5. SURVEILLANCE

Surveillance of drinking-water quality is defined as "the continuous and vigilant public health assessment and overview of the safety and acceptability of drinking-water supplies". Surveillance contributes to the protection of public health by promoting improvement of the quality, quantity, coverage, affordability, and continuity of water supplies and is complementary to the quality control function of the drinking water supply agency. Surveillance does not remove or replace the responsibility of the water supplier to ensure that water supply is of acceptable quality and meets pre-determined health-based and other performance targets.

One of the roles of surveillance is to allow for legal regress in pursuing safe drinking-water. Surveillance is also used to ensure that any transgressions that may occur are appropriately investigated and resolved. In many cases, it will be more appropriate to use surveillance as a mechanism for collaboration between health agencies and water suppliers on improving water supply rather than resorting to enforcement, particularly where the problem lie mainly with community-managed water supplies.

Surveillance requires a systematic programme of surveys or audits that encompass all aspects of the water supply to the population as a whole, including all the aspects noted above, sanitary inspection, and institutional and community aspects. Surveillance is indispensable for the development of rational strategies for the improvement of the quality of water-supply services. It is important that clear strategies and structures are developed for implementing surveillance, collating, analyzing and summarising data; reporting and disseminating the findings.

Water-supply surveillance is based on regular sanitary inspections and field surveys as well as laboratory testing and should be accompanied by recommendations for remedial action. Follow-up will be required to ensure that remedial action is taken. Frequent sanitary inspections and water-quality testing, particularly for microbiological contamination, are essential elements in any surveillance programme aimed at ensuring that drinking-water meets the standards and guidelines established at national and local levels. Surveillance extends beyond water supplies operated by a discrete water supplier, to include water supplies that are managed by communities and promotion of good hygiene in the collection and storage of household water.

5.1 Roles of responsible authorities

The roles of authorities responsible for surveillance encompass three areas of activity:

- Public health oversight of organised water supplies including utility and municipal supplies;
- Public health oversight and information support to population without access to organised water suppliers including communities and households; and
- Consolidation of information from diverse sources to enable understanding of the overall water supply situation for a country as a whole as in input to the development of coherent public health centered policies and practices.

A surveillance programme should include approval of water safety plans before they are implemented to ensure that they are adequate. This should ensure that the water safety plan covers normal operating conditions, extreme events and have contingency plans in case of an

incident/emergency. This approval will involve review of the system assessment, identification of appropriate control measures and supporting programmes, operational monitoring and comprehensive management plans.

The surveillance agency may also undertake the development of water safety plans for community-managed supplies and household water storage. Such plans may be generic for particular technologies rather than specific for individual systems.

5.2 Types of approaches

There are two approaches to surveillance of drinking-water quality; audit based approaches and approaches relying on direct assessment. Implementation of surveillance will generally imply a mixture of these approaches according to supply type. This may involve for example; auditing for larger drinking-water utilities, direct assessment for small municipalities and community-managed supplies, using rolling programmes whereby systems are addressed progressively. Often it is not possible to undertake extensive surveillance of all community or household supplies. In these cases, well-designed water supply quality surveys should be undertaken in order to understand the situation at the country or regional level.

The model adopted in some countries is to carry out independent testing of water supplies. Such an approach implies that the regulatory body has access to analytical facilities of its own, with staff trained to carry out sampling, analysis and sanitary inspection. It is increasingly common that analytical services are procured from accredited external laboratories. Some authorities are experimenting with the use of such arrangements also for services such as sanitary surveys, sampling and audit reviews.

In all cases, the surveillance agency must have, or have access to legal expertise in addition to expertise of drinking-water and water quality, see section 2.4.

5.2.1 Audit

An audit approach implies the existence of a stable source of expertise and capacity within the surveillance agency in order to:

- review and approve new WSPs;
- undertake or oversee auditing of the implementation of individual WSP as a programmed routine activity; and
- respond, investigate and provide advice on receipt of reports on significant incidents.

Periodic audit of implementation of the WSP is required:

- at intervals (the frequency of routine audits will be dependent on factors such as the size of population served, and the quality of source water/treatment facilities;
- following substantial changes to the distribution system or treatment process; and
- following significant incidents.

