



Assessing Public Health Jurisdictional Use of the Model Aquatic Health Code From the Centers for Disease Control and Prevention: A Mixed-Methods Approach

Abstract The Model Aquatic Health Code (MAHC) from the Centers for Disease Control and Prevention (CDC) provides scientifically based recommendations that state, tribal, local, and territorial (STLT) public health partners can use to ensure healthy and safe experiences in public aquatic venues. Our study aimed to characterize MAHC use and implementation and identify facilitators and barriers to MAHC use across STLT jurisdictions. A mixed-methods approach was used, combining a web-based survey with virtual focus groups that included public health professionals from STLT health departments working on aquatic venue safety, regulation, and inspection. In total, 88 participants from 35 STLT health departments completed the survey that was distributed to 13,887 recipients via CDC-administered and nongovernmental listservs.

In total, 47 (53%) respondents reported using the MAHC to justify existing code, 34 (39%) to provide guidance for sections not covered in their code, and 31 (35%) to grant code exceptions. Further, 13 (15%) respondents reported they frequently incorporate or have adopted the MAHC in full, and 34 (39%) reported they do not incorporate the MAHC but are considering incorporating the MAHC into code. Facilitators to MAHC use included the need for updated regulations, political will, and collaboration. Barriers included slow regulatory processes, resource constraints, and insufficient staff training. MAHC users indicated that an up-to-date MAHC provides flexibility for jurisdictions to adopt or reference it to best fit jurisdictional needs. Overall, MAHC use varies, and a multifactorial approach beyond code adoption might be needed to measure MAHC use. Moreover, implementation and adoption tracking support could improve MAHC use. Respondents generally agreed that the MAHC should be kept up-to-date, but that future update cycles could extend beyond every 3 years.

Keywords: Model Aquatic Health Code, environmental health, public health codes

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Introduction

The Model Aquatic Health Code (MAHC) is a comprehensive guidance document published by the Centers for Disease Control and Prevention (CDC) to help ensure healthy and safe experiences in aquatic venues such as pools, hot tubs, and splash pads (Centers for Disease Control and Prevention [CDC], 2024a). Swimming has been identified as the fourth most popular sports activity and the most popular among children ages 7–17 years; estimates are that more than 300 million swimming visits by persons ≥ 7 years occur each year (Hlavsa et al., 2016).

The MAHC provides science-based, code-formatted recommendations on the design, construction, operation, and management of public aquatic facilities. CDC also publishes an Annex for the MAHC that provides the scientific and best practices rationale that are the basis for the MAHC recommendations. State, tribal, local, and territorial (STLT) public health partners can voluntarily use all or parts of the MAHC to create or update their own codes for public aquatic facilities to reduce the risk of illness and injury (e.g., drowning, pool chemical injuries, disease transmission and outbreaks) and subsequent facility closures due to public health hazards (Clemens et al., 2024; Hlavsa et al., 2016, 2021; Lawinger et al., 2024; Vanden Esschert et al., 2019).

The MAHC was first released in 2014. To ensure the MAHC remains current with emerging science and best practices, CDC has worked to review and update the document every 3 years, with the 5th edition published in December 2024 (CDC, 2025). The extent to which STLT partners use the MAHC, including more nuanced uses beyond complete adoption of the MAHC, has not been formally assessed nationwide. Previous efforts to evaluate MAHC use by STLT partners have focused on a limited number of states or jurisdictions, making it difficult to identify broad trends in MAHC use or to understand how well it meets partner needs (Knight & Vincent, 2018; Ramos et al., 2018; Vander Kelen et al., 2024).

To address this gap, during September 2024 to January 2025, CDC conducted a mixed-methods assessment involving a web-based survey and focus group discussions with STLT partners. This effort aimed to better understand how the MAHC is being used, to identify barriers and facilitators to its implementation, and

to inform MAHC user support strategies and future CDC aquatic guidance. Results from this assessment can help optimize the MAHC as a resource for STLT public health and environmental health partners and other MAHC users.

Methods

Survey Administration and Analysis

For the quantitative portion of the evaluation, we distributed a web-based survey to STLT partners across 50 states and 5 territories. We developed questionnaires with review and feedback from subject matter experts at STLT health departments. We built the survey using the Epi Info Web Survey System, and the first page of the web survey included informed consent language. Data were collected using a Generic Information Collection mechanism from CDC's STLT Generic Information Collection Service (STLT Generic), OMB No. 0920-0879.

We distributed a web link for the survey using CDC-administered listservs and email lists administered by nongovernmental organizations such as the National Association of County and City Health Officials (NACCHO), the National Environmental Health Association (NEHA), the Council for State and Territorial Epidemiologists (CSTE), and the Council for the Model Aquatic Health Code (CMAHC). The listservs included between 53 and 7,050 recipients each, totaling 13,887 recipients. The actual number of unique individuals, however, is likely lower due to overlap among the email lists.

The survey weblink and recruitment information specified that the survey was for public health officials who work on public aquatic venue safety, regulation, and inspection, with any level of MAHC experience. The survey remained open for 8 weeks between September and November 2024. We distributed reminder emails every 2 weeks for the first 6 weeks, followed by two final reminders. To be included in the analysis, survey responses were required to have at least 70% of the questions answered. Survey results were analyzed through descriptive statistics in R (Version 4.4.3) by one primary author and replicated by a second author.

