INFORMATION FOR ACTION FROM THE WATER AND SANITATION FOR HEALTH PROJECT

Household Water Disinfection in Cholera Prevention

1. Introduction

In January 1991, cholera appeared in Peru after an absence of nearly 100 years and spread rapidly throughout Latin America and the Caribbean, creating a public health emergency. One very effective emergency measure, household disinfection of water, is the subject of this technical note, written primarily for U. S. Agency for International Development (A.I.D.) health officers and appropriate national health personnel in countries where cholera is endemic or epidemic or other waterborne diseases are prevalent. Household disinfection of water can make a significant contribution to protecting people in situations where water supplies are contaminated.

Household disinfection outreach and extension campaigns must instruct people in threatened communities in how to disinfect their household water and motivate them to do so. National-level commitment is crucial for such campaigns to be effective. Recent experience in Peru provides an example of how a national policy for household disinfection may be established and successfully implemented. Following the outbreak of cholera in early 1991, Peru's Ministry of Health made a policy at the national level to distribute disinfection packets for disinfecting water in the home. Collaboration was enlisted with the Ministry of Housing and Construction, and the Pan American Center for Sanitary Engineering and Environmental Science (CEPIS), located in Lima. Technical assistance was extended to regional and local government agencies to organize cholera committees through community health centers. These committees distributed the disinfection materials to households and also provided demonstrations on how to purify water in the home.

To be successful, household-level prevention efforts must be part of a comprehensive "package" of anti-cholera interventions, such as programs and policies that encourage oral rehydration therapy, breastfeeding of infants, safe and sanitary excreta disposal, personal and household hygiene, and disinfection of drinking water. National-level support for education and training programs at the community and individual levels is also essential.

There are more than 20 serious waterborne diseases in addition to cholera. And while their impact on the mortality of infants and small children is most visible, they undermine families' overall well-being and adult productivity as well. Anecdotal evidence of a significant connection between household disinfection and diarrhea morbidity is being gathered in Guatemala, where health officers observed a significant decline in diarrheal illness and death during a recent hygiene education campaign directed against cholera. As the disease receded, however, the motivation to continue disinfection dropped and diarrhea returned to previous levels.

2. Last Line of Defense: Household Disinfection

When the supply of water to a community is found to be unsafe, it may not be possible to make it safe in the short term. If cholera is present, disinfection at the household level—the last line of defense—may be appropriate.

Disinfecting water kills or inactivates most pathogenic organisms, including those that cause cholera. Unlike sterilization, disinfection does not kill all living micro-organisms, but should kill those causing disease. Those that are disinfectant-resistant may be bacterial spores, bacteria in clumps, fungi, protozoan cysts, and parasite eggs and worms (some may be pathogenic) that require additional treatment, such as filtration, to be removed from water.

Chemical measures of disinfection include treatment with chlorine or iodine, while physical measures include boiling and ultraviolet radiation, the latter not a method suitable for household use. Filtration, while not a method of disinfection, can improve water quality.

By far the most common chemicals used for water disinfection are chlorine and iodine. While chlorine is not

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without its risks, it is the most widely available, most cost effective and best understood chemical used for the disinfection of drinking water. Iodine, on the other hand, has not been used much because of cost, limited availability, and more important, potential side effects when used for long periods. Chlorine owes its wide availability to its use in large-scale water treatment facilities and in the production of a variety of household cleaning and washing materials. When properly applied to water disinfection, chlorine does not have adverse health effects and is very effective for controlling acute gastrointestinal diseases caused by bacteria and viruses.

Boiling is also a very effective means of disinfection, and often the order to boil water is issued by government health officials when cholera first appears. Boiling is often too expensive and impractical, however, as seen below.

The amount of clean water per person that is required to maintain good hygiene is about 20-30 liters a day; a minimum of two liters is needed to sustain life. In situations where it is difficult to disinfect enough water for drinking and cooking, as well as for washing hands and all surfaces coming into contact with food, nondisinfected water can be used for bathing or washing laundry so long as people are careful not to get the water in their mouths.

Chlorination

Chlorination is the most common disinfection method because it is cheap, reliable, and widely available in several forms. In adequate amounts chlorine kills or inactivates cholera vibrios and other pathogens in 30 minutes.

