World Health Organization

REGIONAL OFFICE FOR Europe

Policy guidance on water-related disease surveillance

PROTOCOL ON WATER AND HEALTH

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ABSTRACT

The present document contains guidance on the policy related to water-related disease surveillance developed by the Task Force on Water-related Disease Surveillance established under the Protocol on Water and Health to the 1992 Convention on Protection and Use of Transboundary Waters and International Lakes. It was adopted by the Meeting of the Parties during their second session (Bucharest- Romania, 23/25 November 2010).

The guidance provides explanations on legal obligations with regard to disease surveillance under the Protocol and other international frameworks, and outlines policy advice on how to set up and maintain an effective and efficient disease surveillance system. These explanations are coupled with illustrative examples of good practices in the pan-European Region.

Keywords

ENVIRONMENTAL MONITORING – methods

EPIDEMIOLOGICAL SURVEILLANCE – methods

WATER POLLUTION – prevention and control

WATER MICROBIOLOGY

DISEASE TRANSMISSION

HEALTH POLICY

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ISBN 978 92 890 0236 3

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1. THE PROBLEM

Contaminated drinking-water that has not undergone adequate treatment can transfer several risk factors to consumers, such as pathogenic microorganisms, chemical agents including cyanotoxins, and radioactive substances.

Water-related diseases remain a major health concern worldwide. Diarrhoeal diseases account for some 2 million deaths each year, primarily of children in developing countries. They are responsible for 17% of deaths in children under 5 years of age, with an estimated median of 3.2 episodes per child per year. A total of 94% of this disease burden is considered to be attributable to the environment, which includes unsafe water, lack of sanitation and poor hygiene. Moreover, severe outbreaks of diseases such as cholera, typhoid fever and hepatitis A can be transmitted through faecally contaminated drinking-water.

Much attention has been focused on the detection and investigation of outbreaks of waterborne disease. It is likely that most illnesses caused by contaminated water will not be part of an obvious outbreak. Identifying these illnesses as being due to water is more problematic. Most surveillance systems for diarrhoeal disease will not be able to distinguish those illnesses acquired from water from those acquired from other sources.

Furthermore, the issue of emerging pathogens has become a major concern in recent years. Emerging pathogens comprise different groups of microorganisms: those that have been newly detected (for example, for water-related pathogens: *Cryptosporidium parvum*, *Legionella pneumophila*); those whose pathogenic mutants have been newly detected (enterohaemorrhagic *Escherichia coli*); those that have been newly identified as the cause of a well-known infectious disease (hepatitis E virus); and those whose association with a well-known malignant or degenerative disease has been newly detected (*Helicobacter pylori*). The increase in water-related diseases caused by emerging pathogens is associated with the growing numbers of people with reduced immunocompetence, an increase in population age (demographic transition) and mobility, and new and complex technical applications of water, for example, dental units, air conditioning, cooling towers and spas.

Drinking-water-related outbreaks often cause the simultaneous infection of a large number of consumers, who may represent a substantial proportion of a community.

Surface water used for drinking generally represents the major vehicle of human disease transmission. In contrast to groundwater, surface water can be more easily contaminated by animal husbandry, pasture farming, sewage discharge and the disposal of dangerous substances.

Within the WHO European Region there are clear differences between the different geographical areas in the burdens of mortality and morbidity attributable to outbreaks of water-related diseases.

Over 30 million cases of water-related disease outbreaks could be avoided annually by means of adequate water and sanitation interventions. Investing in water supply and sanitation has produced benefits far greater than those directly related to the cost of treatment for these human pathologies.

From a human health point of view, the chemical contamination of drinking-water is generally of much less importance than microbiological contamination. Nevertheless, in some situations, some chemicals (for example, nitrate, fluoride, arsenic) can reach particularly high concentrations and can constitute an issue of public concern.

Surveying the health status of communities and promoting adequate preventive measures are two main and complementary tools that can be successfully applied to ensure adequate quality and quantity of water needed to ensure and foster human health.

2. WATER SAFETY PLANS

The risk-assessment/risk-management method recommended in the third edition of the WHO guidelines for drinking-water quality (WHO, 2004) to manage risks from source to tap is known as a water safety plan (WSP). Experience gained in assessing, managing and preventing such risks to health can be successfully used to reduce and minimize the burden of water-related diseases. It is well known that:

(a) raw waters should be protected against pollution in the catchment area;

(b) surface and shallow waters must always be treated before being used as a source of drinking-water, while groundwater from deep wells should be treated only when contaminated; the higher the level of contamination of raw water, the greater the required efficiency of the water-treatment process;

(c) drinking-water should be subject to surveillance for the main risk factors, with special attention to microbial quality; chemical quality must also be included in the surveillance;

(d) the personnel responsible for safe drinking-water distribution and monitoring systems should receive adequate education and training.

In this context, one of the most important tools for ensuring safe water is the WHO WSP; a management approach that emphasizes prevention or reduction of contamination of water sources and decreases reliance on treatment processes for the removal of contamination. WSPs should be developed for each individual drinking-water system, whether large or small scale.

The key steps of a WSP are as follows:

(a) assemble the team to prepare the WSP;

(b) document and describe the water supply area;

(c) undertake a hazard assessment and risk characterization to identify how hazards can enter into the water supply;

(d) assess the existing or proposed system, including a description of the system and a flow diagram;

(e) identify control measures to reduce and manage the risks;

(f) define how control measures are to be monitored to ensure acceptable performance of the WSP;

(g) establish procedures to verify that the WSP is working effectively and will meet the relevant health-based targets;

(h) develop supporting programmes, along with training, hygiene practices, standard operating procedures, upgrading and improvement, and research and development;

(i) prepare management procedures, including corrective actions, both for normal and incident conditions;

(j) establish documentation and communication procedures; these can have a significant impact on the efficacy of certain removal processes;

(k) review periodically each WSP.

WSPs should be reviewed and agreed on in consultation with the authority responsible for protection of public health to ensure that they will deliver water of a quality consistent with health-based targets.