Focus Group Implementation and Thematic Analysis

For this evaluation, we conducted focus groups using semistructured interview guides

Article Summary

What is already known about this topic?

The Model Aquatic Health Code (MAHC) was first released in 2014. To ensure the MAHC remains current with emerging science and best practices, the Centers for Disease Control and Prevention has worked to review and update the document every 3 years, with the 5th edition published in December 2024. Previous efforts to evaluate MAHC use by state, tribal, local, and territorial partners have focused on a limited number of states or jurisdictions, making it difficult to identify broad trends in MAHC use or understand how well it meets partner needs.

What is added by this article?

Respondents reported using the MAHC to justify existing code ($n = 47$; 53%), provide guidance for sections not covered in their code ($n = 34$; 39%), and grant code exceptions ($n = 31$; 35%). Moreover, 13 (15%) participants reported they frequently incorporate or have adopted the MAHC in full, and 34 (39%) reported they do not incorporate the MAHC but are considering incorporating the MAHC into code. Facilitators to MAHC use included the need for updated regulations, political will, and collaboration. Barriers included slow regulatory processes, resource constraints, and insufficient staff training.

What are the implications for the practice of environmental public health?

This study reinforces the importance of an updated MAHC that allows public health partners to use it as best fits their jurisdiction's needs. Jurisdictions reported a wide variety of MAHC use that goes beyond adoption, and thus, a multifactorial approach that includes the use of code exceptions is needed to effectively measure MAHC use. A MAHC adoption tracking system and implementation support are needed to overcome barriers to use. Additionally, the MAHC update cycle could be adjusted beyond every 3 years to reduce the burden on MAHC users.

with STLT public health and environmental health programs, stratified across different levels of MAHC use and implementation. “Use” is defined as incorporating the MAHC language into public aquatic venue code or referencing the MAHC or Annex to address a need not directly addressed by a jurisdiction’s code. “Implementation” is defined as operationalizing the MAHC or information in the Annex, which includes activities such as training inspectors and pool operators.

Participants were recruited for the focus groups based on a question in the survey about interest in focus group participation. We separated participants across three levels of MAHC use and implementation (i.e., limited use [L], intermediate use [I], advanced use [A]) using a 4-question series in the survey to determine focus group allocation (Supplemental Table 1). We recruited 4 to 6 participants per level for a total of 6 focus group sessions. Focus groups were conducted between November 2024 and January 2025.

Each focus group had one moderator and one technology coordinator. Focus groups were conducted virtually using the Zoom Webinar feature, and were audio and video recorded. We used the Zoom transcription feature to generate transcripts, which were reviewed and proofread for software auto-transcription errors. Once reviewed, we analyzed transcripts in MAXQDA 2022 (VERBI Software 2021) using structural deductive coding, based on questions covered in the interview guides. Coding was conducted synchronously by four qualitative analysts. Any disagreements were discussed until verbal consensus was reached among the analysts. Once coded, we used thematic analysis to identify emergent themes across the transcripts, leveraging quotations to support and strengthen thematic interpretation.

Results

Survey Participants

The survey was completed by 88 participants from 35 different STLT partners. Of the participating affiliations, 40 (46%) were local health departments and 38 (43%) were state or territorial health departments (Table 1). For their roles, 47 (53%) respondents were environmental health professionals, 10 (11%) were environmental health directors, 2 (2%) were health department directors, 15 (17%) reported “other” roles, and 14 (16%) did not

TABLE 1

Model Aquatic Health Code (MAHC) Use Assessment Survey Responses (N = 88)

Response	# (%)
Affiliation	
Local health department	40 (46)
State or territorial health department	38 (43)
Other	6 (7)
Unreported	4 (5)
Role	
Environmental health professional	47 (53)
Environmental health director	10 (11)
Health department director	2 (2)
Other	15 (17)
Unreported	14 (16)
Who updates aquatic venue codes? Select all that apply. *	
State health departments	65 (74)
State legislatures	20 (23)
County health department	40 (46)
City or county policymakers	12 (14)
Other	8 (9)
Version of the MAHC used? Select one. **	
Version 1: 2014	7 (8)
Version 2: 2016	7 (8)
Version 3: 2018	18 (21)
Version 4: 2023	27 (31)
Do not know/unsure	29 (33)
How do you use the MAHC? Select all that apply. *	
Directly	12 (14)
To justify existing code	47 (53)
For sections not covered in code	34 (39)
For venues not covered in code	17 (19)
To grant variances	31 (35)
Other	15 (17)
To what extent does your jurisdiction directly incorporate MAHC language? Select one.	
We frequently incorporate or have adopted the MAHC in full	13 (15)
We occasionally incorporate the MAHC	13 (15)
We do not incorporate, but are considering incorporating the MAHC	34 (39)
We do not incorporate, and are not planning to incorporate the MAHC	19 (22)
Do not know/unsure	9 (10)

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provide their title. Given the diversity of legislative and municipal processes across U.S. jurisdictions, we asked participants which level of governance was responsible for updating

aquatic venue codes. In response, 65 (74%) identified state health departments, 40 (46%) identified county health departments, and 20 (23%) identified state legislatures (Table 1).

