Technical Brief No.52: Water: quality or quantity?

Anyone thinking of implementing a water project must clearly understand water quality and quantity requirements. This Technical Brief looks at these requirements and compares their importance in relation to improving people's health.

Technical Brief No. 51 discussed, in some depth, just how important good hygiene understanding and practice are; improved water quality or quantity alone will not necessarily improve health if communities do not have an understanding of the concepts of hygiene and disease transmission. If positive benefits are to ensue, communities must also have the will, and the financial and management capabilities to be able both to operate and maintain water projects, and to put into practice what they know about hygiene.

Water (or lack of it) can play a part in the transmission of diseases in various ways. The four water-related transmission routes are highlighted in Table 1.

Many of the water-borne, water-based and water-washed diseases are transmitted through the 'faecal-oral' route; pathogens or parasites from the faeces of one person are transmitted by various routes to the mouth of another, and in this way cause illness. Some diseases, however, such as skin or eye infections, diseases caused by lice or mites, or those caused by pathogens or parasites which penetrate the skin, are not transmitted by this route. For these diseases the main prevention strategies are improved hygiene understanding and practice, and reducing contact with the contaminated medium.

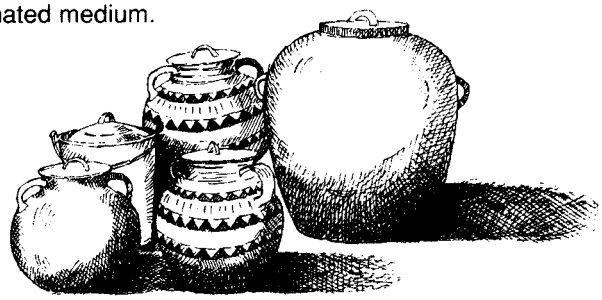

Table 1. Disease transmission and preventive strategies
(Adapted from Cairncross *et al.*, 1983.)

Classification	Transmission	Examples	Preventive strategies
Water-borne (water-borne diseases can also be water-washed)	Disease is transmitted by ingestion	· Diarrhoeas (e.g. cholera) · Enteric fevers (e.g. typhoid) · Hepatitis A	· Improve *quality* of drinking water · Prevent casual use of other unimproved sources · Improve sanitation
Water-washed (water scarce)	Transmission is reduced with an increase in water quantity: · infections of the intestinal tract · skin or eye infections · infections caused by lice or mites	· Diarrhoeas (e.g. amoebic dysentery) · Trachoma · Scabies	· Increase water *quantity* · Improve accessibility and reliability of domestic water supply · Improve hygiene · Improve sanitation
Water-based	The pathogen spends part of its life cycle in an animal which is water-based. The pathogen is transmitted by ingestion or by penetration of the skin.	· Guinea worm · Schistosomiasis	· Decrease need for contact with infected water · Control vector host populations · Improve *quality* of the water (for some types) · Improve sanitation (for some types)
Insect-vector	Spread by insects that breed or bite near water	· Malaria · River blindness	· Improve surface-water management · Destroy insects' breeding sites · Decrease need to visit breeding sites of insects · Use mosquito netting · Use insecticides

Table 2. Recommended minimum water-quantity requirements	
Usage	**Water usage (litres per head per day unless otherwise stated)**
Individuals	15 to 25
Schools	15 to 30 litres per pupil per day
Hospitals (with laundry facilities)	220 to 300 litres per bed per day
Clinics	Out-patients 5 In-patients 40 to 60
Mosques	25 to 40
Pour-flush latrines	1 to 2 litres per flush 20 to 30 litres per cubicle per day
Dry latrines (for cleaning)	2 litres per cubicle per day (more if heavy usage such as in refugee camps)
Livestock: large (cattle)	20 to 35
Livestock: small (sheep, pigs)	10 to 25

There are many water uses (e.g. drinking, cooking, washing, agriculture etc.) and the quantity and quality required for each varies. Drinking-water requirements are usually the most stringent.

Basic requirements for drinking-water

- There must be enough to prevent dehydration.
- It should be acceptable to the consumer. (A bad taste or colour, staining, or unpleasant odour can cause a user to choose an alternative source.)
- It should be free from pathogenic (disease-causing) organisms and toxic chemicals.
- It should not cause corrosion or encrustation in a piped water system, or leave deposits.

Table 3. Collection distance implications on water quantity	
Distance to water-point	**Water consumption (litres per person per day)**
Walking distance > 1000m to communal water-point	5 to 10
Walking distance < 250 m to communal water-point	15 to 50
House or yard connection — single tap	20 to 80

Quantity of water

The minimum quantity of drinking-water needed for survival is 3 to 5 litres per person per day depending on the temperature, and an individual's level of exercise. Table 2 gives further details of water-quantity requirements.

