Background information

At the XXIII Meeting of the Inter-American AIDIS Congress held in Havana, Cuba, in 1992, the Pan American Health Organization (PAHO), the Inter-American Association of Sanitary and Environmental Engineering (AIDIS), and the Caribbean Water and Wastewater Association (CWWA), signed a declaration creating the Inter-American Water Day (IAWD).

Thus, began in 1993, the first IAWD, which is celebrated annually on the first Saturday of October.

The IAWD is a “celebration of water” in the Americas. This event serves to highlight the relationship between water and good health, educate and create awareness among the public about its proper and efficient use, and foster ongoing water-related activities at the school age population and the community at large. The objectives of the IAWD are: 1) To call attention to the problems relating to drinking water supply; 2) To increase public awareness; which is essential for bringing about improvements in the conservation, preservation, and protection of the water resources and in drinking water supply; 3) To promote the fight against water pollution and contamination, especially with regards to water-borne parasitic diseases; particularly Cholera a priority; and 4) To encourage all the governments, international agencies, NGO’s, private sector and communities to participate in the IAWD celebrations.

To achieve these objectives, public awareness and environmental education activities have been implemented at the school and community levels. The target groups for the IAWD activities have been the general public, schools, and all institutions of the sector.

ACTIVITIES

In the four years since its inception, the IAWD has been successfully celebrated in a majority of countries of Latin America and the Caribbean. Most
countries have been able to promote, at the national and local levels, awareness of the major issues as outlined in the Declaration. The signers of the Declaration believed that public awareness was essential for bringing about improvements in the conservation of water resource and in drinking water supply. To this end, the media (television, radio, newspapers) has played an important role in raising public awareness, by promoting events and activities in the individual countries. Press conferences, articles in the newspapers, and radio and television spots have been useful mediums to facilitate the rapid and massive diffusion of materials, particularly in the urban areas.

The airing of special educational programs during the IAWD, has been common in many countries, including Guatemala, Honduras, and Panama. Children’s programming sometimes in the form of a story or caricature have also been an effective teaching tool for young kids and have been well received. Unfortunately, dissemination of materials into the rural, interior and indigenous areas have been somewhat limited.

In addition to the traditional media such as radio, television, and newspapers, countries have utilized other sources such as billboards, public transportation, shopping centers, and sporting events to inform the public about the IAWD, and the importance of protecting, preserving and conserving our water sources. For example, some countries have placed large billboards at strategic points, in populated areas, or on major streets, and in some cases on rural roads. These billboards give information about the theme, or special public events taking place in celebration of the IAWD.

Posters that display information about the IAWD have also been placed on the inside and on the outside of public transportation, such as buses, and trains. In Brazil, and Trinidad, shopping centers and malls have been effectively used for exhibitions and expositions about the uses, problems, and health benefits of water. At these events, educational materials have been made available to the general public.

Children have always been an integral part of the IAWD and many activities and events have been aimed at reaching them. For example, clean-up campaigns have been organized and school children were encouraged to assist in the clean up of community rivers, streams and other water ways. News stories have been written or spots have been shown...
on television so that people would be aware of the waste that are being thrown in the rivers, thus contributing to their contamination.

School children have also been involved in beautification projects. In some chosen neighborhoods, school children have planted trees, and shrubs, and have removed trash from around the community. These projects emphasize to the students the importance of preserving the environment.

By far, the most popular activities for the children have been the competitions and contests organized in the schools and communities. Children have competed in these competitions by drawing, painting, writing poetry or an article about the theme. In some cases, prizes have been given to the winners. In other instances, expositions and exhibits have been organized at art galleries, malls, shopping centers or schools to showcase the talents of the students. This has been effective in creating a sense of pride and awareness in the students.

Students at the university and college levels, along with their professors, have taken part in various symposiums, workshops, technical discussions and seminars during the IAWD. The participation of schools, universities, and colleges in the IAWD activities has continued to increase.

In some countries, government officials have also played an important role in the IAWD activities. Most governments have realized the importance of such a celebration, and have been supportive in providing assistance where possible, such as organizing or participating in seminars, workshops, and lectures. Given the participation of public officials, including those at the highest echelon of the political structure in the IAWD activities, there has been little doubt that they are committed to the event. The positive receptivity of most governments to the IAWD have led to the institutionalization of the Day in many countries, either by decree or other methods.

**IAWD 1997**

This year, the IAWD will be celebrating its fifth year and all indicators show that it will be well celebrated throughout the Region. The event will be celebrated on Saturday the 4th of October 1997. The theme is “Drinking Water Quality and Your Health.” The IAWD will focus on the relationship between the quality of water and the occurrence of diarrheal
diseases including cholera. The importance of the theme relates to the fact that inadequate and unsafe drinking water continues to be a public health problem for most people in the Region, and water-related diseases persist as one of the leading causes of illness and death among young children. In addition, the onset of the cholera epidemic in Peru in 1991, and its rapid spread throughout the Americas, lends credence to the fact that persisting deficiencies in clean water supplies and basic sanitation services, particularly in marginal areas and among the Region’s poor need to be improved. Public awareness campaigns aimed at educating people, particularly those in rural, interior and indigenous communities, on the importance of practicing proper hygiene and water protection will be the focal point of this year’s celebration. As is the practice each year, information kits will be distributed, and Regional posters will be designed. These kits contain booklets, pamphlets and other educational materials on the theme and are distributed to the general public.