TABLE 1 continued

Model Aquatic Health Code (MAHC) Use Assessment Survey Responses (N = 88)

Response	# (%)
To what extent does your jurisdiction reference the MAHC? Select one.	
We frequently reference the MAHC	13 (15)
We occasionally reference the MAHC	21 (24)
We do not reference the MAHC, but are considering to reference the MAHC	27 (31)
We do not reference the MAHC, and are not planning to reference the MAHC	15 (17)
Do not know/unsure	12 (14)
To what extent does your jurisdiction reference the Annex? Select one.	
We frequently reference the Annex	20 (23)
We occasionally reference the Annex	32 (36)
We do not reference the Annex, but are considering to reference the Annex	15 (17)
We do not reference the Annex, and are not planning to reference the Annex	12 (14)
Do not know/unsure	9 (10)
To what extent is your jurisdiction's code in agreement with the MAHC? Select one.	
Not at all in agreement	2 (2)
Somewhat in agreement	33 (38)
Often in agreement/in complete agreement	40 (46)
Do not know/unsure	13 (15)
What challenges have you experienced in implementing the MAHC? Select all that apply. *	
Competing public health priorities	17 (19)
Competing environmental health priorities	32 (36)
Challenges in interpreting the MAHC language	14 (16)
Limited MAHC training for public health staff	17 (19)
Limited MAHC training for environmental health staff	24 (27)
Limited time/resources	37 (42)
MAHC implementation does not take place at our level of decision-making	24 (27)
The MAHC is revised too frequently	7 (8)
Limited knowledge of how the MAHC has been integrated into our jurisdiction's code	15 (17)
Other	25 (28)
None	2 (2)
Which resources have your jurisdiction used? Select all that apply. *	
MAHC Network resources (e.g., webinars, trainings)	32 (36)
MAHC search tool	17 (19)
Mini-MAHCs	14 (16)
MAHC Inspection Form Cross-Reference Guide	7 (8)
MAHC Inspection Form	8 (9)
MAHC Inspection Form Cheat Sheet	6 (7)
Pool Inspection Training for Environmental Health Professionals	20 (23)
None of the above	26 (30)
Do not know/unsure	9 (10)

* Percentages do not necessarily add up to 100 in the "Select all that apply" questions.

** The 5th edition of the MAHC was not released at the time of survey administration.

Jurisdictional Use of the MAHC

STLT partners reported using the MAHC for various reasons: 47 (53%) stated use for providing scientific justification for existing public aquatic venue codes; 34 (39%) stated use for addressing sections not covered by existing local code; 31 (35%) stated use for granting code exceptions, such as variances for venue construction; and 17 (19%) stated use for covering aquatic venue types not included in local codes.

To understand how the MAHC is being used across STLT organizations, we asked respondents how they incorporate MAHC language into codes: 34 (39%) reported they do not currently incorporate the MAHC but are considering incorporating it into local code, 19 (22%) reported they do not currently incorporate the MAHC and are not planning to incorporate it into local code, and 13 (15%) reported they frequently incorporate the MAHC or have adopted it in full. Furthermore, respondents were asked to what extent their jurisdiction's code agreed with the MAHC. In response, 40 (46%) reported that their jurisdiction's code was often in agreement or in complete agreement, while 33 (38%) stated their jurisdiction's code was somewhat in agreement (Table 1).

When respondents were asked how often they reference the MAHC (i.e., use it in another way than incorporating it into their code), 27 (31%) reported that their jurisdiction does not reference the MAHC but are considering referencing it, 21 (24%) reported their jurisdiction occasionally references the MAHC, and 13 (15%) reported their jurisdiction frequently references the MAHC. In regard to referencing the Annex, 32 (36%) reported occasionally referencing it, and 20 (23%) reported they frequently reference it (Table 1).

MAHC Topic Area Use

In response to the question about which was the most frequently reported MAHC topic directly incorporated into code, there were 18 (21%) responses for fecal, vomit, or blood contamination, 14 (16%) for imminent health hazard closure, and 12 (14%) for operator training (Table 2).

When asked about what was the most referenced MAHC topic, 24 (27%) responses were for facility maintenance and operation, 22 (25%) were for facility design and construction, and 21 (24%) were for recirculation and filtration. When asked about the

TABLE 2

Use of the Model Aquatic Health Code (MAHC) Topics in Public Aquatic Facility Regulations (N = 88)

