Model Aquatic Health Code
Hygiene Facilities Draft Module

Hygiene Facilities Module Annex Sections for the First 60-day Review Posted for Public Comment on 10/31/2011

Currently Open for Public Comment that Closes on 12/29/2011

In an attempt to speed the review process along, the MAHC steering committee has decided to release MAHC draft modules prior to their being fully complete and formatted. These drafts will continue to be edited and revised while being posted for public comment. The complete versions of the drafts will be available for public comment again when all MAHC modules are posted for final public comment. The MAHC committees appreciate your patience with the review process and commitment to this endeavor as we all seek to produce the best aquatic health code possible.

This information is distributed solely for the purpose of pre dissemination public comment under applicable information quality guidelines. It has not been formally disseminated by the Centers for Disease Control and Prevention. It does not represent and should not be construed to represent any agency determination or policy.

MAHC Hygiene Facilities Module Abstract

Swimmer hygiene is a critical component that plays a role in documented waterborne disease outbreaks and poor water quality. The Hygiene Facilities Module is a first step towards improving swimmer hygiene and facility water quality to reduce the associated health effects. The Hygiene Facilities Module contains requirements for new or modified construction that include:

1) Minimum distances for hygiene facilities from aquatic venues.
2) Diaper changing stations.
3) Implementation of rinse vs. cleansing showers.

MAHC Hygiene Facilities Module Review Guidance

The **Model Aquatic Health Code (MAHC) Steering** (http://www.cdc.gov/healthywater/swimming/pools/mahc/steering-committee/) **and Technical** (http://www.cdc.gov/healthywater/swimming/pools/mahc/technical-committee/) **Committees** appreciate your willingness to review this draft MAHC module. Your unique perspectives and science-based suggestions will help ensure that the best available standards and practices for protecting aquatic public health are available for adoption by state and local environmental health programs.

Review Reminders:

- Please download and use the **MAHC Comment Form** (http://www.cdc.gov/healthywater/swimming/pools/mahc/structure-content/) to submit your detailed, succinct comments and suggested edits. Return your review form by December 29, 2011, as an email attachment to **MAHC@cdc.gov**.

- If part of a larger group or organization, please consolidate comments to speed the MAHC response time to public comments.

- To provide context for this module review, please consult the **MAHC Strawman Outline** (http://www.cdc.gov/healthywater/pdf/swimming/pools/mahc/structure-content/mahc-strawman.pdf). Section headers of related content have been included in this draft module to assist reviewers to see where each section fits into the overall MAHC structure. Additional MAHC draft modules that contain this content will be or already have been posted for your review.

- MAHC Grading System
  - A grading system is provided for the recommended standards. It is based on the perceived reliability and accuracy of the material presented. This grading system is divided into three levels. The MAHC grading system is as follows:
    - Grade A: Practice supported by science/research/data.
    - Grade B: Generally accepted practice not supported by science/research/data.
    - Grade C: No generally accepted practice. Proposed language not yet supported by science/research/data.

- The complete draft MAHC, with all of the individual module review comments addressed will be posted again for a final review and comment before MAHC publication. This will enable reviewers to review modules in the context of other modules and sections that may not have been possible during the initial individual module review.

- The published MAHC will be regularly updated through a collaborative all-stakeholder process.

Please address any questions you may have about MAHC or the review process to **MAHC@cdc.gov**. You may also request to be on the direct email list for alerts on the other draft MAHC modules as they are released for public comment.

Thank you again, and we look forward to your help in this endeavor.
Sincerely,

Douglas C. Sackett, Director
MAHC Steering Committee

The Hygiene Facilities Code Module shows a Table of Contents giving the context of the Hygiene Facilities Design, Construction, Operation and Maintenance in the overall Model Aquatic Health Code's Strawman Outline (http://www.cdc.gov/healthywater/pdf/swimming/pools/mahc/structure-content/mahc-strawman.pdf).

Reviewer Note on Module Section Numbering:

Please use the specific section numbers to make your comments on this Draft Model Aquatic Health Code module. These numbers may eventually change during the editing of the compiled Draft that will be issued for a final round of comments.

