CHAPTER 1

INTRODUCTION

This volume of the *Guidelines for Safe Recreational-water Environments* describes the present state of knowledge regarding the detrimental impacts of the recreational use of swimming pools, spas and similar recreational-water environments upon the health of users, as well as the monitoring and control of the hazards associated with these environments. These impacts must be weighed against the enormous benefits to health and well-being associated with the use of recreational-water environments.

The hazards associated with the use of recreational-water environments fall into three main groups:

- those concerning injuries and physical hazards (leading, for example, to drowning or spinal injury);
- microbiological hazards; and
- those concerning exposure to chemicals.

All are of importance to public health and of concern to users.

The hazards that are encountered in recreational-water environments vary from site to site, as do the nature and extent of exposure to the hazards. In general, most available information relates to health outcomes arising from exposure through swimming and ingestion of water. In the development of these Guidelines, all available information on the different routes of exposure was taken into consideration.

In order to properly interpret and apply the Guidelines in a manner appropriate to local conditions, it is necessary to take into account social, cultural, environmental and economic characteristics, as well as the routes of exposure and the nature and severity of the hazards. In doing so, local, national and international standard-setting bodies may develop standards that differ between regions and within regions according to differences in these factors.

In seeking to control the health hazards associated with the recreational use of swimming pools, spas and similar recreational-water environments and ensure a safe environment for users, responsible and concerned bodies — including national and local agencies, facility owners and operators, and nongovernmental organizations — have at their disposal a range of very diverse means of intervention, ranging from proper facility planning to good operation and management practices, and including general educational activities for both children and adults to enhance awareness of health hazards and inform users on ways to avoid and respond to the hazards.

In light of the diversity in exposure, hazard and nature of interventions, this guidelines document is structured as shown in Figure 1.1.

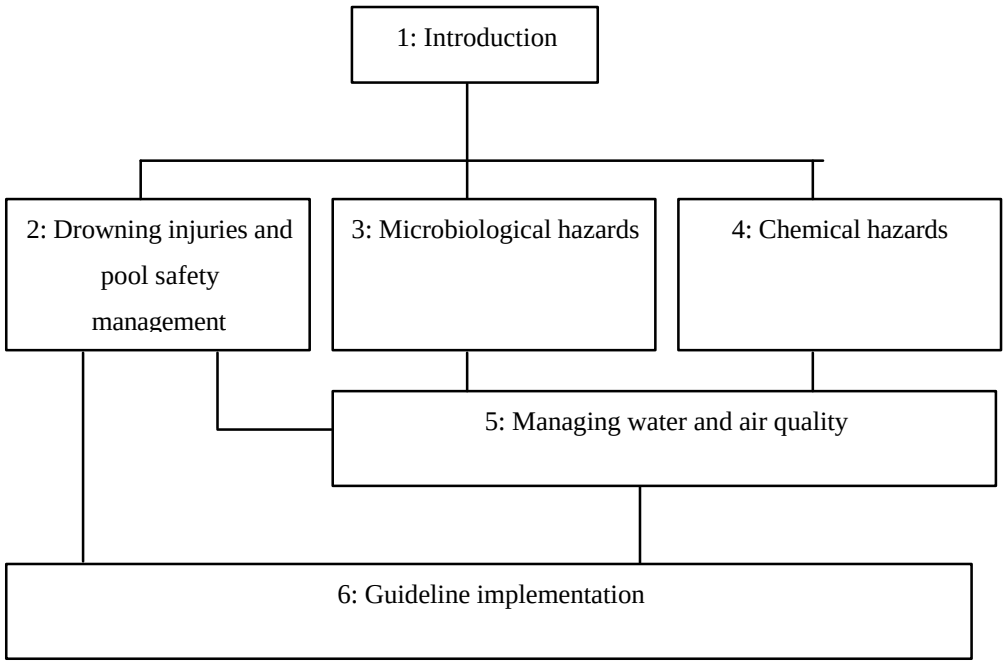

Figure 1.1: Structure of *Guidelines for Safe Recreational-water Environments. Vol. 2: Swimming Pools, Spas and Similar Recreational-water Environments*

1.1 General considerations

The primary aim of the *Guidelines for Safe Recreational-water Environments* is the protection of public health. In this regard, it must be emphasized that the use of swimming pools, spas and similar recreational-water environments — and the resulting relaxation and exercise — is associated with enormous benefits to health and well-being. The purpose of the Guidelines is not to deter swimming pool and spa use but instead to ensure that the pools and spas are operated as safely as possible in order that the largest possible population gets the maximum possible benefit.

