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REPORT OF THE EXPERTS SCIENTIFIC WORKSHOP ON CRITICAL RESEARCH NEEDS FOR THE DEVELOPMENT OF NEW OR REVISED RECREATIONAL WATER QUALITY CRITERIA

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CHAPTER 5
ACCEPTABLE RISK

Paul Hunter, Chair, University of East Anglia, U.K.
Michael Beach, Centers for Disease Control and Prevention
Lora Fleming, University of Miami School of Medicine and Rosenstiel School of Marine and Atmospheric Sciences, Florida
Peter Teunis, RIVM (National Institute of Public Health and the Environment), Netherlands
Timothy Wade, USEPA

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5.1 Introduction

This workgroup was primarily charged to reassess the extent to which existing microbiological criteria protect the health of swimming populations, and whether or not this is appropriate for current U.S. society. In particular, the workgroup was asked to consider the case of vulnerable (susceptible or sensitive) subpopulations and whether current levels of public health protection are sufficient for these people. The workgroup was also asked to consider whether it would be possible that improvements in recreational water quality criteria would be sufficient to improve public health protection for drinking water, recreational water, or consumption of shellfish.

Group members decided to organize the main questions under the following headings:

- Whether the term "acceptable risk" is still the most appropriate term.
- Public involvement in "acceptable risk" decisions
  - To whom should any risk from recreational water contact be "acceptable"?
  - How can we get public involvement in the decision making process over what is and what is not "acceptable"?
  - How best to communicate risk with and educate the general public about risks from recreational water.
- "Acceptable risks" to the general population
  - Whether the current methods for assessing risk from recreational water exposure are sufficient and if not, what new methods may be appropriate?
  - Whether risks differ between marine and freshwaters and whether it is "acceptable" to have different levels of protection for people bathing in these different waters.
  - Whether the current approach, based on protecting people from enteric illness is sufficient, or whether "acceptable risk" decisions need to take into account non-enteric illness.
  - Whether risks are different to people swimming in tropical, subtropical and temperate waters.
- "Acceptable risks" for vulnerable subgroups
  - Define the main vulnerabilities.
  - Determine what risks are greater in vulnerable subgroups and whether general recreational water standards are sufficient to protect these groups.
- What are the current levels of protection from existing criteria?
- Potential synergies for health protection between revised recreational water criteria and standards for drinking water and shellfisheries.

5.2 Main Conclusions and Observations

5.2.1 Whether the Term "Acceptable Risk" is Still the Most Appropriate Term

There was commonality amongst the workgroup members that the term "acceptable risk" is flawed and should be avoided during the process of creating recreational water criteria. The term

"acceptable" was felt to elicit responses related to "acceptable to whom?" and had the connotation that swimmers accepted the risk and there was some level of informed decision making during the process. Although a variety of suggestions for replacing "acceptable" were elicited (e.g., tolerable, appropriate, excess, increased), no agreement on terminology was reached. However, workgroup members felt that any new term should be simple, easily understood, and inclusive rather than paternalistic in nature. Workgroup members also felt that EPA should develop a policy that includes public interaction during the criteria development process.

This approach to determining "acceptable risk" should be broadly inclusive of impacted groups (e.g., swimmers, taxpayers who pay for beaches to be open) throughout the process. This would mean that EPA's decision making and criteria development process should include information on how impacted groups would determine the level of "acceptable risk" and how those risks and the concept of protective criteria would be best communicated. This would require that EPA's criteria development process (1) be clear, transparent, and communicated to all stakeholders; (2) factor in and include input and data collected from impacted groups; (3) include a data-informed communication package to educate impacted groups when the new criteria are released; and (4) develop a plan for assisting state and local authorities with future communication of the concepts of "acceptable risk" and the meaning of beach closures and advisories to the public. Such an effort would require collaboration with sociologists and anthropologists to assess risk perception and risk communication research and apply this to development of appropriate assessment tools for determining key elements necessary for criteria development, release, and interpretation. Rapid integration of this information into ongoing EPA criteria development would be expected to build or improve partner involvement and acceptance of the new criteria.

