

©ASHRAE www.ashrae.org. Used with permission from ASHRAE Journal at <https://www.cdc.gov/nceh/ehs/docs/reducing-legionnaires-in-spas-508.pdf>. This article may not be copied nor distributed in either paper or digital form without ASHRAE's permission. For more information about ASHRAE, visit www.ashrae.org.

Reducing Legionnaires' Disease in Public Spas

BY CANDIS M. HUNTER, REHS; JOE LACO, REHS; AND JASEN KUNZ, REHS

Data from the Centers for Disease Control and Prevention (CDC) shows improper maintenance of public spas increases risk for Legionnaires' disease. Legionnaires' disease affects thousands of individuals each year and represents a significant public health burden, with a 10% case fatality rate and an estimated annual hospitalization cost burden of \$433 million.^{1,2} CDC's Model Aquatic Health Code (MAHC) offers critical guidance for reducing the risk of Legionnaires' disease in public aquatic facilities.

For example, the MAHC contains construction, operation and procedural requirements to facilitate appropriate water pH and disinfectant concentrations levels in public spas. Additionally, the MAHC outlines policies and certifications for training documentation among aquatic facility staff. Facility owners, operators, managers and other stakeholders involved in design, construction, maintenance and repair of building water systems can use the MAHC provisions to develop a water management program in aquatic facilities that is compliant with ASHRAE Standard 188-2015, *Legionellosis: Risk Management for Building Water Systems*. These elements will support program elements such as control limits, corrective actions and record keeping, which are important components of an ASHRAE Standard 188-2015-compliant water management program. Incorporating the MAHC principles of proper spa operations and maintenance, trained operators and monitoring can help reduce risk of Legionnaires' disease.

Legionnaires' Disease

Legionnaires' disease is caused by inhalation of water droplets contaminated with the bacteria *Legionella*,

which is the leading cause of illness among reported drinking water outbreaks in the United States.³ Factors associated with *Legionella* growth are biofilm, scale and sediment, water temperature and pH fluctuations, inadequate disinfectant levels, water pressure changes, water stagnation and warm temperatures.⁴ Since *Legionella* thrives in warm freshwater environments, improperly maintained spas can allow *Legionella* to grow to high numbers and infect people that use or come close enough to spas to inhale the contaminated mist.

CDC's MAHC defines a spa as "a structure intended for either warm or cold water where prolonged exposure is not intended." Spa structures are intended to be used for bathing or other recreational uses and are not usually drained and refilled after each use. Spa types include, but are not limited to, hydrotherapy, air induction bubbles and recirculation.⁴ The MAHC is voluntary guidance based on science and best practices that can help local and state authorities and the aquatics sector (e.g., public health, operators, industries and other

Lt Cdr Candis M. Hunter is an environmental health scientist, Cdr Joe Laco is an environmental health officer, and Cdr Jasen Kunz is an industrial hygienist at the Centers for Disease Control and Prevention (CDC) in Atlanta.

aquatic facility stakeholders) make swimming and other water activities healthier and safer. States, localities and the aquatics sector can use the MAHC to reduce the risk for outbreaks, drowning and pool-chemical injuries. The MAHC guidelines are all-inclusive and address the design, construction, operation, maintenance, policies and management of public aquatic facilities.⁵

Public Health Data to Support MAHC Use

Frequent health and safety violations of local aquatic facility codes (e.g., pH, temperature and disinfectant concentration) have often been reported at public pools and spas, and continue to challenge proper pool and spa maintenance. In 2016, CDC's Network for Aquatic Facility Inspection Surveillance (NAFIS) reported that 11% of routine pool inspections (5,139 out of 43,636) resulted in immediate closure.⁶ An even higher percentage of routine hot tub/spa inspections reported to NAFIS resulted in closure: 15.1% (2,217 of 14,637).

The NAFIS data shows that the most frequent hot tub/spa violations from inspections were problems with:

- Disinfectant concentration (19.2%);
- pH (27.5%);
- Pool chemical safety (9.9%); and
- Excess water temperature (7.5%).

In 2016, CDC further reported that hot tubs (when improperly maintained) was the third most common water source implicated among Legionnaires' disease outbreaks investigated by CDC. More specifically, human errors were implicated in at least half of all investigated outbreaks and included:⁷

- Improper filter maintenance;
- Deficient disinfection levels;
- Inadequate monitoring; and
- Poor temperature control and ventilation.

The CDC data highlights that improper operation and maintenance of public spas is common, and that missed prevention opportunities can lead to outbreaks of Legionnaires' disease.