Chlorine products. Three chlorine products suitable for household disinfection are widely used: sodium hypochlorite solution (liquid bleach); chlorinated lime (bleaching powder); and calcium hypochlorite (used in swimming pools). Some manufacturers of swimming pool hypochlorite and liquid bleaches add stabilizers that may be toxic; however, solutions will be marked accordingly.

Naturally, whichever product is recommended must be available locally. Sodium hypochlorite solution, or

Table 1

Survival of Vibrio Cholerae in Water

Type of Water	*Temperature*	*Survival Time*
Clean (dechlorinated tap water)	4° C	1 month
	20-30° C	2-14 days
Untreated fresh	4° C	1+ month
	20-30° C	1-20 days
Seawater	4° C	2 months
	20-30° C	6-60 days

Source: Feachem, 1983.

Cholera: Facts and Figures

Cholera is an acute enteric bacterial infection that strikes quickly and can kill within hours if untreated. It is produced by ingesting an infectious dose of the disease-causing agent, *Vibrio cholerae* 01 (an infectious dose of 100 million vibrios may be contained in 1 cubic centimeter of a cholera patient's stool). Cholera produces profuse watery stools, vomiting, rapid dehydration, acidosis (increased acidity of the blood and tissues), and collapse of the circulatory system. The vibrios are shed via the stools into the environment during the acute phase and for a few days after recovery, where they continue to spread rapidly by the fecal-oral route. They are shed not only by the obviously sick but by many people with either mild symptoms or no symptoms at all. The onset of cholera occurs after an incubation period of two to three days; the disease may last from one to six days. Susceptibility and resistance are variable, but most clinical cases are observed in the lowest socio-economic groups where safe water and sanitation are often unavailable and where sanitation practices are often poor. Antibodies are developed by early adulthood in endemic areas.

In severe cases, rapid dehydration and loss of electrolytes can lead to death. Cholera victims can be successfully treated by oral administration of a glucose-electrolyte solution. Oral rehydration salts (ORS) are widely available and frequently recommended. Commonly, only the cases that have been allowed to progress to severe dehydration, shock, and/or unconsciousness will require intravenous rehydration. Antibiotic treatment is not considered essential to recovery but is thought to shorten the duration of diarrhea, thus reducing the adverse effects on the patient and the volume of vibrio-contaminated excreta.

Cholera is considered pre-eminently a waterborne disease. Cholera vibrios persist in salt water or contaminated ice. In the recent Peruvian epidemic, municipal drinking water that was inconsistently disinfected was found to be a major path by which the disease traveled. In addition, food, especially that sold by street vendors, can be a vehicle for cholera, although the food is usually contaminated by unsafe water. Transmission through direct contact with infected persons and indirect transmission through locally grown vegetables and fruits and seafood eaten raw can also occur. Any mechanism that allows fecal material to enter into the digestive tract of the host will transmit cholera.

Vibrio cholerae 01 is killed or inactivated by exposure to low pH (<4.0), heat, and several disinfectants. Drying can also destroy it, but this is not a practical control measure. *Vibrio cholerae* can survive a month or more in fresh water at 4° C., and twice that long in seawater at the same temperature, as shown in Table 1. Increasing the temperature shortens the survival time, so that boiling water for one minute at sea level or three minutes at higher elevations will inactivate or kill the cholera organisms.

liquid bleach, is sold in most markets the world over, is relatively inexpensive, and is much more readily available than powdered (or pellet materials). Chlorinated lime and calcium hypochlorite are also widely available and are not costly. Each of these products yields a different amount of chlorine, so instructions for use as a drinking water disinfectant vary. It is therefore advisable that local health authorities check out the availability of chlorine products and their chlorine content. Decisions about which products to use in a household disinfection campaign can be made with some efficiency once this information is known. It should also be noted that chlorine products, once opened, lose their strength over time.

The problem of turbidity. Visibly cloudy water indicates the possible presence of a greater number of bacteria than would be found in clear water. Cloudiness may be due to suspended inorganic or organic matter, or both. Since chlorine reacts readily with any organic matter, cloudy or muddy water will consume more chlorine than clear water. Hence the World Health Organization advocates either boiling turbid water or filtering it before chlorination. If filtering is not possible, allowing the suspended matter to settle will clarify the water.