Periodic audit should include the following elements, in addition to review of the WSP similar to that undertaken at the time of implementation:

- examination of records to ensure that system management is being carried out as described in the WSP;
- ensure that operational monitoring parameters are kept within specification and that compliance is being maintained;

- ensure that verification programmes are operated by the water supplier (either through in-house expertise, or through a third-party arrangement) and that the results provide evidence that the WSP is in overall compliance with water quality targets and performance objectives;
- review and agree changes to WSP including progress with implementation, and need to improvement and updating; and
- in some circumstances, sanitary inspection, which should cover the whole of the water-supply system including sources, transmission infrastructure, treatment plants, storage reservoirs, and distribution systems.

In response to reports of significant incident, it is necessary to ensure the:
- incident is investigated promptly and appropriately;
- cause of the incident is determined and resolved;
- incident and corrective action is documented and reported to appropriate authorities; and
- WSP is reassessed to avoid a similar situation recurring.

The implementation of an audit-based approach places responsibility on the water supplier to regularly provide surveillance agency with information regarding system performance and performance against agreed indicators. In addition, a programme of announced and unannounced visits should be made by auditors to water suppliers to review documentation and records of operational practice to ensure data submitted is reliable. The surveillance agency will normally retain the authority to undertake some analysis of drinking-water quality to verify performance or enter into a third-party arrangement for such analysis.

5.2.2 Direct Assessment

It may be appropriate for the public health protection agency to carry out independent assessment of water supplies. Independent assessment can be carried out by the agency if it has staff trained to carry out sampling, analysis and sanitary inspection and access to analytical facilities.

A surveillance programme based on direct assessment should include the following components:
- specified approaches to utility/small municipalities/community supplies and individual household supplies;
- sanitary inspections to be carried out by qualified personnel;
- sampling to be carried out by qualified personnel;
- tests to be conducted using suitable methods by accredited laboratories or using approved field testing equipment and qualified personnel; and
- clear procedures on reporting findings and follow up to ensure they have been acted on.

Direct assessment may, in some cases, be used as the principal system of WSP verification. This will be particularly the case where water supplies are managed by communities or whose size does not permit the development of in-house verification or third-party arrangements. The latter may include the management of water supplies in small towns by small-scale private sector operators or local Government. Direct assessment may lead to identification of requirements to amend or update the WSP and the process to be followed when undertaking such amendments should be clearly identified.

Direct assessment also implies that surveillance agencies has the capacity to assess findings, report and advise suppliers and communities. It may, in some circumstances, also include a mandate to enforce changes where these have been identified.

5.2.3 Surveillance of community-managed water supplies

Small, community-managed water supplies are found in most countries and may be the predominant form of water supply for large sections of the population. The precise definition of a "community water supply" will vary but the principal distinction from utility supplies is the administration and management arrangements. Community-managed supplies may include simple piped water systems or a range of point sources such as boreholes with handpumps, dug wells and protected springs.

The control of water safety and implementation of surveillance programs for such supplies often faces significant constraints. These typically include:

- limited capacity and skills within the community supplied to undertake regular internal verification. This may both increase the need for surveillance to assess the state of water supplies, and for surveillance staff to provide training and support to community members;
- there may be a very large number of such supplies, which are widely dispersed thus significantly increasing overall costs in undertaking surveillance activities. Furthermore, often it is these supplies that are least accessible and which represent the greatest concern; and
- although the contribution of each individual supply to overall disease burdens is limited, the accumulated contribution is likely to be significant and this may introduce further complexity in surveillance program design.

Experience from both developing and developed countries has shown that surveillance of community-managed supplies can be effective when well-designed and the objectives are geared more towards a supportive role to enhance community-management and in evaluating overall water supply strategies, rather than enforcement of compliance. In the case of evaluating strategies, the principal aim should be to derive overall lessons for improving water safety for all community-managed supplies, rather than monitoring performance of individual supplies.

Surveillance for community-managed supplies is not readily achieved through frequent visits to every individual supply, but can be achieved through a rolling program of visits to water supplies. Commonly, the aim will be to visit each supply once every 3-5 years and either stratified random sampling or cluster sampling used to select specific supplies to be visited.