The need for greater participation by some governments, international organizations and other entities in the organization of the IAWD celebrations continues, however, to be a critical factor to the success of the IAWD. Evaluation has shown that in those countries where there is a greater working relationship between various sectors, there seems to be extensive activities planned. Countries like Brazil, Chile, Honduras, and Panama, are some examples of countries where many organizations are able to work together to plan varied and diverse activities. It is only through such cooperation that a greater portion of the population, particularly the rural, interior and indigenous populations could be reached.

The Inter-American Water Day has achieved a milestone, and many countries are expected to celebrate the event for an entire week, rather than one day of celebration. In future years, hopefully, the event will serve not just as a one-day event, or a week of events, but rather as the culmination of a year-long program of water-related activities designed to raise awareness and motivate the public. The event however, continues to be successful in mobilizing large masses of the population, through activities that educate them about the importance of water, and the need to conserve, protect and preserve this valuable resource.
What is water quality?

Water quality refers to the presence or absence of harmful levels of impurities in water such as: bacteria, viruses, minerals, and organic substances. There is no single measure that constitutes good water quality. For example, water that is suitable for drinking can be used for irrigation, but water used for irrigation may not meet drinking water guidelines.

What factors affect water quality?

Several factors can affect water quality, by far, the most important agents are biological. They originate primarily in human or animal feces and can be bacteria, viruses, or protozoa.

How can I be sure that my water is safe to drink?

It is the responsibility of the county, municipality or state to provide its citizens with safe drinking water, and to provide warnings about any risks that may be related to its use. If you have doubts about your water you can check with the Health Department. Water samples are usually analyzed periodically to check drinking water quality. Water should be free from organisms that cause diseases. If in doubt, rapidly boil your water for one minute. This should kill any pathogenic organism that may be present in the water.

Why does the water from my tap sometimes look brown and cloudy?

Your water may look "dirty" for many reasons. Water from surface sources (rivers, lakes, etc.) must be "cleaned" before it can be used by people. Water treatment plants usually clean water by taking it through the following processes: 1) aeration; 2) coagulation; 3) sedimentation; 4) filtration; and 5) disinfection. However, if the treatment plant is not functioning properly, then your water may have some of the following problems: rusty color resulting from too much iron; blackness as a result of too much sulfur or manganese; and cloudiness due to improper sedimentation and filtration.

Is the water from standpipes as safe as the water people receive in their homes?

Yes. However, water can become contaminated during transportation. This is because when the water is collected from the standpipe it could be contaminated by being placed in unclean pails, buckets or other containers, or by dirty hands.

Water Quality and Your Health • Safe Water- A Source of Life
What is water quality?

Would boiling my water eliminate any chemicals that may be present?

No. Boiled water is recommended for killing germs, such as cholera microorganisms and most other pathogens associated with diarrheal diseases, but it will not remove chemicals from your water. Once you have boiled the water, it should be stored in a clean covered container to reduce the risk of recontamination.

Is it true that chlorine can be added to water to make it safe, and is it hazardous to your health?

Chlorination is a relatively inexpensive and effective method of making water safe for drinking and washing. Chlorination is the mixing of a chemical called chlorine with water, in order to disinfect the water. Chlorine is easily available in most areas. It is sometimes sold or distributed in powder form, tablets or drops. The health risk associated with the long-term consumption of water disinfected by chlorine or other disinfectants is limited when compared to the risk of diarrheal diseases.

Is bottled water safer to drink than tap water?

Today, many people use bottled water because they believe that it has a better taste and is of a better quality than their tap water. However, bottled water can be very expensive and in some cases may not be as safe as some people assume, and may in fact contain certain chemicals and contaminants. Consumers buying bottled water to avoid health hazards from tap water may not get the desired benefits.

Water, good to the last drop..... but how good is it?

Have you ever wondered if your drinking water is safe? You have probably heard that water is good for you, it is essential for life and healthy living, and that people must drink at least eight glasses of water a day. But, what is the quality of the water that you use for drinking and domestic use? Does it contain harmful bacteria, protozoa or viruses? Can you tell if it does, just by looking at it.

When drinking water is of a good quality it is described as "potable". This refers to the absence of disease-causing organisms and harmful chemical substances. It also means that the water is aesthetically acceptable, and is free from objectionable color or odor. It is possible that water that looks, tastes, and smells good can be hazardous to your health.
HOW THE QUALITY OF OUR WATER AFFECTS OUR HEALTH

Availability of water for bathing, cleaning homes, and washing clothes is essential for meeting our basic daily needs, but access to clean water is crucial to human health and well-being.

In some countries of Latin America and the Caribbean water is a principal vehicle for transmission of many diseases that affect humans. In fact, water borne diseases are among the leading causes of illness and death. The most common of these diseases are diarrheal and gastrointestinal diseases which are responsible for about 150,000 deaths per year among children below 5 years of age.

A person can become infected with these diseases through drinking water that has been contaminated. The organisms that are the main causes of these diseases are ingested with water or food or conveyed to the mouth by contaminated fingers. When people live in poor conditions, particularly when they lack access to safe water, and adequate sanitation, they are at risk from diarrheal diseases (including cholera), typhoid fever, hepatitis A, and shigellosis.

DIARRHEAL DISEASES

What are they, and who gets them?

Diarrheal diseases affect the intestinal tract. They are dangerous to both children and adults, but young children are the most vulnerable. The most common symptom is diarrhea. However, a variety of other symptoms, including fever, headache, and vomiting may be experienced. Many children die from diarrhea because they loose too much liquid from their bodies, this is referred to as dehydration. When a child looses water with diarrhea, the child begins to dry up, much like a plant does when it has no water. In addition, the child can also become malnourished as diarrhea drains the body of important nutrients and suppresses the appetite.
How can I reduce my risk of diarrhea?