Alternatively, it is possible to increase the chlorine concentration applied to meet the high demand for chlorine caused by the turbid water. This is done by adding an increased amount of chlorine until the odor of chlorine is evident even after the treated water has been allowed to stand for 30 minutes. This assures that the concentration of chlorine is adequate both to satisfy the demand of the turbidity and to provide excess chlorine for disinfection. Dosages should be adjusted downward until the odor and taste are less noticeable.

Methods of chlorination. There are two ways to chlorinate water using readily available materials. No matter which of the methods is used, certain principles should be observed. After the disinfectant has been added to the water, always let it stand for a minimum of 30 minutes. Even a slight odor of chlorine after this amount of time will confirm that the water is safe to drink. The odor indicates that there is a residual of chlorine in the water, which assures its safety. As with many processes, the effectiveness of chlorine in disinfecting water decreases with lowered temperatures. Therefore, in a cold climate it is advisable to allow a longer waiting time after chlorine is added. Recontamination can easily occur, for example by putting dirty hands into the water container. Therefore, a clean jar with a spigot should be used for storage. Otherwise, water must be poured off the top, not ladled out. Finally, because it is so easy to contaminate drinking water—a minute number of organisms can multiply overnight into an infective dose—the World Health Organization recommends disinfecting only the amount needed for a 24-hour period.

Table 2

Use of Liquid Bleach (5.25% Sodium Hypochlorite) for Water Disinfection

Volume of Water (in liters)	Amount of Bleach to Add: To provide 1 mg/l (1 ppm) of available chlorine	To provide 10 mg/l (10 ppm) of available chlorine
1[1]	2D[2]/4D[3]	4D
5[1]	3D[2]/6D[3]	1.5 ml
10[1]	6D[2]/12D[3]	3 ml
50	1 ml	10 ml
100	2 ml	20 ml
500	10 ml	100 ml
1000	20 ml	200 ml

D = Drop (with eyedropper) = .05 ml

1. Dosages slightly higher than 1 mg/l for ease in measuring.
2. For clear water.
3. For cloudy water.

Source: Adapted from the Clorox Company.

Use of liquid bleach. The easiest method of chlorinating household water is to apply liquid bleach (5.25% sodium hypochlorite) directly according to the recommended dosages presented in Table 2. Typically, in sanitary engineering practice, disinfected water should maintain at least 1 milligram per liter (1 mg/l) of chlorine residual, equivalent to 1 part per million (ppm). The application of 1 ppm (1 mg/l) of liquid bleach to clear water is sufficient for disinfection. The concentration should be doubled for water that has some turbidity.

Table 2 presents application rates for 1 ppm (1 mg/l) and 10 ppm (10 mg/l) of available chlorine (the amount of chlorine present in a product). The 1 ppm rate is normally sufficient for clear water, and thus is appropriate for households in most marginal urban areas and in larger rural communities. These people are likely to obtain their water either from distribution systems that are plagued with intermittent supply problems or from vendors. Both require families to store water in the home. In most cases this water is clear, but if it is slightly cloudy, then the application rate should be doubled to ensure that a safe residual is maintained. However, in those instances where people living in congested areas draw water directly from a river or a stream, the 10 ppm (10 mg/l) application rate is advisable. Water from surface sources will likely be turbid and highly contaminated with fecal matter.

Liquid bleach is plentiful and cheap. For example, on average it costs about U.S.$0.65 per liter in Latin America. A family of six living in a marginal urban area would not have to spend very much to disinfect enough water to maintain hygiene. A household of six consuming water at the rate of 20 liters per person per day would need to disinfect 3600 liters per month (43,200 liters per year). Applied at the rate of 1 ppm, 900 milliliters (ml) of liquid bleach would be required to disinfect 43,200 liters of contaminated water, if it is not turbid. Thus, a one-liter bottle of liquid bleach would be sufficient to disinfect water in the average household for one year. (However, since chlorine dissipates over time once the container is opened, conserving the same bottle for the entire year is not advisable. A household should contemplate buying liquid bleach in smaller quantities and more frequently to assure potency.)

