWS programs generally fairly compensate staff members for their work, according to community standards. The Program Director and Program Administrator, perhaps along with the Water Committee, can determine a fair salary for work completed. It may be possible to depend on volunteer labor in a Safe Water System program, if the NGO wishes to use volunteers instead of paid staff.

Establishing defined roles and responsibilities for each partner in the SWS program is the first step in maintaining good working relationships between all organizations, and assuring program success.

Testing Water for Chlorine Residual in a Refugee Camps in Thailand

The Jolivert Local Program Experience – Step 2

Program Director Bill Gallo, in consultation with Dr. Bob, initially hired Program Administrator Christophe Velcine as the first Jolivert Safe Water for Families employee. Christophe works at the clinic as a supervisor, and was hired part-time to oversee the safe water program and supervise the Technicians. Christophe's experience at the clinic with health, water, sanitation, managing money, and overseeing staff were a great asset to the water program.

Bill and Christophe jointly hired and trained a community member as the first full-time Technician. His responsibilities included making the sodium hypochlorite solution with the electrolytic generator, bottling and selling the hypochlorite solution, preparing safe storage containers, visiting customers' homes every week to test for chlorine residual, maintaining production and sales records, training new and existing users in the proper use of the SWS, troubleshooting, and following up with users who had stopped purchasing the sodium hypochlorite solution.

Administrator Christophe Velcine

Both employees were paid approximately the same amount as a teacher is paid in the community. Initially, staff salaries were paid from private donations. As the program grew, income from sodium hypochlorite solution sales began to pay for a significant portion of operating expenses, including salaries. As the program continued to grow, another Technician was added. A problem occurred when tensions grew between the two Technicians. The situation was resolved when the Senior Technician refused to work with the Junior Technician and so was asked to leave the position by the Program Director. The Junior Technician was promoted, and another Technician was hired.

Key qualities in the Technicians that have been invaluable to the success of the Jolivert Program include good written and record-keeping skills (including budgeting and money management), good rapport with the community, and innovation. The new Senior Technician has responded to the needs of the community by suggesting the development of a "dropper bottle for use when a family is traveling", and by selling bulk volumes of hypochlorite solution to individuals who can resell it in their local communities.

Step 3: Select the SWS Products

Once the decision has been made to establish a Safe Water System program and staff have been selected for the program, the next step is to develop the products. To begin a Safe Water System program three products are needed:

- The hypochlorite solution for household water treatment;
- The bottle for the hypochlorite solution, including a cap that will be used as the dosing mechanism and a label with instructions; and,
- The safe water storage container used to store treated water in the home.

A table summarizing the various options for obtaining the hypochlorite solution and bottles is located on page 35. In addition to these products, the SWS program will need to develop educational and motivational materials for households targeted by the program. These materials are covered separately in Step 4.

Product 1: Sodium Hypochlorite Solution

Sodium hypochlorite solution is a disinfectant that inactivates most bacteria and viruses in water. Regular household bleach, such as Clorox, is a 5-6% concentration of sodium hypochlorite. The hypochlorite solution used in the Safe Water System is a less concentrated form of regular household bleach, and contains approximately 0.5% to 2.0% sodium hypochlorite. This lower concentration is more appropriate for treating drinking water in developing countries. Water is microbiologically safe to drink 30 minutes after the addition of the correct amount of hypochlorite solution.

There are four options for obtaining the hypochlorite solution for a community SWS program. Each of these options is described in detail in the subsequent sections:

1. Produce the hypochlorite solution in the community with an imported hypochlorite generator using salt, water, and electricity;
2. Purchase hypochlorite solution from a local manufacturer that is made to the program organization's specifications;

3. Purchase bleach from a manufacturer or local outlet, and dilute and repackage it for distribution as SWS hypochlorite solution; and,
4. Purchase prepackaged SWS hypochlorite solution that is available through an international social marketing organization, such as Population Services International (PSI).

Option 1: Produce the Hypochlorite Solution in the Community with an Imported Hypochlorite Generator

Hypochlorite solution can be manufactured using a sodium hypochlorite generator in any location with a reliable electrical supply. This process requires salt, water, electricity, and the generator.

The sodium hypochlorite generator has two main parts: a power supply and the probe. The power supply is a transformer that passes direct current (DC) through the probe. When the probe is immersed in a 3% saltwater solution (brine), the current passing through the brine causes a simple chemical reaction that transforms the brine (sodium chloride) into the sodium hypochlorite solution. The final concentration of the hypochlorite solution depends on the concentration of brine and the amount of time the current is passed through the brine. The maximum possible concentration that can be made with a generator is about 0.8% sodium hypochlorite solution. Generators are available in different sizes, with the capacity to generate 20 to 200 liters of hypochlorite solution per day.

The procedure is simple, and can be completed by a local staff person. The following series of pictures shows a Jolivert Safe Water for Families Technician making a 17-liter batch of hypochlorite solution, which takes about 2 hours with a medium-sized generator. One 17-liter batch of hypochlorite solution can provide 68 households (over 400 people) with enough hypochlorite solution to last 1 month, since each household will use about one 250 ml bottle of the hypochlorite solution per month.

A generator costs between $1,500-2,500 and can be used for 5-10 years. After the generator has been purchased, the cost of making bulk hypochlorite solution is minimal, since only water, salt, and a small amount of electrical power are needed.

Information on where to purchase chlorine generators is included below, and further information on their use is included in the accompanying CD. Solar-powered generators are available from some of the companies listed below.

Selected Companies that Sell Sodium Hypochlorite Generators

AquaChlor
Jose Masis, Director
Equipment & Systems Engineering, Inc.
Email: Jotoma1@earthlink.net
Tel: (305) 378-4101
Fax: (305) 378-4121
14260 SW 136th Street, Unit 4
Miami, FL 33186
http://www.equipmentandsystems.com/

SANILEC
Earl Ahrens, Business Development Manager
ClorTec Disinfectant Products
Severn Trent Water Purification, Inc.
eahrens@severntrentservices.com
Tel: (310) 531-7482
Fax: (310) 618-1384
2660 Columbia Street
Torrance, CA 90503

DipCell
Herman Jansen, Director
jansenaben@hetnet.nl
Amsterdam, Netherlands

WatAlys
Isabelle Genoud, Director
Tel: +41 22 776 02 06
Mobile: +41 78 791 62 45
isabelle.genoud@bulane.com
www.bulane.com

Making the Hypochlorite Solution with a Generator

Connecting the probe of the hypochlorite generator to the power supply in preparation for use

Small bubbles forming during the process

It takes approximately 2 hours to turn 17 liters of brine into 17 liters of hypochlorite solution

Testing the solution after adjusting the pH to ensure adequate shelf-life

Option 2: Purchase Hypochlorite Solution from a Local Manufacturer that is Made to Your Organization's Specifications

Private companies manufacture bleach and other chemicals for retail sale in many of the least-developed countries. These companies can be approached to determine if they have the capacity and interest to manufacture the hypochlorite solution for an SWS program. The advantages of having a company make the hypochlorite solution are: 1) a company can easily make the hypochlorite solution with the proper concentration for the program needs; and, 2) if the program grows rapidly, or an increased supply is needed for an outbreak or emergency, it is often possible for a company to easily increase production capacity. Almost all the large-scale Safe Water System programs have opted to engage private companies to manufacture the hypochlorite solution for them.

The disadvantages of buying bulk hypochlorite solution from a manufacturer are: 1) because manufacturing facilities are located primarily in larger cities, SWS programs located in rural areas may have problems transporting the hypochlorite solution to their community, especially if roads are substandard; and, 2) reliance on a single external company could lead to interruptions in the supply chain.

To determine if a company can produce the sodium hypochlorite solution, three steps are necessary:

- First, identify local chemical manufacturing companies.