You and your family can reduce your risk of diarrhea by taking basic precautions in and around your home.

- **Always keep food and water clean.** Diarrhea is caused by germs from feces entering the mouth. These germs can be spread in water, by flies, and dirty food.

  Use the cleanest water possible for drinking. Keep your food and water covered and away from flies. Remember to wash your hands before preparing or eating food. Do not leave food standing or it will collect germs.

- **Always use a toilet or latrine.** Feces and urine can get into rivers, streams, ponds, swamps and other water sources and contaminate them.

What can you do when a person, particularly a child has diarrhea?

Does a person with diarrhea need to stop eating? No, this is not true. Contrary to popular belief, a person, particularly a child, with diarrhea needs lots of liquids and plenty of food. Here are some guidelines:

- **A child with diarrhea needs plenty of liquids to drink.** Unfortunately, when children are sick, particularly with diarrhea, food, is unwelcome. However, because diarrhea can result in dehydration of the child, fluids and energy washed out of the body must be replaced. Use small amounts of fluids at a time. Cooked cereals, Oral Rehydration Salts (ORS), plain water, preferably boiled and cooled, soup, rice water, yogurt, fresh fruit juice, and coconut water (from a young coconut) are recommended. Even if the person is vomiting, more fluids than you think will be absorbed.

Remember to always use clean utensils. For example, clean cups, bowls, spoons.

- **Food is important for a child with diarrhea.** When a child is sick he should be encouraged to eat. Children may prefer soft foods when they are sick. Don't be alarmed, food may increase the volume of diarrhea, but the body will still be able to absorb some nutrients. After the child has recovered, they will need extra food to help regain the lost weight.
The most well-known and classic diarrheal diseases that affect the Region are Cholera, Typhoid Fever, Hepatitis A, and Shigellosis.

CHOLERA

Do you know what is cholera? Have you or someone you know had the disease? If cholera is prevalent in your country, chances are that you may have had the disease or know someone who has. A person can become infected by drinking water or eating food contaminated with polluted water. Eating raw or poorly cooked seafood, raw fruits and vegetables, and other foods that have been contaminated during preparation or storage can also result in you being infected with the disease.

Most cases of cholera are mild, and a person may have no symptoms or only mild diarrhea. However, people can develop very severe cases of cholera resulting in the loss of large amounts of fluids from the body. The loss of large amounts of fluids can rapidly lead to dehydration causing death - sometimes within three to four hours - if the patient is not adequately treated.

What should I do if I, or someone I know have Cholera?

Cholera can be treated. However, it is important that the person be treated immediately. The biggest danger of cholera is the loss of fluids from the body. Thus, delay in treatment may result in death from dehydration. In order to prevent dehydration, clean water, and other fluids, such as soups should be drunk on the way to the doctor, or health center.

Rehydration is the replacement of the water and salts that a person looses through severe diarrhea and vomiting. It is the most important treatment of cholera. A simple solution of Oral Rehydration Salts (ORS) is given to the patient to rehydrate the body. ORS are available in packets and have to be mixed with the recommended amount of safe water (boiled or chlorinated). They are specially made to treat dehydration, but can also be used in the home to prevent dehydration. Do not mix ORS with liquids such as soups, fruit juices, milk, or soft drinks, only mix them with clean water. A simple rehydration solution can be made at home by mixing 1 quart of safe water, 2 tablespoons sugar, and one-half teaspoon of table salt.

In most countries rehydration packets are available. Check your local pharmacies, shops or health centers.
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Remember it is most important not to let dehydration happen in the first place, especially in young children, since dehydration can cause death quickly.

How can I avoid Cholera?
Cholera can be easily prevented. Because contaminated water is the usual source of cholera infection, it is, therefore, important that you have safe drinking water, as well as safe water for food preparation and bathing. Here are simple precautions that you and your family can take to reduce your risk of getting cholera:

- Use safe water for food preparation and for drinking. If you are unsure about the water supply, bring water to a rolling boil before adding it to food that will not be further cooked, or making ice for drinks.

- Cook all raw foods thoroughly. Meats, fish and vegetables should be thoroughly cooked. Cooking your food can kill cholera germs present in food.

- Eat cook foods immediately. Cooked food cooled to room temperature for several hours without being reheated can be an important source of infection.

- Always use soap or ash to wash your hands thoroughly before you prepare, serve, or eat food. Remember that dirt can be carried on your hands without you knowing it.

To reduce the chances of cholera infection, cook your food, boil your water, and wash your hands.

Common Sources of Cholera infection

- Drinking water that has been contaminated at its point of collection or point of use (e.g. household storage containers that are uncovered and permit dirty hands or ladies to touch and contaminate the water).

- Food contaminated during or after preparation- chicken, milk, etc.

- Seafood - especially fish and shell fish from contaminated waters that are eaten raw or are insufficiently cooked.

- Fruits and vegetables that have been cultivated in lands irrigated or contaminated with wastewater, and then eaten raw.
Protect you and your family from Cholera

- Boil or chlorinate all drinking water.
- Water should be stored in a clean container with a small opening and a cover. Use a dipper with a long handle to get your water. Clean water can become contaminated again if it is not stored safely.
- Always wash your hands before you prepare or serve food.
- Cook all meats, fish, shellfish and vegetables. Thorough cooking will kill the germs and bacteria.
- Eat food while it is hot. When food cools to room temperature, bacteria begins to grow. The longer the wait, the greater the risk.
- Reheat all cooked foods thoroughly. Reheating before eating is your best protection against bacteria that may have grown during storage.
- Foods can be easily contaminated, therefore, keep all surfaces used for food preparation absolutely clean.
- Always use soap or ash to wash your hands.
- Always wash your hands before you eat and before you feed young children.