The Guidelines are intended to be used as the basis for the development of national approaches to controlling the hazards that may be encountered in swimming pools, spas and similar recreational-water environments, as well as providing a framework for policy-making and local decision-taking. The Guidelines may also be used as reference material for industries and operators preparing to develop facilities containing swimming pools and spas, as well as a checklist for understanding and assessing the potential health impacts of projects involving the development of such facilities.

The information provided in this volume of the Guidelines is intended to be generally applicable to public pools and spas, semi-public pools and spas (as encountered in clubs, hotels and schools, for example) and private (domestic) pools and spas. The preferred approaches adopted by national or local authorities towards implementation of guideline values and conditions may vary between these types of environment.

Where guideline values are presented, these are not mandatory limits, but measures of the safety of a recreational-water environment. In developing strategies for the protection of public health, competent government authorities should take into account social, economic and environmental factors, including the general education of both adults and children as well as the efforts and

initiatives of nongovernmental organizations and industry operators in this area.

The main reason for not promoting the adoption of international standards for swimming pools, spas and similar recreational-water environments is the advantage provided by adoption of a risk–benefit approach. In the case of swimming pools, spas and similar environments, development of such an approach not only concerns health risks and benefits, but also inter-relates with other risks and benefits, especially those concerning local and national economic development and the health benefits and well-being derived from the recreational use of the these environments.

This approach can often lead to the adoption of standards that are measurable and can be implemented and enforced. These would deal with, for example, water quality, quality of associated facilities and dissemination of information. A broad-based policy approach is required that will include legislation as well as positive and negative incentives to alter behaviour and monitor and improve situations.

Such a broad base will require significant efforts in intersectoral coordination and cooperation at national and local levels, and successful implementation will require development of suitable skills and expertise as well as the elaboration of a coherent policy and legislative framework.

1.2 Types of pools and spas

Pools may be private (domestic), semi-public (e.g., hotel, school, health club, condominium, cruise ship) or public (municipal or governmental). Pools may be located indoors, outdoors or both. In terms of structure, the conventional pool is often referred to as the "main" pool or public or municipal pool. It is by tradition rectangular, with no extra water "features," and it is used by people of all ages and abilities. However, there are many "specialist" pools for a particular user type — for example, paddling pools, diving pools, pools with special features such as "flumes" or water slides, and spas. A "spa" for the purposes of these Guidelines is defined to include hot tubs (domestic), whirlpools (commercial/facility) and natural mineral baths. There are also pools containing thermal or medicinal waters, such as physical therapy pools, in which treatments for a variety of physical symptoms are performed by professionals on persons with neurological, orthopaedic, cardiac or other diseases, in warm water.

Each type of pool has potentially different management problems, which must be anticipated and dealt with by pool managers. Of importance to the type of pool and its management is identification of how the pool will be used:

- the daily opening hours;
- the peak periods of use;
- the anticipated number of users; and
- special requirements, such as temperature, lanes and equipment.

In addition, the type, design and use of the pool may predispose the user to certain hazards. Bubble pools or whirlpools, leisure pools and spas, for example, may be subject to high bather loads relative to the volume of water. Where there are high water temperatures and rapid agitation of water, it may become difficult to maintain satisfactory pH, microbiological quality and disinfectant residuals. Pools with moveable floors will have variable depths, and, as such, the greatest bathing load is likely to be in the shallower areas. In any pool with concentrated bather loads, pollution can be high. In addition, some special provisions of pools, such as forced recirculation and aeration, may contribute to bacterial overgrowth.