  This can be accomplished by looking in marketplaces for bleach products and noting the manufacturer, looking in phone books of larger cities for companies that manufacture chemicals, paints, bleach, or pharmaceuticals, or talking with knowledgeable local people.

- Second, meet with representatives from the companies and discuss the requirements for the hypochlorite solution.

  These requirements include specifying the preferred concentration, usually between 0.5% and 2%, and stabilizing the solution to a pH of greater than 11.9 to ensure adequate shelf life.

- Third, obtain a price quote from the different companies.

  The cost of hypochlorite solution is inexpensive, generally about $0.10 per liter if purchased from a company in bulk.

Determining whether production of the hypochlorite solution at a company is economically feasible requires an estimate of the amount of hypochlorite solution that will be needed. A preliminary estimate can be calculated based on the fact that every 1,000 households in the program will require about 250 liters of hypochlorite solution per month. This amount could be transported in fifteen 20-liter (or 5-gallon) containers.

Option 3: Purchase Bleach from a Manufacturer or Local Outlet, then Dilute and Repackage it for Distribution as SWS Hypochlorite Solution

Small organizations that may not be able to afford the capital expense of a hypochlorite generator and cannot obtain hypochlorite solution from a company because of size or location may still establish an SWS program by diluting and repackaging commercial bleach. Commercial bleach, used primarily for washing clothes, is widely available in most countries, though the concentration varies considerably. In the United States, most commercial bleach contains 5.25% sodium hypochlorite.

There are many benefits of diluting commercial bleach, including: 1) Bleach is widely available in stores or in bulk from manufacturers; 2) bleach is more easily transported because it is more concentrated than the SWS hypochlorite solution; and, 3) bleach is widely distributed for water treatment in emergencies, such as natural disasters.

There are also drawbacks of diluting commercial bleach. The actual concentration often differs significantly from that advertised on the label, and it is necessary to test the concentration of each bottle before dilution. It is also important to purchase bleach that has no additives or perfumes that are unpalatable or unsafe for human consumption. Because of these quality control drawbacks, dilution of commercial bleach is only recommended for very small programs or pilot projects. It is recommended that larger, long-term programs obtain a more reliable supply of hypochlorite solution.

You can dilute commercial bleach to a hypochlorite solution appropriate for a Safe Water System by first testing the bleach using procedures detailed on the accompanying CD. Then, calculate the dilution factor by dividing the concentration of the bleach by the desired final concentration of the hypochlorite solution. For example, if the bleach is 6%, and the final goal is 0.8% solution, the dilution factor is calculated by dividing 6 by 0.8 to obtain 7.5 parts. To dilute 6% bleach to 0.8% bleach a total of 7.5 parts are needed: 6.5 parts of clean water to 1 part of 6% bleach. One liter of the 6% bleach mixed with 6.5 liters of clean water will yield 7.5 liters of the final solution with the desired hypochlorite concentration (0.8%). It is important that clean water is used for the dilution, for if contaminated water is used it can degrade the hypochlorite solution over time.

A community program could begin by using dilution of commercially available bleach in a pilot project, and as the program grows, either Option 1 or Option 2 may be considered as more appropriate methods of obtaining the hypochlorite solution.

Option 4: Purchase SWS Solution as Packaged and Sold by an SWS Partner

Population Services International (PSI), a social marketing NGO that operates in over 60 countries, has partnered with CDC since 1999 to market the Safe Water System solution in national and sub-national programs. The most successful program with PSI, in Zambia, sells over 2 million bottles of hypochlorite solution, branded 'Clorin', each year. More information about PSI can be found at www.psi.org.

In many countries, it is possible to use the PSI hypochlorite solution in community programs. Using the local PSI product has many advantages: 1) Since it is immediately available, and packaged with clear instructions for use, a program can begin without delay; 2) PSI advertises their products, so the product would potentially already be familiar to the community; and, 3) PSI assures quality control of the product.

The retail cost of the PSI hypochlorite solution varies between $0.15 - $0.50 per bottle, depending on the country, and each bottle provides approximately 1.5 months of safe water for a family. The major drawback of using the PSI product is that the cost is higher than the other three options. However, PSI is often willing to sell their products to other NGOs at the wholesale price, which lowers the cost of the product and allows

resellers to sell the product at retail prices, which encourages distribution because of the profit margin. Because the product is manufactured and packaged in a central location, the organization should ensure that transportation from the point where the product is manufactured to the community where it will be used can be assured year-round and will not generate excessive costs.

PSI and another social marketing organization, Constella Futures, currently operate established SWS programs in:

Afghanistan	Guinea	Malawi	Rwanda
Angola	Haiti	Mozambique	Tanzania
Burundi	India	Myanmar/Burma	Uganda
Cameroon	Kenya	Nepal	Vietnam
Ethiopia	Madagascar	Nigeria	Zambia

Examples of PSI SWS products

Malawi

Nigeria

Nepal

Burundi

Quality Control Considerations

If your organization chooses to buy and distribute hypochlorite solution from an organization such as PSI, there will be no need to consider quality control, as the product quality is assured by PSI. If your organization decides to make hypochlorite solution with a generator (Option 1), have the chlorine manufactured at a company (Option 2), or dilute commercial bleach (Option 3), you should perform quality control of the solution regularly.

The quality control considerations for the hypochlorite solution are listed below:

- The sodium hypochlorite concentration of the solution must be exactly as specified; and,
- The pH must be stabilized to a pH value above 11.9.

The hypochlorite solution concentration is critical to the effectiveness of the solution. If the concentration is too low, the solution will not be effective as a disinfectant. However, if the concentration is too high, the taste and smell of chlorine will discourage people from using the solution.

The pH must be stabilized above 11.9. At normal pH values (pH<8) sodium hypochlorite will degrade significantly within 4-6 weeks. This shelf life is not adequate for use in the Safe Water System. By raising the pH of the hypochlorite solution, the stability and shelf-life of the solution is assured for 12-18 months. The pH can be adjusted by the addition of sodium hydroxide (widely available in rural areas in the form of lye or caustic soda) until the pH is above 11.9. Due to variations chemical characteristics of dilution water each batch of hypochlorite solution will demand a different amount of sodium hydroxide to adjust the pH. To complete the pH adjustment, simply add sodium hydroxide one teaspoon at a time while mixing the solution and measuring the pH. Stop adding sodium hydroxide when the pH reaches 11.9.

Both the sodium hypochlorite concentration and the pH of the solution can be measured through multiple methods. Sodium hypochlorite concentration can be measured using chemical test kits. pH can be measured using test strips or a pH meter. Please see the accompanying CD for details on where to buy equipment to measure these critical quality control parameters, and how to use them.

Product 2: Hypochlorite Solution Bottles and Dosage of Chlorine

If your organization chooses to buy and distribute hypochlorite solution from an organization such as PSI, there will be no need to consider dosing, labeling, and selection of bottles. Hypochlorite solution for water treatment produced by PSI and other organizations is sold in disposable plastic bottles already labeled with directions on how to dose and other necessary information. However, organizations that choose to produce hypochlorite solution, purchase it in bulk from a company, or dilute it from commercial bleach need to make several decisions about how to package the solution for distribution. A bottle of the correct capacity made from suitable materials needs to be selected, along with a cap of the appropriate size for measuring the doses of the solution. In addition, labels with dosing directions, instructions, and warnings will need to be developed.

Hypochlorite Solution Dosage

Dosage, the amount of hypochlorite added to untreated water to inactivate disease-causing organisms, is affected by the following four factors:

- The volume of solution that is added to the untreated water.

  In most cases, the cap of the bottle of hypochlorite solution is used to measure the dose necessary to treat the water. The capacity (volume) of the cap is measured in milliliters, and one-half cap, one full cap, or two full caps may be used to dose. Since the capacity of the cap determines the dose, it is essential to carefully measure it. The volume of caps that fit on bottles which are appropriate for SWS programs varies between 3 and 10 mL. For comparison purposes, a standard soda or water bottle cap is 10 mL in volume.