During each visit, testing of water stored in the home may be undertaken in a limited number of households. The objectives for such testing should include to identify whether contamination primarily occurs at the source or within the home. This will allow evaluation of the need for investment in supply improvement or hygiene education. Household testing may also be used to evaluate the impact of a specific hygiene education programme.

5.2.4 Surveillance testing

Surveillance testing required in national regulations should be undertaken by relevant local authority or by the water supplier through appropriate mechanisms and reported to the

surveillance agency. Surveillance testing should always include water quality indicators, the actual indicators being described in the national/regional guidelines. Usual practice would be to include the critical parameters for microbial quality (i.e. *E. coli*, chlorine, turbidity and pH) and for a sanitary inspection to be carried out each time a sample is taken.

It may be appropriate in some circumstances to examine water for a range of other parameters (e.g. chemical contaminants, selected pathogens or algal toxins) where there is evidence to suggest their presence in drinking-water. Priorities for the scope of surveillance of drinking-water must take into consideration priority constituents that have been identified based on local circumstances (see section 2.4).

Piped supplies

Sampling programs for piped water systems must ensure that the data obtained is representative of the system as a whole, whilst ensuring that particular problem areas are identified.

The points at which sampling occurs will be dependent on the individual water supply. The nature of the public health risk posed by contamination by pathogens and the significant contamination potential throughout the distribution systems, mean that sampling for microbial analysis (and associated parameters such as chlorine residual) will typically be done frequently and with a dispersed range of sampling sites. By contrast, chemical quality is generally less likely to change within the distribution system and therefore testing may be restricted in both time and space. The principal exception is chemicals arising from piping and plumbing materials which are controlled through their direct regulation.

Recommended sampling frequencies and sample numbers for analysis of microbial quality for drinking-water are shown in table 5.1.

Table 5.1 Recommended minimum sampling frequencies and sample numbers for water in distribution systems*

Population	Sampling Frequency	Samples/annum
<5 000	Quarterly	12
5000 to 100 000	Monthly	12 per 5000 head of population
>100 000	Weekly	12 per 10 000 health of population plus an addition 120 samples

* minimum critical parameters include a faecal indicator such as *E.coli*; chlorine, turbidity and pH

Sampling should cover the whole distribution system, particularly the extremities where the water quality may be likely to be at its worst. Selection of sampling points should also reflect the nature of the system and areas where it may be at greatest risk of contamination. This would include both areas where the hazards in the environment are greater and areas where the supply is more vulnerable (because of the age of type of material or pipes).

Sampling sites may include some fixed sampling points including points at elevated risk (for instance service reservoirs or public taps in markets) but should also include some randomly selected sampling points that vary between sampling rounds. The use of stratified random sampling in distribution systems has proven to be effective and will in most cases, be the most appropriate approach.

Source waters

Testing source waters is necessary especially where there is no water treatment. I will also be useful following failure of the treatment process or as part of an investigation of a serious waterborne disease outbreak. The frequency of testing will be dependent on the reason that the sampling is being carried out. Testing frequency may be:

- on a regular basis (the frequency of surveillance testing will be dependent on several factors including: the size of the community supplied, the reliability of the quality of the drinking-water / degree of treatment and presence of local risk factors);
- on an occasional basis (e.g. random); and
- following an incident/emergency considered likely to increase the potential for a transgression (e.g. following a flood).

1. (*for further information – see WHO Chemical Monitoring Protocol)*

5.3 Adequacy of supply

As the public health surveillance agency has an interest in the population at large, its interest therefore extends beyond water quality in isolation to include all aspects of adequacy of drinking-water supply for the protection of public health.

In undertaking an assessment of the water supply, the basic service parameters of a water supply must be taken into consideration, which are:

Quality	the proportion of samples or supplies that comply with national standards and/or guideline values for drinking-water quality and minimum criteria for treatment and source protection
Access	the percentage of the population that has reasonable access to an improved water-supply
Service level or Quantity:	e.g. the average volume of water used by consumers for domestic purposes (expressed as litres per capita per day)
Continuity:	the percentage of the time during which water is available (daily, weekly or seasonally)
Affordability	the tariff paid by domestic consumers

The current and potential future uses of the supplied water should be reviewed. This description may include the following.