5.2.2 Public Involvement in "Acceptable Risk" Decisions

Including public involvement in the criteria setting process would require that impacted groups are first informed about the process and then information solicited about how these groups make "acceptable risk" decisions and how tolerant these groups would be of risk associated with recreational swimming area use. Key research questions include the following: (1) What does the public understand currently? (2) What does the public think of when one uses the term "acceptable risk"? (3) How does the public interpret existing criteria and beach closures/advisories? (4) How does/should EPA communicate this risk? and (5) What level of risk would the public accept? The voluntary nature of recreational swimming needs to be clearly explained and put in context with other routinely and voluntarily accepted risks (e.g., driving to the beach, eating at local restaurants, smoking). The breadth of illness associated with swimming and types of illness to be reduced by new or revised recreational water quality criteria needs to be clear. Workgroup members felt that current criteria were not well understood by the public or beach managers so that indicator cutoff values (i.e., beach closures) connoted zero risk and "safe" water rather than an understanding of the concept of "acceptable risk." These groups should be allowed to provided input on factors used in the decision making process (i.e., reduction of illness in children being a decision point). Workgroup members appreciate that EPA will ultimately be making the decisions and setting criteria but felt that a more informed and communicative path for this decision making is critical to future acceptance of these new or revised criteria.

Workgroup members suggested that EPA conduct the following activities:

1. Begin building a transparent communication plan to inform impacted groups about ongoing criteria development.
2. Rapidly initiate studies to assess how impacted groups understand and perceive the risks associated with recreational water use and what level of voluntary risk would be "acceptable," followed by evaluation of final communication materials.
3. Develop a multi-year plan to communicate the criteria development process to impacted groups and a communication plan for educating impacted groups about the new criteria.
4. Assist state and local officials in developing data-based risk communication plans for communicating information on criteria interpretation and beach closures/advisories to the public.

5.2.3 "Acceptable Risk" Levels for the General Population

Method for Assessing Risk

Workgroup members identified epidemiological (both randomized control and prospective observational cohort designs) and quantitative microbial risk assessment (QMRA) studies as the main methods for assessing risk. Some workgroup members noted that while QMRA is widely used and relied on by EPA for drinking water applications, it does not seem to be as widely used for recreational waters (with the exception of the work done by Jeffrey Soller). To broadly evaluate the gastrointestinal (GI) illness risk associated with the numerous potential pathogens found in recreational waters, epidemiological studies were viewed as more appropriate, although workgroup members believed the EPA should investigate expanding the role of QMRA (see also Chapter 4). One distinction noted was that although epidemiological studies are good at assessing the generally common and self-limiting risks associated with swimming in fecally-contaminated waters, they are not well-suited for investigating rare but potentially severe (and potentially life-threatening) illnesses that may be associated with recreational water exposure such as enterohemorrhagic *E. coli* (EHEC). For these special cases, workgroup members felt QMRA approaches may be the best way to assess risk and address potential outbreak situations.

Other cases where QMRA could be useful would be for evaluating specific risks associated with specific waterborne pathogens (although not necessary rare) such as *Cryptosporidium*, Norovirus, and *Shigella*. A third method that has not yet been widely applied to assess risk from recreational waters is dynamic infectious disease modeling (with the exception noted above). These models are a form of QMRA, but specifically account for factors such as the immune status of the population (susceptible, infected, immune), rates of secondary transmission of illness, and other parameters.

Workgroup members also noted that epidemiological studies can identify illness, but not infections, whereas QMRA studies can predict infections, but have more uncertainties associated with translating infections into an estimation of illness. Although epidemiological studies provide valuable results, there may be some confusion in their interpretation and application; for example, most studies of recreational waters to date have been conducted at beaches with known human sources of fecal contamination and results may not apply to other sites. EPA needs to

clearly explain the purpose of such studies (current, planned, and previous studies), their focus, and limitations.