Where people are taking water from rivers or streams, an urban family living in a marginal area using about 43,200 liters per year would need nine liters of liquid bleach at a total cost of about U.S.$6.00—not a prohibitive sum.

Use of a stock solution. The second way to chlorinate household water is to make a stock solution (chlorine diluted with water) and use it to disinfect water. Table 3 presents how a one-percent stock solution can be made from other materials containing chlorine. The application of a one-percent solution is presented in Table 4. Application rates for a one-percent stock solution are given for 1 ppm and 10 ppm respectively. Clear water would be treated with the 1 ppm rate, the rate would be doubled for cloudy water with some turbidity, and the 10 ppm rate would be applied if water was being taken from streams or rivers.

A one-percent stock solution can be prepared by filling a clean one-liter bottle with clear water and adding the recommended amount of bleaching powder, liquid bleach, or calcium hypochlorite. The bottle should then be covered and shaken. Stored in a dark place, it should provide a reliable disinfectant for at least 30 days.

Prepackaging and distribution. In the event that products to use directly for disinfection, such as liquid bleach, or to use to make a disinfectant solution, such as bleaching powder, are not readily available on the local market, it may be necessary for policymakers to include in their household disinfection program the prepackaging and distribution of packets of chlorine materials. Or a decision may be made to use pre-packaged materials because there is less guesswork connected with their use, and distributing them free may yield public health benefits.

The product could be packaged in amounts sufficient to make one liter of a one-percent stock solution: 200-gram packets of 5 percent available chlorine bleaching power, for example, or HTH (high-test hypochlorite) tablets. Figure 1 shows the kind of instructions that were given by the government of Peru in a household disinfection campaign using HTH tablets.

Pros and cons of chlorination. Chlorination is generally the cheapest safe method of disinfection. The materials required are widely available and it is a relatively easy process. Because it contains residual disinfectant, chlorinated water can be transferred from one container to another without risk of recontamination.

As for drawbacks, any undiluted chlorine product is potentially harmful to children, either through skin contact or ingestion. Hence the product, as well as the stock solution, should be stored out of their reach. Likewise, getting the dosage right could present problems in some settings. If too little chlorine is added, the water still may not be safe. Also, chlorinated water has a definite taste and odor that people may find objectionable.

Chlorination has been found to produce trihalomethane (THM) compounds. The formation of these compounds is a function of concentration, contact time, chlorine dose, and pH. One of the THMs, chloroform, is a potential human carcinogen. However, since the mean age at death for those who die of cancer is 67 years, it is not sensible to argue that it is better to risk death in childhood or as a young adult from cholera or another waterborne disease, than to risk death at 70 from cancer.

Table 3

Making a One-Percent Stock Solution

Product (% concentration by weight of available chlorine)	*Amount per liter of water*
Sodium hypochlorite (liquid bleach, 5%)	200 ml
Sodium hypochlorite (10%)	100 ml
Chlorinated lime (bleaching powder, 5%)	200 g
Calcium hypochlorite (HTH, high-test hypochlorite powder, 70%)	14 g

Table 4

Use of One-Percent Chlorine Solution for Water Disinfection

Volume of Water (in liters)	*Amount of Solution to Add* — *To provide 1 mg/l (1 ppm) of available chlorine*	*To provide 10 mg/l (10 ppm) of available chlorine*
1	10D[1]/20D[2]	5 ml
5	2.5ml[1]/5 ml[2]	25 ml
10	5 ml[1]/10 ml[2]	50 ml
50	25 ml	250 ml
100	50 ml	500 ml
500	250 ml	2.5 l
1000	500 ml	5 l