Reviewer Note on the MAHC Annex

Rationale

The annex is provided to:

(a) Give explanations, data, and references to support why specific recommendations are made;
(b) Discuss the rationale for making the code content decisions;
(c) Provide a discussion of the scientific basis for selecting certain criteria, as well as discuss why other scientific data may not have been selected, e.g. due to data inconsistencies;
(d) State areas where additional research may be needed;
(e) Discuss and explain terminology used; and
(f) Provide additional material that may not have been appropriately placed in the main body of the model code language. This could include summaries of scientific studies, charts, graphs, or other illustrative materials.

Content

The annexes accompanying the code sections are intended to provide support and assistance to those charged with applying and using Model Aquatic Health Code provisions. No reference is made in the text of a code provision to the annexes which support its requirements. This is necessary in order to keep future laws or other requirements based on the Model Aquatic Health Code straightforward. However, the annexes are provided specifically to assist users in understanding and applying the provisions uniformly and effectively. They are not intended to be exhaustive reviews of the scientific or other literature but should contain enough information and references to guide the reader to more extensive information and review.

It is, therefore, important for reviewers and users to preview the subject and essence of each of the annexes before using the document. Some of the annexes (e.g., References, Public Health Rationale) are structured to present the information in a column format similar to the code section to which they apply. Other annexes or appendices provide information and materials intended to be helpful to the user such as model forms that can be used, recreational water illness outbreak response guidelines, and guidelines for facility inspection.

Appendices

Additional information that falls outside the flow of the annex may be included in the Model Aquatic Health Code Annex

Acronyms in this Module: See the Hygiene Facilities Module, Code Section

Glossary Terms in this Module: See the Hygiene Facilities Module, Code Section

Preface: *This document does not address all health and safety concerns, if any, associated with its use. It is the responsibility of the user of this document to establish appropriate health and safety practices and determine the applicability of regulatory limitations prior to each use.*

Model Aquatic Health Code
Hygiene Facilities Annex

Keyword	Section	Annex
	4.0	**Design Standards and Construction**
	4.1	**Plan Submittal**
	4.2	**Materials**
	4.3	**Equipment Standards**
	4.4	**Pool Operation and Facility Maintenance**
	4.5	**Pool Structure**
	4.6	**Indoor/Outdoor Environment**
	4.7	**Recirculation and Water Treatment**
	4.8	**Decks and Equipment**
	4.9	**Filter/Equipment Room**
	4.10	**Hygiene Facilities**
	4.10.1	***General***
General	4.10.1	Language similar to this section is found in most state CODES.
Hygiene Facilities	4.10.1.1	During 2005–2006, 29 (50.0%) of 58 treated recreational water–associated outbreaks were caused by *Cryptosporidium.*[1] These cryptosporidiosis outbreaks tend to disproportionately affect children <5 years of age and can cause community-wide outbreaks.[2] Infectious *Cryptosporidium* oocysts' extreme chlorine tolerance allows them to survive for 3.5–10.6 days when free chlorine levels are maintained at 1–3 mg/L.[3] The oocysts small size (4.5 µm x 5.5 µm) also allows them to bypass typical sand and cartridge filters.[4] While secondary or supplemental disinfection can inactivate the oocysts, these ultraviolet and ozone treatment systems are

[1] Yoder *et al*. Surveillance for waterborne disease and outbreak associated with recreational water use and other aquatic facility–associated health events — United States, 2005–2006. MMWR Surv 2008;57(SS-9):1–38.
[2] CDC. Communitywide cryptosporidiosis outbreak--Utah, 2007. MMWR Morb Mortal Wkly Rep. 2008;57(36):989-93.
[3] Shields *et al.* Inactivation of *Cryptosporidium parvum* under chlorinated recreational water conditions. J Water Health 2008;6(4):513–20.
[4] Smith H. Diagnostics. In: Fayer R, Xiao L, eds. *Cryptosporidium* and cryptosporidiosis. 2nd ed. Boca Raton, Florida: CRC Press, 2008:173–207.