Marine versus Freshwater

Workgroup members did not see any reasonable rationale for different "acceptable risk" levels in marine and fresh recreational waters. Although the current "acceptable risk" levels based on EPA's *Ambient Water Quality Criteria* [AWQC] *for Bacteria – 1986* are different for fresh and marine waters (gastroenteritis rate of 8 per 1,000 swimmers in freshwaters and 19 per 1,000 in marine waters), workgroup members believed this to be an arbitrary decision that was not well founded. Workgroup members agreed that there could be different indicators, or different levels for the same indicator across marine and fresh recreational waters, but those levels should relate to the same estimate of risk. Furthermore, justifying differences in risk to the public and stakeholders based on type of water would continue to be confusing and problematic.

There was some further discussion about how to account for differences in baseline levels of illness that could exist across locales and whether use of a relative risk scale instead of an excess (or attributable risk) scale may be a better way of addressing such differences. There is a distinct difference between doubling an absolute risk versus doubling a relative risk (see Section 5.2.5).

Enteric versus Non-enteric

Workgroup members felt that criteria based on pathogen indicator levels derived to protect against GI illness would not necessarily protect against all non-enteric illnesses, with the possible exception of certain upper respiratory illnesses (URIs) transmitted via the fecal-oral route. At least one study (Fleisher et al., 1996) observed exposure-response relationships with fecal streptococci (enterococci) and URI; workgroup members believed there was potential for pathogens causing such illnesses (e.g., adenoviruses) to be transmitted via fecally-contaminated waters. The workgroup members felt that most causes of other non-enteric illnesses (e.g., rash, earache) were most likely to be caused by environmental or naturally occurring conditions and/or pathogenic microorganisms unrelated to fecal contamination (e.g., *Naegleria* infection, non-cholera *Vibrios*) and therefore would not be explicitly controlled by criteria based on protection for GI illness (WHO 2003).

There was uncertainty about EPA's role in protecting against such illnesses, particularly those that are not anthropogenic. However, there are some risks that were unclear. For example, cyanobacteria concentrations can be influenced by nutrients and human impact, and may also be a cause of swimming-associated skin infections, respiratory infections, or long-term chronic conditions such as liver cancer (Chorus and Bartram, 1999; Fleming et al., 2002).

Workgroup members felt that earaches (*otitis externa* or "swimmers ear") were probably the most debilitating of the commonly occurring swimming associated non-enteric illnesses. However, they also felt that there was no evidence that such infections (often caused by *Pseudomonas*) were associated with fecal indicator bacteria, and therefore AWQC or State Water Quality Standards based on fecal indicators would not afford public health protection for

those illnesses. Workgroup members also felt that other indicator bacteria, or other types of indicators, are not currently available to protect swimmers from most non-enteric illnesses.

Workgroup members agreed that when a beach was closed due to fecal contamination then potential non-enteric swimming associated illnesses would also be prevented, although this would be inadvertent and it is not clear how often or under what circumstances this would occur (e.g., Do currently used indicators correlate with the presence of cyanobacteria or *Pseudomonas*?).

Tropical and Subtropical versus Non-tropical Recreational Waters

Workgroup members identified the possibility that tropical and subtropical recreational waters may have to be approached differently from temperate waters because of issues such as regrowth and significant spatial or temporal variability of both indicator organisms and pathogens in the water and soils, substantially different ecosystems and climatic conditions (including heavy rains), and possibly the presence of a greater range of "exotic" pathogens. In addition, persons may experience longer term seasonal exposures in tropical and subtropical recreational waters due to the warm waters throughout the year. Finally, it is highly likely that the background rate of GI diseases is higher in tropical and subtropical populations (Payment and Hunter, 2001).

It is important to note that workgroup members believe that people in tropical and subtropical areas should not be exposed to greater health risks from exposure to recreational waters than people in more temperate areas.