Pools without water treatment and recirculation are permitted in some countries, as their construction does not impose a major economic burden. These pools may be associated with a higher risk of transmission of waterborne diseases among users and thus pose a special set of problems to operators.

Spas with thermal and medicinal waters are also a special case, as they are generally impossible to treat in the usual way — they cannot be recycled or disinfected, because the therapeutic agent, such as sulfides, would be eliminated or impaired. As well, chemical substances of geological origin in some sorts of deep thermal springs and artesian wells, such as humic substances and ammonium, may hamper the effect of disinfectants when these waters are used to fill pools without any pretreatment. These spas therefore require non-oxidative methods of water treatment to keep the water effective and microbiologically safe at the same time. A very high rate of water exchange is necessary — even if not effective enough — if there is no other way of preventing microbial contamination.

Pools and spas on ships are also a special case, as the source water may be either seawater or from the potable water supply for the ship. The pool configurations should be of a safe design, as with land pools. However, the hydraulic and circulation system of the pool will necessitate a unique design, depending upon ship size and pool location. The filtration and disinfection systems will also require adaptation to the water quality. It has been recommended that spa systems on cruise vessels destined to call on US ports be designed to permit daily shock treatment or super halogenation and allow for routine visual inspection of granular filtration media (US Department of Health and Human Services, 1997a,b).

1.3 Types of users

The type of pool reflects the users, which may include:

- the general public;
- children/babies in small teaching groups;
- hotel/motel guests;
- tourists on board cruise ships;
- health club members;
- medical patients in therapy pools;
- competitive swimmers;
- clients of outdoor camping parks;
- leisure bathers, including clients of theme parks; and
- specialist sporting users, including scuba divers and water polo participants.

Certain groups of users may be more predisposed to hazards than others. Children, for example, particularly when unattended, may cause an elevated risk of accidents for themselves and others because of their uncontrolled physical competitive spirit and desire for attention. They are also generally reluctant to observe formal rules of safety and hygiene. In addition, they generally play longer in recreational waters and are more likely to intentionally or accidentally swallow water.

The elderly and partially disabled, who are most likely to use pools with thermal and medicinal waters that are regarded to have a healing effect against different — mostly locomotory — diseases, tend to spend a longer time in the water, as the advantageous effect of the water is considered to be proportional to the time spent in contact with it. These people, as well as immunocompromised individuals, may be at higher risk of health damage from the possible

microbiological deterioration of water quality, as they are more susceptible to the pathogenic organisms that may occur in this environment. The elderly and handicapped also have strength, agility and stamina problems that limit their recoverability from problems encountered in pools and spas.

1.4 Hazard and risk

Popularly, the terms hazard and risk are used interchangeably. Correctly, a *hazard* is a set of circumstances that could lead to harm — harm being injury, illness or loss of life. The *risk* of such an event is defined as the probability that it will occur as a result of exposure to a defined quantum of hazard. In simpler terms, hazard is the potential for harm, while risk is the chance that harm will actually occur. The *rate of incidence* or *attack rate* is the expected number of events that occur for this defined quantum of hazard. Strictly speaking, probabilities and rates obey different laws; however, if the probabilities are small and the events are independent, the two values will be approximately equal.

1.4.1 Types of hazard encountered

The most prominent adverse health outcomes arising from the use of swimming pools, spas and similar recreational-water environments are:

- drowning and near-drowning;
- major impact injuries (e.g., spinal injury);
- slip, trip and fall accidents;
- cuts, lesions and punctures;
- infection arising from inhalation of, ingestion of or contact with pathogenic bacteria, viruses, protozoa and fungi that may be present in water as a result of faecal contamination, carried by participants using the water or naturally present; and
- adverse effects relating to toxic chemicals, with exposure arising from inhalation, ingestion and dermal exposure.

Examples of these adverse health outcomes are given in Table 1.1.