- The concentration of sodium hypochlorite in the solution.

  While it may not be possible to choose a cap for your hypochlorite solution bottle with exactly the volume desired, it is possible to vary the concentration of the hypochlorite solution to match the volume of the cap you are working with. If

your organization is diluting commercial bleach or purchasing bleach from a manufacturer, the concentration can be adjusted as desired. If your organization is using a generator, the concentration can be adjusted between 0.3 and 0.8%.

- The volume of water being treated.

  The volume of water to be treated depends on the size of the container used to store water in the home. In-home storage containers are discussed in the following section, but common sizes found in many places throughout the world include the 20-liter jerry can or the 5-gallon (19-liter) plastic bucket. For the purposes of determining dosing, the benchmark is 20-liter storage containers; when containers are larger or smaller, the dose is adjusted proportionally.

- The relative turbidity ("dirtyness") of the water.

  When the source water is turbid (dirty-looking), it is preferable to remove as much of the dirt and contaminants as possible before chlorination (as discussed on page 8). If it is not possible to pre-treat the water, it is acceptable to simply double the regular dose of hypochlorite solution.

Dose Factor and Dosing for 20-liter Containers

To determine the cap size and hypochlorite concentration that best serves your Safe Water Program, begin by computing the *Dose Factor* for the amount of water you intend to treat. The dose factor is calculated by multiplying the volume of the cap in milliliters times the concentration of the hypochlorite solution expressed in percent.

CDC has conducted extensive testing of drinking water sources in many countries, and has consistently found that 3.75 is the optimal dose factor to add to 20 liters of clear water. The dose factor is doubled for turbid water, for a dose factor of 7.5.

$$3.75 \text{ (Dose Factor for 20 L container)} = \text{Volume cap (mL)} \times \text{Concentration of hypochlorite solution (\%)}$$

Using the dose factor equation, and the fixed cap volumes available to your program, it is possible to calculate the hypochlorite concentration necessary for treating 20 liters of water (Table 1). An Excel spreadsheet that auto-calculates these values based on cap volume and other variables is included on the accompanying CD. Some example calculations are shown here:

- With a cap of 8 mL (Option A), and a solution of 0.94%, one cap will have a dose factor of 7.5 (8 mL * 0.94% = 7.5). This leads to a dosing scheme of one half cap for 20 liters of clear water, and 1 full cap for 20 liters of turbid water.
- With a cap of 5 mL (Options B & C), you could either use a concentration of 0.75%, and thus have a dose factor in one cap of 3.75 (Option B), or you could have a concentration of 1.5% and use one half-cap for clear water, one full cap for turbid water (Option C).
- With a small 3 mL cap (Option D), a concentration of 1.25% can be used in a one cap for clear water, two cap for turbid water.

Dropper bottles can also be used to dose the hypochlorite solution. Generally, there are approximately 20 drops to 1 mL, although this should be confirmed with the actual dropper bottle. If you use 5.25% chlorine (Option E in Table 1), you would need to add 14 (14.3) drops to 20 liters of clear water and 29 (28.6) drops to 20 liters of turbid water.

Table 1: Dosing Scheme Development for 20-liter Storage Containers

	Cap Size (mL) Fixed	**Concentration Calculated %**	**Dose Factor (one cap)**	**Dosing: Clear water**	**Dosing: Turbid Water**
Option A	8	0.94%	7.5	1/2 cap	1 cap
Option B	5	0.75%	3.75	1 cap	2 caps
Option C	5	1.5%	7.5	1/2 cap	1 cap
Option D	3	1.25%	3.75	1 cap	2 caps
	# Drops				
Option E	14	5.25%	3.75	14-15 drops	28-30 drops

Computing the Dose Factor for Various Size Containers

The dose factor is computed for a container that holds 20 liters. If the predominant storage container used in the community holds more or less than 20 liters of water, the dose factor can be adjusted accordingly. The adjusted dose factor is computed as follows:

$$\text{Adjusted Dose Factor (variable volume)} = \frac{\text{Liters to be treated}}{\text{20 Liters}} \times 3.75$$

For example, if the water storage container used in your community holds 18 liters, the adjusted dose factor would be 18/20 x 3.75 = 3.375. Using the same equation for a single liter of water leads to an adjusted dose factor of 1/20 x 3.75 = 0.188.

With this adjusted dose factor for the storage container you want to treat, you can then calculate, as in Table 1, the concentration of the hypochlorite solution needed, or the cap size needed.

For example, if you plan to treat 18 liters of clear water with a dose of hypochlorite solution from a cap that holds 8 mL and wish to find out the appropriate sodium hypochlorite concentration for that solution, use the following formula:

$$\text{Adjusted Dose Factor (18 L)} = \frac{\text{18 Liters}}{\text{20 Liters}} \times 3.75 = 3.375$$

$$\frac{\text{Adjusted Dose Factor (18 L)}}{\text{Cap Size (mL)}} = \text{Hypochlorite Solution Concentration (\%)} = \frac{3.375}{\text{8 mL}} = 0.42\%$$

A simple Excel spreadsheet calculator for the computations above is included on the accompanying CD.

Some general considerations in developing dosage regimes are as follows:

- A good hypochlorite concentration range is 0.5%-2.0% for 100-500 mL bottles, and 5-6% for dropper bottles;
- The lower the hypochlorite solution concentration is, the more volume of hypochlorite solution needed per treatment. If transportation is a barrier in your

program, you might want to consider increasing the concentration to decrease the weight and volume of the product;

- Because a full cap is easiest for the user to measure, it is recommended that in programs where the source water is usually clear, a 1 cap/2 cap dosage be used, and in programs where the source water is usually turbid, a half-cap/full-cap dosing scheme be used;
- Because it is hard to accurately measure half of a smaller cap, a half-cap/full-cap dosing scheme should only be used if the cap is 5 mL or larger; and,
- Counting more than 20 drops can be difficult for users.

Correct dosage of hypochlorite solution depends on all users having a storage container of known, consistent volume. Information on the existing water storage container types and volumes should be collected in the feasibility assessment (as detailed in Step 1). Existing containers can be promoted or modified, or special containers provided, as described on page 37, Safe Storage Containers.

Hypochlorite Solution Bottle Characteristics

When choosing a bottle for hypochlorite solution in an SWS program, we consider the volume, the material from which the bottle is made, and the labeling.

Bottle Volume

Generally, families use a minimum of one 20-liter container of water per day. Once a bottle of hypochlorite solution is opened, it should be used within 60 days, and have a maximum of 60 doses. To find out how many doses the bottle you are considering contains, divide the capacity of the bottle in milliliters by the cap size you intend to use per dose. Table 2 provides an example of calculating the number of uses and liters treated for the first option detailed in Table 1. *Note: 1 ounce is approximately 30 mL.*

Table 2: Liters Treated per Bottle

Option	Cap Size (mL)	Dosing (20 L, clear water)	Bottle Size (in mL)	Number of uses per bottle	Liters treated by one bottle (20 L per use)
Option 1	8	1/2 cap	150	37.5	750
			250	62.5	1250
			500	125	2500

For example, if you use a 4 mL dose and a bottle with a 250 milliliter capacity, the bottle would contain 250 mL / 4 mL = 62.5 doses, and last a family approximately 62 days. If the calculation shows that the bottle you are using holds more than 60 doses then you should consider using a different bottle or a weaker concentration hypochlorite solution.

The parameters we recommend for large-scale programs using disposable bottles and 20-liter storage containers are 1.25% hypochlorite solution packaged in a 150 mL bottle with a 3 mL cap. The dosage is one cap for clear water, and two caps for turbid water. This bottle has 50 clear-water uses, and lasts a family approximately 1.5 months.