Typhoid Fever

Like Cholera, Typhoid Fever is a classic and well known water borne disease. Anyone can get typhoid fever. Typhoid germs are passed in the feces of an infected person. The germs are spread by eating or drinking water or foods contaminated by feces from the infected person. Symptoms of typhoid fever generally appear one to three weeks after you have been exposed, and may be mild or severe.

Signs and symptoms of Typhoid Fever

- Fever
- Diarrhea, or constipation
- Vomiting
- Headaches
- Muscle aches
- Rose-colored skin rash on the abdomen
- Chills, fatigue
How can I avoid Typhoid Fever?
Follow all of the routine food and water precautions.

- Thoroughly cook all foods and eat while they are still hot.
- When you eat raw fruits and vegetables that can be peeled, peel them yourself. Do not eat peelin g.
- Avoid foods and beverages from street vendors. It is difficult for food to be kept clean on the street.
- Avoid poultry or poultry products left unrefrigerated for long periods of time.
- Always wash your hands after bowel movement and before handling food.

How is Typhoid treated?
Antibiotics are often used to treat cases of typhoid.

REMEMBER: Even if your symptoms seem to go away, you may still be carrying the germ. If so, the illness could return, or you could pass the disease to other people.

Hepatitis A
Hepatitis A may not be a household name like that of Cholera and Typhoid, but the disease is common all over the world, particularly when sanitary conditions are poor. Hepatitis A is a disease that affects the liver, and symptoms may include, fever, nausea, abdominal pain, loss of appetite, and jaundice. Symptoms may not be immediate, and usually appear 10 to 14 days after ingesting contaminated foods.

- Many infected people, particularly children under the age of three, have few or no symptoms.
- People infected with the disease can pass the disease on to other people from two weeks before they become ill.

How does Hepatitis A spread?
The disease can occur at an early age and is transmitted person to person. Infected persons can transfer the virus to food. This usually occurs when hands, or other things are contaminated with feces or urine from an infected person. The disease can be spread when people:
do not wash their hands thoroughly after going to the toilet or latrine;

- eat non-cooked foods such as salads which have been contaminated by being handled by an infectious person;

- eat shellfish from contaminated water; and

- drink contaminated water.

Foods contaminated by food-handlers and subsequently not sufficiently heated, have been identified as a source of transmission of the disease. Consequently, many cases of Hepatitis A have been linked to restaurants and street-side vendors.

**What should I do if I have Hepatitis A?**

If you show any signs or have any symptoms of Hepatitis A, you should report them to your doctor, or go to the nearest health center immediately. Early detection is important for your health, but it also reduces the risk of spreading the disease. People with Hepatitis A should not prepare or handle food that will be eaten by other people. People with Hepatitis A should not work and children should not attend school, for at least one week after they become jaundiced.

**How can I avoid Hepatitis A?**

Contaminated foods and drinks are common sources of this disease. For your best protection it is important that you select and prepare all food carefully.

**Avoid:**

- uncooked foods, particularly vegetables and fruit which cannot be peeled before eating;

- shellfish; and

- unpacked drinks and ice.

In addition, the following guidelines below could help you and your family avoid getting Hepatitis A.

- **Personal hygiene.** This is an essential part of disease prevention. Proper hand washing techniques and hygiene practices are necessary to prevent transfer of the Hepatitis A virus from infected persons to
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food. Therefore, it is important that you wash away germs from your body by bathing, and washing your hands with soap (or ash) after going to the bathroom or handling refuse. Hands should also be washed before and after preparing and eating food.

- **Boil water.** If your water is untreated, it may be contaminated with human feces. Always boil or disinfect your water before drinking it.

- **Food vendors and road-side restaurants.** Foods should be bought only from vendors who have containers of drinking water in good condition, who wrap the foods they sell, and who practice good personal hygiene.

- Thorough cooking of food may destroy the Hepatitis A virus if present.

- Toilets and latrines. Should be cleaned often to avoid the spread of viruses. Place soap, or ash and clean water near the latrine so you can always wash hands after use.

**Can I be immunized against Hepatitis A?**

A vaccine is available and is recommended for food handlers. However, because of its high cost, its use has not been widely promoted.

**Shigellosis**

**What is Shigellosis?**

This is a bacterial infection of the intestines. The disease is common in young children, however, it can occur in all ages, particularly those suffering from malnutrition and poor sanitation, especially where there are crowded conditions.

**What are the symptoms?**

Diarrhea is one of the most common symptoms of this disease. Fever, stomach cramps, nausea, vomiting, and sometimes constipation may also occur. It usually takes about one to three days before the person becomes ill. This illness usually lasts from four to seven days. Some infected people, especially adults, may not show any symptoms.

**How does this disease spread?**

Shigellosis occurs when shigella bacteria is taken in by mouth and the most common way this happens is by person-to-person spread.
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- A person with shigellosis has the shigella bacteria in their feces. If that person does not wash their hands properly after using the toilet or latrine, then their contaminated hands can spread the bacteria to surfaces and objects (toys, pens, etc.) which will be touched by other people.

- Contaminated hands can also spread the bacteria to food which may be eaten by other people.

- Flies can spread shigella when they have contact with infected stool and then contaminate drinking water or food.