Table 1.1: Examples of negative health outcomes associated with hazards encountered in swimming pools, spas and similar recreational-water environments

Type of negative health outcome associated with exposure to a hazard	Examples (with chapter references in parentheses)
Drowning and near-drowning	Swimmers under the influence of alcohol; poor swimming ability; no supervision; diving accidents; entrapment (2).
Major and minor impact injuries	Impact against hard surfaces (2). The impact may be driven by the participant (diving, accidents arising from the use of water slides, collision, treading on broken glass and jagged metal — especially in outdoor pool surrounds).
Physiological	Acute exposure to heat and ultraviolet (UV) radiation in sunlight — heat exhaustion, sunburn, sunstroke in outdoor pools (refer to Volume 1 of the Guidelines). Cumulative exposure to sun for outdoor pool users — skin cancers (basal and squamous cell carcinoma, melanoma) (refer to Volume 1 of the Guidelines). Heat exposure in spas or cold exposure in plunge pools (2).
Infection	Ingestion of, inhalation of or contact with pathogenic bacteria, viruses, fungi

Type of negative health outcome associated with exposure to a hazard	Examples (with chapter references in parentheses)
	and protozoa, which may be present in water and pool surrounds as a result of faecal contamination, carried by participants or animals using the water or naturally present (3).
Poisoning	Ingestion of, inhalation of or contact with chemically contaminated water, and inhalation of chemically contaminated air (4).

Drowning, near-drowning and spinal injury are severe health outcomes of great concern to public health. Human behaviour — especially alcohol consumption — is a prime factor that increases the likelihood of accidents. Other accidents, such as cuts and slip, trip and fall accidents, while less severe, cause distress and decrease the benefits to well-being arising from recreation. The Guidelines do not cover rescue and resuscitation or other lifeguarding techniques, although prevention, as a key factor in mitigating risk, is promoted. Preventive and remedial actions take diverse forms and include general education, posting of warnings where appropriate, the presence and training of lifeguards, the availability of health services such as first aid, the availability of communication with health and rescue services, and the cleaning of pools and associated facilities.

It should also be noted that the most important consideration by first-aid providers is to avoid danger themselves; hence, potential rescuers should not attempt a rescue beyond their capabilities.

Notwithstanding the above, much attention has focused in recent years upon microbiological hazards. In particular, the health risks associated with contamination by excreta and associated gastroenteric outcomes have been the topic of both scientific and general public interest. It should be noted that the adverse health outcomes are not restricted to gastrointestinal infections but also include skin, eye and ear infections arising from pollution of water by excreta from bathers. The frequency and severity of outcomes relate to the type of pool and efficiency of its operation, especially with respect to filtration, disinfection and response procedures for contamination events.

Hazards to human health exist even in unpolluted environments. For example, eye irritation and some additional eye infections probably occur as a result of reduction in the eye's natural defences through limited contact with water and do not relate to water quality or pollution *per se*. The importance of hazards to human health should be weighed against the benefits for human health and well-being derived from recreational-water use.

Because hazards may give rise to health effects after short-term exposures, it is important that standards, monitoring and implementation enable preventive and remedial actions within real time frames. For this reason, emphasis in the Guidelines is placed upon identifying circumstances and procedures that are likely to lead to a continuously safe environment for recreation. This approach emphasizes monitoring of both conditions and practices and the use of threshold values for key indicators assessed through programmes of monitoring and assessment.

1.4.2 Assessment of hazard and risk

Assessments of hazard and risk are essential preliminaries to the development of rational policies for controlling and managing risks to health and well-being in water recreation. Both

draw upon experience and the application of common sense, as well as the interpretation of data. Isolated measurements of risk are not very helpful when decisions have to be made for managing risks or developing policies for controlling them. Comparing and balancing risks are basic prerequisites for prioritizing risk management actions.

Figure 1.2 provides a schematic approach to comparing health hazards encountered during recreational-water use. A severe hazard, such as diving into shallow water, resulting in permanent paralysis or death, may affect only a small number of bathers annually, but may warrant a high management priority. Minor skin irritations, encountered at the other end of the scale, may affect a higher number of bathers per year, but do not result in significant incapacity, and such hazards require lower management priority. Figure 1.2 can be applied throughout the Guidelines to each of the hazards discussed.