The Plastic Bottles

The most practical material for the hypochlorite solution bottle is plastic. Hypochlorite solution should be stored only in high-density polyethylene (HDPE) bottles. The type of plastic a bottle is made from is sometimes stamped onto the bottom of the bottle. HDPE bottles are stamped with the number 2. In addition, the bottle must be opaque, so that light will not pass through it and degrade the hypochlorite solution.

Many countries have plastics manufacturers that can or do produce HDPE plastic bottles suitable for the SWS program. Plastic bottles can be chosen in a similar manner to that described for the hypochlorite solution on page 21. If suitable plastic bottles are not available in the host country, bottles may be imported from a nearby country. Sometimes the bottles may be produced locally, while the caps may be imported. The accompanying CD has information on how to work with local manufacturers to purchase bottles. A large program might even consider having a unique bottle designed and produced at a local plastics company.

The Label

A label, including dosing directions, instructions for use, and other information, is attached to the bottle of hypochlorite solution. The following information is needed on the label:

- Dosing Directions
    - Pictoral and written directions instructing users to add the correct amount of hypochlorite solution to the correct volume of water in the storage container, agitate the storage container, and wait 30 minutes before drinking.
- Usages
    - Directions showing the treated water can be used for drinking, washing hands, rinsing fruits, cleaning dishes, and cleaning in the home.
- Warnings and other information
    - Keep away from children, sunlight, and heat.
    - The hypochlorite solution concentration in percent, manufacturer, expiry date, and lot number.

A large SWS program can design and print labels commercially. Community programs can produce labels on publishing software and print them on weatherproof paper with a copier or laser printer. It is important that the labels be weatherproof, especially if the product is to be distributed in reusable bottles. An attractive, well-designed label will make the product more acceptable to users, and improve compliance with recommended dosing instructions and uses.

The PSI/Nigeria label below is an example of a commercially produced label. The Jolivert label below is made on word publishing software and printed and copied onto weatherproof label paper.

PSI Nigeria Bottle and Label

Jolivert Safe Water for Families Bucket Label

Choosing Reusable or Disposable Bottles

SWS programs can choose to use either refillable or disposable plastic bottles for the hypochlorite solution.

The advantages to using refillable bottles are: 1) Because the plastic bottle is the most expensive component of the product, reusable bottles make it possible to sell hypochlorite solution at a much lower price; and, 2) hypochlorite solution transported in small bottles takes up more space than the same amount of solution transported in bulk which can increase costs.

The advantage of using disposable bottles is that quality control at the point where the solution is bottled is simpler, particularly if tamper-proof seals are used on the bottles.

In communities where many commodities come in disposable packaging, disposable bottles may be easily accepted. In communities where most items come to the market in bulk and are resold in smaller amounts there may be more resistance to disposable bottles.

For reasons of quality control and the logistics of large-scale manufacturing, the social marketing NGO's favor disposable bottles. With the information presented above about the hypochlorite solution and bottle options, combined with the information from the community, you can determine which of the following combinations you would like to use to manufacture your product, as detailed in Table 3.

Table 3: Product Options: Organizational Responsibilities, Costs, and Appropriateness

Chlorine Production Method	**Hypochlorite Solution Concentration and Bottle Type**	**Organizations' Responsibilities**			**Appropriate For:**		
		Producing Chlorine	Bottling and Labeling	Quality Control	Location	Size of Program	Program Costing
Use PSI Bottle	PSI determines Dose Factor 3.75 150-250 mL Disposable Bottle	No	No	No	Areas where PSI is distributing already	Any size	- No initial investment - The cost per family is ~$0.25 per month
Using commercial 3-6% bleach	~5.25% dropper Dose Factor 3.75 Refillable bottle possible	No	Yes	Yes	Anywhere, transport costs are low for high concentration solution	Smaller Programs (less than 1,000 familes)	- Depends on cost of commercial bleach - No initial investment
Diluting commercial 3-6% bleach with clean water	125-250 mL Dose Factor 3.75 Refillable bottle possible	No	Yes	Yes	Anywhere, transport costs are low for high concentration solution	Smaller Programs (less than 1,000 familes)	- Depends on cost of commercial bleach - No initial investment
Obtaining low concentration (0.5-1.25%) commercial bleach in bulk	125-250 mL Dose Factor 3.75 Refillable bottle possible	No	Yes	Yes	Higher transportation costs due to increased volume of solution	Any size	- Depends on cost of commercial bleach - No initial investment
Local generation using hypochlorite generator	250-500 mL Dose Factor 3.75 Refillable bottle possible	Yes	Yes	Yes	Rural areas where commercial production is not feasible	1,000 - 8,000 families per generator	- $2,000 initial investment for generator - Cost per family ~$0.09 per month

The Jolivert Local Program Experience - Step 3

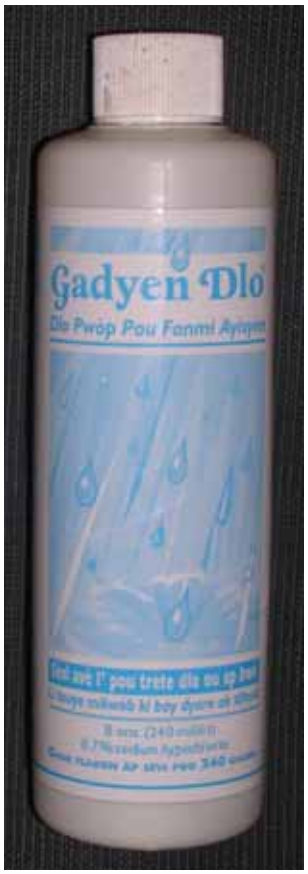
Hypochlorite Solution and Plastic Bottle

Because of its considerable distance from Port-au-Prince, the only place in Haiti where bleach is manufactured, the Jolivert Program chose to make its own hypochlorite solution with a sodium hypochlorite generator purchased from AquaChlor in Florida for $1,500. The generator can produce about 50 liters of 0.7% sodium hypochlorite solution in 6 hours. Local Technicians were trained to use the generator. Local unrefined rock salt is purchased in the market and cleaned by the Technicians. Electricity is available from the generator at the clinic, which runs at least 6 hours per day. Filtered water is available from the clinic. The Technicians stabilize the solution to a pH value above 11.9 by using locally purchased lye (sodium hydroxide). Each batch is tested with a pH meter.

An 8-ounce bottle (240 mL) and a 5 mL cap, both imported from the United States, are used in the program. A hypochlorite concentration of 0.7% was chosen, which leads to a dose factor of 3.5, and an adjusted dose factor for the 19-liter bucket used in the program of 3.68. Each bottle has forty-eight 5 mL doses, treating forty-eight 19-liter containers, or 912 total liters of water. Each bottle lasts a family approximately 1-1.5 months.

Because the clinic is within easy walking distance of the rural population in this area of Haiti, it was decided to save costs by using a refillable bottle model. Users walk to the clinic to refill the bottle for a cost of 9 cents per bottle, or about 0.01 US cents per liter treated.

The label on the bottle instructs users, through text and illustrations, to add one cap of the solution to the water in the storage container, and wait 30 minutes before drinking. No instructions for double dosing turbid water are on the label because users in the area drink only clear water.



The Jolivert Bottle

Product 3: Safe Storage Containers

There are many options for storing water safely after treating it with the hypochlorite solution. These options fall into three general categories: 1) existing water storage containers in the home; 2) water storage containers used in the community modified by the program; or, 3) commercial safe storage containers purchased by the program.