D = Drop (with eyedropper) = .05 ml

1. Clear water.

2. Cloudy water.

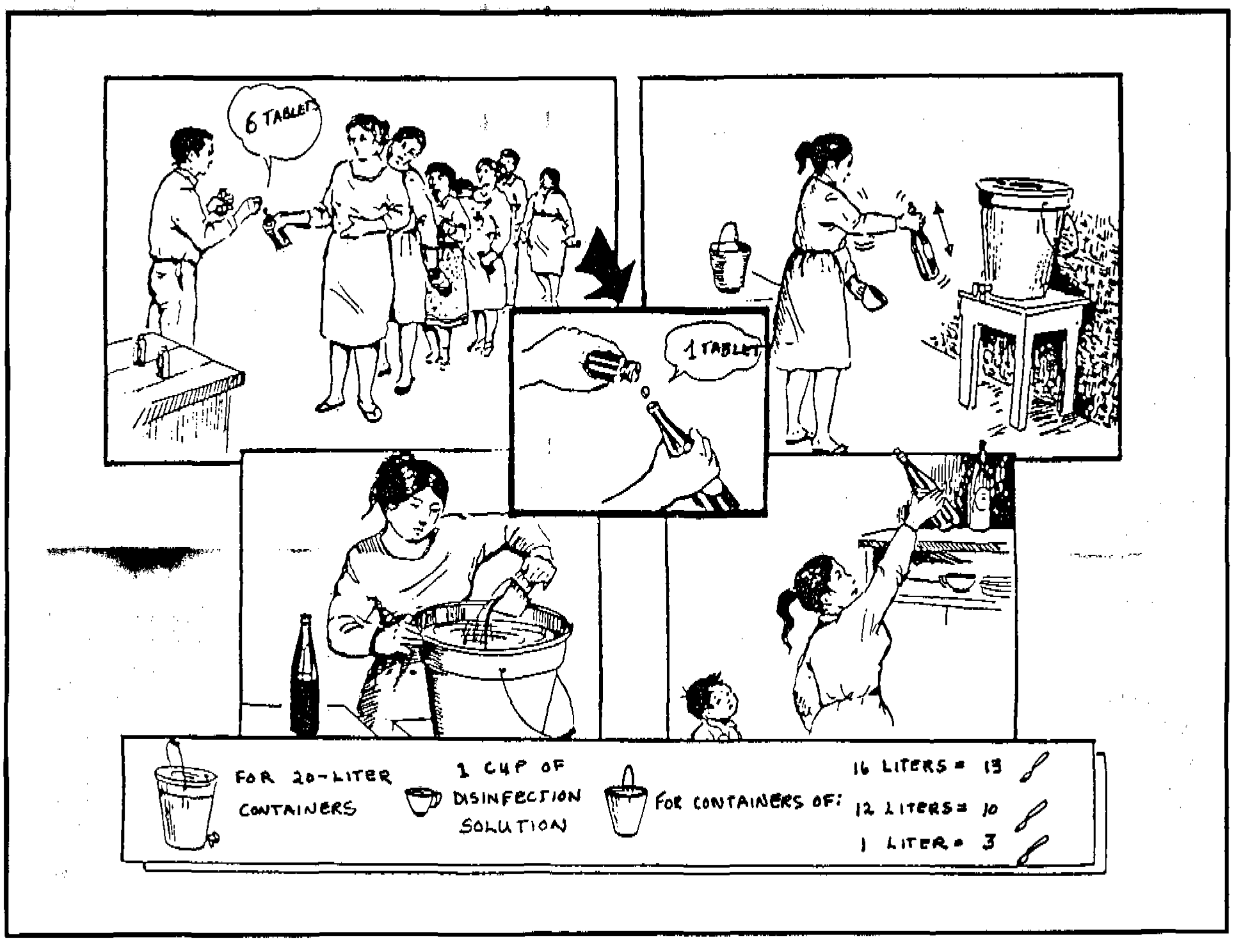

Figure 1. Instructions for making and using a chlorine stock solution contained in a publication of the Government of Peru: "Desinfección del Agua para Usos Domiciliarios y Centros Comunales."

Boiling

Boiling is the simplest disinfection method so long as fuel is readily available. Unfortunately, fuel is scarce and expensive in many developing countries. However, boiling can serve as an important line of defense in the short term, particularly in an emergency situation where chlorine and the skill to use it have not yet been acquired.

Water need only be boiled vigorously for two minutes in order to be safe for drinking. According to conventional wisdom, the duration of boiling is to be increased for altitude adding one minute for each thousand meters above sea level. However, just bringing water to a boil at any altitude is sufficient to kill cholera vibrios. A good rule of thumb is to boil water everywhere for two minutes to be safe, and for added safety for five minutes at 9000 meters or higher altitude.