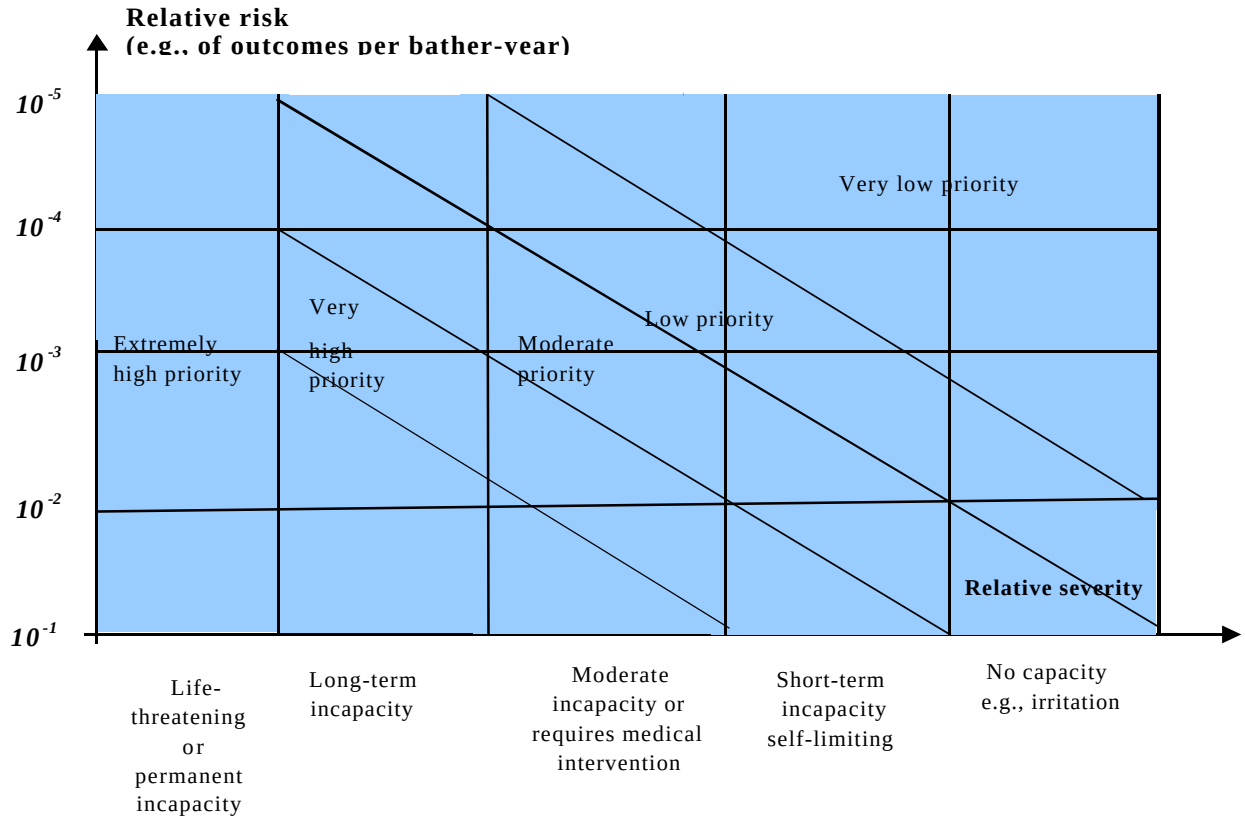

Figure 1.2: Schematic approach to comparing health hazards encountered during recreational-water use

Data on risk related to the use of swimming pools, spas and similar recreational-water environments take four main forms:

- national and regional statistics of illness and deaths;
- clinical surveillance of the incidence of illness and outbreaks;
- epidemiological studies and surveys; and
- accident and injury records held by swimming pool owners/managers and local authorities.

