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## **Policy Statement: Model Aquatic Health Code**

Americans swim hundreds of millions of times in pools, oceans, lakes, rivers, hot tubs, and spas every year and most people have a safe and healthy time enjoying these activities. Outbreaks of recreational water illnesses, however, have increased significantly over the last several decades and drowning, near-drowning, and pool-related chemical injuries continue to occur. These incidents highlight the importance of public pools and spas to be designed, constructed, operated, and inspected to keep swimmers healthy and safe. The National Environmental Health Association (NEHA) advocates for national, state, and local policies, regulations, research, and resources that will enhance the abilities of environmental health professionals to ensure aquatic venue safety and to protect public health. NEHA recommends the following:

For State, Local, Tribal, and Territorial Government Agencies

- Incorporation of the Model Aquatic Health Code (MAHC) into state and local regulations and public health policies to reduce aquatic injury and illness.
- Participation in the Council for the Model Aquatic Health Code (CMAHC) to provide input and vote on future editions of the MAHC.
- Performance of pool inspections that is based on the MAHC to ensure safety and provide uniform data on aquatic health.
- Encouragement of the public to engage in safe and hygienic swimming behavior.
- Use of the MAHC to standardize pool inspections across jurisdictions and to encourage uniform understanding of and compliance with aquatic health and safety requirements.
- Assurance that regulatory agencies have the resources, as well as the training and guidance needed, to conduct inspections of aquatic facilities.
- Investment in research to ensure that improvement of aquatic facility design and operation is a part of the national research agenda.

### **Background**

Americans make more than 300 million trips to swimming pools and other aquatic facilities every year, making water activities among the most popular forms of physical exercise and recreation in the nation (Centers for Disease Control and Prevention [CDC], 2016a). Swimming can reduce the risk of chronic illness, improve mental health, and provide a source of exercise for the elderly (CDC, 2016b).

Implementing measures to reduce the inherent risks associated with engaging in these types of activities can be challenging for environmental health professionals. There is no federal regulatory agency that oversees aquatic facilities, therefore, the task falls to state and local governments. Regulations governing aquatic facilities differ widely across the nation, with many codes that are outdated or lack the breadth to adequately protect public health in aquatic settings. The lack of uniformity in health codes might create confusion for designers and builders who operate across jurisdictions and for interstate businesses such as hotel chains.

A recent study showed aquatic facility inspection findings, specifically violations and closures, under current health codes. In the five states included in the report, approximately 80% of inspections identified at least one health code violation and nearly one in eight inspections identified threats to public health serious enough to warrant immediate closure of the facility. Common violations included improper disinfectant concentrations and pH levels, lack of required safety equipment, and unsafe pool chemical practices such as disinfectant chemicals being improperly labeled or stored (Hlavsa et al., 2016).

Aquatic facilities that do not meet health codes or follow codes that do not reflect the latest science and best practices might not minimize the risk of recreational water illness and injury and protect public health. Pool water might be contaminated by human and environmental sources and could become a vehicle for transmission of pathogens once they are introduced into the water. One of the ways swimmers can introduce potentially infectious microorganisms into pool water is from contaminants washing off their skin. For this reason, bather hygiene is particularly important for protecting public health. By analyzing shower water samples, one study demonstrated that most contaminants can be removed from the skin by a 60 second preswim shower (Keuten, Schets, Schijven, Verberk, & van Dijk, 2012).

Reported disease outbreaks associated with aquatic facilities have increased over recent decades. From 1978–2012, 650 disease outbreaks associated with aquatic facilities were reported to the Centers for Disease Control and Prevention (CDC) (Hlavsa et al., 2016). A study that looked at only 2011–2012 data documented 69 waterborne outbreaks in treated U.S. waters, resulting in 1,309 cases of illness and one death (Hlavsa et al., 2015). The increase in the number of outbreaks associated with the chlorine-resistant pathogen *Cryptosporidium*, beginning in the early 1990s, has contributed significantly to the rise in recreational water-associated outbreaks reported annually. *Cryptosporidium* was the most common agent in the outbreaks reported from 1978–2012 and accounted for 52% of outbreaks from 2011–2012, infecting as many as 144 people in a single outbreak (Hlavsa et al., 2015, 2016). While chlorine does not effectively treat *Cryptosporidium* at levels normally maintained for disinfection and bather comfort, it does inactivate many other pathogens at these levels. Outbreaks of chlorine-susceptible pathogens illustrate the prevalence of improper operation and maintenance, which produces inadequate disinfectant concentrations and pH levels.

A 2012 study analyzed medical and pharmaceutical insurance claim information to assess the cost of treatment for selected waterborne diseases. This study estimated that treatment of cryptosporidiosis costs \$9,000–\$20,000 for hospitalized cases and \$270–\$760 for outpatient treatment. Legionnaires' disease, which is also sometimes associated with treated recreational water illness outbreaks, was estimated to cost \$27,000–\$38,000 for inpatient treatment and \$560–\$590 for outpatient treatment (Collier et al., 2012).

In addition to increasing the risk of waterborne illness, improper operation, water chemistry issues, and equipment failures can cause injuries. Injuries associated with pool chemicals led to approximately 3,000–5,000 visits to emergency departments every year from 2003–2012. These injuries can be the result of equipment failure, operational errors, and lack of oversight. Common adverse health effects to bathers include irritation of the skin, eyes, nose, and throat. Improper chemical use and storage can also lead to injury. Chemical burns, respiratory irritation, headache, and nausea can occur from improper mixing and handling of chemicals (Hlavsa, Robinson, Collier, & Beach, 2014). Aspects of facility design can also affect exposure to pool chemicals and disinfection byproducts. In 2007, 665 reports of respiratory and eye irritation were documented among employees and patrons at a newly opened indoor water park in Ohio. An investigation determined that the ventilation system installed at the time was insufficient to reduce levels of airborne pool chemicals (Chen et al., 2008).