	Directly Incorporate the MAHC # (%)	Reference the MAHC # (%)	Reference the MAHC Annex # (%)	No, We Do Not Incorporate or Reference the MAHC # (%)	I Do Not Know # (%)
Facility design and construction	11 (13)	22 (25)	21 (24)	34 (39)	10 (11)
Facility maintenance and operation	9 (10)	24 (27)	21 (24)	36 (41)	7 (8)
Lifeguard and bathing supervision	6 (7)	16 (18)	20 (23)	43 (49)	10 (11)
Operator training	12 (14)	13 (15)	15 (17)	44 (50)	8 (9)
Recirculation system and filtration	11 (13)	21 (24)	21 (24)	36 (41)	7 (8)
Risk management and safety	9 (10)	16 (18)	18 (20)	41 (47)	10 (11)
Monitoring and testing	10 (11)	16 (18)	14 (16)	43 (49)	10 (11)
Hygiene facilities	9 (10)	16 (18)	15 (17)	42 (48)	10 (11)
Ventilation and air quality	7 (8)	18 (21)	18 (21)	45 (51)	10 (11)
Drowning prevention	8 (9)	13 (15)	12 (14)	47 (53)	10 (11)
Flotation tanks	6 (7)	12 (14)	14 (16)	48 (55)	11 (13)
Interactive water play venues	11 (13)	21 (24)	19 (22)	36 (41)	8 (9)
<i>Legionella</i> response	10 (11)	13 (15)	15 (17)	42 (48)	11 (13)
Imminent health hazard closure	14 (16)	16 (18)	13 (15)	41 (47)	8 (9)
Fecal, vomit, or blood contamination response	18 (21)	19 (22)	17 (19)	36 (41)	9 (10)
Other	0	21 (24)	2 (2)	1 (1)	8 (9)

Note. Survey respondents could select all applicable answers, so percentages for each option will not necessarily add up to 100.

least used (i.e., not directly incorporated into code or referenced) MAHC topics, 48 (55%) responses were for flotation tanks, 47 (53%) were for drowning prevention, 45 (51%) were for ventilation and air quality, 44 (50%) were for operator training, and 43 (49%) were for lifeguard and bathing supervision (Table 2). Furthermore, when directly incorporated into the code and referenced were combined to describe overall MAHC use, fecal, vomit, and blood contamination (n = 37); facility design and construction (n = 33); and facility operation and maintenance (n = 33) were the three most frequently used MAHC topic areas (Figure 1).

Barriers to Using the MAHC

Respondents noted several barriers to using the MAHC in their jurisdiction: 41 (47%) noted limited training for environmental and public health staff, 37 (42%) limited time and

resources, and 32 (36%) competing public health priorities (Table 1).

Focus Groups

Across six focus groups, participants reported diverse uses of the MAHC and Annex. They shared varying perspectives on update frequency, implementation, barriers, and facilitators, among other topics. For additional details on the themes that emerged from the analysis, including selected quotations from participants, see Table 3.

Variety of MAHC Use

Participants across all three levels indicated that they used the MAHC or Annex in their jurisdiction (L = 2, I = 3, A = 3). Nine participants responded that they use direct MAHC code/language within their STLT codes (L = 2, I = 4, A = 3). Respondents also reported using the MAHC as a reference or to review

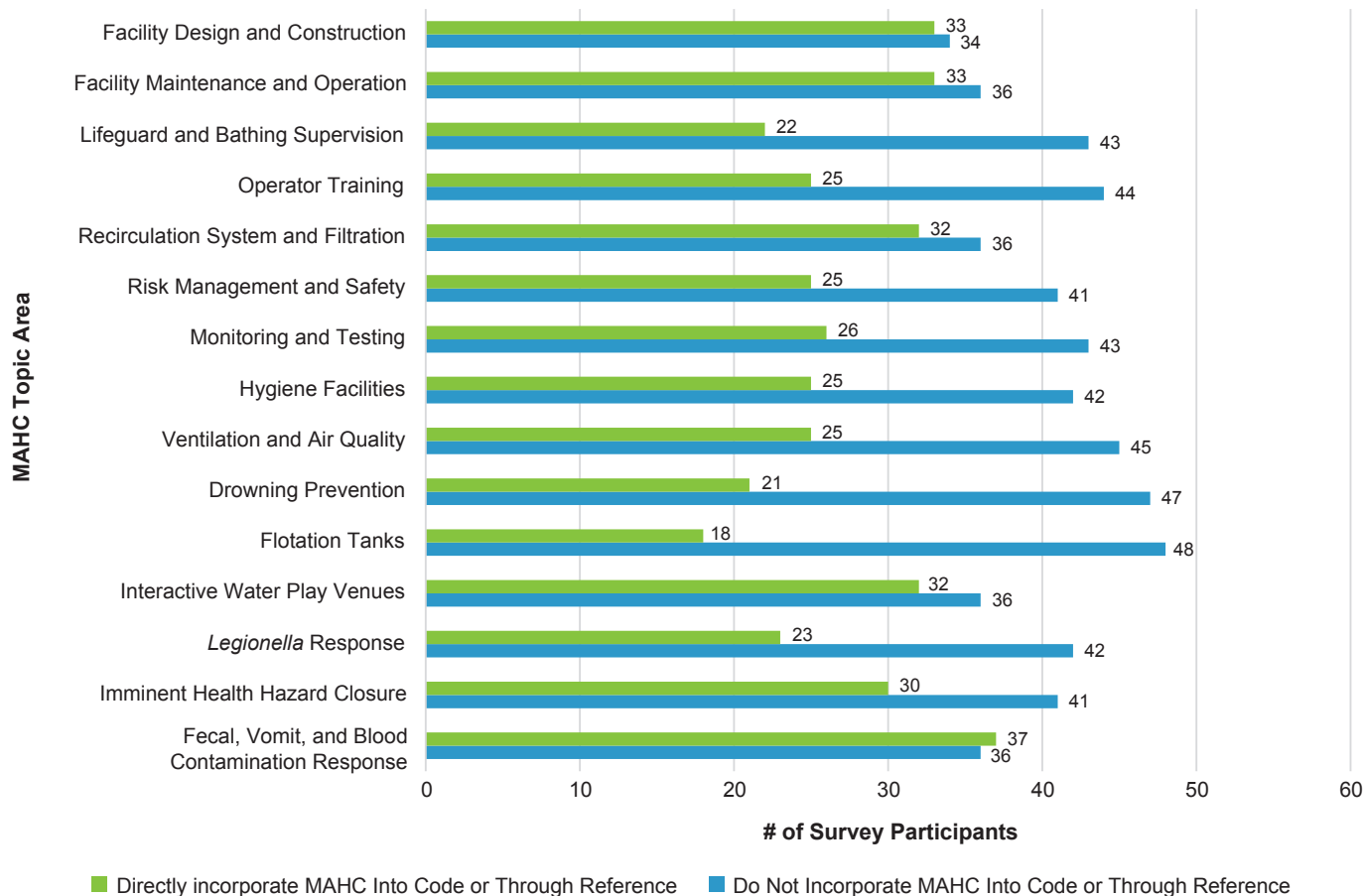
regulations, for making decisions on code exceptions, to document safety issues, or to use stronger language in their own policies and code when needed. Some participants stated, however, that although they used the MAHC, they did not directly incorporate sections of it into their code (L = 6, I = 2, A = 1).