The hypochlorite solution and the bottles (Products 1 and 2) together effectively treat water in the home. The hypochlorite solution not only inactivates the organisms to make the water safe, but also helps to protect the stored water because the residual chlorine that remains in the water acts as a chemical barrier to recontamination. It is preferable, but not necessary, to store treated water in a plastic, ceramic, or metal container that has the following characteristics that help maintain the residual chlorine, which serves as a physical barrier to recontamination:

- A small opening or lid that discourages users from placing potentially contaminated items such as hands, cups, or ladles into the stored water;
- A spigot or small opening to allow easy and safe access to the water without inserting hands or objects into the container; and,
- Instructions that are permanently attached for dosing the hypochlorite solution and for cleaning the container. The container can be cleaned by washing with one capful of hypochlorite solution, a small amount of water, and a brush or cloth.

Although closed, lidded containers are preferred; it is still beneficial to treat water with hypochlorite solution even if it will be stored in open containers. In this situation, efforts should be made to educate users to access the water by pouring from the container rather than dipping into the container with a potentially contaminated object.

In order to determine the appropriate safe storage container for a program it is best to first identify the containers currently used for water collection, transport, and storage in the community, as it is possible the containers are already safe, or could easily be modified to be safe storage containers. It is also recommended to review the options for safe water storage containers (presented in the following section) to determine which is most appropriate for your program.

Jerry Can

In many countries in Africa, 20 liter (5 gallon) jerry cans, initially used to transport vegetable cooking oils, are cleaned and used to transport and store water. They are easy to carry on the head, and are a good option for safe storage. The opening is too small to allow hands or utensils into the water, and thus the water is poured out. They can be modified by drilling a hole in the plastic and adding a tap, which offers easier access to the treated water and provides a place to wash hands in the home. Used jerry cans are approximately $1-5 on the open market in Africa.

Carrying Water in Mozambique

Jerry Can

CDC SWS Modified Jerry Can

In the initial SWS programs, CDC designed 20-liter modified jerry cans and provided them to users. This jerry can is now produced in Uganda, South Africa, Bolivia, and the United States. The cost of the jerry can is approximately $5 per can, excluding transport. Contact safewater@cdc.gov for ordering information.

The CDC Bolivia Container

Jolivert Safe Storage Bucket

In Haiti, people use 5 gallon (19 liter) paint buckets for water transport and storage. In Jolivert, the buckets are modified for safe storage by ensuring there is a tight-fitting lid, drilling a hole through the plastic and installing a tap, placing a label on the bucket that teaches people how to use the SWS, and teaching people to use the tap instead of dipping into the bucket. In Haiti this is an easy educational message, since the tap is seen as a sign of higher socio-economic status, and families take pride in using the tap. The tap and label are imported from the US at a cost of $0.75 and about $0.60 respectively. Gary Strunak at Tomlinson Industries can be contacted at gstrunak@tomlinsonind.com to purchase the taps.

The Jolivert Container

The Oxfam Bucket

Oxfam Bucket

The 14-liter Oxfam Bucket was designed to provide a safe storage option to NGOs working on water safety in the home or refugee camps. It is manufactured in England, and sold to NGOs for use in program implementation. The lids snap on to prevent entry of the hands or objects into the container. The cost of the Oxfam Bucket is about $5, excluding transport from England to the program site. A minimum order of 200 is required. Contact fieldlog@oxfam.org.uk to order.

Modified Clay Pots

In many cultures, clay pots are the preferred storage container, because as water evaporates through the clay it cools the water inside the container. In some rural areas, water is transported in the clay pots, but in most areas water is transported in plastic containers and then stored in clay pots. Because clay pots usually vary in size, it is recommended that SWS users dose in the plastic transport container (like the jerry can), wait 30 minutes, and then pour the treated water into the clay pot for storage. It is possible to modify clay pots to have a tap, as is seen in the two examples below.

Locally-made Modified Clay Pots in Kenya and Nicaragua

The Jolivert Local Program Experience – Step 3

Safe Storage Container

Five gallon (19 liter) plastic buckets are the most commonly used water storage container in Haiti. These buckets normally do not have a lid or a tap to access the water. To create a safe storage container, the Jolivert Safe Water for Families project modifies this local container by providing a lid, attaching an instructional label, and drilling a hole and installing a tap to access the water. The tap is imported from the United States. This safe storage container is widely accepted because the users view it as an improvement on the already existing culturally appropriate container.

When users enter the program, they either purchase a subsidized bucket from the program (at a cost of approximately $3.80) or bring their own clean bucket for modification (at a cost of approximately $1.00). Families who have sick members, with children in nutritional supplement programs, with members who have HIV/AIDS, and others clearly in need according to pastors or community leaders are provided a modified bucket free of charge subsidized by external funding.

Modifying the Local Bucket

The Jolivert Container and Label

Step 4: Develop Strategy and Materials for User and Community Education

Once the SWS products have been developed, strategies and materials to train and motivate community members to consistently and correctly use the SWS are needed. There are several goals of the education:

- To educate the community and users about the health benefits of the SWS;
- To ensure positive community reaction to the program and encourage people to join and continue in the program;
- To train users how to treat their water with hypochlorite solution and motivate them to treat the water accurately and consistently; and,
- To educate and encourage water and sanitation practices that will enhance the benefits of the SWS.

Community Motivation

To promote the new SWS program in the community and attract the first users, the program should undertake promotional activities such as radio spots and presentations at community meetings, schools, clinics, and churches. Once the community is aware of the program, the program staff and Water Committee can determine who will be initially accepted into the program. It is valuable for community leaders to be among the first users of the hypochlorite solution. They can provide a positive example and ensure community acceptance and trust.

User Training

Once the user population is selected, an initial training on why and how to disinfect water is the first step for users joining an SWS program. There are several points to consider in development of a successful initial training:

- The training should be conducted in a clear and concise manner by a knowledgeable and thoroughly trained local community leader, such as the SWS Technician/Community Health Worker;

- Users are most highly motivated immediately after the training, and should therefore receive their water storage container and first bottle of hypochlorite solution at the training, instead of a later date; and,
- The trainings may be carried out in small to medium groups consisting of less than 25 people or individually depending on cultural acceptability. In all cases the trainings sessions should include hands-on demonstrations and dedicated time to encourage and respond to questions. Some programs have found that a 2-hour training period is appropriate to cover the necessary material.

It is critical that both the initial training and subsequent outreach efforts target the water handlers in the home. Women are often responsible for water collection and treatment, but sometimes cannot attend public training sessions or can only be trained by other women. If this is the case, special efforts need to be made to ensure that women are appropriately trained in culturally acceptable ways.

The training should discuss the following topics related to the SWS program:

- A description of the program and the products, and the expected benefits of their proper use;
- How to use the hypochlorite solution, including a demonstration of how to treat water, focusing on the dosage instructions;
- The uses for the treated water, including drinking, making juices, cooking, washing dishes, and cleaning the house to have a hygienic environment;
- The need to store the treated water in a clean, covered container from which it can be removed without dipping hands or objects in the container;
- How to clean dirty storage containers with a small amount of water, one capful of solution, and a brush or clean cloth; and,
- Warnings to store the hypochlorite solution in a cool, dry place, and to not let children drink it.

The primary training materials for the initial training sessions are the label on the bottle of hypochlorite solution and the directions on the safe storage container. Because many of the users may be illiterate, each topic on the label should be presented and reiterated until it is well understood by the users. Essential information on the label, including dosing directions, should be presented with a hands-on demonstration.

Educating Users on Healthy Water and Sanitation Practices

In addition, the training should include more general information on diarrheal disease, including the facts that diarrhea is a disease caused by contaminated water and food, poor sanitation, and insufficient hygiene. Diarrhea can be prevented by treating water, preparing food correctly, and washing hands.