- How is the water to be used?
- What consumer education is in place for water use? How are these communicated to consumers? How are consumers notified of potential contamination?
- Who is the water intended for? What special considerations are in place for vulnerable groups such as infants, the elderly and immuno-compromised?

5.3.1 Access

From the public health standpoint, the percentage of the population with reliable access to a drinking-water supply of acceptable quality is the most important single indicator of the overall success of a water-supply programme.

There are a number of definitions of access (or coverage), many with qualifications regarding safety or adequacy. The preferred definition is that used by WHO and UNICEF in their "Joint Monitoring Programme", which defines 'reasonable access' to improved sources as being: '*availability of at least 20 litres per person per day within one kilometer of the users*

dwelling'. Improved and unimproved water supply technologies have been defined as summarised in table 5.2 below.

Table 5.2 Improved and Unimproved supply technologies in the Joint Monitoring Programme

Improved	Unimproved
• Household connection to piped supply	• Unprotected well
• Public standpipe	• Unprotected spring
• Borehold	• Vendor-provided water
• Protected dug well	• Bottled water
• Protected spring	• Tanker truck-provided water
• Rainwater catchment	

5.3.2 Quantity

Estimates of the volume of water needed for health purposes vary widely. In deriving the Guideline Values, it is assumed that the daily per capita consumption of drinking-water is approximately 2 litres, although actual consumption varies according to climate, activity level and diet. In addition, adequate domestic water is needed for personal food and domestic hygiene, which are also important for the maintenance and improvement of public health. Water may also be important in income generating and amenity uses.

The quantities of water collected and used by households is primarily a function of the distance to the water supply or total collection time required. This broadly equates to the level of service. Four levels of service can be defined which provides a reasonable basis for estimating the likely quantity of water collected by households. These are shown in table 5.3.

Table 5.3 Service level and quantity of water collected

Service Level	Distance/Time	Likely volumes of water collected	Public health risk from poor hygiene	Intervention priority and actions
No access	More than 1 kilometer/more than 30 minutes round trip	Very low - 5 litres per capita per day	**Very high** Hygiene practice compromised. Basic consumption my be compromised	**Very high** Provision of basic level of service
Basic access	Within 1 kilometer/within 30 minutes round trip	Average – approximately 20 litres per capita per day	**High** Hygiene may be compromised. Laundry may occur off-plot	**High** Hygiene education Provision of improved level of service
Improved access	Water provided on-plot through at least one tap (yard level)	Average – approximately 50 litres per capita per day	**Low** Hygiene should not be compromised. Laundry likely to occur on-plot	**Low** Hygiene promotion still yields health gains. Encourage optimal access
Optimal access	Supply of water through multiple taps within the house	Average – 100-200 litres per capita per day	**Very low** Hygiene should not be compromised. Laundry will occur on-plot	**Very Low** Hygiene promotion still yields health gains

As quantities of water collected and used are strongly correlated to service level, there is little justification in regular measurement of volumes of water by the surveillance agency. Water suppliers, however, will typically collect this data. If data is collected on water consumption as a baseline for assessing relationships to service level, then it should be based on surveys that capture water use practice. If the analysis of bulk figures related to water entering piped distribution systems, it should be borne in mind that:

- the figures will be averages, and consumption in different households may vary widely, e.g. with socioeconomic status and physical layout and specification of the system;
- leakages may make a significant contribution to apparent consumption;
- even a single dwelling using piped water for irrigation or for commercial purposes may significantly influence the apparent consumption for a community water supply; and
- the flow of water entering the distribution system during day-time does not necessarily represent the sustained input during 24 hours, and overflows may be significant at certain times.

If estimations of quantities of water used are required, then this is most effective when households are individually metered to allow direct household consumption to be measured, However, it should be noted that the accuracy of such figures is dependent on the reliability of the meters and the readers.

