3.5 Monitoring

Monitoring for the presence of specific pathogenic bacteria, viruses and other agents in water is impracticable and indeed unnecessary for routine control of most small supplies. Pathogens are only shed by infected humans and animals, so will not be present all the time, and it is infeasible to examine water for every possible pathogen, which might be present. Any pathogenic micro-organisms that are present will often be so only in small numbers, and the methods for their detection are usually difficult, comparatively expensive, and time-consuming. Reliance is therefore placed on simpler and more rapid bacteriological tests for the detection of certain commensal intestinal bacteria – especially enterococci, *Escherichia coli* and other coliform organisms – because they are easier to isolate and characterise, and because they are always present in the faeces of man and warm-blooded animals (and hence also in sewage) in large numbers. The presence of such faecal indicator organisms in a sample of drinking water denotes that intestinal pathogens could be present, and that the supply is therefore potentially dangerous to health.

As discussed earlier, *E. coli* and coliforms have been and still are the most commonly used indicator organisms. *E. coli* is particularly important because it is specifically of faecal origin. It is abundant in the faeces of humans, other mammals and birds, and is rarely found in water or soil that has not been subject to faecal contamination. However, other indicators are available which could be equally relevant, or even more so, in assessing the quality of small water supplies.

Enterococci (previously referred to as faecal streptococci) are bacteria that are found exclusively in the faeces of warm-blooded animals. They are more tolerant of the aquatic environment and water treatment processes (including disinfection) than *E. coli* and coliforms, but are present in smaller numbers in human faeces. However, they are found in higher numbers than *E. coli* in the faeces of many domestic and farm animals. There is some evidence that testing for enterococci (and especially their speciation) might be useful in identifying faecal pollution as being of human or animal origin, but this has not been widely tried or accepted.

Methods of analysis for enterococci are no more expensive than those for *E. coli* and coliforms (though a longer incubation period is usually necessary), and no special sampling equipment is required.

The sulphite-reducing bacteria belonging to the genus *Clostridium* can also be useful indicators of faecal contamination. Only *Clostridium perfringens* is specific to faecal material, with other species being found in soil and other environmental materials. Clostridia can form spores that are extremely resistant to the water environment and water treatment processes. As a consequence, their presence in the absence of *E. coli* and enterococci can be taken to indicate a historic pollution event. *Cl. perfringens* is present in lower numbers than *E. coli* or enterococci in the faeces of all animals, so its value as an indicator comes from the resistance of its spores to a wide range of environments.

3.5 Monitoring (continued)

The parameter included in the drinking water Directive 98/83/EC is *"Clostridium perfringens* (including spores)" but it is also possible to test for spores alone, if necessary. In either case the method of analysis is slightly more complex than the methods for the other indicator organisms, but should be within the scope of any competent microbiology laboratory.

Because of logistic difficulties the monitoring of private water supplies is commonly infrequent. As a consequence, the value of the monitoring as an aid to protection of public health is often questioned, since contamination of the source may be sporadic and dependent on factors such as rainfall. In these circumstances the use of indicators that survive for longer periods of time than *E. coli* would be advantageous, in that they should allow historic or intermittent pollution to be detected.

Risk assessment of the catchment is better than monitoring for micro-organisms. To be of most value, monitoring for faecal indicators needs to be undertaken frequently, so that samples representative of the water quality are obtained. This is generally impractical for small water supplies and therefore a risk assessment of the catchment should be carried out, and protection measures aimed at excluding faecal contamination should be taken. If the risk assessment predicts a high risk of faecal contamination, alternative sources of supply will need to be considered.

Where total exclusion cannot be guaranteed, and no other supplies offer a viable alternative, treatment barriers must be strengthened and assessed against the microbial loading predicted to occur in the source water.

Following installation of the treatment processes a period of validation based on microbiological monitoring should be undertaken to ensure that the strategy adopted is adequate for the protection of public health. This would usually involve relatively intensive monitoring of the source and final water quality using faecal indicator organisms, but some sampling for specific pathogens should be considered where a particular risk has been identified (e.g. high probability of contamination from farm animals, where monitoring for *Campylobacter* and *Cryptosporidium* might be appropriate). Ideally this monitoring should include periods when the risk assessment has shown that the source water is highly likely to become contaminated (e.g. following heavy rainfall).

Regulatory monitoring frequency should only be introduced once satisfactory performance from the treatment has been obtained, and a maintenance procedure has been introduced which will ensure that any shortcomings in the performance of the treatment are detected at an early stage. This procedure will include very frequent (at least daily) checks that UV or other disinfection equipment is operating properly, and observation of the performance of any filtration processes being used. This procedure should also include a contingency plan for the use of alternative supplies or the instigation of a boil water regime, when necessary, for water used for drinking.

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