Proper handwashing with soap is crucial to the reduction of diarrheal diseases. Training should include both how to wash hands and critical times to wash hands, including before cooking and eating, after using the bathroom, and after changing a baby. Proper sanitation is also crucial to the reduction of diarrheal diseases. Sanitation training should include information on safe disposal of excreta. Handwashing and sanitation educational materials are included on the accompanying CD.

Further Training

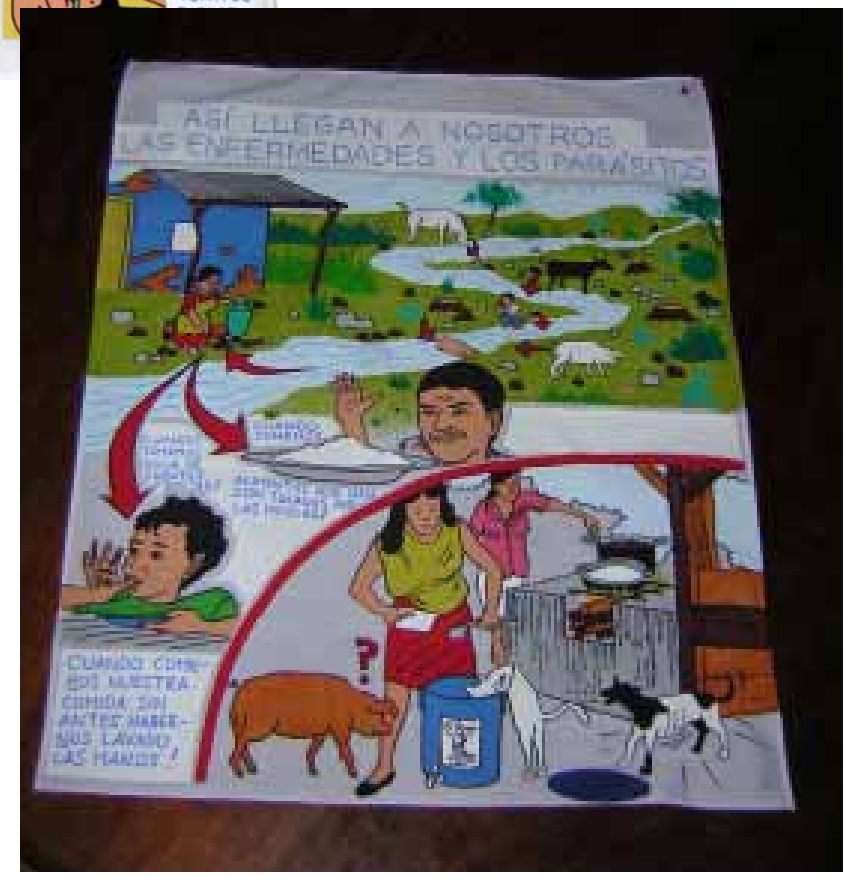
A follow-up home visit by a Technician/Community Health Worker should occur approximately 2 weeks after the initial training to test for chlorine residual, answer any questions, encourage correct and consistent use of the hypochlorite solution, and reaffirm the general water, hygiene, and sanitation training.

In addition to the initial follow-up visit, the Technicians/Community Health Workers need to conduct semi-regular household visits, such as monthly or quarterly visits. Also, the Technicians/Community Health Workers should be available at a central location, such as a clinic, to answer questions, replace any broken parts of the storage containers, and (in refillable bottle programs) to refill hypochlorite solution when users come in to refill their bottles.

Targeted trainings for schools or health clinics can also be conducted and might require the development of more extensive educational materials. Examples of training materials developed for health workers, retailers, and users are included on the accompanying CD. There are examples of visual educational materials from other programs on the next two pages.

PSI Guinea

Educational Material



Flip Charts on Causes and Prevention of Diarrhea from Potters for Peace, Nicaragua

The Jolivert Local Program Experience – Step 4

The Jolivert Safe Water for Families program began educating the community by thorough discussions at community events and at churches, and by working with the Water Committee in the community.

The Program Administrator, Head Technician, and Head Nurse from the clinic developed a training session for those entering the program. Training takes place at the Jolivert Clinic and groups of up to 25 people are trained at one time. The trainings take place in a lecture format similar to the format used in schools throughout Haiti. The main instructional materials are the labels on the hypochlorite solution bottles and the safe storage container.

The trainings consist of: 1) an introduction of the program staff; 2) a formal introduction by the Administrator of the SWS program; 3) a demonstration by the Head Technician of how to use the hypochlorite solution and safe storage container; 4) a presentation of information on water and sanitation and health; 5) a question and answer session; and 6) formal distribution of modified buckets and first bottle of hypochlorite solution. Users are then registered in the program. The training lasts about 2 hours, and a follow-up visit is conducted by a Technician soon after the training.

To continue with the training, semi-regular follow-up visits are conducted by Technicians at the household as part of regular rounds visiting all users approximately every 1-6 months. These visits are important to answer questions, fix problems, and ensure consistent use.

The Jolivert Trainings: Demonstrating Hypochlorite Addition, Distributing the Products

Step 5: Establish a Pilot Project in the Community

Before launching the SWS program widely in a community, it is wise to begin with a small pilot project to iron out logistics and understand community reaction and acceptance. There are 5 steps to developing a successful pilot project include:

1. Establish a timeline for the pilot project;
2. Choose the families that will be part of the pilot;
3. Determine the price you will charge families for the products;
4. Train the pilot families, including distributing or selling the safe storage container and hypochlorite solution; and,
5. Follow up regularly with the pilot families as the pilot project proceeds, and maintain adequate records in order to evaluate the pilot project.

Timeline

A pilot project should last long enough to reveal and resolve problems with logistics and acceptance, but short enough to maintain program momentum. Generally, 4-6 months is sufficient to launch and evaluate a pilot project. During this time, it is recommended that the Program Director, Program Administrator, and Technicians/Community Health Workers work closely together, and have significant time to dedicate to the program as questions and challenges arise.

Choose Families

A manageable number of families in a pilot project is generally between 100-200. The goal is to have enough families in the pilot to learn from, but not so many as to overwhelm capacity. Your program will need to decide how to select the families for inclusion into the pilot project, whether it will be open enrollment, or targeted distribution, such as to those of lower socio-economic status, those within a particular geographic area of the target community, or those with children under 5 years old. As noted in Step 4, it is valuable to include community leaders and other respected members of the community in the pilot project.

In many communities there may be great interest in joining the Safe Water System program. Often, there are more families who want to join the program than the program can immediately accommodate. This issue should be anticipated so that families who cannot immediately enter the program will not be disappointed.

Pricing

In setting a price for the safe storage container and hypochlorite solution, the program should consider both the community's ability to pay and the program's need to recover costs.

There is significant debate in the development community about pricing of health products for people in developing countries. It is generally accepted that users who pay something for a product, even if that amount is minimal and does not lead to full cost recovery, are more likely to value the product, use it correctly, and continue to use it. We recommend that some payment be made by users for the initial material (hypochlorite solution and bottle, safe storage container) and for the resupply of the hypochlorite solution. We understand this viewpoint is not universally accepted, and encourage those who do not want to charge for these products to incorporate educational messages that encourage non-paying users to value the products. For a discussion of these issues from the social marketing perspective please see the CDC Safe Water Handbook.

The pilot project time will allow you to determine if the selected price points for the initial materials and the resupply are acceptable to the users, and assess the willingness to pay and any significant price barriers.

Training and Distribution

Once the families are chosen for the pilot project and prices selected, training may begin. It is recommended that trainings occur in groups of no more than 25 family representatives at a time until at least one representative from each family has been trained.

If your program is in a rural area, transportation may be an issue. The pilot project will offer the opportunity to see if the users can get to a centralized location without

difficulty, or if the trainings should be moved to a more convenient location. In the pilot project the difficultly of supplying hypochlorite solution to outlying areas can be evaluated. Transportation of materials to the homes of the users is often more difficult than anticipated. It may be possible to set up a system of resellers in outlying areas who buy the hypochlorite solution in bulk, and then sell it in their communities. It is also important to ensure that the delivery mechanisms do not exclude families of lower socio-economic status.