Facilitators for MAHC Adoption and Implementation

Top facilitators of MAHC adoption included the need to update regulations (L = 2, I = 4, A = 4); necessity driven by outdated regulations, new technologies, authorizing statutes, or incidents such as Legionnaires' disease illnesses and drownings (L = 2, I = 4, A = 1); collaboration and support across multiple organizations within the sector (L = 2, I = 1, A = 3); and political will (L = 1, I = 1, A = 1). Additional facilitators included CDC name recognition as a national standard, education

FIGURE 1

Model Aquatic Health Code (MAHC) Topic Area Use Comparison: Incorporation Into State or Local Code or Through Reference (N = 88)



Note. Respondents could select all applicable response options. Therefore, response totals for individual questions do not sum to 88. Counts for overall MAHC use represent the combined responses from two survey questions (directly incorporating the MAHC into code and incorporating the MAHC by reference). Counts for not incorporating the MAHC into code or by reference represent responses to a single survey question.

of interested partners, cost-benefit analysis, increased funding for staffing and resources, and prior experience adopting the Food and Drug Administration (FDA) *Food Code* in their jurisdictions.

Barriers for MAHC Adoption and Implementation

Frequently reported barriers for MAHC adoption included STLT administrative and legislative processes for updating code (L = 6, I = 6, A = 1); staff resources, needed staff skill sets, and time constraints (L = 2, I = 3, A = 1); outdated code or infrequent updates (L = 1, I = 3); deprioritization of aquatic health in their jurisdiction (L = 1, I = 2); and unique

jurisdictional challenges (L = 3, I = 2, A = 2). Administrative and legislative examples included having an unsupportive legislative environment, shifting political agendas, having competing legislative priorities, and the long process to pass legislation for codes.

When asked about difficulties in MAHC implementation, seven participants stated that it would take too much effort or time to implement (I = 4, A = 3). Old aquatic infrastructure within their jurisdiction (L = 2, I = 2, A = 2), getting buy-in from industry and other interested partners (I = 2, A = 2), and political will (L = 3, I = 3, A = 1) were also mentioned as barriers to putting the MAHC into practice (Table 3).

Frequency of MAHC Updates

Most participants found that updates every 3 years to the MAHC are both beneficial and necessary (L = 6, I = 6, A = 4). Several participants noted that regular updates help ensure alignment with emerging technologies, pool designs, research developments, and industry standards (L = 4, I = 6, A = 4). While a 3- to 5-year revision cycle was reported as acceptable, any period longer than 5 years raised concerns about timely adaptation-to-innovation length.

Individual responses reflected the diversity of STLT needs: one participant in the limited use category highlighted that the current cycle provides a balance between

TABLE 3

Model Aquatic Health Code (MAHC) Use Assessment: Summary of Thematic Findings From the Focus Groups