Although "incident records" held by local pools and authoritative bodies are often comprehensive, published statistics are seldom sufficiently detailed for risk assessment. Surveillance is the process of continuous and vigilant assessment of the state of public health and of safety and acceptability. Processes for surveillance of drinking-water supplies have been recommended by WHO (1976, 1997) and involve the dual responsibility of a national,

governmental regulator and the supplier or provider of the service. Systems for surveillance of public health operate in most countries. They serve the broad purpose of alerting either regulator or supplier to changes in incidence of disease and to the need for initiating immediate investigation of the causes and remedial action. Such investigation will involve epidemiology (the study of the occurrence and causes of disease in populations). Galbraith & Palmer (1990) give details of the use of epidemiology in surveillance. Epidemiology may also be used as a research tool to investigate hypotheses concerning the causes of illness (see section 1.4.3).

There are other reasons why it is difficult to estimate risk directly, such as the following:

- In most active water sports, enjoyment arises from the use of skill to avoid and overcome perceived hazards. The degree of competence of participants and the use of properly designed equipment, accompanied by supervision and training, will considerably modify the risk.
- Risks of acquiring infectious disease will be considerably influenced by innate and acquired immunity (for examples, see Gerba et al., 1996). The former comprises a wide range of biological and environmental factors (age, sex, nutrition, socioeconomic and geographic), as well as body defences (impregnability of the skin, lysozyme secretion in tears, mucus and sweat, the digestive tract and phagocytosis). Previous challenge by pathogens often results in transient or long-lasting immunity. Immunocompromised individuals will be at greater risk of acquiring infectious diseases.
- Assessment of harm itself and the degree of harm suffered depends upon judgement at the time. Medical certification of injury and of physiological illness and infection, accompanied by clinical diagnosis, is the most reliable information. Information obtained by survey or questionnaire will contain a variable degree of uncertainty caused by the subjects' understanding of the questions, their memory of the events and any personal bias of the subject and interviewer. Survey information is only as good as the care that has gone into its design and conduct.
- The causes of harm must be ascertained as far as possible at the time. There are considerable difficulties in determining causes in the cases of low-level exposures to chemical and physical agents that have a cumulative or threshold effect and of infectious diseases caused by those pathogens that have more than one route of infection or have a long period of incubation. For example, gastroenteric infections at swimming pools may result from person-to-person contact or faulty food hygiene in catering, as well as from ingesting excreta-contaminated water.
- Where data are in the form of published regional or national statistics giving attack rates, the exact basis on which the data are collected and classified must be ascertained. For example, national statistics on deaths by drowning will usually include suicides, occupational accidents (e.g., lifeguards) and misadventure in recreation.
- It cannot be assumed that risk is directly proportional to exposure or that risks from multiple exposures or a combination of different factors will combine additively.

1.4.3 The use of epidemiology in assessing risk

Epidemiology is a discipline designed to reduce sources of bias and errors in the interpretation of statistical and other data for assessing risks. However, epidemiological studies are usually limited to single or a few closely related hazards and carefully defined populations. Hence, epidemiological approaches do not always measure the full range of variation in population responses (Grassman, 1996). The results of epidemiological studies, usually presented in the form of relative risks or odds ratios (see Box 1.1), can therefore be applied only to activities and

subjects similar to those studied. There is only a little epidemiological information available concerning hazards associated with swimming pools and spas.

Box 1.1: Definitions of relative risk and odds ratio

Controlled epidemiological studies involve a comparison of attack rates between the experimental group exposed to the hazard and an unexposed control group, carefully selected to be otherwise as identical to the experimental group as possible. The objects of such studies take the form of statistical examination to disprove the null hypothesis that there is no significant difference in the outcome between the two groups. The results are therefore usually presented in the form of *relative risk* (risk of outcome in the exposed group / risk of outcome in the control group) or the *odds ratio* (odds of outcome in the exposed group / odds of outcome in the control group), together with a statement of the level of statistical significance (the probability that the stated result could have occurred by chance).