3. LEGAL OBLIGATIONS

3.1. Obligations under the Protocol on Water and Health

Parties to the Protocol on Water and Health have a number of obligations concerning the surveillance of water-related diseases.

Article 6, paragraph 2 of the Protocol states:

> For these purposes, the Parties shall each establish and publish national and/or local targets for the standards and levels of performance that need to be achieved or maintained for a high level of protection against water-related disease. These targets shall be periodically revised. In doing all this, they shall make appropriate practical and/or other provisions for public participation, within a transparent and fair framework, and shall ensure that due account is taken of the outcome of public participation. Except where national and or local circumstances make them irrelevant for preventing, controlling and reducing water-related diseases, the targets shall cover, *inter alia*:
>
> (a) The quality of the drinking-water supplied, taking into account the WHO's guidelines for drinking-water quality (WHO, 2004);
>
> (b) The reduction of the scale of outbreaks and incidents of water-related disease.

According to article 6, paragraph 3, "within two years of becoming a Party, each Party shall establish and publish targets referred to in paragraph 2 of this article, and target dates for achieving them".

In addition to routine surveillance, the Protocol also makes specific provisions for response systems under article 8.

> 1. The Parties shall each, as appropriate, ensure that:
>
> (a) comprehensive national and/or local surveillance and early-warning systems are established, improved or maintained which will:
>
> (i) identify outbreaks or incidents of water-related disease or significant threats

of such outbreaks or incidents, including those resulting from water-pollution incidents or extreme weather events;

(ii) give prompt and clear notification to the relevant public authorities regarding such outbreaks, incidents or threats;

(iii) in the event of any imminent threat to public health from water-related disease, disseminate to members of the public who may be affected all information that is held by a public authority and that could help the public to prevent or mitigate harm;

(iv) make recommendations to the relevant public authorities and, where appropriate, to the public regarding preventive and remedial actions;

(b) comprehensive national and local contingency plans for responses to such outbreaks, incidents and risks are properly prepared in due time;

(c) the relevant public authorities have the necessary capacity to respond to such outbreaks, incidents or risks in accordance with the relevant contingency plan.

2. Surveillance and early-warning systems, contingency plans and response capacity in relation to water-related disease may be combined with those in relation to other matters.

3. Within three years of becoming a Party, each Party shall have established surveillance and early-warning systems, contingency plans and response capacities referred to in paragraph 1 of this article.

3.2. Surveillance and the International Health Regulations (2005)

The International Health Regulations[1] are an international legal instrument that is binding on 194 countries across the globe, including all the Member States of WHO. Their aim is to help the international community to prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide. The Regulations entered into force on 15 June 2007.

The Regulations require each State Party to develop, strengthen and maintain corenational public health capacities at the primary, intermediate and national levels in order to detect, assess, notify and report events and to respond promptly and effectively to public health risks and emergencies. A fundamental innovation in the new legal public health framework is the mandatory obligation for all State Parties to develop, strengthen and maintain core public health capacities for surveillance and response as soon as possible. The Regulations set out a two-phase process to assist States Parties to plan for the implementation of their capacity-strengthening obligations.

Phase 1 covered: 15 June 2007 to 15 June 2009

By 15 June 2009, State Parties had to assess the ability of their existing national public health structures and resources to meet the core surveillance and response capacity requirements described in Annex 1A of the Regulations. Following this assessment, State Parties were required to develop national action plans to ensure that these core capacities existed and were

[1] For further information, see the WHO web pages dealing with the International Health Regulations (http://www.who.int/ihr/en/, accessed 6 April 2010).

functioning properly throughout the country. WHO supports such assessments and provides guidance on the content and structure of national plans.

Phase 2 covers 15 June 2009 to 15 June 2012

By 15 June 2012, the surveillance and response capacities set out in Annex 1A of the Regulations are expected to be implemented by each State Party. State Parties that experience difficulties in implementing their national plans may request an additional two-year period until 15 June 2014 to meet their Annex 1A obligations. In exceptional circumstances, the Director-General may grant an individual State Party a further two years, until 15 June 2016, to meet their obligations.

3.3. Surveillance and the acquis communautaire of the European Union

Epidemiological surveillance in the European Union (EU) is based on Decision 2119/98/EC of the European Parliament and of the Council of 24 September 1998, setting up a network for the epidemiological surveillance and control of communicable diseases in the Community, now the EU. The Decision entered into force on 3 January 1999.

Commission Decision 2000/96/EC of 22 December 1999 on the communicable diseases to be progressively covered by the Community network under Decision 2119/98/EC of the European Parliament and of the Council (notified under Document C (1999) 4015) lists in Annex 1 the communicable diseases and special health issues to be covered. These include, *inter alia*, viral hepatitis A, foodborne and waterborne diseases of environmental origin (campylobacteriosis, cryptosporidiosis, giardiasis, infections with enterohaemorrhagic *E. coli*, shigellosis and others) and serious imported diseases (cholera, malaria). The Health Surveillance System for Communicable Diseases within the European Public Health Information Network (Euphin-HSSCD) is identified as the interim technical implementation mechanism. Decision 2000/96/EC took effect on 1 January 2000.

Commission Decision 2002/253/EC dated 19 March 2002 provides definitions for reporting communicable diseases to the Community network under Decision 2119/98/EC of the European Parliament and of the Council. This Decision-makes reporting mandatory for a number of diseases, including, *inter alia*, campylobacteriosis, cholera, cryptosporidiosis, enterohaemorrhagic *E. coli* infections, giardiasis, viral hepatitis A, legionellosis, malaria, salmonellosis, shigellosis and typhoid and paratyphoid fever. Information on current national efforts in disease reporting is coordinated through the Inventory of Resources for Infectious Diseases in Europe. Decision 2002/253/EC applied as of 1 January 2003.