5.3.3 Continuity

Interruptions to drinking-water supply through either intermittent sources or resulting from engineering inefficiencies is a major determinant of the quality of drinking-water. Analysis of data on continuity of supply requires the consideration of two components – frequent (daily and weekly) and seasonal continuity. Continuity can be classified as follows:

- year-round services from a reliable source with no interruption of flow at the tap or source;
- year-round service with frequent (daily or weekly) variation, of which the most common causes are:
  - restricted pumping regimes in pumped systems, whether planned or due to power failure or sporadic failure;
  - peak demand exceeding the flow capacity of the transmission mains or the capacity of the reservoir;
  - excessive leakage within the distribution systems;
  - excessive demands of community-managed point sources
- seasonal service variation resulting from source fluctuation, which typically has three causes:
  - natural variation in source volume during the year
  - volume limitation because of competition with other uses such as irrigation
  - periods of high turbidity when the source water may be untreatable;
- compounded daily and seasonal discontinuity.

This classification reflects broad categories of continuity, which are likely to affect hygiene in different ways. Daily or weekly discontinuity results in low supply pressure and a consequent risk of in-pipe recontamination. Other consequences include reduced availability and lower volume use, which adversely affect hygiene. Household water storage may be necessary, and this may lead to an increase in the risk of contamination during such storage and associated handling. Seasonal discontinuity often forces users to obtain water from

inferior and distant sources. As a consequence, in addition to the obvious reduction in quality and quantity, time is lost in making regular collections.

5.3.4 Affordability

The affordability of water has a significant influence on the use of water and selection of water sources. It is well-documented that those households with the lowest levels of access to water supply frequently pay more for their water that households connected to a piped water system. The high cost of water may force households to use alternative sources of water of poorer quality and which represent a greater risk to public health. Furthermore, high costs of water may reduce the volumes of water collected by households, which in turn may influence hygiene practices and increase risks of disease transmission.

When assessing affordability, it is important to collect data on the price at the point of purchase. Where households are connected to the utility, this will be the tariff applied. Where water is purchased from public standpipes or from neighbors, price at the point of purchase may be very different from the utility tariff. It should also be noted that many alternative water sources (notably vendors) also involve costs and this should be included in evaluations of affordability. In addition to recurrent costs, total investment costs for acquisition of a connection may also be of value when evaluating the impact of affordability on service level.

5.4 Planning and implementation

For water-supply surveillance to lead to improvements in drinking-water supply services, it is vital that the mechanisms for promoting improvement are recognized and used.

A checklist of mechanisms for water-supply improvement based on the output of surveillance is given in Table 5.4. The focus of water supply improvement (whether as investment priority at regional or national levels; development of hygiene education; or enforcement of compliance) will depend on the nature of water supplies and the types of problems identified from the surveillance activities. Each of the mechanisms is discussed in greater detail in subsequent chapters.

Table 5.4 Mechanisms for the improvement of water-supply services based on the results of water-supply surveillance

Establish national priorities
When the commonest problems and short comings in water-supply system have been identified, national strategies can be formulated for improvements and remedial measures; these might include changes in training (of managers, administrators, engineers, or field staff), rolling-programmes for rehabilitation or improvement, or changes in funding strategies to target specific needs.
Establishing regional priorities
Regional offices of water-supply agencies can decide which communities to work in and which remedial activities are priorities; public health criteria should be considered when priorities are set.
Establishing hygiene education
Not all of the problems revealed by surveillance are technical in nature, and not all are solved by supply and construction agencies; surveillance also looks at problems involving private supplies, water collection and transport, and household treatment and storage. The solutions to many of these problems are likely to require educational and promotional activities coordinated by the health agency.
Enforcement of standards
Many countries have laws and standards related to public water supply. The information generated by surveillance can be used to assess compliance with standards by supply agencies. Corrective action can be taken where necessary, but its feasibility must be considered, and enforcement of standards should be linked to strategies for progressive improvement
Ensuring community operation and maintenance

Support should be provided by a designated authority to enable community members to be trained so that they are able to assume responsibility for the operation and maintenance of their water supplies.

Information alone does not lead to improvement. It is the effective management and use of the information generated by surveillance that makes possible the rational improvement of water supplies - where "rational" implies that available resources are used for maximum public health benefit.