Relative risk measures, unlike excess risks, express risk as a proportion of baseline risk and thus correct for varying background levels. Workgroup members discussed other ways to describe risk in place of an "acceptable risk" framework, including illnesses prevented as a result of implementing criteria (as done by the U.S. Food and Drug Administration [FDA]). Workgroup members felt that there was need for risk communication in this area so that risks are fully and accurately communicated.

5.2.4 "Acceptable Risk" Levels for Vulnerable Subgroups

Definitions

In considering vulnerable human populations with regards to the health risks from exposure to recreational water, workgroup members distinguished between two major categories of vulnerability, (1) persons at different life stages, and (2) persons with suppressed immune function.

What is Different?

Life stage connotes that for a variety of reasons, humans vary in their level of vulnerability to the health risks associated with exposure to recreational water over their life span. In particular, the discussion focused on the possible increased vulnerability of children, pregnant women (and their fetuses), and the elderly. Workgroup members felt that children are at a greater increased

risk compared to all other life stages because of their behavior and possibly because of naïve immune status. Because all members of the population pass through life stages, classifying childhood as a life stage instead of simply a subpopulation strengthens the argument for explicitly considering children when developing AWQC. Regarding behavior, children probably have higher exposures; that is, they are more likely to consume both marine and freshwater. Moreover, young children have significant hand-to-mouth and fecal-oral behavior that may lead to the consumption of contaminated substances. Very young children may also be more vulnerable to pathogens in recreational waters because they have never been exposed to these pathogens previously. Of note, preliminary, unpublished data from recent studies by EPA (NEEAR; Timothy Wade, EPA Office of Research and Development, personal communication, 2007) as well as results from other published studies appear to demonstrate an increased risk of GI illness and possibly respiratory illness for children from exposure to recreational waters, although this has not yet been formally reviewed.

Pregnant women (and their fetuses) and the elderly may be at increased risk for more severe consequences from acquiring GI diseases from exposure to recreational waters. Pregnant women and their fetuses may be at greater risk from certain recreational water pathogens (e.g., coxsackie B virus associated with fetal infection when acquired close to delivery, and enterovirus associated with certain fetal malformations). Furthermore, pregnant women may be at increased risk for significant dehydration and its consequences if they do acquire a GI infection resulting from contact with recreational water. Finally, although the elderly were believed to be less exposed due to decreased high intensity swimming behavior, it might be possible that the decreased immune function associated with increasing age might make them more vulnerable to infection and illness.

Workgroup members also identified a potentially large subpopulation of persons with suppressed immune function, ranging from persons with HIV/AIDS to persons undergoing chemotherapy and using other immunosuppressive medications. Of note, a portion of the latter subpopulation could be completely unaware of their suppressed immune function. As a group, persons with suppressed immune function would be at increased risk compared to the healthy population of acquiring diseases from a range of opportunistic pathogens found in recreational waters, such as *Cryptosporidium, Toxoplasma*, and *Vibrio parahemolyticus*. Furthermore, persons with suppressed immune function may be at increased risk of more severe consequences from these diseases as well as from the effects of dehydration—a secondary ramification of GI diseases.

Tourists and visitors were identified by workgroup members as a unique potentially vulnerable group to increased health risks associated with exposures to recreational waters. Similar to small children, these people may be previously unexposed to the range of pathogens in a new recreational water environment, and as such, more susceptible to both acquiring the infection and disease—possibly with more severe health consequences. Given that many of these people are on vacation, they may experience greater exposure to recreational waters.[9] Further, given that significant tourist travel is to tropical and subtropical areas, there may be additional risks from a range of exotic pathogens and potentially unique ecosystem conditions found in tropical and subtropical recreational waters.

[9] Tourists may spend long periods of time in the water over several days, whereas local users may have shorter exposures that are spread further apart.