Theme	Description	Quote
Variety of MAHC and Annex use	Using the MAHC or Annex as a reference document, to review regulations, for making decisions on waivers, to document safety issues, as scientific rationale, and to keep up to date with new technologies.	"Really educating operators on Why. You get that question a lot, you know? 'Why do you have to do this? Why this change? Why? And it's nice to have that 250-page document...to point to, and it lays out the science, lays out that rationale. And it's not just us saying, 'Well, we changed this because we wanted to,' and that has really been useful several times in the field for us." (Transcript_FG5_Advanced_MSWord_01072025, Pos. 39)
MAHC update frequency	Positive thoughts on keeping the frequency at every 3 years included that it allows for meaningful updates based on new scientific research, while enabling code changes that prevent code from becoming antiquated. Negative thoughts on having less frequent updates included no updated reference material, no national standard, and increased workload (time consuming and repetitive) for updates.	"I really appreciate how frequently the MAHC is revised. It is, I think, very important, especially [when] things are constantly changing in the pool world. There is new equipment, new designs we're not used to. And of course, our old codes make it very complicated to review something that's different. Like lately, we have cold-plunge pools that have been very popular, and we have nothing in our MAHC talking about cold-plunge pools, and we have to use our spa code to apply that to cold-plunge pools currently, and you know that's something if the MAHC could provide the information on the future, that would be great. So I think the frequency of it being revised is good. I think that's a good rule of thumb—3 to 5 years." (MAHC_Limited1_Transcript_Clean_12112024, Pos. 132) "It would take away a resource that we use for reference. I think similarly, if you went to a longer, if you went to the 7-year longer update, then I think beyond the 4- or 5-year period when we looked at the MAHC, we would start to qualify what we're seeing as, well: This is old information. We're always scrambling for resources and information, so we would mourn the loss of it if it went away." (MAHC_Intermediate1_Transcript_Clean_11252024, Pos. 179)
Facilitators for MAHC and Annex use	Facilitators included not having any current code, serving as a national standard, and political will.	"And then we had a multiple drowning, which was just horrible, in a mobile home park. And so having . . . those things then when a lot of people say, 'Well, how did this happen and what can we do about it?' and having the CDC really stay ahead of those things and . . . emerging threats with these new types of parks and these new aquatic facilities and these new venues is very, very helpful." (Transcript_FG5_Advanced_MSWord_01072025, Pos. 118–119)
Barriers for MAHC and Annex use	Barriers included legislation; legal issues; politics; lack of funding, resources, and staff power; and the long rigorous process to make it to legislation.	"We have state rules that are enforced by local jurisdictions . . . to change a rule requires pretty much a driving force in the legislature. Because we have enabling statutes that are then fleshed out by administrative code . . . So, we can't revise rules for our pleasure, it kind of has to be a mandate. And then when we revise rules, anything that has a fiscal impact, there has to be a study done. So I would say . . . the bureaucracy of rule change is our biggest barrier to making changes. It's a long arduous process, so the juice really has to be worth the squeeze, and you have to be allowed or invited to even do it." (MAHC_Intermediate1_Transcript_Clean_11252024, Pos. 104)
Useful aspects of the MAHC and Annex.	Useful aspects included providing scientific rationale/justification and that it is easy to find what you need.	"Yeah, for us it's both. Both the scientific backing of some of the items that I'm looking at and just the code statement itself because sometimes I'll compare it to what we have and it may have a lot more detail. And then being able to go into the Annex to get that scientific reasoning behind it really helps and that helps us to explain the why, or why we can't do something, or why we can do something. So that's been beneficial." (Transcript Intermediate 01_16, Pos. 132–133)

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timeliness and feasibility for code integration. Another participant in the advanced category noted that regular updates help reduce costs and streamline review and implementation efforts.

Participants also raised concerns about the workload associated with frequent updates (L = 4, I = 2), while other participants (L = 2, I = 2) reported minimal impact because their jurisdiction was already in the practice of regularly aligning their codes with the MAHC.

Nine participants stated that their jurisdiction would encounter challenges if CDC

stopped updating the MAHC, as there would be a lack of updated reference material and established national standards (L = 5, I = 4). Other negative consequences included shifting the burden of researching new science and technology to STLT staff and giving the perception of federal deprioritization of aquatic safety and regulation. Several participants stated that ending MAHC updates would not necessarily affect their use of the document (L = 2, I = 2, A = 2), but that their jurisdictions would go a longer period between code updates.

Discussion and Conclusion

MAHC Use

Throughout this evaluation, respondents reported their MAHC use as adoption of the code into their own jurisdiction's code and policies, justification for granting code exceptions, and usage as a reference for scientific best practices. Respondents noted that the STLT code adoption process can be slow and resource intensive, often resulting in the MAHC being used to grant code exceptions to keep up with research

TABLE 3 continued

Model Aquatic Health Code (MAHC) Use Assessment: Summary of Thematic Findings From the Focus Groups