What should I do if I have Shigellosis?
If you have symptoms of the disease, report it to your doctor, or health care worker immediately. This will ensure that you receive proper treatment and that steps are taken to reduce the spread of the disease. People with shigellosis should not prepare or handle food to be eaten by other people.

How can I avoid getting Shigellosis?
Always wash your hands
It is important that you thoroughly wash your hands with soap or ashes:

- before preparing food;
- before eating;
- each time you use the toilet or latrine;
- after using a tissue or handkerchief.

Always handle food safely

- thoroughly cook all raw foods;
- thoroughly wash raw vegetables before eating; and
- reheat food thoroughly before eating.

Hand washing of young children should be supervised after they use the toilet or latrine, and before they eat. This is important since, young children are most likely to be infected with shigella and are also likely to infect others.

What you should know about diarrheal diseases
Practice water safety because....
How the quality of our water affects our health

- Diarrheal diseases are among the leading causes of death among children in the Region.
- Each year 150,000 children die from diarrheal related diseases.
- Children between 2-4 are most vulnerable.
- Diarrhea is an important cause of malnutrition, since patients with diarrhea eat less and their ability to absorb nutrient is reduced.

Reduce your risk of diarrheal disease....

- Always wash your hands before preparing or eating food.
- When preparing food for children make sure that your hands are clean. Dirty hands or dirt under the nails can cause children to get diarrhea.
- Always keep food and water covered and away from flies.
- Children and adults should always use the cleanest water possible for drinking.
- Food should be thoroughly cooked, and prepared just before eating. Do not leave it standing or it will collect germs.

WATER TREATMENT

Access to safe drinking water is essential to the prevention of many diarrheal diseases, since contaminated water is the usual source of some diseases like cholera infection. Many people collect their drinking-water from sources outside of their homes and store them in household storage vessels. There is however, a high risk of the water being contaminated at the source or in the storage containers. Most water sources must therefore, be treated in order to make it potable, that is - safe to drink and use. Here are some simple homemade methods that you and your family can use for treating water.

Boiling

This is one of the most effective ways of disinfecting small supplies of water. All pathogenic organisms are destroyed in water brought to a rolling boil. Though this method is simple and relatively easy to carry out, it is very costly and most people cannot afford to boil their water on
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a regular basis. Often fuel such as firewood, charcoal, kerosene, or bottled gas which is required to boil the water, can be very expensive, and sometimes difficult to get.

You will need:

- a cooking pot, large steel drums; and
- a fireplace, woodstove.

Method:

- boil water strongly for at least one minute; and
- cover and cool in the same container that the water was boiled in to prevent recontamination.

Remember: Dirty hands make boiled water dirty again, use a dipper to take water from the container.

Chlorination

Chlorine is one of the oldest and most commonly used disinfectants in the Region. It is the most effective and least costly method of making water safe for drinking. Chlorine is easily available in most areas.

You will need:

- Chlorine powdered, tablets, or liquid

Method:

- Add a small amount of chlorine to water supply and allow thirty minutes to react to the contamination present.

Remember: when water is too polluted, chlorine has no effect.

Filtration

There are many types of filters. They are used to remove particles from water. Sand filters are the most inexpensive and simple filters to construct and maintain. They can filter large quantities of water quickly but do not kill pathogenic organisms.

Here is how you can build your very own filter:

- Get a large barrel or any other container that is at least 1 meter deep. If it has a top, remove it and scrub and clean the outside
and inside. If possible, a tap can be attached to the bottom of
the barrel. You can place some bricks under the barrel so that
you can fit a pail or jug underneath the tap to catch the water.

- Then partially fill the container with a layer of small stones.
  Place a layer of clean sand on the top of the stones. Then add a
  layer of gravel on top of the sand to prevent the sand from being
  stirred up in the water.

- Water can now be poured into the filter. Any sediments in the
  water would be trapped in the sand, thus resulting in clear water.

The sand layers must be changed every two to three weeks to prevent
bacteria from growing in the sediments trapped in the sand and recon-
taminating the water. Clean the filter by scraping off the top layer of sand.
After four or five cleanings you will need to add more sand. Sand filters
must be carefully maintained because dirty filters can breed and spread
bacteria.

**Remember:** It is better to use any of these methods than no method at
all. They can be used alone, or in combination with each other, depend-
ing upon the quality of the water.

For more information please contact your local health authorities. The fol-
lowing articles *Chlorine in Water Disinfection* by Hend Galal-Gorchev, and
*Low-cost Safe Water* by Fred M. Reiff, et. al provide more information on
water quality.
Chlorine in Water Disinfection

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Abstract:

Disinfection of drinking-water is one of the main achievements of our time in the protection of public health. The use of chlorine for the destruction of micro-biological pathogens is essential to protect the public from outbreaks of waterborne disease. Chlorine, as well as other disinfectants, produces a variety of chemical by-products. The risk from the presence of microbial pathogens in drinking-water is estimated to be several orders of magnitude greater than the risk from chlorination by-products. Any efforts to control these by-products must not compromise the micro-biological quality of drinking-water.

INTRODUCTION

Safe drinking-water has been recognized for centuries as a major determinant of health

It is estimated that 1.5 billion people still lack access to clean water supplies [1]. Diseases arising from the ingestion of pathogens in contaminated water have the greatest health impact worldwide. The health effects of these diseases are heavily concentrated in the developing world and, within the developing world, among the poorer urban and rural households of the poorer countries.

One of the major achievements of this century is the extent to which waterborne diseases have become of minor significance in the mortality and morbidity of most developed countries. The use of chlorine and its
compounds for the disinfection of drinking-water has played a central role in reducing the incidence of these diseases and can be considered one of the most important success stories of our times for the preservation and promotion of public health.