The quantities used will fluctuate with distances that have to be walked to collect water (Table 3). It should be expected, therefore, that usage will increase with the improved convenience of a piped supply, when a new source nearer to the home is realized, or when income levels increase (Table 4).

Increased quantity of water can also improve:

- agricultural practices
- nutrition
- socio-economic growth

Quality

Pollutants and the physical features of water can affect health in the following ways:

- some can be directly harmful to health, such as microbiological and biological contaminants, fluoride, pesticides and industrial pollutants;
- colour, taste, turbidity and odour can make the water objectionable to consumers, and cause them to use another, superficially less objectionable, but not necessarily safer, source; and

- others such as pH and turbidity can reduce the effectiveness of treatment processes such as disinfection.

Microbiological and biological contaminants are the major source of illness.

The World Health Organization (WHO) has produced guideline levels for quality for use as targets and as an aid for countries who wish to produce their own. In many regions, however, the WHO guideline levels may not be achievable in the short term and, therefore, interim national standards should be set which promote improved water quality and which are realistic. *Setting targets that are too high can be counterproductive; they may be ignored if they are not attainable.* National standards should reflect national conditions, priorities and capacity to improve water supplies, especially in small communities where the choice of source and treatment are limited, and finances are constrained.

E.coli (or thermotolerant coliforms) are used as indicators of faecal pollution. If *E.coli* are present then it is likely that pathogens are also present. The WHO guideline level for thermotolerant coliforms indicates that, for all water intended for drinking, none should be detectable in any 100 ml sample. Alternative figures are often quoted which are more appropriate for rural communities and emergency situations (Table 5).

Water-quality data gives information about the present situation but does not show the patterns of intermittent or seasonal pollution. A *sanitary survey* (see Technical Brief No. 50) will give information about the likelihood of faecal pollution. *Local knowledge* and *local medical information* can also help in assessing pollution problems.

When making an assessment of drinking-water quality, the investigator should be aware that *drinking-water can often become contaminated from unclean collection vessels or storage containers in the home.*

In general, microbiological pollution levels of sources vary from low levels in rainwater (if it is collected in a clean environment), deep groundwater and springs (unless in an area of highly fissured rock), to high levels in shallow groundwater (unprotected hand-dug wells), rivers, streams and lakes.

Table 4. Economic circumstances and domestic water use

(Adapted from Twort *et al.*, 1994, p7)

Economic circumstances	**Quantity of water used for domestic purposes (litres per person per day)**
Upper to middle-income groups (warm climate: piped supply to home)	200
Upper to middle-income groups (Europe: piped supply to home)	165
Low-income groups (warm climate: standpipe supply) · urban · rural (washing at standpipe) · rural (drinking and washing only)	 70 65 25
Low-income groups (Europe: piped supply to home) · small flat with shower	 100

Table 5. Thermotolerant coliform guide

(Adapted from Ockwell, 1986, p327)

Level of faecal pollution (number of thermotolerant coliforms present per 100ml)	**Inference**
0 - 10	Reasonable quality
10 - 100	Polluted
100 - 1000	Dangerous
> 1000	Very dangerous

Quality can be improved by:

- ❍ source protection;
- ❍ improved hygiene awareness and practice;
- ❍ improved sanitation;
- ❍ water treatment;
- ❍ efficient and safe distribution to the consumer; and
- ❍ good storage practices.

Quality versus quantity

Steven Esrey highlights the relative impact of interventions on the reduction in diarrhoeal diseases (Table 6). From this it can be seen that quantity has a greater effect than quality, and also that good hygiene and sanitation practice have even greater impacts.

Table 6. The effect of interventions on the reduction of diarroheal diseases

Intervention	Reduction in diarrhoea (approx. %)
Water quality	15
Water quantity	20
Hygiene	33
Sanitation	35

Summary

When setting up a water-supply programme, the following points should be noted:

- ❍ In general, an increase in water quantity is more beneficial than an increase in water quality.
- ❍ The relative importance of water quality and water quantity depends on the situation. In urban areas or in refugee situations, for example, where large numbers of people live in close proximity, greater care must be undertaken to prevent epidemics. The quality of water therefore becomes more important.
- ❍ An excess supply of water can lead to other health hazards, such as standing water.
- ❍ In general, sanitation and hygiene understanding have a greater impact on health than improvements in water quality or quantity.

Further reading

Cairncross, S. and Feachem, R.G., *Environmental Health Engineering in the Tropics: An introductory text,* John Wiley, Chichester, 1983.

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Twort, A.C., Law F.M., Crowley, F.W. and Ratnayaka, D.D., *Water Supply,* Edward Arnold, London, 1994.

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