Overall, workgroup members believed that the apparent increased risk for children for acquiring GI and possibly other diseases from exposure to both fresh and marine recreational waters should drive the health risk assessment of any future recreational water criteria development efforts, assuming the current and future research continue to demonstrate their apparent increased risk. Workgroup members emphasized that future recreational water criteria set on health risks and exposures of adults would not be sufficiently protective for children. As mentioned previously, because of differences in susceptibility between adults and children (and other subpopulations as well) a given numeric criteria translates to different risk levels for each subpopulation. Therefore, it is impossible to protect adults and children equally. The workgroup members felt that data on children should be explicitly considered for deriving the "acceptable risk" level in the development of new or revised recreational water quality criteria, with the understanding that the associated risk level for adults would then be even lower.

Workgroup members felt that the increased risk to immunosuppressed people should not be an important factor in setting any future recreational water criteria because the factors associated with the increased risk of disease in this vulnerable subpopulation are not controllable or achievable through management of recreational water sites. Rather, an emphasis should be made on improved risk communication with immunosuppressed groups and health care professionals to inform them about risks associated with recreational water use and, in consultation with their health care provider, assessment of the need to avoid recreational water exposure.

5.2.5 What are the Current Levels of Protection from Existing Criteria?

It is not certain how accurate the current levels of protection are. "Magic" numbers like 8 or 19 cases of gastroenteritis in 1,000 swimmers can "take on a life of their own," increasing the risk of distraction from the basic objective—providing best effort to protect swimmers. This provides a compelling reason for not deriving and using a single numeric value for the targeted risk for new or revised AWQC. Risk levels from preliminary unpublished data from the EPA NEEAR study seems to agree with WHO (2003) B category waters (i.e., 1 illness per 20 swimmers) (see Table 1, Chapter 1; Timothy Wade, EPA Office of Research and Development, personal communication, 2007). Pathogens associated with threshold indicator levels in current (US EPA, 1986) AWQC may differ from those in 2007; the population established in 1986 also may have different susceptibility due to differences in immunity to current pathogens in 1986 versus 2007. Aside from protection against enteric illnesses, it seems likely that enterococci levels below current standards also provide some protection against upper respiratory tract infections.

Instead of absolute levels of risk, workgroup members felt that the preventable fraction is a better measure for the level of protection. This includes information on the background level of risk against which the risk associated with recreational water use must be compared. Presence of other major exposure routes may mask any beneficial effects of lowering risks due to recreational bathing. Thus, an absolute reduction in illness from recreational water may not be reflected in a similar reduction in total cases in the community if people simply become infected by other transmission routes. On the other hand, disease reduction may be even greater if secondary cases are also prevented. Most recreational water exposures are experienced by a minority of the population who are repeatedly (chronically) exposed.

It is also possible that part of the primary contact-associated infections is caused by bather-to-bather transmission. This independent, direct fecal contamination would be unaffected by monitoring programs designed to limit sewage contamination. Further studies are needed to understand the role of bather shedding in disease transmission and microbial water quality indicator levels.

In a trade-off situation, acceptability of risk is partially determined by its source; that is, pathogen-shedding by fellow swimmers is difficult to control and may be more readily accepted than contamination by treated sewage effluent or agricultural runoff, whose risks are usually considered less acceptable. More important than trying to enforce compliance with a fixed standard level of risk, is the need to work toward continual improvement in public health associated with recreational water use.

5.2.6 Potential Synergies for Health Protection between New or Revised Recreational Water Criteria and Standards for Drinking Water Sources and Shellfish Harvesting Waters

Workgroup members considered that any change in recreational water criteria that led to improved public health protection would not negatively impact on the risks from drinking water or shellfish consumption. However, some workgroup members did express concern about any change that would encourage further recreation in waters intended to be used for drinking water production or for shellfish harvesting. When people bathe they invariably contaminate the water to some extent with potential pathogens. Such pathogens may then be concentrated within shellfish or contaminate drinking water supplies and pose a health risk to others.