4. SURVEILLANCE SYSTEM FOR WATER-RELATED DISEASE

Surveillance systems for the main communicable diseases have been established and implemented in almost all the countries in the WHO European Region. However, they often do not include specific surveillance for water-related diseases. Specific surveillance systems tailored to water-related diseases would provide relevant added value, as they can:

(a) identify the diseases transmitted by water (these are usually not well identified through the current surveillance systems);

(b) define or estimate the burden of water-related diseases;

(c) use data and information to identify communities in which there are problems with water-related diseases (mapping of pollution hazards and identifying risks may be particularly useful);

(d) promote intervention measures to control and prevent water-related diseases;

(e) target resources towards areas with priority needs;

(f) assess the effectiveness of the implemented water and sanitation interventions in reducing diseases.

Surveillance systems for water-related diseases can be especially useful in countries with limited resources, where interventions should be designed to be feasible, effective and economical. Examples are given here.

(a) Information on the incidence of typhoid fever may indicate the need for targeted immunization campaigns in specific geographic locations.

(b) Information on epidemic and endemic giardiasis and cryptosporidiosis in communities that use surface water supplies may indicate the need for water filtration processes because chlorination is not very effective against these pathogens. However, not all countries have the capacity to detect cryptosporidiosis and giardiasis in their laboratories. Laboratory strengthening in the area of chlorine resistance pathogen detection is urgently needed, as is advice on household water treatment in high-risk areas.

(c) Information on outbreaks of a waterborne disease in adequately treated piped water supplies may indicate intrusion problems in the water distribution system and the need to keep water pressure stable or accept additional measures, such as booster chlorination systems in the distribution system or additional water treatment at the household level; information showing a high prevalence of helminth infections may suggest the need for improvements in sanitation and increased water availability for general hygiene.

(d) Information on the incidence of blue-baby syndrome in an area may indicate the need to control and reduce nitrate concentrations in drinking-water.

5. HOW TO SET UP A SURVEILLANCE SYSEM FOR WATER-RELATED DISEASE

Public health surveillance systems represent the ongoing and systematic collection, analysis and interpretation of health data to describe and monitor a health event.

The surveillance of water-related diseases should be included within the context of more general surveillance systems for communicable diseases. A specific surveillance system for waterborne disease outbreaks should include a method for evaluating the evidence that an outbreak is indeed attributable to contaminated water.

Several approaches can be used to establish waterborne disease surveillance systems, depending on the data to be collected, how quickly they need to be collected and analysed and the human and financial resources available.

A wide spectrum of possible health outcomes – ranging from asymptomatic infections, specific symptoms and diseases, to death – can be covered by the surveillance system.

According to the first meeting of the Parties to the Protocol on Water and Health (Geneva, Switzerland, 17–19 January 2007), water-related diseases can be defined as priority diseases when they are characterized by a high epidemic potential, as in the case of cholera, diseases caused by enterohaemorrhagic *E. coli*, viral hepatitis A, bacillary dysentery and typhoid fever. Emerging diseases are those showing a rapid increase in the affected population, or which are being observed in countries in which they were previously absent. They include campylobacteriosis, cryptosporidiosis, giardiasis and legionellosis.

Local diseases are those that are not present throughout the country concerned but may potentially have a severe local impact. They include methemoglobinaemia, arsenicosis, viral infections (particularly those attributable to norovirus) and parasitic diseases.

The surveillance system can focus on the detection of individual cases, or of outbreaks; it can monitor broad categories of health outcomes, such as diarrhoeal diseases, or a few specific pathogens such as typhoid fever, hepatitis, cholera or legionellosis.

Surveillance data should be collected, analysed and interpreted. Public health authorities should be informed to allow then to take appropriate action. In most surveillance systems, information is collected at the local level and sent to regional and national health authorities, which compile and analyse the data. The results of the data analyses are then summarized in reports that are provided to the national and local health authorities. In some countries, these reports are also made available to the public and to international agencies, such as WHO and nongovernmental organizations (NGOs). Data collectors must understand the purpose of the surveillance system, be committed to its goals and see evidence that the information is used to improve public health.

5.1. Local level

An outbreak management team should be set up at the local health unit, headed by a public health officer reporting to the local director of public health. The outbreak management team should be composed of representatives of the waterworks and sanitation system, the water department of the regional environmental agency and an expert in hygiene and environmental medicine.

In case of an outbreak of water-related disease, the local outbreak management team should:

(a) review the evidence for an outbreak

(b) identify the population at risk

(c) decide on control measures

(d) provide quick and adequate information to the public

(e) make arrangements for the commitment of personnel and resources.

A clear way forward is to link routine health surveillance data with data on the quality and distribution of water supplies in the same area. There have been a number of examples on how this can work in practice, including:

(a) the use of geographical information systems to map the distribution of cases of illness in relation to the geographical boundaries of different water systems in order to determine whether illness rates are greater in people drinking from one water source compared with others;

(b) time-series analysis, whereby reports of illness are linked to data from routine water-quality measurements to determine whether illness rates increase after deterioration in water-quality results;

(c) prospective studies and enhanced surveillance in areas known to have poorer quality drinking-water.

The key issue is to be able to bring together water and health data. In many countries, different government ministries are responsible for health surveillance and water-quality monitoring. Sometimes, communication between them may not be ideal. National governments should encourage the sharing of relevant data between their agencies or ministries responsible for health surveillance and water-safety monitoring.

5.2. Regional level

An outbreak management team with similar features should be established at the regional level, to perform the following tasks after outbreaks of water-related disease.

(a) Prepare a notification to be sent to the national agencies.

(b) Prepare a report to be sent to the regional authorities responsible for management measures.

(c) Promote further epidemiological and environmental studies, as necessary.

(d) Provide adequate information to the public.

(e) Provide feedback on surveillance results and analyses to the local outbreak management team in order to sustain the interest and cooperation of the data collectors and data providers.

5.3. National level

An outbreak management team at the national level should be composed of representatives from the following sectors: health, environment, waterworks and sanitation, as well as agriculture, including animal husbandry and aquaculture. The outbreak management team, led by a health officer, should accomplish the following tasks.