Theme	Description	Quote
Not useful aspects of the MAHC and Annex	Not useful aspects included formatting (numbering, color coding) and harmonization across codes.	"Honestly, I find the language a little bit difficult to read in the MAHC itself. Both the section numbers are very difficult to keep track of. And I think the color coding is supposed to be helpful, but since we don't use it, I find it rather confusing." (MAHC_Limited2_Transcript_Clean, Pos. 113)
Ease of understanding the MAHC and Annex	Aspects that facilitated use included the formatting, writing structure, color coding, and that the language is easy to understand.	"For me, I really can't praise the Annex more. I love the way that it's tied directly to each code entry. I love that it has primary sources listed. So you can go and look at those if needed. That's been a huge help for us. It's very well laid out. Very. It's in plain language. Very easy to understand." (Transcript_FG5_Advanced_MSWord_01072025, Pos. 154–155)
Difficulty in understanding the MAHC or Annex	Difficult aspects included formatting, writing, structure, color coding, technical language, unclear wording, and a lack of resources for training.	"Oh yes, I feel like the MAHC would be more useful. Okay, I think my big complaint is the pool world does not get any resources. We don't get, like there's no plan review training. I had to learn by going word-for-word from the regs on how to do a pool plan review. No one to guide me, no training classes. So a lot of the MAHC I just don't understand, and I feel as a public health official—like the indoor pool ventilation, that is way above my head—and I feel like that's why we even said we're not going to put it in our draft, because then we would have to regulate it. And I feel like we wouldn't be able to do a good job about that. So there are some complex areas of the MAHC, but I think that really is because we're not trained properly as public health officials who are in charge of these pools. Not just plan reviews, but also pool inspections. We just don't get the right training." (Transcript Intermediate 01_16, Pos. 142–143)
Implementation facilitators	Facilitators included past experiences with the MAHC, which were accompanied by a learning curve. They also discussed difficulties working with partners that might not be as familiar with the MAHC.	"Our inspectors after two rounds of doing routine inspections, got really into the swing of it and got very good at going through those. So our inspections now take roughly the same amount of time that they did under the old code, which is nice. So you're getting at reasons why your chemical disinfection is out of whack as opposed to saying, 'Yeah, it's wrong.' So I think that was good and easy to do, and then we have developed some resources for our operators. We've developed a class that we launched last year where operators can send folks in who do the day-to-day work." (Transcript_FG5_Advanced_MSWord_01072025, Pos. 203–204)
Implementation barriers	Barriers included lack of time, staff and funding, need for training, old infrastructure, getting buy-in from industry and other partners, political will, and inability to pass the MAHC in its entirety or enforce regulations.	"Somebody has to write the regulations and reference the information that we've adopted in the Model Aquatic Health Code, but we have to have political support at the state and local levels in order to get that done because no attorney—whether it's a state or local level—is going to arbitrarily do that without orders to, or grassroots effort to, change or modify/improve the regulations that are being enforced in the local areas." (MAHC_FG_Limited 121324 Transcript, Pos. 176) "I would say if we just wanted to adopt the MAHC the same way that [state name removed] adopted the Food Code, it would require a massive fiscal impact because it would be a substantive change. There was political will to do such a fiscal impact when we adopted the Food Code because we had the support of [state name removed] in a restaurant association. So, we would require similar support from the private side to undergo that type of adoption." (MAHC_Intermediate1Transcript_Clean_11252024, Pos. 269–270)

continued ►

and technologies emerging from a rapidly expanding aquatics industry. Multiple jurisdictions, however, reported they frequently incorporate or have adopted the MAHC in full, indicating that jurisdictions function in diverse operational environments with a wide range of MAHC use.

Examining MAHC adoption revealed that topics such as facility design and construction, interactive water play features, and recirculation systems and filtration were among the most frequently referenced topics. This finding reinforces what focus

groups shared about how jurisdictions often reference the MAHC to grant code exceptions for engineered systems as aquatic venues are designed and built. In contrast, the least used (i.e., not directly incorporated into code or referenced) MAHC topics included flotation tanks, ventilation and air quality, lifeguarding and bathing supervision, and drowning prevention, all of which have been included in the MAHC since at least the 2018 version.

Facilitators and Barriers to MAHC Use and Adoption

The wide variety of MAHC use highlights the importance of understanding facilitators and barriers to its use. Jurisdictions that reported complete or partial MAHC adoption noted the code language format facilitated easier adoption because they did not have to translate typical guidance language into code format. Overall, jurisdictions identified the MAHC as a leading national resource and valued it for keeping current with the latest science and emerging

TABLE 3 continued

Model Aquatic Health Code (MAHC) Use Assessment: Summary of Thematic Findings From the Focus Groups