5.2.7 Areas of Discord

Although workgroup members accepted that the phrase "acceptable risk" was widely used, they realized that there were difficulties in its general acceptance. However, no alternative to the phrase was thought to be "acceptable" to all workgroup members. Although the phrase "tolerable risk" is now being used more frequently internationally, it was still not tolerated by all members of the workgroup.

5.3 Research Needs

1. ***Risk perception studies to inform the risk communication strategy for the criteria rollout and focus groups to evaluate the risk communication strategy***
    a. Assess public understanding of relative versus absolute risk.
    b. Key research questions include the following: (1) What does the public understand currently? (2) What does the public think of when one uses the term "acceptable risk"? (3) How does the public interpret existing criteria and beach closures/advisories? (4) How does/should EPA communicate this risk? and (5) What level of risk would the public accept?

2. ***Define the data and conditions where a directed monitoring program would be necessary to protect against certain non-enteric (non-GI) illness.***

a. Such research would probably require pathogen-specific studies, and a possible role for QMRA.

3. ***EPA should investigate expanding the role of QMRA, particularly for investigating rare but potentially severe (and life-threatening) illnesses that may be associated with recreational water exposure such as EHEC (e.g.,* E. coli *O157:H7).***
   a. Define data needed for the QMRA modeling for special/outbreak cases and also for background/regular situations.
   b. Engage EPA experts in QMRA in recreational water research.
   c. Explore approaches to integrate QMRA (and/or dynamic modeling) to better understand recreational risk, especially situations with rare, but potentially severe outcomes.

4. ***Conduct methodologic comparisons in tropical and subtropical recreational waters and if appropriate, conduct epidemiological studies.***

   Methodological and ecological studies need to be conducted in tropical and subtropical recreational waters because of issues such as regrowth, significant spatial and temporal variability of both indicator organisms and pathogens in the water and soils, substantially different ecosystems and climatic conditions (including heavy rains), and possibly a greater range of exotic pathogens. These studies would determine the impact of these environmental factors on the use of proposed indicators organisms to be used for monitoring and regulatory purposes. Depending on the results of these studies, assessment of the need for epidemiologic studies specifically in tropical and subtropical recreational waters should be performed. This information will be essential to determine whether the same recreational water criteria as used elsewhere in the United States are also appropriate in these waters. Information on risks in such waters will help ensure appropriate risk communication to healthcare providers, public and environmental health managers, and residents of and visitors to tropical and subtropical areas concerning the risks of tropical and subtropical recreational waters.

5. ***Ensure that future epidemiological studies obtain data on and existing studies are reviewed for risk to children.***

   Children appear to be at increased risk for acquiring GI illness and possibly other illnesses from exposure to recreational waters; therefore, workgroup members felt future recreational water criteria should be based on the health risk to children. If existing standards are deemed not to provide sufficient protection to children then additional information will be needed to establish new or revised criteria that are thought to provide sufficient protection. Such information will also be essential to provide risk information to parents and others responsible for children.

6. ***Review prior data to evaluate whether additional epidemiological studies are needed to determine the risk of severe disease to pregnant women and their fetuses, to the elderly, and to immunosuppressed individuals.***

   There is evidence that pregnant women (and their fetuses), the elderly, and immunosuppressed people may suffer more serious disease and/or more serious health

consequences from recreational bathing waters. If these data show that there may be increased risks, then the incorporation of these subpopulations as specific target populations in future epidemiological studies should be considered. Information on risks in such waters will help ensure appropriate risk communication to healthcare providers, public, and environmental health managers, and these potentially increased risk groups from recreational waters.

7. Determine how risks in tourists and visitors differ from those in residents.

There is some evidence that risk may be greater for tourists and visitors than for residents local to a recreational water; thus, current estimates may underestimate the actual risk and so give inappropriately lax criteria (Payment and Hunter, 2001). Consideration should be given to the design and implementation of future epidemiological studies to address risk in tourists and visitors. It may also be possible to review data from previous studies to determine if there are increased risks to tourists. Information on risks in such waters will help ensure appropriate risk communication to healthcare providers, public, and environmental health managers, and tourists with exposure to recreational waters.