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circulation dependent.[5,6,7,8,9]

Thus, changing BATHER behavior through enforcement of diarrhea-exclusion policies, swimmer education about hygienic swimming behaviors (e.g., taking a CLEANSING SHOWER before entering the water, and not swallowing the water), and employing secondary or supplemental disinfection are needed to help prevent cryptosporidiosis outbreaks.

During January–March 2007, >660 BATHERS and aquatic staff at the waterpark experienced respiratory symptoms and eye irritation caused by chloramines.[10] Chloramines form when free chlorine oxidizes nitrogenous compounds (e.g., sweat, urine, and personal care products) that wash off BATHERS' bodies. Chloramines can volatilize into the air where it can accumulate in air of indoor AQUATIC VENUES. One (17%) in five American adults reports having ever urinated in a pool[11], and elite athletes can sweat >700 ml/h.[12] Rinsing off in the shower for 17 seconds and wearing bathing caps introduces 35–60% and 79% less contamination to the water, respectively, and studies suggest that ultraviolet treatment can reduce chloramine levels in the water.[13,14,15]

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[5] Betancourt WQ, Rose JB. Drinking water treatment processes for removal of *Cryptosporidium* and *Giardia*. Vet Parasitol. 2004;126(1-2):219-34.
[6] Craik SA *et al*. Inactivation of *Cryptosporidium parvum* oocysts using medium- and low-pressure ultraviolet radiation. Water Res. 2001;35(6):1387-98.
[7] Rochelle PA *et al*. The response of *Cryptosporidium parvum* to UV light. Trends Parasitol. 2005;21(2):81-7.
[8] Corona-Vasquez B *et al*. Inactivation of *Cryptosporidium parvum* oocysts with ozone and free chlorine. Water Res. 2002;36(16):4053-63.
[9] Korich DG *et al*. Effects of ozone, chlorine dioxide, chlorine, and monochloramine on *Cryptosporidium parvum* oocyst viability. Appl Environ Microbiol. 1990;56(5):1423-8.
[10] CDC. Respiratory and Ocular Symptoms among Employees of a Hotel Indoor Waterpark Resort — Ohio, 2007. MMWR 2009; 58(4):81-85.
[11] Wiant C. A snapshot of swimmer hygiene behavior. Int J Aquat Res Ed. 2011;5(3):244-245.
[12] Cox *et al*. Body Mass Changes and Voluntary Fluid Intakes of Elite Level Water Polo Players and Swimmers. *J Sci Med* Sport. 5,3 (2002): 183-193.
[13] Keuten M *et al*. Determination and reduction of bathing loads in public swimming pools [Presentation]. Swimming Pool & Spa International Conference, London, UK; March 17–20, 2009.
[14] Cassan D *et al*.Effects of medium-pressure UV lamps radiation on water quality in a chlorinated indoor swimming pool. Chemosphere 2006;62(9):1507-13.
[15] Li J, Blatchley ER, 3rd. UV photodegradation of inorganic chloramines. Environ Sci Technol 2009;43(1):60-5.

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		Accumulation of chloramines in the air at indoor treated recreational water venues can be prevented with policies that require showering before entering the water, swimmer education about hygienic swimming behaviors (e.g., taking a RINSE SHOWER and using the toilet before entering the water, not urinating in the pool, and wearing bathing caps), and employing ultraviolet treatment and improving ventilation.
Based on Bather Load	4.10.1.3.1	The minimum number of HYGIENE FACILITIES should have fixture counts correlated directly to the BATHER load. Any fixture counts above this should be tied to the AHJ CODE.
Location	**4.10.2**	**Location**
300 Feet	4.10.2.1	When possible, it is preferable to have a bathroom on the same floor as the pool; however, it is not required at this time in the MAHC. Water should be available so that patrons, especially young children, are less likely to drink pool water and to ensure that patrons are kept well-hydrated. The intent of this CODE item is to discourage patrons from drinking pool water and encourage them to keep themselves hydrated.
	4.10.3	**Design and Construction**
Design		Language similar to this section is found in most state CODES.
Floors	4.10.3.1	Slip resistant is usually considered to mean having a static coefficient of friction of 0.6 or better for both wet and dry conditions. Currently, this ASTM standard C1028 is under revision.
Floor Base	4.10.3.2	The purpose of coving is to prevent water splashing on the wall when mopping. Six inches is a common height was taken from 2000 International Building Code Section 1209.1. Also see FDA model food code for kitchens
Opening Grill	4.10.3.3.1	Holes in floor drain cover openings need to be sized so as