By way of definition, if the baseline rate of illness unrelated to exposure is r (the fraction of the control group who become ill) and exposure to the hazard studied increases it by a factor b, the rate observed in the exposed group is obviously br, and the relative risk is br/b = r. The odds ratio is defined as [br/(1 - br)]/[r/(1 - r)], or the ratio of ill to well exposed subjects divided by the ratio of ill to well control subjects. The odds ratio is larger than the relative risk, but the differences are small when the direct risks are 1% or less. Odds ratios are readily calculated in the analytical procedure known as logistic regression analysis, which is commonly used to analyse the effects of different factors on illness in large, multivariate epidemiological studies. Relative risk has no real meaning in retrospective case–control studies of outbreaks, where the number of well, but exposed, subjects is an unknown fraction of the total population who were exposed to the hazard, and the odds ratio is therefore given instead.

1.4.4 The use of quantitative microbiological risk assessment in assessing risk

Quantitative microbiological risk assessment (QMRA) can play a useful role in assessing the risk of infection from the use of recreational water. In its simplest form, it consists of four steps:

- hazard assessment;
- exposure assessment;
- dose–response analysis; and
- risk characterization.

In terms of recreational water, the hazard assessment relates to the microorganism of concern, *Cryptosporidium*, for example. The exposure assessment determines the likely dose (or range of doses) of microorganisms received by the water user and is a function of the level of microbiological contamination and amount of water ingested. Information on microbiological contamination is usually derived from the results of routine monitoring. Few data exist on the amount of water ingested during a "typical" recreational-water exposure, so a standard default value of 100 ml per day is generally used (Haas, 1983). The dose–response analysis step relates the dose of microorganisms received to the likely infection. These data are usually determined from limited healthy adult volunteer feeding experiments and then extrapolated, using a mathematical model, to the low doses typically experienced from recreational waters. Human dose–response data are available for a number of microorganisms, including *Cryptosporidium parvum*, which has documented swimming pool transmission (Lemmon et al., 1996; see also chapter 3). The risk characterization step combines the information on exposure and dose–response and results in an overall estimation of the likelihood of infection, which is often expressed as an annual risk of infection of, say, 1/10 000.

The results of QMRA can provide useful guidance, but a number of factors must be borne in mind. Monitoring data may present only a "snapshot" picture of the true situation and, depending upon how the monitoring is conducted, may not be representative. Data are lacking on the level of ingestion of recreational water, and levels may vary significantly between different groups of users. The dose–response relationships may be derived from single experiments involving a small number of healthy adult volunteers; the results of these experiments may not be appropriate for all user groups. In its simplest form, QMRA does not account for issues such as secondary infection, although more sophisticated techniques, employing epidemiologically based models, are being pioneered (Eisenberg et al., 1996).

1.4.5 Degree of water contact

For hazards where contact with water and ingestion of water are important, an understanding of the different degrees of contact associated with different pool types and uses is essential. The degree of water contact directly influences the degree of contact with infectious disease and toxic agents found in contaminated water and therefore the likelihood of contracting illness and the symptom severity.

The degrees of water contact encountered in the many different types of swimming pools, spas and similar recreational-water environments may be classified as follows:

- *No contact* — for example, outdoor pools where sunbathing may be the primary reason for visiting the facility.
- *Meaningful direct contact* — involves a negligible risk of swallowing water, such as wading and the use of spas, hydrotherapy pools, etc., where the body is immersed but the head is not.
- *Extensive direct contact* — with full body immersion and a significant risk of swallowing water, e.g., swimming, diving.

1.5 Nature of the guideline values

A guideline can be either a concentration of a constituent that does not represent a significant risk to the health of members of significant user groups or a condition under which such exposures are unlikely to occur. In deriving guideline values, account is taken of both the severity and frequency of associated health outcomes.

Bodies of water conforming to the guidelines may present a health risk to especially susceptible individuals or to certain user groups.

When a guideline is exceeded, this should be a signal to investigate the cause of the failure and identify the likelihood of future failure, to liaise with the authority responsible for public health to determine whether immediate action should be taken to reduce exposure to the hazard, and to determine whether measures should be put in place to prevent or reduce exposure under similar conditions in the future.