The MAHC

The MAHC, updated every two years, is comprised of six chapters that contain guidelines to improve health and safety in aquatic facilities. Chapters that are pertinent to the risk reduction of Legionnaires' Disease in public spas are: Design and Construction (Chapter 4), Operation and Maintenance (Chapter 5) and Policies and Management

Legionella Prevention Resources

Legionnaires' Disease General Information

<https://www.cdc.gov/legionella/about/index.html>

Disinfection of Hot Tubs Contaminated with *Legionella*

www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf

Preventing Illness and Injury at the Pool and Hot Tub

www.cdc.gov/healthyswimming

www.cdc.gov/healthywater/pdf/swimming/resources/legionella-factsheet.pdf

How to Sample Spas and Fountains During Legionellosis Outbreaks

www.youtube.com/watch?v=oOP9gEmhLZk

Water Management to Prevent *Legionella*

www.cdc.gov/vitalsigns/legionnaires/index.html

Model Aquatic Health Code Tools

www.cdc.gov/mahc/pdf/2016-mahc-code-final.pdf

www.cdc.gov/mahc/pdf/2016-mahc-annex-final.pdf

www.cdc.gov/mahc/fact-sheets.html

www.cdc.gov/mahc/infographic-decoding-ig.html

www.cdc.gov/mahc/pdf/mahc-aquatic-facility-inspection-report.pdf

www.cdc.gov/mahc/pdf/mahc-aquatic-facility-inspection-report-cheat-sheet.pdf

(Chapter 6). The MAHC outlines specific guidance that can be incorporated into water management programs to reduce *Legionella* growth and spread in spas.

MAHC Design and Construction (Chapter 4)

- Chapter 4 incorporates specific design and construction language that can be used to reduce the risk of Legionnaires' disease in new aquatic facilities or substantial alteration of an aquatic facility or venue.
- For example, the MAHC includes requirements for automated disinfection and pH control, defines flow rates and turnover times, outlines inlet spacing to ensure adequate mixing and requires a means to easily drain and clean the spa.
- MAHC design and construction requirements also specify that spas have proper ventilation with an air-handling system that complies with ASHRAE Standard 62.1- 2013, *Ventilation for Acceptable Indoor Air Quality*.

MAHC Operation and Maintenance (Chapter 5)

- Chapter 5 addresses specific operational and maintenance recommendations for spas, including requiring aquatic facilities to have a preventative maintenance program, continuous operation of the recirculation system, filters and filter media listed and labeled to

conform with NSF/ANSI 50, *Equipment for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities*, and filtration and backwashing rates.

- MAHC operational and maintenance standards also require the establishment of minimum and maximum disinfectant concentrations, minimum and maximum pH levels, water quality chemical testing frequency, water clarity specifications, prohibition of cyanuric acid use in spas and regular draining and cleaning of spas.
- It also recommends routine, compliant and follow-up assessments of public aquatic facilities conducted by trained supervisors and aquatic facility operators.

MAHC Policies and Management (Chapter 6)

- Spa-specific policies and procedures include recommendations that all spa operators have appropriate state or local certified pool and spa operator and chemical handling training. The MAHC outlines essential topics in qualified operator training courses and staff training requirements. Additionally, these trained staff should be available during peak hours and seasons that

spas are used most frequently.

- Pool and spa operators play a critical role in Legionnaires' disease risk reduction. These professionals should have a working knowledge of the key areas of MAHC and ASHRAE guidance and their relationship to waterborne disease mitigation.

Keeping the MAHC updated is an ongoing task.³ CDC works with the Council for the Model Aquatic Health Code (CMAHC) to help ensure the Model Aquatic Health Code is regularly updated and stays current with the latest science and best practices. CMAHC members from public health, aquatics sector, business, universities and the general public work across the country to ensure the latest scientific and technological improvements are addressed by the MAHC. Recommendations to improve the MAHC are sent to CDC every two years to ensure the guidance is adequately updated.

Conclusion

Incorporating the MAHC, in conjunction with ASHRAE guidance, can be a powerful tool to develop and implement a water management program to reduce the risk of Legionnaires' disease associated with public spas.

References

1. Dooling, K.L., K.-A. Toews, L.Á. Hicks, L.E. Garrison, B. Bachaus, S. Zansky, R. Carpenter, B. Schaffner, E. Barker, S. Eetit, A. Thomas, S. Thomas, R. Mansmann, C. Morin, B. White, G.E. Langley. 2015. "Active bacterial core surveillance for legionellosis—United States, 2011–2013." *Morbidity and Mortality Weekly Report* 64(42):1190–1193.
2. Collier, S.A., L.J. Stockman, L.A. Hicks, L.E. Garrison, F.J. Zhou, M.J. Beach. 2012. "Direct healthcare costs of selected diseases primarily or partially transmitted by water." *Epidemiology & Infection* 140(11):2003–2013.
3. Benedict K.M., et al. 2017. "Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water—United States, 2013–2014." *Morbidity and Mortality Weekly Report* 66 (44):1216–1221.
4. CDC. 2016. "Developing a Water Management Program to Reduce *Legionella* Growth and Spread in Buildings: A Practical Guide to Implementing Industry Standards." Centers for Disease Control and Prevention. <http://tinyurl.com/ycyp4brn>.
5. CDC. 2016. "The Model Aquatic Health Code (MAHC): An All-inclusive Model Public Swimming Pool and Spa Code Centers for Disease Control and Prevention. Centers for Disease Control and Prevention. <http://tinyurl.com/y9z4vowh>.
6. Hlavsa, M.C. 2016. "Immediate Closures and Violations Identified During Routine Inspections of Public Aquatic Facilities—Network for Aquatic Facility Inspection Surveillance, Five States, 2013." *Morbidity and Mortality Weekly Report*, "Surveillance Summaries," 65(5):1–26.
7. Garrison, L.E., et al. 2016. "Vital signs: deficiencies in environmental control identified in outbreaks of Legionnaires' disease—North America, 2000–2014." *American Journal of Transplantation* 16(10):3049–3058. ■

Advertisement formerly in this space.