National Environmental Health Association

The National Environmental Health Association (NEHA) represents more than 7,000 governmental, private, academic, and uniformed services sector environmental health professionals in the U.S., its territories, and internationally. This workforce represents the second largest constituent of the existing public health workforce, second only to nursing. We are the profession's strongest advocate for excellence in the practice of environmental health as we deliver on our mission to build, sustain, and empower an effective environmental health workforce.

Policy Statement on Recreational Waters and the Model Aquatic Health Code

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NEHA supports 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:

- Incorporate the Model Aquatic Health Code (MAHC) into state and local regulations and public health policies to reduce aquatic injury and illness at public venues. (*Note*. The MAHC is not intended for single family residences or small nonregulatory purposes).
- Participate in the Council for the Model Aquatic Health Code (CMAHC) to provide input and to vote on future editions of the MAHC.
- Perform pool inspections that are based on the MAHC to ensure safety and to provide uniform data on aquatic health.
- Encourage the public to engage in safe and hygienic swimming behavior.
- Use the MAHC to standardize pool inspections across jurisdictions and to encourage uniform understanding of and compliance with aquatic health and safety requirements.
- Ensure that regulatory agencies have needed resources, as well as training and guidance, to conduct inspections of aquatic facilities.
- Invest in research to ensure that improvement of aquatic facility design and operation is a part of the national research agenda.

Analysis

People in the U.S. 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], 2016). Swimming can reduce the risk of chronic illness, improve mental health, and provide a source of exercise for older adults (CDC, 2022a).

Recreational waters include public aquatic venues, public beaches, backyard pools, and natural bodies of water such as lakes, oceans, and rivers; however, injuries, drownings, chemical exposures, and outbreaks can occur at these different types of recreational waters. The MAHC is the foremost public health guidance for public aquatic venues but not for other recreational water venues.

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.

The MAHC is updated triennially to address new venue types and emerging technologies. The MAHC is focused on public health and is independent of business interests. This direction, combined with the many performance-based and prescriptive standards, allows state, local, tribal, and territorial 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 by CMAHC, an organization composed of regulators, industry experts, and MAHC users to remain current with public aquatic venue trends, best practices, and emerging technologies. Health departments can instead focus their resources on conducting facility inspections and preventing illness and injury rather than developing public health-based codes for aquatic venues.

The MAHC covers all aspects of aquatic facilities including design, operation, maintenance, policies, and management. The MAHC looks toward emerging issues, addressing novel venues such as splash pads, artificial lagoons, floating tanks, and surf menus. 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 can 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.

Justification

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.

Hlavsa et al. (2016) conducted a study of aquatic facility inspection findings, specifically violations and closures, under current health codes. In the five states included in the study, 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.

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. 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 pre-swim shower for 60 seconds (Keuten et al., 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 (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 1 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.

Collier et al. (2012) analyzed medical and pharmaceutical insurance claim information to assess the cost of treatment for selected waterborne diseases. The study estimated that treatment of

cryptosporidiosis costs $9,000–$20,000 for hospitalized cases and $270–$760 for outpatient treatment. Legionnaires' disease is also sometimes associated with treated recreational water illness outbreaks and was estimated to cost $27,000–$38,000 for inpatient treatment and $560–$590 for outpatient treatment.

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 error, 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 the improper mixing and handling of chemicals (Hlavsa et al., 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 389 children younger than 15 years fatally drowned in pools and spas every year from 2017–2019. Of these incidents, 20% occurred in public or regulated facilities. In the 5 to 9-year-old and 10 to 14-year-old ranges, however, public venues were the location of 49% and 53% of fatal pool and spa drownings, respectively. An annual average of the reported fatal drownings from 2017–2019 involved children younger than 5 years. In addition, from 2019–2021, an estimated 6,300 nonfatal drowning injuries related to pools or spas are treated in hospital emergency departments each year (U.S. Consumer Product Safety Commission, 2022). In the U.S., drowning is the leading cause of death in children ages 1–4 years and the second leading cause of injury death in children ages 5–14 years (CDC, 2022b). 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, 2023). 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, suction entrapment is also a contributing factor to reported fatal and nonfatal drownings. Suction outlet fitting assembly (SOFA) installations that are noncompliant can lead to hair entrapment, limb entrapment, body suction entrapment, evisceration and disembowelment entrapment, and mechanical entrapment. Entrapment incidents can cause severe injury or death and resulted in 11 injuries among children younger than 15 years, including 2 fatalities, in public and residential pools and spas from 2014–2018. Pools and spas in public settings accounted for 45% of reported suction entrapment incidents (U.S. Consumer Product Safety Commission, 2019). 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.

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