**The Global Burden of Disease and Death from the Microbial Contamination of Drinking-Water**

An estimated 80 percent of all diseases and over one-third of deaths in developing countries are caused by the consumption of contaminated water and, on average, as much as one-tenth of each person’s productive time is sacrificed to water-related diseases [2]. Those at greatest risk are infants and young children, people who are debilitated or living under unsanitary conditions, the sick, and the elderly. For these vulnerable people, infective doses are significantly lower than for the general adult population.

The transmission of infectious and parasitic diseases that have been confirmed by epidemiological and micro-biological studies through the ingestion of pathogens in contaminated drinking-water includes hepatitis A and E, rotaviral and Norwalk agent enteritis, cholera, typhoid, campylobacter enteritis, shigellosis, Escherichia coli infections, enteritis due to Yersinia enterocolitica, cryptosporidiosis, giardiasis, amoebic dysentery, and dracunculiasis. Symptoms of these diseases are varied but most include diarrhea, one of the big killers of our time.

Diarrheal diseases are associated with unsafe water and remain a major cause of morbidity and mortality in infants and young children in developing countries. Across the globe there are an estimated 1.8 billion episodes of childhood diarrhea annually, mostly in developing countries. Each episode of diarrhea, if not properly managed, contributes to malnutrition and growth retardation. Diarrheal diseases were responsible for around 3 million childhood deaths in the developing world in 1993. An additional one million deaths a year occur in adults [3].

Cholera epidemics, frequently transmitted by unsafe drinking-water, are on the increase. Cholera has become endemic in many countries in Africa, Asia and Latin America. The cholera epidemic that began in Peru in 1991 and spread to 16 other countries in Latin America: a region which had been free of the disease for almost a century had disastrous impact on health and on national economies. The number of cholera
cases worldwide, notified to WHO in 1991, was 595,000 and 19,300 deaths [4].

Epidemiological studies have implicated drinking-water supplies (including ice) as one of the most important transmission vehicles of the cholera epidemic in Peru. Virtually none of the water supplies implicated was found to be adequately disinfected. Throughout Latin America, the failure to disinfect water supplies has repeatedly been proven to be a major contributing factor to the propagation of cholera and many other waterborne diseases. The concern over chlorination by-products, especially trihalomethanes has been cited as the reason for abandoning disinfection in Peru resulting in the cholera epidemic [5].

It is estimated that the 1991 outbreak of cholera cost Peru alone, approximately US$1 billion as a result of reduced economic activity, losses to the fishing, agriculture and tourism sectors, unemployment, and reduction of exports [1].

In a number of African countries, cholera cases are also increasing at a catastrophic pace. July 1994 was marked by the dramatic cholera outbreak that devastated the Rwandan refugee camps in Goma, Zaire. The lack of safe water and basic sanitation, and massive overcrowding created ideal conditions for the rapid spread of the disease. The worldwide total of cholera cases in 1994 was 384, 400, with a death toll of 10,700 [6].

Dracunculiasis is a disease caused by the parasitic worm Dracunculus medinensis or guinea worm. This worm, The Fiery Serpent, has been a major health risk for millions of people in Africa and the Indian subcontinent. The disease does not kill people, but it causes dreadful suffering and disability among the world’s most deprived people. Dracunculiasis can only be contracted by drinking contaminated water.

**Benefits To health of safe drinking-water**

It would be erroneous to ascribe the source of hepatitis, cholera, amoebiasis and other intestinal infectious and parasitic diseases exclusively to unsafe drinking-water. With the exception of dracunculiasis, drinking-water is only one vehicle of transmission. Inadequate sanitary disposal of human excreta, cultural behavior, lack of health education, poor food-handling practices, overcrowding, poverty, inadequate quantities of water
for hand washing, bathing, laundering and cleaning, are all important factors in the transmission of diseases. Quantitative assessment of the risks associated with each of these individual factors is difficult and controversial because of insufficient epidemiological evidence, the number of factors involved, and the changing interrelationships between these factors. Improvements in the quality and availability of water, in excreta disposal, and in general hygiene education, are all important factors in achieving reductions in morbidity and mortality rates of infectious and parasitic diseases.

High risks are associated with the ingestion of water that is contaminated with human and animal excreta. In addition, the microbial contamination of drinking-water will result in the contamination of food, an increased number of carriers and cases, the re-contamination of drinking-water, and the vicious circle of disease spreading and death will thus be completed. Of all routes of exposure, the microbial contamination of drinking-water is particularly to be avoided because of its capacity to result in the simultaneous infection of a high proportion of the community.

Numerous studies have clearly shown that provision of micro-biologically safe drinking-water can significantly reduce, directly or indirectly, the morbidly and mortality of diarrheal diseases, schistosomiasis, and dracunculiasis.

Provision of safe drinking-water and the proper disposal of human excreta can significantly reduce the morbidity and mortality of some of the most serious disease, and can significantly reduce overall child mortality [7].

The impact of the quality of water alone was examined in a number of studies. A median reduction of 17 percent in diarrheal disease morbidity was found as a result of the use of safe versus contaminated water supplies, and infant mortality was decreased by some 20 percent [7].

One of the goals of the World Health Organization and its Member States is the eradication of dracunculiasis. Eradication depends largely on the provision of safe water: village pumps in endemic areas, filtering of surface water through finely-meshed cloth and destruction of the cyclops, the intermediate host of the worm. As a result of an intense international effort focusing on safe water supplies, the number of reported cases
of dracunculiasis has declined from 892,000 in 1989 to 165,000 in 1994 [8].