(a) Draft notifications on water-related diseases and provide information to the public.

(b) Map water-related diseases on a national scale, possibly using geographic information systems.

(c) Identify most critical areas or situations.

(d) Assess the burden of water-related diseases.

(e) Transmit the information on water-related diseases to the relevant actors at the international level.

(f) Provide training and educational initiatives.

(g) Promote specific surveys.

(h) Provide feedback on surveillance results and analyses to the regional outbreak management teams in order to sustain interest and cooperation.

(i) Assess the functionality of the whole surveillance system.

(j) Prepare a report to be sent to the national authorities responsible for management measures.

(k) Coordinate activities in the case of transboundary waterbodies.

6. HOW A WATER-RELATED DISEASE SURVEILLANCE SYSTEM SHOULD WORK IN PRACTICE

6.1. Preparedness

First and foremost, the local outbreak management team should be well prepared to detect water-related outbreaks and react adequately when such an outbreak occurs.

The outbreak management team should meet regularly to build up trust and reduce communication barriers. Rules on alternate representation should be established at the beginning of the process to ensure that representatives of each relevant institution are always available.

In setting up a surveillance system, it is crucial to take into account the local situation and focus on critical areas or situations. For example, rural and poorer population groups are less likely to be included in a surveillance system because of their limited access to medical care. Sometimes, alternative active surveillance approaches must be used to capture the true disease burden in these populations. Surveillance systems for waterborne disease outbreaks are more likely to detect larger outbreaks that occur in large municipal water systems because more people are likely to be affected and they have better access to medical care and diagnostic laboratories that can detect and report the illness.

Smaller water utilities may be at greater risk of problems relating to waterborne disease because water quality at these facilities may be monitored less frequently, the facilities may have fewer treatment processes and the operators may have less training and may only work on a part-time basis. However, it is more difficult to detect waterborne disease outbreaks associated with small water utilities because fewer people may be affected, access to medical care may be limited and there may be little communication with regional or national health authorities.

However, sometimes small outbreaks in small communities – for example, when 20 out of 40 elderly people in nursing homes become ill – can be more easily recognized than big outbreaks in larger communities (for example, an outbreak of cryptosporidiosis in Milwaukee in 1993 was recognized when some 200 000 people were already ill; that is, half of the population had been affected by the outbreak).

6.2. Response

The response phase of an outbreak management approach can be divided into the following steps:

(a) trigger event: outbreak detection and confirmation;

(b) acute reaction: outbreak declaration, quick and preliminary descriptive hazard investigation, initial and immediate control measures;

(c) analysis: in-depth analytical hazard investigation, continuous re-evaluation of control measures;

(d) normalization: conclusion of outbreak and declaration of normalization;

(e) end: evaluation, formal report, lessons learned for the future.

The term *trigger event* covers a wide range of situations represented, for example:

(a) an increase in the number of cases of a particular, potentially water-related disease being reported through the surveillance system (local medical doctors and hospitals may communicate this information);

(b) a drinking-water sample exceeding microbiological or chemical limits; this should always raise the alarm and should prompt immediate action (local laboratories should provide information);

(c) relevant technical failures in water-treatment or distribution facilities, giving rise to failure in the water-treatment process (waterworks should give notification of such events);

(d) unusual events in the catchment area, such as a transport accident, extreme rainfall and run-off, flooding, sewage or liquid manure accidents (environment agencies and waterworks should provide information);

(e) clusters of customers' complaints from one supply zone concerning changes in organoleptic quality of tap water (waterworks should provide information).

Furthermore, pharmacies should provide information on higher usage levels of specific drugs, and schools and workplaces should provide notification when an unusually high number of absences is noticed.

In the *acute reaction*, any trigger event should prompt an immediate first meeting of the outbreak management team. The team should use descriptive epidemiological techniques to summarize key information regarding the people affected and their illness. Who? When? Where? An initial case definition must be formulated. This is based on the disease (clinical symptoms, laboratory results), the time period for dates of onset and a geographical locator. The main outcomes of the descriptive study are an epidemic curve and an epidemic map depicting the important information relating to time and place. Based on this information, the epidemiological risk must be assessed and a hypothesis on the causes of the outbreak must be generated. The latter is important for both implementing control measures and designing an analytical study.

In the case of flooding, all potential health effects should be taken into account: direct health effects, including drowning, injuries, diarrhoea, vector-borne diseases (including those carried by household pests), respiratory infections, skin and eye infections and mental health problems; as well as other indirect effects, such as damage to health and water infrastructures, contamination of the food chain, destruction of shelter and population displacement.

The major goal of this phase is to reduce the risk by quickly implementing preliminary control measures. Treatment failures must be corrected; in some cases, an additional disinfection step may help. Sometimes an alternative water supply needs to be activated. High-risk individuals should be excluded from water consumption (it is advisable to have identified those individuals and institutions in advance) and consumers may adequately apply household treatments before consuming it.

Information should be given to the public by only one person, authorized by the outbreak management team; it is clearly advantageous to have a relevant professional assume this position.

The in-depth *analysis* of the situation is based on two approaches, detailed here.

(a) Different analytical epidemiological and sanitary studies can be used for the risk assessment of water-related disease outbreaks: ecological, time series, case control, retrospective cohort, intervention and seroprevalence studies.

(b) A detailed hygienic–ecological site inspection including catchment area, treatment plant and distribution net may lead to important hypotheses concerning the causes of an outbreak. Mapping is the central method for this approach, supported by the results of water analysis in standard chemical and microbiological parameters from the samples of raw water, treated water, disinfected water and water from the consumer's tap.

During the analytical phase, the further development of the outbreak situation should be checked critically. Do new cases occur? Is the incidence of cases increasing or decreasing? Are morbidity levels stagnating or decreasing? The immediate controlmeasures must be continuously revaluated. Recommendations for long-term control measures should be given.

The analysis should also concern itself with longer-term effects such as the type of contamination of the pollution of the water resource, the duration of the contamination event, the seasonal characteristics of the time at which the contamination occurred, new challenges in waste management and the personal hygiene conditions of the population.