Methods of providing drinking-water vary widely. They may include the use of piped supplies with or without treatment and with or without pumping (supplied via domestic connection or public standpipe), delivery by tanker truck or carriage by beasts of burden, or collection from groundwater sources (springs or wells) or surface sources (lakes, rivers, and streams). All members of the population receive water by some means, and it is important for the surveillance agency to build up a picture of the frequency of use of the different types of supply, especially as a preliminary step in the planning of a surveillance programme. There is little to be gained from undertaking the surveillance of piped water supplies alone if these are available to only a small proportion of the population. Although the supply agency should be responsible for the quality control of all its supplies, its water sources will only rarely include open dug wells and private supplies, which may be more highly contaminated. For these sources surveillance is of paramount importance.

The limited availability of resources (in both developing and developed countries) makes it advisable to start surveillance with a basic programme that develops in a planned manner. Activities in the early stages must generate enough useful data to demonstrate the value of surveillance. Thereafter, the objective should be to progress to more advanced surveillance as resources and conditions permit. The activities associated with phases of surveillance development are summarized in Table 5.5.

Table 5.5 Activities to be undertaken in the initial, intermediate, and advanced phases of water-supply surveillance

Initial phase
• Establish requirements for institutional development • Provide training for staff involved in programme • Develop methodologies suitable for the area • Commence routine surveillance in priority areas (including inventories, assessments and ongoing monitoring) • Limit water-quality analysis to essential parameters and known problem substances • Establish reporting, filing, and communications systems (either paper-based or computerized, depending on local capacity) • Make improvements according to identified priorities • Establish reporting to local suppliers, communities, and regional authorities • Establish liaison with communities; identify community roles in surveillance and means of promoting community participation
Intermediate phase
• Train staff involved in programme • Establish and expand systematic routine surveillance • Expand analytical capability (often by means of regional laboratories, national laboratories being largely responsible for analytical quality control and training of regional laboratory staff) • Undertake surveys for chemical contaminants using wider range of analytical methods • Evaluate all methodologies (sampling, analysis, etc.) • Use draft standard methods (e.g. analytical methods, fieldwork procedures) • Establish national database archive

- Identify common problems, improve activities to address them at regional and national levels
- Expand reporting to include interpretation at national level
- Draft or revise national standards and legislation
- Use legal enforcement where possible
- Involve communities routinely in surveillance implementation

Advanced phase

- Train staff involved in programme
- Establish routine surveillance for all health and acceptability parameters at defined frequencies
- Use full network of central, regional, and local laboratories (including analytical quality control)
- Use national standards and legislation
- Improve water services on the basis of national and local priorities, hygiene education, and enforcement of standards
- Establish regional database archives compatible with national database
- Develop capacity for statistical analysis of data
- Disseminate data at all levels (local, regional, and national)
- Involve communities routinely in surveillance implementation

5.5 Reporting and Communicating

An essential element in a successful surveillance programme is the reporting of results to key stakeholders. It is important to establish appropriate systems of reporting to all relevant bodies. Proper reporting and feedback will enable the development of remedial strategies. The ability of the surveillance programme to support the interventions to improve water supply are highly dependent on the ability of the surveillance bodies to analyse and present information in a meaningful way to different target audiences. The target audiences for surveillance information will typically include:

- Public health officials at local and national levels
- Water suppliers
- Local administrations
- Communities and water users
- National/regional authorities for development planning and investment

5.5.1 Interaction with community and consumers

Community participation is a necessary component of the surveillance framework, particularly for community supplies. As primary beneficiaries of improved water supplies, community members have a right to take part in decision-making about their own future. The community represents a resource that can be drawn upon for local knowledge and experience. They are the people who are likely to first notice problems in the water supply and therefore can provide an indication when immediate remedial action is required. Communication strategy should include:

- procedures for promptly advising of any significant incidents to the water supplier as well as the public health protection agency and, in the event of significant public health risk;
- summary information to be made available to consumers, for example through annual reports, or the internet; and
- establishment of mechanisms to receive and actively address community complaints in a timely fashion.