Since boiled water is easily recontaminated, transferring it from the boiling pot to another container is strongly discouraged. This could be a problem in households that may need all their vessels for cooking.

3. Disinfection Systems Not Proven Effective Against Cholera

Some disinfection systems destroy many bacteria but are of unproven effectiveness when it comes to cholera. Solar disinfection, for example, has aroused considerable interest, and many community-level health or appropriate technology manuals give instructions for its use. The use of the sun alone in certain situations can provide substantial improvement in water quality. With nothing more than a glass jar or polyethylene bag, it is possible to destroy many bacteria. Unfortunately, however, solar disinfection has so far not been found to kill the cholera vibrio.

Other disinfection methods have also been developed, but none is effective against cholera. Chlorine disinfection and boiling are the only practical methods suitable for household use when cholera is present.

4. Filtration To Improve Water Quality

Filtration of water can greatly reduce pathogen counts and increase water quality, but it cannot remove 100 percent of organisms and therefore does not provide protection against cholera. Where filtration is useful is in reducing turbidity. Because the particles that cause turbidity harbor organisms, filtering reduces chlorine demand.

Slow-sand filter technology, which provides drinking water treatment for many communities in both developed and developing countries, can be adapted to household use in the form of a packed-drum filter (see Figure 2). Like a larger-scale slow-sand filter, the packed-drum filter improves water quality in two ways. First, it decreases turbidity. Second, a properly constructed sand filter will have a biological mat on the surface that is composed of algae, plankton, bacteria, and other life forms. This active layer traps bacteria, viruses, spores, and protozoan cysts. However, the layer may not be 100 percent effective, allowing enough organisms to penetrate the filter medium to cause disease in those who drink the water. Therefore, the adaptation of this slow-sand filter technology to households is not recommended.

In addition to the risk of not providing complete effectiveness in trapping bacteria, maintaining the integrity of the filter presents technical challenges well beyond the capability of the average household, especially in marginal urban areas. For example, the packed-drum filter must be properly packed with appropriate sized sand and stones, and, once put in use, must be maintained wet with water covering the biological mat at all times. The water cannot be allowed to flow too fast through the filter. And the biological mat must be cleaned out routinely and a new layer of disinfected sand put in, along with a small portion of the original biological mat to encourage regeneration of the mat over the new sand. In short, the packed-drum technology requires considerable training and a sustained effort to manage the unit.

Filtering for clarifying water only. A sand filter may be used only to clarify the water and not to remove bacteria. In that case, the design is simpler and operation and maintenance are less demanding. For simple filtration, it is not necessary to keep the sand layer submerged. To filter the water, the cover of the packed-drum is removed and the desired quantity of water is simply poured into the filter.

Pros and cons of filtering. If the materials are ready at hand, filtering is a relatively easy and inexpensive way of improving water quality. However, in situations where cholera is present, filtering can only be relied on to eliminate turbidity, not to protect against infection. The water must be disinfected after filtering.

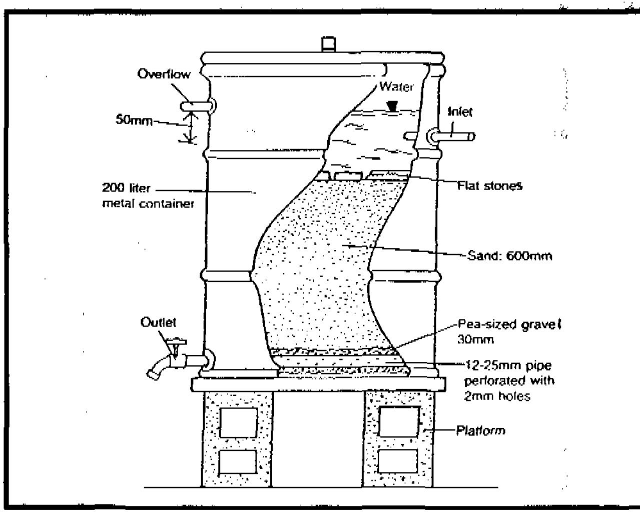

Figure 2. The packed-drum filter is not a simple technology.

5. Health-Enhancing Support Systems

Household disinfection will not be effective unless it is supported by health-enhancing practices.