Before *normalization* of the situation can be declared, the following questions should be answered.

(a) Are the causes of the outbreak completely understood?

(b) Have efficient control measures been implemented?

(c) With respect to the incubation period, do new cases occur?

(d) Have water-sample results met microbiological or chemical requirements for at least three days?

Finally, the outbreak management team formally declares the *end* of the outbreak to the public. Its work has been completed once a formal outbreak report has been written. The efficiency of incidence management has to be evaluated. What worked? What could have been done better? What lessons can be learned from past mistakes? Additionally, the costs of the outbreak should be assessed to give decision-makers an idea of what savings could be made if adequate preventive measures were to be installed. Finally, lessons learned should be identified in order to prevent or at least to better manage future outbreaks.

7. HOW TO EVALUATE A SURVEILLANCE SYSTEM FOR WATER-RELATED DISEASES

The output of a surveillance system can be mainly evaluated against the following criteria: sensitivity, timeliness, representativeness and data quality. The sensitivity of a system is its ability to detect the events under surveillance. A surveillance system should be sensitive enough to detect not only changes in disease incidence, but also a high continuous level of sporadic cases. The timeliness of a waterborne disease surveillance system can be assessed by measuring how long it takes for a case of waterborne disease or an outbreak of waterborne disease to be recognized and reported to the system. The data collected in a surveillance system should be representative of the true situation in the population covered by the surveillance system. Assessments of data quality in accordance with international norms can be carried out in order to verify whether data collected in the system are complete and accurate.

Most people without access to an improved water source live in rural areas (six out of seven). At the global level, 1.1 billion people lack access to water. Rural communities – both in developing and developed countries – are the most affected by waterborne disease outbreaks. Providing safe and reliable water services to these people is an essential long-term goal that will yield health and economic benefits.

Establishing specific water surveillance systems in rural areas can strongly decrease diarrhoea-related morbidity and mortality, as well as other water-related diseases, if accompanied by relevant water supply measures.

As a rule, a local body is responsible for managing this issue in rural areas. For example, a local outbreak management team should be organized according to the above-mentioned set-up and task allocation. These bodies should also take responsibility for implementing the main components of the WSPs to ensure that drinking-water is of adequate quality.

Outbreak management teams should also carry out the following tasks, if they are not already the responsibility of other agencies, such as the local public health authority.

(a) Raise awareness among the rural population regarding water-quality issues and related waterborne diseases.

(b) Build the capacity of health facilities to perform field tests using simplified kits and, in particular, to maintain the managerial responsibility in their respective area.

(c) Establish water-testing laboratories in selected critical services, such as schools and rural hospitals.

(d) Take immediate corrective action when water samples are found to be contaminated.

(e) Select adequate sources of drinking-water supply that comply with water-quality targets, such as those defined in the WHO guidelines for drinking-water quality (WHO, 2004).

(f) Train operators to ensure the most suitable, continuous and adequate treatment of raw waters.

Many studies indicate a decrement in diarrhoeal episodes by 39% by means of household water treatment and safe storage. Hence, important results can be achieved in preventing waterborne disease through the following household interventions.

(a) Boiling is by far the most commonly used approach to disinfect water at the household level.

(b) Point-of-use disinfection – adding chlorine in liquid or tablet form to drinking-water stored in a protected container – can be a low-cost option.

(c) Water filtration is another means to purify water; water purification with ceramic filters – often coated with silver to control bacterial growth – is effective in removing many microbes and other suspended solids and also makes water aesthetically acceptable for consumers.

(d) Solar disinfection exposes water in disposable clear plastic bottles to sunlight for a day, typically on the roof of a house.

(e) A combined approach, using powders or tablets to coagulate and flocculate sediments in water – followed by a timed release of disinfectant – is particularly useful for treating turbid water.

However, water treatment also needs to be accompanied by safe storage. This can be accomplished by using containers with narrow openings and a dispensing device, such as a tap or spigot, to protect collected water against contamination. These measures are particularly important because the microbial quality of drinking-water frequently declines after collection.

Finally, significant health benefits can be achieved through hygiene education.

8. NATIONAL EXAMPLES

The following subsections illustrate the guidance, with examples taken from countries that participated in the work of the subsidiary bodies established under the Protocol on Water and Health, particularly the Task Force on Surveillance.

8.1. Water-related disease surveillance in Armenia

In Armenia, water-related disease surveillance is conducted by the State Hygiene and Anti-epidemiological Inspectorate of the Ministry of Health. Water-related disease surveillance systems include drinking-water quality surveillance and epidemiological surveillance systems to prevent and assess outbreaks.

Drinking-water quality surveillance is conducted by setting sanitary–epidemic safety standards, developing sanitary and epidemiological rules and norms, as well as hygiene standards, and conducting controls with regard to their requirements. Sanitary rules and hygiene norms define environmental safety standards and hazard criteria for the population, as well as requirements relating to hazard conditions for human activity. Sanitary rules and hygiene norms define environmental safety standards and favourable criteria for the population as well as requirements related to favourable conditions for human activity.

Regular and situational drinking-water quality monitoring is conducted by the State Hygiene and Anti-epidemiological Inspectorate. Monitoring of drinking-water quality is ensured by the organization operating the water supply system.

Problems include lack of sufficient environmental health regulations, monitoring requirements and outdated water quality control laboratory methodologies. The requirements of existing sanitary hygienic rules are not fully enforced, especially requirements for drinking-water source delineation, inventory of the significant potential sources of water contamination and developing programmes for prevention of source water contamination. Rule requirements for choosing a list of chemical contaminants for monitoring – as well as extended chemical analysis of source water according to its contaminant-susceptibility assessment – are not conducted in an appropriate manner because there are no reliable data on sources of contaminant vulnerability.

Armenia is dealing with issues of secondary contamination of water because of worn-out water intake structures, treatment plants and distribution system networks, as well as intermittent water supply and insufficient leak detection mechanisms.

