DIRECT FROM CDC ENVIRONMENTAL HEALTH SERVICES

2021 Model Aquatic Health Code (4th Edition)

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Editor's Note: The National Environmental Health Association (NEHA) strives to provide up-to-date and relevant information on environmental health and to build partnerships in the profession. In pursuit of these goals, NEHA features this column on environmental health services from the Centers for Disease Control and Prevention (CDC) in every issue of the *Journal*.

In these columns, authors from CDC's Water, Food, and Environmental Health Services Branch, as well as guest authors, will share insights and information about environmental health programs, trends, issues, and resources. The conclusions in these columns are those of the author(s) and do not necessarily represent the official position of CDC.

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The Centers for Disease Control and Prevention (CDC) will be releasing the 4th edition of the Model Aquatic Health Code (MAHC, www.cdc.gov/mahc) in the coming months. The MAHC represents a collaboration among local, state, and federal public health officials, particularly environmental health practitioners, and representatives of the aquatics sector to optimize prevention of illness and injury associated with public aquatic venues (e.g., pools, hot tubs, and water playgrounds).

Thank you to those who submitted change requests (i.e., proposed MAHC revisions), and particularly to the Council for the Model Aquatic Health Code (CMAHC, www.cmahc.org) committees that submitted change requests reflecting committee consensus. Thank you to Dewey Case, CMAHC technical director, for the late nights and weekends spent supporting the CMAHC Technical Review Committee (TRC). And above all, thank you to Amanda Tarrier, principal sanitarian in the New York State Department of Health, for her leadership. As TRC chair, she led the committee in its evaluation of an unprecedented 530 change requests during the COVID-19 pandemic.

The following sections highlight substantial topics addressed by the change requests.

Cyanuric Acid

Cyanuric acid (CYA) binds to chlorine to prevent it from being degraded by UV light from the sun. Consequently, CYA increases the amount of time it takes for chlorine to inactivate pathogens. CYA is sold as a stand-alone product or as chlorinated isocyanurates (chlorine and CYA, commonly known as dichlor or trichlor). In 2015, CMAHC established a CYA ad hoc committee that included representatives from across the CYA industry and researchers but did not include state or local public health officials. CMAHC charged the committee to develop guidance on CYA concentrations.

The committee reanalyzed data in scientific, peer-reviewed articles that examined the effect of CYA on pathogen inactivation. The committee developed mathematical models that accounted for the rate of pathogen introduction into aquatic venue water, disinfection, transport, and pathogen uptake by swimmers to predict the associated risk of acute infectious gastrointestinal illness. Mathematical models are mathematical equations that aim to distill the relationship among factors within a system to predict an outcome. Potential factors include established science (e.g., concentration of chlorine needed to inactivate pathogens over time at set water pH and temperature), current practices (e.g., closing aquatic venues to swimmers at night), and real-world variability (e.g., the efficiency at which different filters remove pathogens).

Based on the original models, the committee recommended a maximum ratio of 20 ppm CYA:1 ppm DPD (N,N-diethyl-p-phenylenediamine) free available chlorine (Falk et al, 2019). This ratio was chosen based on the U.S. Environmental Protection Agency (2012) 36/1,000 annual risk of *Giardia* infection limit for untreated recreational waters (e.g., in lakes). The proposed definition of DPD free available chlorine includes cyanurate-bound available chlorine and hypochlorous acid and hypochlorite ions.

The committee subsequently refined its models, tweaking factors included in the model to better reflect the complexity of water chemistry and aquatic venue operation. These changes resulted in varying recommended CYA:DPD free available chlorine ratios—20:1 through 40:1—and explains, in part, why several CYA-related change requests were submitted.

One of the change requests approved by the CMAHC membership called for adding the following parameters to the list of MAHC violations requiring immediate correction or closure: >45 ppm CYA:1 ppm DPD free available chlorine or >300 ppm CYA. The proposed maximum 45:1 ratio is the de facto ratio in the 2018 MAHC, with the MAHC calling for CYA concentration to remain ≤90 ppm and for maintaining a minimum of 2 ppm chlorine when using CYA (Centers for Disease Control and Prevention, 2018). The proposed maximum 300 ppm CYA concentration is based on a toxicity report (Cox & Hamilton, 2019).

CDC foresees incremental CYA-related revisions to the 2021 MAHC (4th edition). Bringing state and local public health officials onto the committee, as well as additional research and development of best practices, will inform future incremental CYA-related revisions to the 2024 MAHC (5th edition) and subsequent editions.

Consistency Between the Model Aquatic Health Code and International Swimming Pool and Spa Code

The MAHC is an open access, science- and best practices-based model code that aims to protect public health through design, construction, operation, and maintenance. In 2018, CMAHC established a standing committee focused on maximizing consistency between the MAHC and the International Swimming Pool and Spa Code (ISPSC). This committee is charged with:

1. identifying inconsistencies between design criteria in the MAHC and ISPSC;
2. evaluating appropriate scientific, peer-reviewed articles (or in their absence, best practices); and
3. making recommendations accordingly for revisions to the MAHC, ISPSC, or both.

Chapter 5 (Operation and Maintenance) and Chapter 6 (Policies and Management) of the MAHC will likely be adopted into the ISPSC in 2024. Harmonizing the MAHC and ISPSC marks a big step toward establishing one set of aquatic venue and facility design, construction, operation, and management criteria across the U.S. A total of seven harmonization change requests, focused on a range of topics (e.g., use of computational fluid dynamics models and design of no diving markers), were approved by CMAHC membership. The remaining two harmonization change requests were approved by the CMAHC Board of Directors. A few inconsistencies remain unresolved and could be addressed in the next MAHC and ISPSC update cycles.

Novel Aquatic Venues

Three change requests each addressed the design, construction, operation, and management of one of three novel aquatic venues. The CMAHC TRC determined the artificial swimming lagoon change request and surf venue change request needed to be revised to clarify the text. The revised change requests will be resubmitted for the 2024 MAHC. Waiting 3 years to address artificial swimming lagoons and surf venues in the MAHC, however, doesn't immediately protect public health. Through a collaboration with state and local public health departments, the aquatics sector, and CMAHC, CDC will develop interim guidance. The change request addressing natural swimming pools defers to standards developed elsewhere. Consequently, the TRC recommended that CMAHC convene an ad hoc committee to evaluate if the MAHC should address natural swimming pools, and if so, how.

CMAHC has provided CDC with proposed revisions for the 2021 MAHC based on CMAHC membership approval, or in a few instances, CMAHC board approval. As CDC staff across three centers and three offices evaluate the revisions and finalize the 2021 MAHC, CDC and CMAHC set their sights on the 2024 MAHC.

Without the frontline healthy and safe swimming expertise of state and local environmental health practitioners, the MAHC cannot optimally prevent illness and injury. How can CDC and CMAHC support state and local public health official participation despite their limited resources being further strained by the COVID-19 pandemic? Part of the answer is the CMAHC State Designee Committee, a forum for tackling issues once as a public health cadre instead of many times over individually.

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