Schistosomiasis (bilharziasis or snail fever) is a water-related helminthic disease acquired by contact with water used in normal daily activities for personal or domestic hygiene and swimming, or in professional activities such as fishing, rice cultivation, irrigation, etc. It affects 200 million people in 74 countries in the Americas, Africa and Asia, and kills perhaps 200,000 people [3]. Recent studies have shown that populations with safe public water supplies can have up to 40 percent lower incidence of the disease than those without [1].

**DRINKING- WATER DISINFECTION**

As far as possible, water sources must be protected from contamination by human and animal wastes, which can contain a variety of bacterial, viral, protozoal and helminthic pathogens. It is always better to protect water from contamination than to treat it after it has been contaminated.

However, in many cases protection of the water source from pollution is problematic. In the case of contaminated water sources, several treatment processes such as coagulation, sedimentation, filtration and disinfection, will be necessary to provide multiple barriers to the spread of pathogenic microorganisms, so that the failure of any one process will not result in waterborne disease. The final barrier is disinfection. The function of the entire system, and indeed of much of water treatment, may with some justification be regarded as that of conditioning the water for effective and reliable disinfection [9,10].

The destruction of microbial pathogens almost invariably involves the use of reactive chemical agents such as free chlorine (hypochlorous acid and hypochlorite), chloramine, chlorine dioxide and ozone. Each of these disinfectants has its advantage and disadvantage in terms of cost, efficacy, stability, ease of application, and nature of disinfectant by-products (DBPs). Chlorine is by far the most commonly used disinfectant and, in developing countries, the use of chlorine is often the only affordable mean of disinfecting drinking-water.

Comparing the efficiency of the four main disinfectants, the most efficient disinfectant for the inactivation of bacteria, viruses and protozoa is
Chlorine in Water Disinfection

... ozone, whereas chloramine is the least efficient. Free chlorine is an effective disinfectant for bacteria and viruses, and compares well with the efficiency of ozone and chlorine dioxide for these microorganisms. However, it is less effective against Cryptosporidium parvum and Giardia lamblia than chlorine dioxide or ozone [11].

Several factors influence the efficiency of disinfection with chlorine. These include the pH and turbidity of the water and, of course, the concentration of chlorine and contact time.

When added to water, chlorine rapidly hydrolyses, yielding hypochlorous acid (HOC1) and hydrochloric acid. Hydrolysis to HOC1 is virtually complete at pH greater than 4 and at chlorine doses up to 100 mg/L. Hypochlorous acid is a weak acid that dissociates partially into hypochlorite ion (OC1-). At pH of about 7.5, there is an equal distribution of HOC1 and OC1-; at pH 6.5, 90 percent of the free chlorine is present at HOC1; at pH levels above 9, hypochlorite ions are the dominant species. Hypochlorous acid is a considerably more efficient disinfectant than hypochlorite ion, thus efficient disinfection is favored by lower pH [12].

Turbidity can have negative effects on disinfection because high levels have been shown to protect microorganisms from the action of chlorine, and to increase the chlorine and oxygen demand [10].

Conditions for effective terminal chlorination as recommended in the WHO Guidelines for drinking-water quality are as follows [9,10]:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>less than 8.0</td>
</tr>
<tr>
<td>Median turbidity</td>
<td>not to exceed 1 heptihemetric turbidity unit (NTU)</td>
</tr>
<tr>
<td>Maximum turbidity</td>
<td>5 NTU</td>
</tr>
<tr>
<td>Residual concentration of free chlorine</td>
<td>not less than 0.5 mg/L</td>
</tr>
<tr>
<td>Contact time</td>
<td>at least 30 min</td>
</tr>
</tbody>
</table>

These conditions of chlorination are expected to ensure the absence of bacteria and viruses in treated water but not of pathogenic helminths,
cysts or oocysts of protozoa. For these microorganisms, effective filtration is an essential requirement.

Distribution systems are vulnerable to microbial contamination. Residual chlorine concentrations of approximately 0.2-0.3 mg/L are often maintained in distribution systems to serve as a sentinel for the entry of pollution and to prevent the growth of nuisance bacteria and other organisms.

Chlorine, as well as other disinfectants, reacts with certain water constituents to form new compounds with potentially harmful long-term health effects. Chlorine disinfection by-products have been extensively identified and assessed for toxicity. Considerably less is known about the nature and toxicity of the by-products of the other disinfectants, ozone, chlorine dioxide, or chloramine.

The levels of potentially toxic chlorination by-products can be reduced through appropriate treatment while maintaining the micro-biological quality of drinking-water. Effective application of conventional treatment (coagulation, sedimentation, filtration) will reduce the levels of organic precursors before final disinfection, and avoiding pre-chlorination will result in an overall decrease in the concentration of DBPs.

**WATER CHLORINATION: BENEFITS AND RISKS**

Diseases caused by pathogenic bacteria, viruses, protozoa or helminths are the most common and widely spread health risk associated with drinking-water. For this reason, the WHO Guidelines for drinking-water quality place the greatest importance on the micro-biologically quality of drinking-water, and repeatedly emphasize that the potential consequences of microbial contamination are such that its control must always be of paramount importance and never be comprised [9].

The disinfection of drinking-water using chlorine has saved many lives, beginning with the dramatic decline in typhoid and cholera cases which accompanied the introduction of this process in Europe and North America in the early 1900s.