Problems connected with drinking-water-related disease surveillance include:

(a) lack of sufficient water quality control laboratory methodologies;

(b) lack of hydrogeological inventory of the potential sources of chemical contamination of drinking-water sources;

(c) lack of data on the vulnerability of sources and extended analysis of water resources based on the vulnerability assessment;

(d) lack of reliable information on contamination by radionucleides, cryptosporidium and *Legionella* or their impact on the health of the population.

In addition, a number of measures need to be taken to strengthen and enhance the professional skills of those dealing with water, through targeted training. As such:

(a) intersectoral data flow and information exchange needs to be strengthened and facilitated;

(b) surveillance systems need to become more holistic in their effort to prevent and assess water-related outbreaks, including data collection, exchange and epidemiological investigation; and management needs to include evaluation of retrospective data, as well as the current status;

(c) targeted surveillance systems for water-related diseases need to be improved.

8.2. The Slovak experience of intersectoral collaboration in water protection and management

Water protection and management in Slovakia is the responsibility of the Ministry of the Environment, mainly in cooperation with the Ministry of Health and the Ministry of Agriculture, and with financial contribution from the Ministry of Finance.

The Water Act (No. 364) of 13 May 2004 is the key legislation that protects water resources in Slovakia. EU legislation in this area is completely transposed into this Act.

The Ministry of the Environment is the central body that manages State water administration in accordance with the aforementioned legislation. It is responsible for the transposition and implementation of EU directives related to water, with the exception of the drinking-water and bathing-water directives, which remain the responsibility of the Ministry of Health. On 6 December 2001 the Slovak Government adopted Resolution No. 1138 on the integrated approximation strategy of Slovakia for the environment chapter, which defined intersectoral cooperation.

The Ministry of Agriculture has developed a codex of good agricultural practice, ensuring the protection of water against nitrates through the implementation of Council Directive 91/676/EEC concerning the protection of water against pollution caused by nitrates from agricultural sources (the Nitrates Directive), and is responsible for its implementation. The Ministry of the Environment designates the sensitive and vulnerable areas.

Implementation of Directive 2006/7/EC of the European Parliament and of the Council of 15 February 2006 concerning the management of bathing water quality and repealing Directive 76/160/EEC was ensured in cooperation with the Ministry of Health and the Ministry of the Environment. The Ministry of Health and the Ministry of the Environment jointly designate bathing waters.

The Ministry of the Environment and its local representatives cooperate with local authorities in issuing permits with individual producers with the aim to set up discharge limits in the implementation of Council Directive 76/464/EEC of 4 May 1976 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community. In order to eliminate industrial pollution of the environment, the Ministry of the Environment cooperates with other bodies, such as the Association of Industrial Ecology, an NGO.

Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment is being implemented by water services and local governments, but its implementation is carried out in accordance with the plan for the development of public water supply systems and public sewerage systems in the territory of Slovakia. This plan was taken into consideration by the Government. During its preparation, representatives of the Association of Towns and Communities of Slovakia (ZMOS) were present, representing more than 96% of all municipalities.

The Ministry of the Environment has carried out flood risk management plans, which are prepared, implemented and updated in cooperation with ZMOS representatives.

Prevention of floods and management of flood impacts is the responsibility of the Central Flood Protection Commission. The Minister of the Environment is the Chair of the Commission, with

the Minister of Internal Affairs as his deputy. All other ministers are members of the Commission and cooperate in harmony within the mandates of their respective jurisdictions. The Ministry of the Environment invites stakeholders for discussion and preparation of key documents, such as the Plan for the Development of Public Water Supply Systems and Public Sewerage Systems for the Territory of the Slovak Republic, as well as flood risk management plans. In addition to representatives of towns and communities, NGOs are also invited. Documents from the Ministry of the Environment and Ministry of Health are available to the public on their web sites and are open for comments.

Information regarding environmental issues is presented to the public through the cultural film festival, the International Festival of Sustainable Development Films (EKOTOPFILM). The main organizer of the festival is the agency EKOTOPFILM, in cooperation with other partners — professional guarantors — 13 ministers of the Slovak Government, the capital city of Bratislava and various NGOs.

The Ministry of Health and the Ministry of the Environment work together to implement the Protocol on Water and Health. In 2003 both ministries prepared a national report on the status of implementation of the Protocol, including targets and target dates, which was approved by the Government and updated in 2005. This document was replaced in 2006 by the national targets.

8.3. Norway: example of complementarity of water-quality monitoring and disease outbreak detection

The current regulatory system, based on EU Council Directive 98/83/EC on the quality of water intended for human consumption imposes a sampling frequency whereby for each litre analysed, 600 million litres are delivered to the consumer. Comparing this to a road between Rome and Oslo, this equates to the yearly examination of 5 mm of a 2008 km road. It is therefore not surprising that no outbreaks have been discovered in Norway through water analyses alone, although they remain a powerful tool to establish retrospectively the connection between an outbreak and the drinking-water supply quality.

Norway has progressively developed a regulatory approach similar to the concept of a WSP.

(a) Hygienic Safety 1951: source protection, water treatment according to need (early example of double safety measures).

(b) Hygienic Safety 1995: minimum of two hygienic barriers against all kinds of contaminants.

(c) Regulation 2001: minimum of two hygienic barriers against all kinds of contaminants (multiple barrier system).

Although WSPs are the current basis of negative health impact prevention, one should remain aware that gaps in the system may still cause failures.

Emphasis should be placed on understanding the capacity as well as the weaknesses of surveillance systems, based on indicator organisms. Traditional indicators, such as *E. coli*, coliforms and intestinal enterococci may be commonly seen as good indicators for priority pathogens, such as *Vibrio cholerae*, *Shigella dysenteriae* or *Salmonella typhi*, because they have similar survival characteristics in water and exhibit comparable sensitivity to disinfection.