For most parameters, there is no clear cut-off value at which health effects are excluded, and the derivation of guideline values and their conversion to standards therefore include an element of valuation addressing the frequency and nature of associated health effects. This valuation process is one in which societal values play an important role. The conversion of guidelines into national policy, legislation and standards should therefore take account of environmental, social and economic factors.

Also because of the above, the existence of a guideline value or national standard does not imply that environmental quality should be degraded to this level. Indeed, a continuous effort should be made to ensure that recreational-water environments are of the highest attainable quality.

Many of the hazards associated with swimming pools, spas and similar recreational-water environments are of an instantaneous nature: accidents and exposures to microbiological infectious doses may occur in very short periods of time. Short-term deviations above guideline values or conditions are therefore of importance to health, and measures should be in place to ensure and demonstrate that recreational-water environments are continuously safe during periods of actual or potential use.

This volume of the *Guidelines for Safe Recreational-water Environments* does not address:

- occupational exposures of individuals working in recreational-water environments, with the exception of exposures of pool attendants or lifeguards to chemical hazards;
- waters afforded special significance for religious purposes and which are therefore subject to special cultural factors;
- risks associated with ancillary facilities that are not part of swimming pool and similar recreational-water environments — thus, while poolside surfaces are addressed, toilet facilities in adjacent areas are not considered beyond assertion of the need for them in order to minimize soiling of the recreational environment;
- electrocution;
- hazards associated with UV radiation;
- aesthetic factors — while the importance of aesthetic factors in ensuring maximum benefit for well-being from the recreational use of the water environment is discussed, no guideline values for aesthetic aspects are derived, since their valuation is one of societal and cultural values and since their control will not reduce adverse health effects;
- beneficial effects from medicinal claims, the efficacy of therapeutic use, or the scale of health benefits arising from relaxation and exercise associated with recreational-water use; or
- rescue, resuscitation or other lifeguarding techniques or evacuation procedures from swimming pools, spas and other recreational-water facilities.

1.6 Measures to reduce risks

Study of the examples of hazard given in Table 1.1 indicates that reduction of most, if not all, of their associated risks can be obtained by avoiding the circumstances giving rise to the hazard or by mitigating their effect. Table 1.1 also suggests particular types of recreation that may be prone to certain hazards and actions that may be taken to reduce the risk. For example, glass left on the poolside may cause the risk of cuts to walkers with bare feet, which may be overcome by regular cleaning of the pool, excluding glass from the pool area, provision of litter bins and educational awareness campaigns. Accidents caused by misuse of water slides may be overcome by education of users regarding proper behaviour and increased supervision by lifeguards. This suggests that each type of recreational activity should be subject to a hazard assessment to determine what type of control measures will be most effective. Assessment should include modifying factors, such as local features, seasonal effects (for outdoor pools) and competence of the participants.

The most appropriate controls for reducing risks in swimming pool/spa water recreation are discussed in chapters 5 and 6. Different uses and types of pools involve different degrees of

water contact and exposure to the various hazard forms. For each pool type, more than one hazard will be encountered, and the list of hazards for each will differ. Measures for risk reduction will therefore be tailor-made to each pool type and to particular circumstances.

Management of swimming pools, spas and similar recreational waters should consider different strategies to minimize health risk. These can be classified in four major fields:

- design and construction of facilities (including licensing and authorization, as appropriate);
- operation and management (including lifeguard training and certification and pool safety operating procedures);
- public education and information; and
- regulations and good practice (including licensing of equipment, chemicals, etc., available for use in swimming pools and spas).

Regulatory institutions responsible for the programmed process of sampling, measurement and subsequent recording of various characteristics (e.g., governmental environmental agencies/local authorities) are advised to assess the conformity of swimming pool and spa waters to local or national standards. In those countries where for many reasons it is difficult to achieve the guideline objectives immediately, central and local governments may set interim standards to ensure a progressive improvement towards the regulatory limits.

1.7 References

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