Water quality monitoring

Concepts of on-site testing

On-site testing of water involves using portable equipment to carry out testing in areas where there is no easily accessible laboratory. The equipment used for on-site testing generally relies on tablet reagents and simple hand-held instruments which do not need electricity or have special batteries which can be used for several days in remote areas and then recharged.

On-site testing has several advantages over laboratory testing :

- Samples do not need to be transported and so do not have time to deteriorate before testing ; more accurate results can therefore be obtained.
- Results are available locally immediately or the next day, so action can be taken rapidly.
- Local people can be more involved and can carry out some of the tests themselves, which helps to reinforce hygiene education messages.

Critical parameters of drinking water quality

There are many different chemicals and microorganisms present in water which may harm our health, but even if it were possible to test for all these it would be impossible to remove them all without expensive treatment. Many of these contaminants are only rarely a problem or vary slowly and can be picked up by occasional screening of water samples. To carry out all analyses on every sample would be wasteful and expensive. It is recommended that a few basic tests are carried out regularly on all water supplies to see if there is a risk to health. Generally, four critical tests are recommended :

- *Faecal coliforms* - a family of bacteria which live in the gut of human and other animals and can get into water through excreta. If these bacteria are present in drinking water, those people who drink the water are at risk of catching diarrhoeal disease. Details of the test required to identify faecal coliforms in water are given in Fact Sheet 2.32.
- *Turbidity* - the cloudiness of water. Chlorine and other disinfectants may not work properly if the water is too turbid. Turbidity measurement is covered in Fact Sheet 2.33.

- *Chlorine residual* - the amount of chlorine in the water. Chlorine is a very effective disinfectant and kills many microorganisms. The amount of chlorine should be controlled to ensure that adequate chlorine is in the water to disinfect it properly, but that there is not so much as to be unacceptable. Testing for chlorine is covered in Fact Sheets 2.30 and 2.31.

- *pH* - a measure of the acidity of the water which can affect the ability of chlorine to kill microorganisms.

Tests for chlorine residual, turbidity and pH are always best done on-site, testing for faecal coliforms can be done on-site or at the laboratory base.

Portable kits which include all the critical tests, are available from various suppliers.

Sampling of water supplies

When samples for water quality analysis are taken it is important that they are representative of the supply as a whole and also representative of conditions at the places most vulnerable to contamination, such as low-pressure points, ends of systems and storage tanks. The samples should also be representative of the supply over time. The source water of supplies frequently varies with the season, thus it is important that tests are taken to check that the supply provides safe water all year.

Frequency of sampling

The frequency of water sampling and analysis depends on the size and type of water supply. Tables 1 and 2 below give the minimum frequencies of routine sampling and analysis under non-epidemic conditions. In general, all protected groundwater supplies should be tested twice yearly, once in the wet and once in the dry season. Surface water supplies with treatment plants should be tested

Table 1.
Minimum frequency of sampling and analysis of small community water supplies

Source and mode of supply	Bacteriological sampling and analysis	Physical/chemical sampling and analysis
Open wells	once monthly	once monthly
Covered dug wells and tubewells with handpumps	twice yearly	twice yearly
Springs and piped supplies	twice yearly	twice yearly
Rainwater collection systems	once yearly	once yearly

Table 2.
Minimum sampling frequency for large piped water supplies

Population served	Minimum frequency of sampling
Less than 5000	1 sample monthly
5000 - 100 000	1 sample per 5000 population monthly
Over 100 000	20 samples monthly plus 1 sample per 10 000 population monthly

During outbreaks of cholera, sampling and analysis should be more frequent than routine sampling and analysis. All water supplies should be chlorinated, and tests for chlorine residual and turbidity should be carried out daily. Bacteriological tests should be carried out as often as is feasible with available resources. Where chlorine residuals are low and turbidity high, a bacteriological test should be carried out as soon as possible. Water quality requirements in emergencies are covered in Fact Sheet 1.7.

Sample location

When collecting water samples, it is important to ensure that they are representative of the quality of water supplied and the point of use.

Samples should be taken from locations which are representative of the water source, treatment plant, storage facilities, distribution network, points at which water is supplied to the consumer and where it is used. In selecting sample points, each locality should be considered individually. The following general criteria are usually applicable :

- Sampling points should be selected so that they are representative of the different sources from which water is obtained by the public or enters the system. Where more than one source supplies a system, sampling points should be located so as to take into account the number of inhabitants supplied by each source.

- Some samples should be taken from points representative of sources or places in the system that are more likely to be contaminated (such as unprotected sources, loops, reservoirs, low-pressure zones, and ends of the system).

- Sample points should be spread uniformly throughout a piped distribution system, in proportion to the number of links or branches, taking into account population distribution.

Chlorination in epidemic and disaster situations

Water supplies present a means by which epidemic diseases such as cholera can be transmitted to large numbers of people very rapidly. In situations where diseases which can be transmitted by water (such as cholera, typhoid, hepatitis A and many diarrhoeal diseases) may spread, such as when an outbreak is recognized or a disaster occurs, it is vital that adequate drinking water supplies are assured.

Adequate supplies must be :

- of good quality ;
- continuously available ;
- accessible to all of the population ;
- available in adequate quantities to maintain human health ;
- affordable to all.

Many measures to improve drinking water quality are medium or long-term in nature. The response to outbreaks of infectious disease and disaster situations must be immediate. Attention should therefore focus on :

- protection of source water quality ;
- ensuring the optimal use of available treatment facilities ;
- emergency disinfection ;
- ensuring adequate household treatment and storage.