However, some pathogens may survive disinfection better than the classic indicator organisms. Examples of such hardier pathogens are viruses (norovirus), protozoa (*Giardia intestinalis*, *Cryptosporidium parvum*, *Entamoeba* sp.) and even certain (spore-forming) bacteria.

8.4. Croatia

The Act on the Protection of the Population from Infectious Disease (Official Journal of the Republic of Croatia NN60/92) defines 75 diseases as notifiable, and the list is updated yearly by the Ministry of Health. Two devolving regulations are important with regard to water-related disease surveillance: the Infectious Disease Notification Method Regulation (NN23/94) and the Drinking-water Safety Regulation (NN182/04). Upon any suspicion of infectious disease, the physician should immediately notify the local hygiene and epidemiological offices of the National Institute of Public Health. The Epidemiological Service of the Institute reports regularly to the Ministry of Health on trends in infectious diseases, and on any any grouping of disease over a short period of time. When cases of an infectious disease exhibit a grouping that goes beyond the local level, an intervention by the Institute becomes mandatory. This is also obligatory in the case of large epidemics, epidemics of unknown causes and the outbreak of diseases the control of which is very complicated. Since 2004, laboratory testing has been conducted on samples for which norovirus infection is suspected.

All institutions are required to immediately inform their own epidemiological services when water analysis shows that any microbiological or chemical factors pose a health hazard. At the international level, Croatia informs WHO of the incidence and number of cases of infectious diseases.

8.5. Hungary

In Hungary, communicable diseases are notifiable, including all diseases identified as important under the Protocol on Water and Health. Case definitions established by WHO were adopted in 1998.

There are three administrative levels in reporting: national, county and municipal. Initial notification is carried out by health care providers to the municipal institutions. The Hungarian reporting system benefits from four types of information source, as detailed here.

(a) Physicians report data on case report forms.

(b) Microbiological laboratories participate in laboratory-based surveillance systems.

(c) Sporadic cases of certain diseases are investigated and case investigation forms are routinely processed. In case of important disease outbreaks, so-called early-reporting forms are to be completed within 24 hours.

(d) Epidemiological information on outbreaks is available, as each outbreak must be investigated.

Suspected outbreaks are reported by experts of the National Public Health and Medical Officers Service, which is responsible for investigating outbreaks. Reporting frequency through the service is threefold:

(a) immediate report — when there is suspicion of an outbreak;

(b) weekly report — intermediate results of the outbreak investigation;

(c) summary report — as soon as all the epidemiological and microbiological information has been obtained.

According to the strength of evidence for association between exposure and illness, outbreaks are classified as presumptive (human cases that are not laboratory confirmed), confirmed based on epidemiological data (descriptive epidemiological study suggests association) and laboratory confirmed (etiological agent detected and identified).

From 1955 to 2004, there were 237 waterborne disease outbreaks in Hungary.

8.6. Germany

The German surveillance system is based on the Infection Protection Act (2001),which governs the competence between the Federal Government (*Bund*) and the states (*Länder*) with regard to the surveillance of infectious diseases. The 16 states conduct the surveillance and are responsible for the reporting. The case definitions of notifiable diseases are based on EU case definitions, and most laboratory results on acute cases are notifiable. Laboratories and physicians independently report notifiable cases to the local health departments within 24 hours after case confirmation. For some diseases with a high burden, such as cholera, the local health department is notified even if a case is suspected but not yet confirmed.

The local health departments report to the state department, which then reports within one week to the national surveillance institution, the Robert Koch Institute. By law it should not take more than four weeks from case confirmation to publication in the weekly bulletin of the Robert Koch Institute; in practice, the process is usually completed within three weeks.

The identification of the source of infection, and thus the identification of outbreaks, is carried out at the local level. Upon request, the Robert Koch Institute will provide support for the local health departments in the detection of the source of infection. Information relating to the outcome of these investigations may be reported to the federal Government, but this is not obligatory.

The German system is very effective in picking up even small outbreaks. Therefore, 70% of all European infectious disease outbreaks are registered as originating in Germany. This result reflects the quality of the surveillance system more than the comparative health risks in the participating countries. In order to assure the high quality of the surveillance system, training courses are provided every year for local and state health department professionals on epidemiological methodology, in particular with regard to outbreak investigations.

8.7. Finland: surveillance of waterborne outbreaks

In Finland, foodborne and waterborne outbreaks have been monitored since 1980. The voluntary reporting system found occasional outbreaks every year but small outbreaks with comparatively few cases undoubtedly remained unknown. A significant change took place in 1997, when a new notification system for waterborne outbreaks was launched. According to this system, municipal health protection authorities that are responsible for frequent monitoring of the quality of drinking-water are obliged to notify all suspected waterborne outbreaks to the National Institute for Health and Welfare (THL). The purpose of the preliminary notification is to

obtain information immediately relating to the extent of an outbreak, the symptoms of patients, the suspected causative agent of an outbreak, the management and remedial actions taken and the contact details of authorities engaged with the outbreak. The THL maintains a national task group, which helps local authorities with technical, analytical and epidemiological problems associated with waterborne outbreaks.

The detection of a waterborne outbreak is not an easy task. There is normally a common disbelief in an outbreak. Usually, a sudden increase of illness cases is the only symptom of an outbreak. The monitoring results of drinking-water analyses, both microbiological and chemical, usually comply with the quality requirements, thus hampering the detection of an outbreak. A fast-acting and fluent cooperation and communication system between bodies working with the health and water sector is therefore the most important factor to prevent, restrict and solve an outbreak.

After launching the compulsory notification system for waterborne outbreaks, even the smallest outbreaks associated with the use of private wells are revealed, which can be seen in the higher number of waterborne outbreaks after 1997 (see Fig. 1.). Since 1999 there have been 59 outbreaks, with a total of 27 000 illness cases. Outbreaks have typically been associated with the use of groundwater that has not been disinfected, in small communities with fewer than 500 consumers. Noroviruses and campylobacteria have been the most common causative agents behind the outbreaks.