The right of consumers to information on health-related parameters of the water supplied to them for domestic purposes is fundamental. However, in many communities, the simple right of access to information will not ensure that individuals are aware of the quality of the water

supplied to them. The agencies responsible for monitoring should therefore develop strategies for disseminating and explaining the significance of results obtained.

It may not be feasible for the surveillance body to provide feedback information directly to the entire community. Thus it may be appropriate to use community organisations where these exist to provide an effective channel for feedback of information to users. Some local organisations (e.g. local councils and community-based organisations such as women's groups, church groups, mosques and schools) have regular meetings in the communities that they serve and can therefore provide a mechanism of relaying important information to a large of number of people within the community. Furthermore, by using local organisations it is often easier to initiate a process of discussion and decision-making within the community concerning water quality. The most important element in working with local organisations is to ensure that the organisation selected can access the whole community and have the ability on the ground to initiate discussion around the results of surveillance.

5.5.2 Regional use of data

Strategies for regional prioritization are typically of a medium-term nature and have specific data requirements. While the management of information at national level is aimed at highlighting common or recurrent problems, the objective at regional level is to assign a degree of priority to individual interventions and to prioritize remedial actions accordingly.

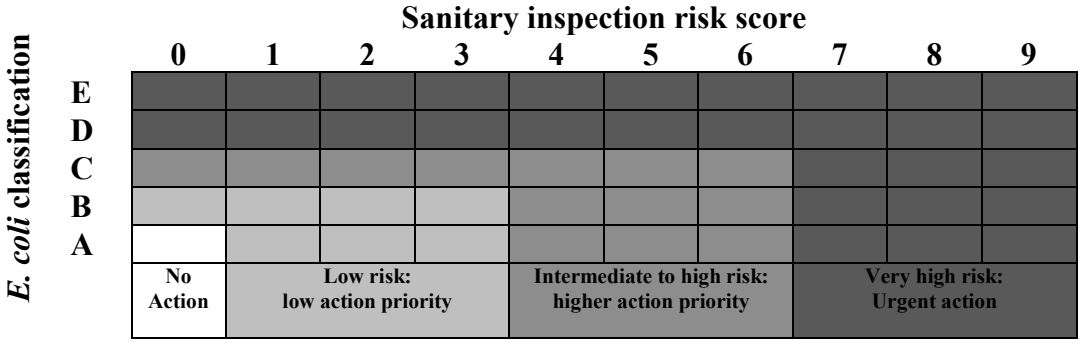
It is therefore important to derive a relative measure of health risk and thus establish the priority for remedial action. While the data cannot be used on their own to determine which systems should be given immediate attention (which would also require the analysis of economic and socio-cultural factors), they provide an extremely important tool for determining regional priorities. It should be a declared objective to ensure that remedial action is carried out each year on a predetermined proportion of the systems classified as high-risk.

At regional level, it is also important to monitor the improvement (or deterioration) both of individual supplies and of the supplies as a whole. In this context, simple measures, such as the mean sanitary inspection score of all systems, the proportion of systems with given degrees of faecal contamination, the mean continuity or quantity of water supplied per capita per day, and the mean tariff for domestic consumption, should be calculated yearly and changes monitored.

In many developing and developed countries, a high proportion of small-community water-supply systems fail to meet local or national quality standards. However, it should be recognized that to condemn a large number of supplies is not particularly useful and may be counterproductive. In such circumstances it is important that realistic goals for progressive improvement are agreed with the suppliers and subsequently implemented. Recognising that achieving the Guideline may be difficult in some emergency situations it is practical to classify water quality results in terms of an overall grading for water quality linked to priority for action.

Sophisticated grading schemes may be of particular use in community supplies where the frequency of testing is low and reliance on analytical results alone is especially inappropriate. Such schemes will typically take account of both analytical findings and sanitary inspection through schema such as illustrated in figure 5.1

Fig. 5.1 Example of assessment of priority of remedial actions by risk analysis



Combined analysis of sanitary inspection and water quality data can be used to identify the most important causes and control on contamination. This is important to support effective and rational decision-making. For instance, it will be important to know whether on-site sanitation or source sanitary completion measures are principally associated with contamination events as the actions required are very different. This analysis may also introduce other factors including contamination such rainfall.