Follow-up and Records

Weekly or bi-weekly follow-up visits with each family after the training and continuing for the full length of the pilot project are essential. Because relatively few families will be in the pilot project, the Technicians/Community Health Workers should have time for a number of follow-up visits.

To evaluate the effectiveness of the pilot project, it is important to maintain complete records for each family's use of, and responses to, the program. The program should maintain a record of when each family first received the SWS products, each time they purchased hypochlorite solution, how they use the products, and what they think of them, including any problems or complaints. If a family stops using the hypochlorite solution, it is important to learn why they stopped so that these issues can be addressed.

During the pilot project good communication between all program staff is critical to effectively respond to information gained and challenges raised.

Safe Water and Handwashing Training with Nurses in a Hospital in Kenya

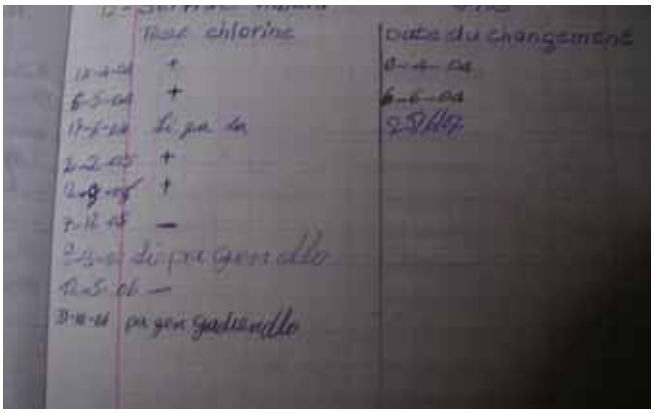
The Jolivert Local Program Experience – Step 5

The pilot project for the Jolivert Safe Water for Families program operated from September 2002 through May 2003. The program was announced through the clinic, the local FM radio station, and in local churches. Approximately 500 people expressed an interest in joining the program, and 200 families (from homes relatively near the clinic so that the pilot project would be easier to administer) were selected. The remaining families on the list were told they could join after completion of the pilot project.

The families were trained in small groups of about 25 people at the clinic on Sunday afternoons over a period of 10 weeks. After completing the training and receiving the modified bucket and first bottle of hypochlorite solution, each family was visited once per week by a Technician. During these visits the Technician provided follow-up training, addressed problems, answered questions, and completed a chlorine residual test.

The price of the new or used bucket modified with a label and tap was set to cost the same as a used bucket (without a tap) in the market. The price to refill the hypochlorite solution bottle was set at 3 gourdes (about $0.09) if it was purchased at the clinic and 5 gourdes ($0.15) if purchased from outside the clinic. These prices are well within the reach of all but the very poorest Haitians.

In addition, a record was maintained for each family in the pilot project, including when they purchased hypochlorite solution and the results of their chlorine residual tests. These records greatly facilitated a detailed analysis of the program that took place in January 2003.



Household Record – Household visitation notes and chlorine residual results are on the left, and chlorine purchase dates are on the right.

Step 6: Evaluate the Pilot Project

While the pilot project is ongoing, and when it is completed, successes and challenges can be evaluated to help with the development of an expansion plan. There are major questions to be answered in the evaluation are: 1) Are there technical or motivational issues that keep the systems from being used correctly and consistently in the homes? 2) Is there an improvement in water quality that is associated with a reduction of diarrheal disease in the households of the users?

The most efficient way to answer these questions is to conduct a survey of some (or all) of the participants in the pilot project and compare it with the information compiled at beginning of the program in the need and feasibility assessment described in Step 1. In the follow-up survey both quantitative data about the water quality and incidence of diarrheal disease and qualitative data about issues surrounding the use of the system should be collected. In addition to the survey, informal discussions among and between program staff and users can provide important qualitative information.

There are some considerations in conducting a follow-up survey:

- The survey should either include all pilot project families or a randomly selected subset.
- The household member who actually prepares the water should be interviewed.
- Survey questions should be asked in a consistent, non-leading manner. For example, the question “How often do you use the SWS system?” will yield more accurate results than “Do you use the SWS system every day?”
- The survey should include the following types of questions:
    - Questions about use of the product, such as: “When was the last time you purchased the hypochlorite solution?” “How often do you use the solution?” “How much solution do you add to the water each time you make the water?” “What do you use the treated water for (drinking, juice, cooking, handwashing)?”
    - Questions about satisfaction with the product, such as: “What do you or your family like about the treated water?” “What do you or your family not like about the treated water?” “Have you ever had any problems with the

system?" "Do you have any suggestions for improvements to the program?"

- Questions about acceptability of cost, such as: "How much would you pay for the hypochlorite solution?"
- Questions about ease of access to repurchase the hypochlorite solution and to obtain help from the Technicians/Community Health Workers if needed, such as: "How far do you have to walk to refill the solution?" "If you had a problem with the program, were you able to talk with someone about it?"
- Questions to assess efficacy of healthy water and sanitation educational messages, such as: "When do you wash your hands?" "Do you have soap?" "Do you have a latrine?"
- Observations, such as: "Is there drinking water present in the household at the time of the unannounced survey visit?" "Is it stored safely?" "Has the water been treated with hypochlorite solution, as verified by measuring with a chlorine residual test kit?" "Is there soap present in the household?"

Sample post-pilot project surveys are included on the accompanying CD.

After the data collected during the pilot project, the post-pilot survey, and chlorine residual sampling have been assembled; they can be analyzed to develop an expansion plan for the program.

A School in Haiti

The Jolivert Local Program Experience – Step 6

After 1-3 months of operation, the Jolivert Safe Water for Families pilot project was evaluated by Genevieve Brin, a graduate student from MIT studying environmental engineering. Genevieve worked with Bill Gallo, the Program Director, and the Technicians to develop and implement a survey of users and non-users of the system. In addition, she tested the concentration of the hypochlorite solution produced in the program, and measured chlorine residual levels in stored water in homes of pilot project participants. There were several key findings of her thesis:

- 95% of users knew how to use the system correctly, and 65% had residual chlorine present in their household drinking water at the time of the unannounced survey visit.
- The concentration of the hypochlorite solution produced in the program was correct, although without pH stabilization the product degraded after 3 weeks.
- There was a 39% reduction of diarrheal disease incidence in users compared with non-users, and there was a 56% reduction in diarrheal disease incidence in users who were using the system correctly (defined as chlorine residual present in the drinking water at the time of the unannounced visit). Of particular interest, diarrheal disease was not significantly reduced in children under 5 years old (except in girls under 3). This was attributed to other routes of infection (poor sanitation and hygiene), and also to the fact that families did not always include children under-5 when responding to survey questions, due to high mortality rates in children under 5 years old.

Based on her findings, Genevieve recommended expanding the program, as it was largely successful. Specific recommendations included creating satellite hypochlorite solution resale stations to reach a larger geographic area, incorporation of schools into the program to educate children, and a “bring your own bucket to be modified” scheme to reduce costs for the family and the program. Genevieve also recommended the program stabilize the pH of the solution in order to extend the expiry date to 1 full year after production. She also recommended training mothers on hygiene practices for their children. For Genevieve’s full thesis, please see the accompanying CD.

Based on Genevieve’s results, and the perceptions of the program staff, an expansion plan was developed for the Jolivert Safe Water for Families program.

Step 7: Develop a Plan for Moving Forward

The size and scope of the program was considered during the feasibility assessment conducted at the outset of the program in Step 1. Using the information and experience gained during the pilot project, this original assessment can be reexamined, and a decision can be made to discontinue, continue, or expand the program.