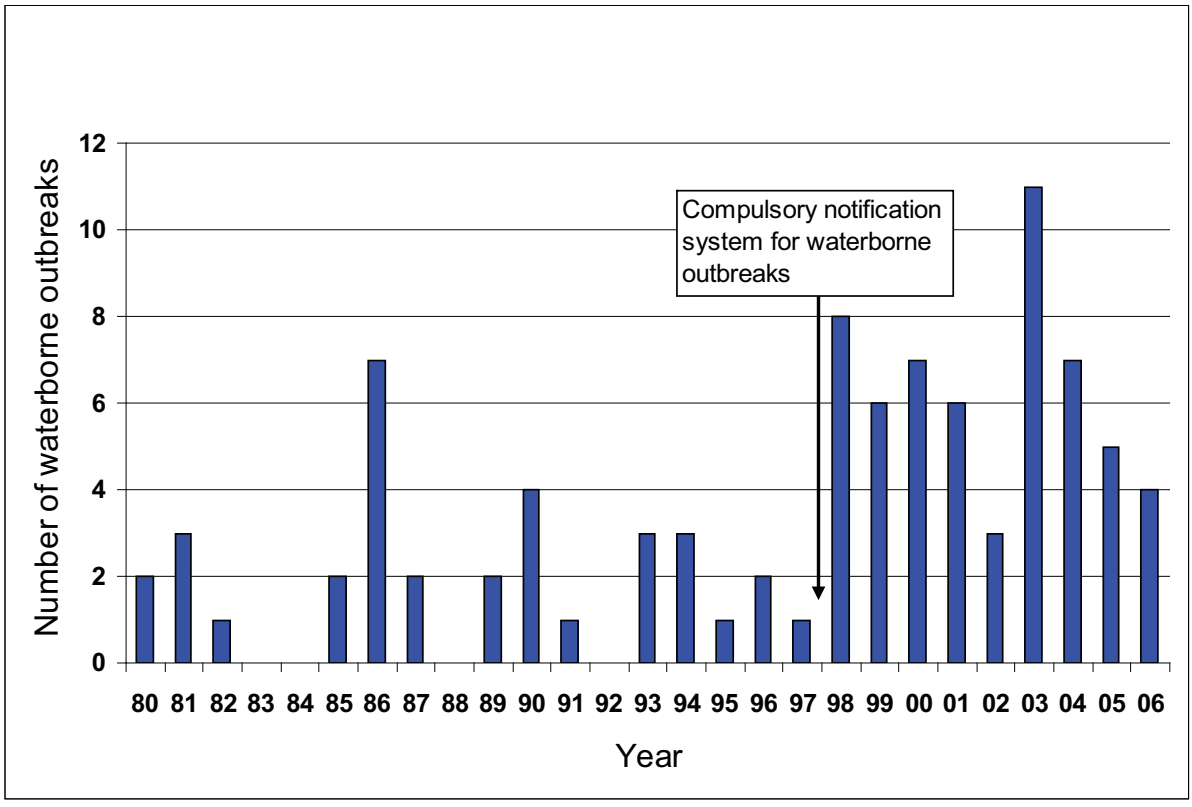

Fig. 1. Number of waterborne outbreaks in Finland 1980-2006
Source: **Finnish Food Safety Authority Evira, 2007**

8.7.1 Advantages of the compulsory notification system

Immediate notification of an outbreak accelerates the cooperation between authorities, water companies, laboratories and the THL, and enables the design of immediate management and remedial action to control and restrict the outbreak and to prevent harmful health effects. The notification system has decreased the detection threshold of an outbreak and increased the awareness of possible microbiological problems associated with the quality of drinking-water. Figures on waterborne outbreaks are more realistic today than before the introduction of the system, although the number of illness cases may still be underestimated.

Today, authorities and water companies are perhaps more capable of reacting to potential problems and malfunctions related to water services. Knowledge about waterborne outbreaks associated with the use of groundwater has, for example, increased the use of disinfection methods such as ultraviolet radiation in groundwater supplies. Contingency plans, risk assessment and risk management have been or are being developed by water companies. Information and communication systems related to waterborne outbreaks has been improved through new legislation on drinking-water. Legislation also requires supplementary education and skill examinations for personnel working in water-treatment plants. At five year intervals, personnel should participate in and pass an examination in water service and hygiene. Guidebooks and reports have been published on, for example, operation and maintenance of waterworks, security of water supplies and provision of information in cases of severe incidents. Research programmes have been developed to promote research activities related to water services and sanitation.

CONTRIBUTORS

The WHO Regional Office for Europe is grateful to the United Nations Economic Commission for Europe (UNECE) for providing the original funding for the work that led to this publication

Roger Aertgeerts, WHO Regional Office for Europe, (Co-Secretary of the Protocol)

Enzo Funari, Chair of the Task Force on Surveillance, Italy

Nana Gabriadze, Deputy Head of Public Health Department, National Centre for Disease control and Public Health of Georgia

Paul Hunter, School of Health Medicine, Health Policy and Practice, University of East Anglia, United Kingdom

Frantisek Kozisek, Director, National Institute of Public Health, Czech Republic

Arben Luzati, Head, Environmental Health Department, Institute of Public Health, Albania

Aida Petikyan, Head, Environmental and Communal Hygiene Department, State Hygienic Anti-epidemiological Inspection, Ministry of Health, Armenia

Andrea Rechenburg, Executive manager, University Clinic Bonn, Institute of Hygiene and Public Health, Germany

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The WHO Regional Office for Europe

The World Health Organization (WHO) is a specialized agency of the United Nations created in 1948 with the primary responsibility for international health matters and public health. The WHO Regional Office for Europe is one of six regional offices throughout the world, each with its own programme geared to the particular health conditions of the countries it serves.

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ISBN 978 92 890 0236 3

World Health Organization
Regional Office for Europe

Scherfigsvej 8, DK-2100 Copenhagen Ø, Denmark
Tel.: +45 39 17 17 17. Fax: +45 39 17 18 18. E-mail: contact@euro.who.int
Web site: www.euro.who.int