Theme	Description	Quote
Working with multidisciplinary teams and other codes	Respondents reported that they worked with multidisciplinary teams (including policymakers, industry, general public, and local and state health departments) when updating regulations. Participants reported referencing other established professional and regulatory codes, including the International Swimming Pool and Spa Code, within their jurisdictions' codes and using the MAHC to resolve conflicts between documents.	"It's taken five rounds of discourse with our stakeholder work group. And then we took that draft, as plain language as we possibly can, and submitted it to our work group for them to provide feedback. And we edit, we update, we revise, and we send out another version of that, and then we do it all over again. Another thing that we have to consider is our local municipalities that have adopted local pool codes that are much more stringent than our existing regulations. We get feedback from them because if we bolster our regs, they're going to have to go back and revise their own local code. And so it's a big impact on a lot of different stakeholders, and we have to engage them at different levels." (MAHC_Limited2_Transcript_Clean, Pos. 86–88)
Recommendations for improvement	Recommendations included 1) hyperlinks and hot links in the little annex notations in the code that take you to the exact section in the Annex, illustrations, and in the table of contents in the MAHC; 2) translating the MAHC into other languages (e.g., Spanish, Chinese, Korean, Hindi, Russian); and 3) enhancing the workforce through training and providing technical assistance was mentioned across participants across all of the groups. Training was also mentioned for other groups, including pool inspectors, pool operators, and other partners.	"I would add illustrations. It's one of those things I always dream about, you know, where you have like a full illustration of a venue with everything identified as to where it probably will be, and what it is. That would be awesome. And then you can take all those crazy words in the MAHC and find them on that illustration, or at least in a very quickly accessed glossary. I mean, the glossary is there, but you have to go over here to get there. Maybe if it could be sectionalized a little bit per section and with the words and the illustration. That'd be a dream come true." (MAHC_Limited2_Transcript_Clean, Pos. 146) "I really, really, really appreciate the network that we have with the program standards for retail food and with our retail food specialist. So something along those lines for pools, where there's relatively easy access to a technical expert and maybe some incentives for adopting parts of the code or implementing things would always be useful at the local level." (MAHC_Limited2_Transcript_Clean, Pos. 203–204)
Wish list for future topics	Wish list items included guidance and signage for cold-plunge pools, tanning ledges, and ADA compliance.	"We make designers aware that they need to comply with ADA, but we're not enforcing that because it's federal standards. So I think where the MAHC might pick up on it is where we know there might be a conflict . . . at least if we're recommending something that may not be consistent with ADA, to call that out and say we understand that there's a conflict or even reaching out to ADA because sometimes it falls down to like reasonable accommodation. And so, maybe a design thing wouldn't be completely against their standards if there were alternatives or things like that. I don't think the MAHC has gone and done a thorough job of looking for everywhere where it may conflict with ADA or not." (MAHC_Limited1_Transcript_Clean_12112024, Pos. 113–116)
Note. ADA = Americans with Disabilities Act; CDC = Centers for Disease Control and Prevention.		

industry trends. The Annex was mentioned on several occasions as being a hallmark of the MAHC because it provides the scientific rationale to support updating codes, documenting safety hazards, granting code exceptions, or informing evidence-based decision-making.

Several barriers to MAHC use were reported, including bureaucracy and legal issues, outdated codes, politics, and lack of resources such as personnel and funding (D'Angelo et al., 2021; Knight & Vincent, 2018). Similar resource constraints and slow regulatory processes have also been observed via tracking of FDA *Food Code* adoption efforts (Tomlinson et al., 2024; Wildey et al., 2023).

A dedicated MAHC adoption tracking system and implementation support, similar to those used with FDA *Food Code* and the Voluntary National Retail Food Regulatory Program Standards, could help remove barriers and improve MAHC use and implementation (Food and Drug Administration [FDA], 2025, 2026; Tomlinson et al., 2024; Wildey et al., 2023). This support could include training and technical assistance, and even incentives for MAHC adoption.

MAHC Update Frequency

Characterizing MAHC update frequency was a key aim of our study. At the time of the 5th edition publication in December 2024,

the MAHC was being updated on a 3-year cycle. Since the initial MAHC release, CDC has worked with CMAHC to ensure guidance stays current. CMAHC collected, assessed, and relayed national input from interested partners about the MAHC revisions, which are often driven by the need to keep current with the rapidly expanding aquatics industry. For example, recent editions of the MAHC included code language for flotation tanks (2018 edition) and artificial swimming lagoons (2024 edition).

Most participants found the 3-year MAHC updates beneficial to keep current with new technology, although there was a mixed response on the 3-year cycle being enough

time to modify or keep existing codes current. Additionally, the focus group discussions reinforced that each public health jurisdiction is unique with regard to regulatory processes, local considerations, and resource limitations.

Overall, study participants reported that an out-of-date MAHC would be unhelpful. Without updated national guidance, jurisdictions would look elsewhere for guidance that might not be public health-focused or evidenced-based—or available at all—ultimately increasing the resource burden on STLT jurisdictions to keep codes current. This scenario was identified as a critical public health issue that brought public health and industry partners together to develop and release the MAHC in 2014 and to keep it updated with the latest science and best practices (CDC, 2024b).

Public Health Implications

Our study reinforces the importance of an updated MAHC that allows public health partners to use it as best fits their jurisdiction's unique needs. Jurisdictions reported a wide variety of MAHC use that goes beyond simple adoption; thus, a multifactorial

approach that includes the use of code exceptions is needed to effectively measure MAHC use. Similar to efforts supporting the FDA *Food Code*, a MAHC adoption tracking system and implementation support are needed to overcome barriers to MAHC use (FDA, 2025; Tomlinson et al., 2024; Wildey et al., 2023). Additionally, the MAHC update cycle could be adjusted to longer than every 3 years to reduce the burden on MAHC users.

Limitations

Our study has several limitations. Incomplete surveys were excluded, and the survey and focus groups are not representative of all STLT agencies that regulate public aquatic venues. As such, findings cannot be extrapolated beyond the actual survey respondents and focus group participants. Additionally, multiple survey participants could have been from the same STLT jurisdiction, potentially resulting in duplicate responses or inconsistencies based on MAHC experience and familiarity with the STLT aquatic health code. Furthermore, requiring MAHC experience to participate in the survey could have excluded individuals with experience in pub-

lic swimming pool regulation but no MAHC experience. Future research could include representative MAHC user groups and focus on specific topics to address gaps in MAHC implementation and use. 🌸

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