In order to develop a plan for moving forward, the following assessments should be made:

- Is there need in the community for your program to continue and/or expand?
- Are resources and funding available to expand the program?
- What should be considered when expanding the program?

Assessing Community Need

If community reaction to the pilot project was negative, and families do not wish to continue using the SWS, your organization will need to decide whether to discontinue the program or to attempt to address the concerns raised by the community and families and initiate a second pilot project.

If the pilot project was successful, and families wish to continue using the SWS, a plan for continuing (and potentially expanding) the program can be developed. Program continuation and program expansion are influenced by the number of families that wish to be part of the program and the resources that are available.

It is possible that individual families or entire communities or families at some distance from the original community may become interested in the program and wish to join. Remote or distant areas present a unique logistical challenge because ensuring a continuous supply of hypochlorite solution may be beyond the capabilities of the program. There are a number of ways to expand the program into remote areas, including: 1) having Technicians/Community Health Workers in the program make occasional visits to the remote communities; 2) training a representative from the remote community to be a Technician/Community Health Worker; and, 3) establishing stations to resell hypochlorite solution for the remote community.

Resources and Funding

Even if there is significant community interest in expanding the program, there are several factors that might limit the growth of a community-based SWS program. The most obvious factor is funding. If the Technicians/Community Health Workers are salaried, the program may not be able to afford to hire additional staff to support new families. Another potential limitation is the availability of supplies, including the buckets, bottles, waterproof labels, and hypochlorite solution. Continuation and expansion plans will need to consider any potential budget constraints the program may face.

Continuation and expansion plans should include provisions for a constant supply of program products, especially the hypochlorite solution. A week's stock of hypochlorite solution should be available at all times, in case there are unexpected problems with manufacturing or distribution. In the event of a prolonged interruption of supply, commercial bleach can be diluted to use as the hypochlorite solution if needed according to the steps outlined in Step 3.

In addition, a health crisis in the community, such as a cholera or typhoid outbreak or a natural disaster, may require an immediate increased output of hypochlorite solution. Contingencies for manufacturing for emergencies should be considered.

Considerations in Expanding the Program

It is best to expand a program in careful, deliberate steps, adding users in controlled groups. A schedule that allows a generous amount of time to evaluate any problems that arise should be used. Adding homes more quickly than they can be served by program personnel is detrimental to long-term program success. If there is community pressure to add homes more rapidly than the program can absorb them, it is recommended that a waiting list be established, with a firm timeline for when families may enter the program.

Families can be encouraged to join the program by promotion through local churches, government meetings, radio stations, or community events. If fewer families wish to join the program than anticipated, it is not advisable to push the program on disinterested families. The most effective encouragement to join is for non-users to witness a successful program.

The Jolivert Local Program Experience – Step 7

Based on the positive results of the pilot project evaluation, a continuation and expansion plan was developed for the Jolivert program. As the program expanded, the day-to-day operations of the program did not significantly change. 20-40 families were trained each week during one or two training sessions. When the program reached 1,000 families, a third Technician was hired. Additional water and sanitation training was provided to program staff from another water organization in Haiti during the second year of the program.

Transporting the hypochlorite solution to remote areas was too time intensive for the Technicians. So individuals, local shop owners, and clinic managers were invited to become resellers of the hypochlorite solution in remote areas. Resellers were trained to be able to provide residual chlorine testing and assistance to users.

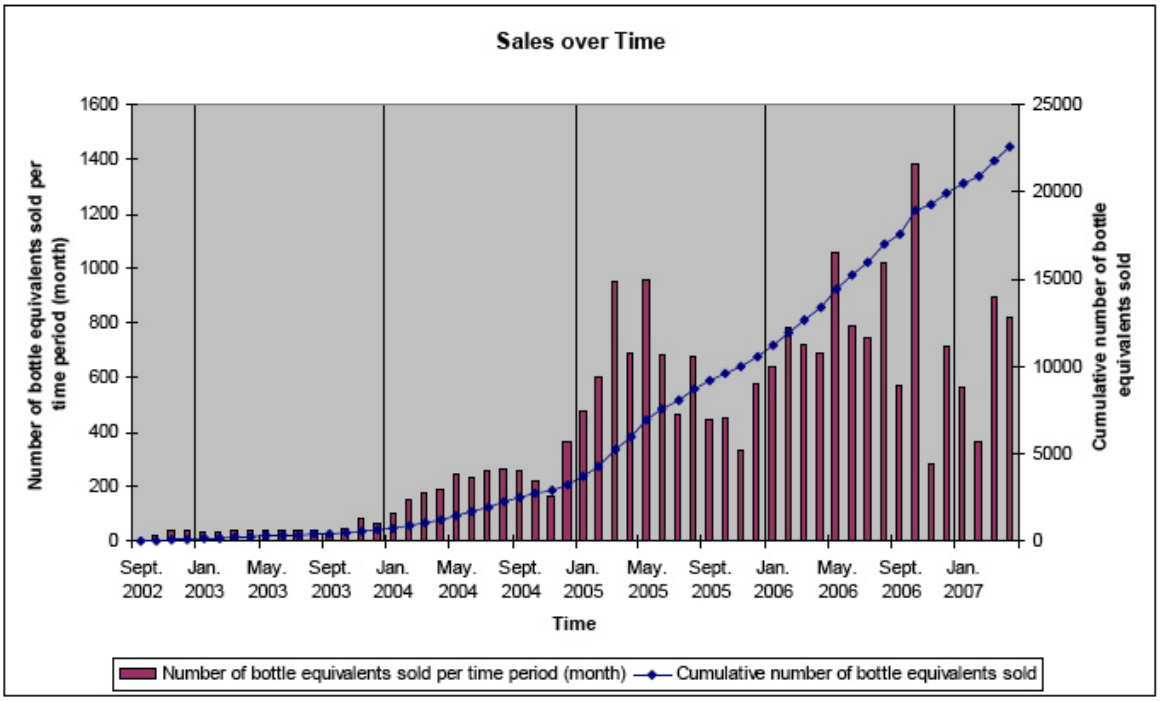
A Reseller Selling Solution

In the third year, the Jolivert program provided assistance to a town 60 km away to start a similar water program. In addition, during the flood of 2005, the program doubled production and distributed free hypochlorite solution for 6 weeks.

On two occasions, the Jolivert program encountered problems with the supply of hypochlorite solution when the generator broke down. Hypochlorite solution was made by diluting commercial bleach until the generator was repaired. The program purchased a back-up generator to prevent these problems in the future.

Currently, the Jolivert program is expanding steadily, with a small grant from USAID currently subsidizing the costs of enrolling new families. As of July 2007, 2,100 families are enrolled in the program, and hypochlorite solution is sold at 11 resale stations. In addition, the local CARE office is using hypochlorite solution in schools. Nearby NGOs are also purchasing the solution to use in their own water and sanitation programming. Sales of hypochlorite solution over time are documented on the next page.

The Jolivert Program has come a long way since its beginning, and the credit for that goes to the dedication of the Haitian Staff and Bill Gallo. While Bill Gallo, the Program Director makes three or four trips to visit the program each year the day-to-day operations are completely in Haitian hands.



Sales of Hypochlorite Solution by Month, 2002 – 2007

Final Notes

CDC's goal is to promote sustainable, long-term drinking water programs that will help prevent disease and improve health. Community-level programs fill a critical niche in access to safe drinking water in the developing world.

CDC and the Jolivert Safe Water for Families program are eager to assist other community-based SWS programs. We look forward to receiving your questions and hearing your examples. If you have any questions about establishing a Safe Water System program, or general questions about the Safe Water System, please consult our website at www.cdc.gov/safewater or email us at safewater@cdc.gov.

A Child in Haiti

We wish you the best of luck with your program!

The Safe Water System in Kenya

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