

Chapter 20

Water Hygiene

Shaheen Mehtar

Key points

- Water is required for drinking, hygiene, health related processes and generating energy.
- Unclean water leads to ill health, outbreaks of infectious disease in the community and healthcare-associated infections in healthcare facilities.
- The integrity of systems used to collect, transport, store and distribute water is essential.
- Potable water can be rendered safe by boiling water for 2-5 minutes or filtering/adding chlorine.
- Water used in healthcare facilities additionally may require distillation, removing chemical impurities or sterilizing.

Introduction

Water is the essence of life. Water for human consumption and domestic use is usually drawn from natural sources and stored before distribution. In some rural communities, water is obtained directly from rivers or dams; however, in established communities water is usually piped. The availability of water for domestic use is inversely proportional to the level of health. Distance from the source of water and improper storage have been identified as major risk factors for ill-health.

Water used in healthcare facilities should be in constant supply, of good quality, with low bacterial counts and low mineral content. In instances where water is of poor quality with erratic supply and systems not maintained, high levels of contamination are inevitable.

Uses of Water

There are various domestic and healthcare uses for water as outlined in Table 20.1.

Domestic use

The World Health Organization defines domestic water as being ‘water used for all usual domestic purposes including consumption, bathing and food preparation’. The minimum requirement is 15 litres per person per day, of which 5 litres is recommended for drinking, cooking and sanitation. Water contaminated by microbes or chemicals may affect large populations; the burden of disease is usually carried by children.

In Bangladesh, high levels of chemicals like arsenic and fluoride are found in the water supply and it is estimated that between 55 and 77 million people are at risk of arsenic poisoning.

Health care facilities

A constant water supply is fundamental for health provision, without which the following may occur:

- Non-compliance with hand hygiene and subsequent increased cross infection
- Inadequate support from sterile services, especially autoclaves

Table 20.1. Uses of Water

Domestic	Healthcare
Drinking Washing & laundry Sanitation Cooking	Hand hygiene Processing clinical and non clinical equipment Dialysis Injections Operating theatres Laser equipment Energy source-steam Kitchen Laundry Sanitation

- Failure of essential departments to function optimally, such as operating theatres, endoscopy units, laundry and kitchens.
- Risk of contamination (sewerage and chemicals) of water pipes when supplies are erratic

A well maintained water system prevents transmission of healthcare-associated infection such as *Legionella pneumophila*, cholera and typhoid in endemic areas and diarrhoeal disease. Thus it supports good infection prevention and control practice.

Diseases associated with water

These diseases can be divided into four categories (See Table 20.2):

<i>Water-borne.</i>	Disease associated with consumption of contaminated water
<i>Water-washed.</i>	Disease caused by inadequate volumes of water for personal hygiene
<i>Water-based.</i>	Disease where an intermediate aquatic host is required
<i>Water-related vector.</i>	Disease spread through insect vectors associated with water

Table 20.2. Examples of water related diseases in the community and hospital

	Community	Healthcare facility
Water-borne	Diarrhoeal disease Hepatitis A Typhoid Cholera	Diarrhoeal disease Legionnaire’s disease Typhoid Cholera
Water-washed	Diarrhoeal disease Trachoma	Impetigo Group A streptococcal infection
Water-based	Schistosomiasis Guinea worm	
Water-related vector	Malaria Dengue Yellow Fever	Malaria Dengue

Rendering Water Safe in Community

Boiling

Boiling occurs when the water temperature reaches 100°C or more. During the process, water should be observed to bubble for a minimum of 2-5 minutes before it is considered safe to drink or use. Heating water up to 75°C will remove most vegetative bacterial forms, however not spores or parasites.

Water which has been boiled and then allowed to cool in the same container will be safe to drink providing dirty hands or contaminated items are not used to decant the water. A member of the family is typically chosen to be responsible for dispensing water to everyone in the family and maintaining a clean container. He or she is advised to wash hands thoroughly before using a dedicated container to decant water. Hand washing in a domestic setting is usually performed after defecating or before eating.

Chemical

Chlorine is widely used for purification of water. Individual water storage tanks should contain 0.5 parts per million (ppm) of available chlorine at the end of the chlorination process. It is recommended that water should not be used for 1 hour for river water and 30 minutes for well or borehole water.⁵

Rendering Water Safe in Healthcare Facilities

Potable water

Drinking water generally, but particularly in hospitals, should contain no more than 500 cfu/ml of a total bacterial count.