Aquatic venues can also be associated with other injuries. An average of 367 children younger than 15 years fatally drowned in pools and spas every year from 2011–2013. Of these incidents, 18% occurred in public or regulated facilities. In the 5 to 9-year-old age range, however, public venues were the location of 48% of fatal pool and spa drownings (Consumer Product Safety Commission, 2016). Drowning is also the leading cause of injury death in children 1–4 years old, with half of all fatal drowning events in this age group occurring in swimming pools. Additionally, it is estimated that for every child who fatally drowns, four children are hospitalized for nonfatal drowning (World Health Organization, 2000). The average cost of hospitalization for nonfatal drowning for all ages, including both medical expenses and work lost, is approximately \$284,000. For fatal drowning, the average combined cost is over \$1.2 million per incident (CDC, 2016c). Aspects of pool design that can reduce the risk of drowning include proper barriers to entry and emergency equipment. The presence of qualified lifeguards can also be an important prevention measure.

Furthermore, injuries can result from falls on the pool deck, broken glass near the pool area, overcrowding, or entrapment. From 2001–2008, more than 30,000 children younger than 10 years visited emergency departments for swim-related injuries. Failure to disseminate and enforce safety guidelines likely contributed to this number (Blake & Peters, 2012). Entrapment incidents can cause severe injury or death, and resulted in 29 injuries and 5 fatalities in public pools and spas from 1999–2010 (Consumer Product Safety Commission, 2011). Additionally, spinal injuries can result from diving into water that is too shallow, especially when the depth of the pool is unknown or improperly marked.

## **Justification**

In response to the recognized need for a coordinated effort regarding swimmer health and safety, the Council of State and Territorial Epidemiologists called for a national strategic plan in 2004. The following year, CDC organized a national workshop. A major recommendation from this workshop was that CDC lead a national partnership to create a model guidance document for swimming pool codes. Over the next several years, 12 technical committees were formed and were composed of industry experts, academics, and environmental health professionals from federal, state, and local levels. With input from two public comment sessions, the committees put together the first edition of the Model Aquatic Health Code (MAHC), which was released in 2014.

The MAHC draws on the experience of all sectors involved and presents a set of guidelines using science and evidence-based best practices. Its mission is to provide guidance on how “state and local officials can transform a typical health department pool program into a data-driven, knowledge-based, risk reduction effort to prevent disease and injuries and promote healthy recreational water

experiences” (CDC, 2014). Jurisdictions can choose to adopt the MAHC in its entirety or use sections to amend or supplement current codes. This flexibility, combined with the many performance based and prescriptive standards, allows health departments to tailor the MAHC to fit their needs.

Local and state health departments can lack the resources and expertise necessary to maintain an effective and up-to-date code. The MAHC is designed to be updated biennially by CMAHC, an organization composed of regulators, industry experts, and MAHC users in order to remain current and to continue to include best practices. Health departments can instead focus their resources on conducting facility inspections and preventing illness and injury.

The MAHC covers all aspects of aquatic facilities including design, operation, maintenance, policies, and management. Facility design includes secondary disinfection requirements for venues that are at an increased risk due to intrinsic characteristics of its users. This requirement is applicable to new construction or aquatic facilities undergoing substantial alterations and will help to reduce the impact of chlorine-resistant pathogens such as *Cryptosporidium*. The MAHC also provides facility layout requirements that encourage bather hygiene, including the location of showers and diaper changing stations to maximize their use and to reduce the introduction of contaminants into the water. Requirements for barriers to entry, self-closing gates, uniform depth markings, and warning signs are intended to reduce drowning and injury. Operation and maintenance requirements govern the disinfection process crucial to killing pathogens and preventing chemical injury. The MAHC also includes guidelines on how and when to test the water to confirm that it is maintained in a condition that is acceptable for swimmers. The policies and management section of the MAHC contains training requirements to ensure lifeguards and pool operators are qualified and properly trained.

The cost of improvements to existing facilities and required design elements for new facilities will be mitigated by the reduction in the risk of recreational water illness, injury, and drowning. Each of these events carries a substantial financial burden, as previously mentioned. For example, just one case of Legionnaires’ disease traced back to an aquatic facility can end up costing a facility more than what would have been spent on improvements and design elements.

The uniformity of aquatic facility requirements achieved through the adoption of the MAHC will also facilitate data collection and tracking of public health issues to conduct analysis and identify strategies to arrive at better health outcomes. Variation in the ways inspections are currently carried out make the study conducted by Hlavsa and coauthors (2016) difficult to conduct. Jurisdictions collect different data or collect the same data in different ways. For example, very few inspection forms used in the study recorded kinds of pools, like wading pools versus interactive water play venues. This lack of data uniformity limits the ability to recognize trends and prioritize inspections by venue type. Additionally, pH data are often reported only as being in or out of compliance. Data on the specific pH value, however, would provide better information to assess the impact of pH on the effectiveness of the disinfection process and bather comfort. Widespread implementation of the MAHC inspection form would create more consistent data that can be utilized by CMAHC to further improve the MAHC and give health departments and the aquatics industry information regarding where their resources can be more effectively invested.

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