Handwashing

Good personal hygiene is critical. The importance of washing with soap or ash and decontaminated water after any contact with feces and before eating needs to be impressed upon everyone. Whoever handles food in the household should exercise special care. This means washing before preparing or serving food. In addition, hands must be washed after handling raw food or anything else that might be contaminated.

Proper Storage and Handling of Water

Disinfected water (as well as disinfection solution) should be covered and stored in a dark place because sunlight and air hasten the deterioration of chlorine. Storage containers should be cleaned once a month with a chlorine solution. If there is any possibility that the disinfected water has been recontaminated by coming into contact with a dirty cup or utensil or a dirty hand, it should be discarded and the container should be thoroughly washed.

The slightest contact with a contaminated surface can introduce pathogens to water and lead to recontamination. It is important, therefore, that the storage container be designed to prevent contact between water and hands or water and utensils. In South Africa, investigators found that *Vibrio cholerae* survived for as long as 7 days in clay pots used as household water containers, 17 days in plastic water containers, and 27 days in water containers made from iron drums (Patel 1989). By contrast, in Calcutta, an intervention trial that provided treatment families with narrow-necked water pitchers (into which hands

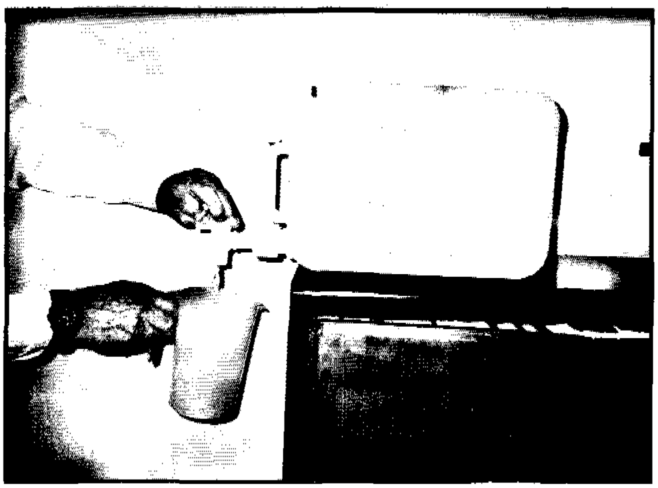

Figure 3. This household water storage container meets all of PAHO's criteria.

could not be introduced) was associated with a significant decrease in cholera, compared with control families (Deb 1982).

The Pan American Health Organization (PAHO) has developed several criteria for judging the suitability of household water containers (Witt and Reiff 1992) as follows.

A good water container should . . .

- be appropriate in size (10 to 20 liters) and have a handle for easy transport and a stable base
- be made of a durable, translucent, lightweight non-oxidizing material resistant to breakage (such as high density polyethylene)
- have a mouth that makes it easy to fill the container and add the disinfectant but difficult (or impossible) to immerse ladles or other utensils;
- be equipped with a non-rusting, durable, easy-to-clean spigot for extracting water
- have a strong serviceable cover connected to the container so that it will not get lost or dirty
- allow air to enter as water is extracted
- be imprinted or labeled with clear instructions for its sanitary use and maintenance.

To ensure that the container meets these criteria, it should be approved by the local sanitary authorities. Figure 3 depicts a container that meets these criteria.

Proper Handling of Food

Since cholera can be transmitted through food, proper handling and preparation of food is essential.

- Raw food other than whole fruits and vegetables that can be peeled should be avoided. However, fruits and vegetables can be scrubbed with soapy water, rinsed and then soaked in a solution made from tincture of iodine (Lugol's solution) for 15 minutes. Five ml of Lugol's solution per liter of water will be adequate for food disinfection. Most drugstores carry Lugol's solution. The water should be discarded after use.
- Fish and shellfish are often contaminated and should be washed and cooked.
- Food must be cooked thoroughly and then eaten promptly.
- If foods are to be stored for more than four or five hours, they should be refrigerated or kept in an ice box below 10° C. Or they can be kept in a hot box above 60° C. Food prepared for infants should not be stored at all.
- All cooking and serving utensils, cutting boards, or tables used for preparing food must be washed and air dried after use. These may also be soaked in Lugol's solution mixed in the proportion for food disinfection given above.
- Even slight indirect contact with raw food—through a knife or cutting board, for example—can contaminate properly cooked food. Persons who touch raw food should wash their hands afterward.
- Canned, dried, and acidic foods are generally safe to eat in areas where cholera is present. Most fruits that taste slightly sour have a pH safely below 4.5 and are not receptive to the cholera organism. Still, their skins need to be cleaned and peeled. Olive oil, fish oil, cocoa butter, and olives are unlikely to contain cholera vibrios. Table 5 shows the survival time of cholera in some common foods and drinks.