8. Ecology of swimming-related waterborne pathogens, including studies on the role of bather shedding on transmission of illness and microbial water quality indicators

Further studies are needed to understand the role of bather shedding in disease transmission and microbial water quality indicator levels. How efficiently are pathogens transmitted through swimming or bathing? This could be an experimental study, partly, augmented by epidemiology (serology, or microbial source tracking in a small study population).

9. *How many illnesses are prevented by beach closures?*

Studies of the number of illnesses prevented by beach closures would be primarily a modeling/statistical exercise. First, the procedures/modeling assumptions should be agreed upon. It could be done relatively easily in a QMRA-type of study.

Table 6 provides a summary of how each workgroup member ranked the above research needs in relation to overall importance (1 to 5), relevance to EPA, and estimated time needed to complete the project.

Table 6. Research Needs and Rankings from Five "Acceptable Risk" Workgroup Members.

Description	Importance					Relevance to EPA					Near- and/or Long-term				
Conduct risk perception studies to inform the risk communication strategy for the criteria rollout and focus groups to evaluate the risk communication strategy (#1)	5	5	5	5	5	5	5	5	5	5	N and L	N	N	N	N
Assess public understanding of relative versus absolute risk (#1)	1	2	1	3	3	1	1	1	3	3	N and L	N	N	N	L
Define the data and conditions where a directed monitoring program would be necessary to protect against certain non-enteric (non-GI) illness (#2)	3	3	2	3	3	3	3	2	3	3	N and L	N	L	N	L
Define data needed for the QMRA modeling for special/outbreak cases also for the background/regular situation (#3)	3	4	3	3	5	3	4	3	3	5	N and L	L	N	N	N
Engage QMRA in recreational water research (#3)	2	3	3	3	5	2	3	4	3	5	N and L	N	N	N	N
Explore approaches to integrate QMRA (and/or dynamic modeling) to better understand recreational risk, especially situations with rare, severe outcomes (#3)	4	2	4	3	4	4	2	4	3	4	N and L	L	N	N	N
Conduct future epidemiological studies in tropical and subtropical bathing waters (#4)	4	4	2	5	5	4	4	2	5	5	N	N	N	L	L
Ensure that future epidemiological studies obtain data on and existing studies are reviewed for risk to children (#5)	5	4	5	5	5	5	4	5	5	5	N	N	N	L	N
Review prior epidemiological studies to determine the risk of severe disease to pregnant women and their fetuses (#6)	2	2	1	3	5	2	2	2	5	4	L	L	L	L	L
Review prior epidemiological studies to determine the risk of severe disease to the elderly (#6)	1	2	1	3	5	1	2	2	5	4	L	L	L	L	L
Review evidence about whether or not immunosuppressed individuals are at increased risk from recreational bathing waters (#6)	4	3	1	4	5	4	3	2	5	3	L	N	N	N	N
Determine how risks in tourists and visitors differ from those in residents (#7)	4	5	2	4	4	4	5	2	4	5	N	N	L	N	L
Conduct studies on the role of bather shedding on transmission of illness and microbial water quality indicators (#8)	5	5	5	4	5	5	5	5	5	5	N	N	N	L	N
Determine the ecology of swimming-related waterborne pathogens (#8)	3	4	3	5	3	3	4	3	5	5	L	L	L	L	L
Determine how many illnesses are prevented by beach closures?(#9)	4	4	4	5	3	4	4	4	5	5	N and L	N	N	N	N

Scoring for importance: score 1 not at all important to 5 highly important
Relevance to EPA: score 1 not at all relevant to 5 highly relevant
For time: N (within next 2 to 3 years); L (within next 10 years)

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