Water supplies to hospitals

Storage Tanks - prevention of Legionnaire's Disease⁶

- There should be adequate storage of water to meet the needs of the hospital for 24 hours. Water should be stored in tanks which are located in areas to provide a minimum heat gain.
- Tanks should be well insulated and temperatures of 20°C or lower should be maintained.
- Tanks should be cleaned regularly by emptying and removing debris and flushed through with water containing >2mg/l (2 ppm) available chlorine. After the tank is filled, the chlorine concentration should be 1-2mg/l of free residual chlorine at delivery point.
- End point hot water should be delivered at 55°C with a circulating temperature of 60°C. All hot water taps should be clearly labelled for safety.
- The hot and cold pipes should be tagged if these are close together to avoid diffusion of heat and an increase in the cold water tap temperature. Cold water temperatures should be less than 20°C after running for 2 minutes.
- Rubber washers should be replaced with plastic ones. Shower heads should be cleaned regularly.

Chemical processes for water

Filtration

Filtration is a system designed to remove particles of varying structure and sizes. In some countries it is used for removing sediment routinely from water; however this system is expensive and requires considerable maintenance. Therefore, filtration is recommended where heat or chemical disinfection is inappropriate. Various methods may be used for filtration including carbon, ion exchange/salt, and reverse osmosis.

Chlorination

Chlorine is widely used for treating water supplies after filtration in most towns and cities, particularly where water supplies are recycled. It is also a recommended method of water purification during large disease outbreaks, particularly in disaster areas. It is an easy and effective method used in large water containers. The recommended final concentration for potable water is 0.5 ppm of available chlorine.

In hydrotherapy pools, 15 ppm of available chlorine is recommended, while for whirlpools and spas it is 2-5 ppm of available chlorine.

Ozone treatment

Ozone is being introduced in some laundries to conserve energy by reducing the temperature of the water. Ozone has known antimicrobial properties particularly against vegetative forms of bacteria. However, capital outlay is expensive and there must be precise and regular monitoring and maintenance.

Dialysis units

The water supply should be fitted with an ultra filter or pyrogen filter with a pore size to remove particles or molecules of >1 kilodalton.

Endoscopic equipment

Rinse disinfected endoscopes with water filtered through 0.1-0.2 mm filter

De-ionisation: used in specialised fluid production in pharmacy and radiotherapy. An expensive process with high maintenance costs.

De-mineralization: a complex process used in surgery, particularly for laser equipment.

Alternatives methods of using water in healthcare facilities

In low resource countries water supplies may be limited by environmental or engineering deficiencies. A short list of examples is provided in Table 20.3. Boil water if running water is not available.

Table 20.3. Alternative choices for water use

Use	Alternative choice
Sterile services	Steam generation by boiling water in large tanks. Feed autoclaves and washing area for instruments. Run water from clean to dirty areas.
Washing equipment	Hot water (70°C)
Hand washing	Cold running water. Do not use standing water in basins for multiple hands. Alcohol hand rub may also be used.
Drinking water	Boiled water stored in clean, closed, dedicated containers. Allow a dedicated person to decant.
General use	Hot water from large tanks heated to 60°C.
Laundry	Wash in available water, use small quantities of bleach and dry in the sun.
Bedpans / urinals	Clean thoroughly and lay face down in the sun.

Engineering support

- A well trained team should be responsible for maintaining the water supply within the community and healthcare facilities.
- In healthcare, all water-associated equipment must be cleaned and maintained regularly with adequate levels of disinfection.
- Temperature controls for hot and cold water systems must be maintained according to recommendations.
- Water and sewerage pipes should not run parallel to each other.

Minimum requirements

Domestic use

1. **Collection:** from source into a clean container or directly delivered to residence.
2. **Transportation:** large and small containers must be cleaned regularly and decontaminated using chlorine.

3. **Storage:** in containers with well fitted lids and preferably with a tap.
4. **Distribution:** either via pipes or with a clean container.
5. **Effluent:** into a municipal system or, in the absence of sewage systems in rural areas, it should be kept away from the source water supply.

Healthcare use

1. **Piped water:** well maintained pipes with no leaks or cracks located away from the sewerage pipes.
2. **Storage:** large clean tanks which are maintained regularly.
3. **Distribution:** piped system with clearly labelled hot and cold water at the recommended end-point temperatures. Multi-purpose use open containers are unacceptable.
4. **Effluent:** into a municipal system. If not, then treated with chlorine before discharge.

References and Further Reading

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