Table 5

Survival of Cholera in Food and Drink

Specimen	*Period of Survival at 20-25° C*
Ground coffee	1 hour
Lime, lemon	1 hour
Papaya	5 days
Tomatoes, figs, raisins	1 day
Celery, green beans, bean sprouts	5 days
Nuts and wheat	3 days
Coca-cola	1 day
Rose water	2 days
Tea leaves	1 day
Fish and shellfish (refrigerated)	1-2 weeks
Cooked rice, tapioca, eggplant	1-2 weeks
Milk desserts	1-2 days

Source: Feacham, 1983.

Water Testing

In many households, testing the water supply to be sure it is disinfected is impractical. However, an odor of chlorine guarantees the presence of residual disinfectant. If a chlorine test kit is available, a reading can be taken after 30 minutes of contact. If the test shows at least 0.5 parts per million residual (0.5 mg/l), the water is safe to drink.

The simplest test kit employs the property of DPD (Diethyl-para-phenylene diamine) to turn pink in the presence of chlorine in water. A sample of treated water is placed in a 10 ml tube. A tablet of DPD is added. The tablet quickly dissolves and the color is read immediately. CEPIS in Lima, Peru, designed a kit for home use that costs about U.S. $1.00. This kit is manufactured in Lima by Ing. Isaac Lavado, tel. (5114) 28-2322 or 27-3809. ATEIN S.A. in Alajuela, Costa Rica, manufactures the Clorotest (60 tests for $2.50 per unit) tel. (506) 37-3054, fax. (506) 41-0107. The HACH Company in Loveland, Colorado, U.S.A., tel. (303) 669-3050, also manufactures simple tests kits that use the DPD process.

6. Educational Campaigns

Educational campaigns are vital, but before they can be designed and organized, background assessments of the beliefs and behaviors of the target audience need to be carried out. Similarly, information on who does what in the household must be available so that the informational campaign is aimed at the right persons.

Household disinfection programs must target persons responsible for household water. For example, the disinfecting materials, the measuring implements and storage vessels used in the promotional campaign must be appropriate for the audience. In the Peru campaign mentioned earlier, a teacup, a beer bottle and a teaspoon were chosen as measuring implements and the written instructions for household disinfection were accompanied by pictures that also carried the message. This seemingly self-evident precept is not always followed.

Also, effective ways must be found to reach the target audience. In some contexts, for example, instructional leaflets might not be appropriate; community demonstrations may be called for. These might be channeled through local or community-based organizations, such as government-sponsored community health groups, church organizations, civic clubs, or any other association with strong ties to the people it works with. Mass media announcements can serve to reinforce the grassroots efforts, if they are targeted carefully. Mistakes can be made. One country broadcast health messages on the national radio station, but the targeted audience had come from a neighboring country and listened only to its broadcasts.

Misconceptions about cholera and disease in general abound, such as the belief that infant feces are harmless. These must be addressed in an educational campaign. Some educational campaigns might also run counter to cultural practices that are not hygienic, such as sharing food and drink from a common vessel or eating uncooked seafood. In some West African countries, for example, it is customary for the same women who prepare the body of a cholera victim for burial to cook the food for the funeral feast. This practice has been shown to contribute to the spread of cholera.

The most successful informational campaigns are built on firmly held ideals or beliefs. For example, Muslims perform ritual ablutions before prayer and value ritual cleanliness. In Muslim communities, informational campaigns about safe hygiene practices can refer to these beliefs and attempt to extend and amplify the practices.

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While a household disinfection program can be very effective in retarding the spread of cholera and other waterborne diseases, it should be viewed as an emergency or temporary measure, not as an alternative to working steadily toward providing safe water and sanitation for all.

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