The use of chemical disinfectants, including chlorine, in water treatment usually results in the formation of chemical by-products, some of which are potentially hazardous. However, the risks to health from these by-
products are extremely small in comparison with the risks associated with inadequate disinfection, and it is important that disinfection should not be compromised in attempting to control such by-products [9].

In 1991, the International Agency for Research on Cancer evaluated the carcinogenic potential of chlorinated drinking-water. IARC concluded that [13]:

“There is inadequate evidence for the carcinogenicity of chlorinated drinking-water in humans. There is inadequate evidence for the carcinogenicity of chlorinated drinking-water in experimental animals.”

Weighing the risks of microbial versus chemical contamination, the WHO Guidelines for drinking-water quality recommends that, where local circumstances require that a choice must be made between meeting either microbiological guidelines or guidelines for disinfectant by-products, the microbiological quality must always take precedence, and, where necessary, a chemical guideline value can be adopted corresponding to a higher level of risk. Efficient disinfection must never be compromised [9].

Efforts are being made to provide quantitative assessment of the health risk from the microbial contamination of drinking-water for comparison with the potential risk from chlorination by-products. Although risk assessment of this kind is fraught with difficulties, Regli et al., concluded that the risk of death from known pathogens in untreated surface water appears to be at least 100-1000 times greater than the risk of cancer from known chlorination by-products, and the risk of illness from pathogens in untreated surface water appears to be at least 10,000 -1 million times greater than the risk of cancer from DBPs in chlorinated drinking-water. Depending on the source water quality, these same relative differences in risk may pertain to filtered systems without disinfection versus filtered systems with chlorination [14].

Control of the microbiological quality of drinking-water is a much higher health priority, especially in developing countries, than the control of chlorination by-products. The use of chlorine for the disinfection of drinking-water is critical for the control of waterborne diseases thus disinfection should not be compromised to minimize the levels of chlorination by-products.
REFERENCES


Inadequate and unsafe drinking water supplies represent a continuing public health problem for most of the world’s population. The World Health Organization (WHO) estimates that 80% of all diseases in the developing world is caused by lack of clean water and proper sanitation. It is also estimated that over 40 percent of the population of Latin America and the Caribbean (LAC) are utilizing water that is micro-biologically unsafe or of questionable quality for human consumption.

Many households are connected to water supply systems that do not have adequate, reliable treatment, or lack the necessary integrity to prevent micro-biological contamination; and other households rely on non-piped water supplies that are micro-biologically contaminated. Simply stated, many people in LAC are using water supplies that are unsafe, and very likely to be threatened by diseases transmitted through drinking water.

The high incidence of waterborne diseases, which include such classical diarrheal diseases as cholera, typhoid fever, and hepatitis A are evident of the need for micro-biologically safe water in the Region. The cholera outbreak in Peru in 1991, and the subsequent rapid spread of the disease throughout the Region, illustrates the public health significance of contaminated drinking water. Drinking water is not the only pathway of these diseases but it is one of the most common.

Public health intervention projects have been developed and implemented to provide even the most impoverished people of Latin America with the ability to disinfect essential quantities of household water by using specially designed containers for water storage and use. The intervention also allows for the production and distribution of the water disinfectants at the local level.

This article was extracted from the original article: Low cost Safe Water for the World: A practical Interim Solution by Fred M. Reiff, Mirta Roses, Linda Venczel, Robert Quick and Vicente M. Witt. 1996 by Journal of Public Health Policy, Inc.
The Problem

The population most threatened by waterborne diseases are the poor. In many areas where water is intermittent or non-existent, storage of water is a common practice. Many people have to go great distances from their home to get water, therefore, it is practical for these people to store the water in containers in their homes. People store their water in a variety of containers. However, most of these containers do not adequately protect the contents from contamination, many of them are left opened, allowing dust, flies, debris and other contaminants to enter the water. The water can be further contaminated by contact with human hands or when contaminated utensils are used to withdraw water. Thus, safe water can easily become contaminated during storage. Even if the water is micro-biologically safe upon its being placed in the containers, it is quickly contaminated during storage and use.

The Solution

A two-component treatment and storage system comprised of a chlorine solution and water container has been introduced into many communities at risk. One, but preferably two specially designed water containers are made available to households. These containers are used to disinfect and store the essential quantities of safe water. The containers are made from a durable material that is easy to clean, lightweight, translucent, fitted with handles to facilitate lifting and carrying, and has a stable base to help prevent overturning. Instructions for use of the container, disinfection of the contents, and cleaning the interior, are permanently affixed to the container on a material that does not deteriorate when wet or moist. The second component which is the chlorine solution is produced at the local level. Consumers purchase the disinfectant in vials and add it directly to the water in the storage container in their homes.

Conclusion

This intervention project makes it possible for households to have micro-biologically safe water at a cost that even the very poor can afford. However, it is essential that individual households unfailingly carry out the task on a daily basis, and the community itself assures the availability of water disinfectant and suitable water storage containers for pur-
chase by each household. This requires education and motivation of the households and mobilization of the community.

The project has been successful in Bolivia, and has produced a dramatic improvement in the quality of their drinking water. It is feasible and practical because it requires only a small initial investment, a few minutes a day on the part of the household, and is sufficiently simple to carry out that it can be accomplished by any of the family members from children to the elderly. ♦
REFERENCES


ACKNOWLEDGEMENT

This document was produced by the Division Of Health and Environment (HEP), of the Pan American Health Organization, Pan American Sanitary Bureau, Regional Office of the World Health Organization, as a general information booklet.

The Organization is grateful to Ms. Denise Bailey for her contribution in the preparation of this document, and the Office of Public Information for the design and layout.