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Covers		to prevent small children's toes from becoming entrapped when walked upon.
Sloped to Drain	4.10.3.3.2	Floors not pitched to drain have been shown to allow bacterial growth on indoor and outdoor POOL DECKS.
Hose Bibb	4.10.3.5	The purpose of these hose bibs is to permit adequate cleaning of shower and toilet facilities and to permit cleaning of any spills. See also Fecal, Blood and Vomit Response (MAHC 6.5).
Fixture Requirements	**4.10.4**	**Plumbing Fixture Requirements**
		Language similar to this section is found in most state CODES.
Protected	4.10.4.1.1	It is fundamental that there be no cross connection between safe (potable) and unsafe (non-potable) water supplies. All hose bibbs should be equipped with a vacuum breaker to prevent back siphonage. This cross-connection protection can also be achieved at lavatories and laundry tub washing facilities through an air gap. As a general rule, the inlet pipe is terminated at a distance about four times the diameter of the pipe and not less than 4 inches above the maximum overflow level of the fixture rim.
Showers	***4.10.4.2***	***Showers***
		Additional RINSE SHOWERS can be provided at up to 300 feet (91m) walking distance from the nearest controlled entry/exit of the most distant aquatic feature. The purpose of the showers described in this section is to remove dead skin and perianal fecal material before BATHERS enter the pool. This is best done through nude showering using warm water and soap. The purpose of the showers described in MAHC 4.10.4.2 is to remove inorganic material such as sand or dirt. This can be done in open showers with ambient temperature water. For that reason, RINSE SHOWERS should not figure into this requirement.
Shower Count	4.10.4.2.1	Perhaps require more showers in certain applications – water park vs. competition pool.

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Toilets	*4.10.4.3*	***Toilets and Urinals***

Facilities in jurisdictions with requirements governing number of sanitary facilities shall follow those requirements. Facilities in other areas with an average patron load of over 100 persons should follow the International Plumbing Code (IPC). Facilities in those areas with average patron loads of less than 100 persons should follow either the IPC or Uniform Plumbing Code (UPC). The IPC may require significantly more toilet facilities for women than for men.

Gender Potty Parity

Previous issues of the nation's model consensus CODE mandated an equal amount of toilet FIXTURES for both men and women. Newer versions of the CODE will likely provide asymmetric recommendations that increase the minimum required facilities for women.

Potty Parity discussion from Reasons to Adopt the 2000 IPC, developed by ICBO as an informational aid to CODE officials and the public.

The IPC requires far less HYGIENE FIXTURES for various types of occupancies than the UPC. This is contrary to the "potty parity" movement which demands more FIXTURES for women's toilet rooms to avoid the long waiting lines. The UPC also provides more water closets and urinals in most men's toilet rooms than the IPC and assures adequate water closets by limiting the number that can be deleted by installing additional urinals.

The authors have suggested that the provisions of the UPC reflect what the "potty parity movement" called for. The IPC is based upon research. The provisions of the IPC do address the issue of "potty parity" and reflect studies by Dr. Sandra Rawls at the University of Virginia, the Stevens Institute of Technology, the National Restaurant Association and the ASPE Research Foundation. The issue of "potty parity" is mostly an issue in assembly buildings with large occupant loads, especially where there is a period of high demand such as at intermission at a theater or at halftime at a football

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stadium. The "potty parity" is not an issue for occupancies where there is no instantaneous demand on the fixture usage. IPC Table 403.1 reflects requirements for twice as many FIXTURES in the ladies' room compared to the men's room, when the type of occupancy demands such a count. In occupancies where the factors do not demand such an increase, the CODE does not require it. It should also be pointed out that part of this issue arises because of some CODES requiring both water closets and urinals within the men's restroom. Therefore, the numbers for men were somewhat higher. The IPC does not have a mandatory requirement for urinals. It will generally require the same number of FIXTURES in the men's and women's restrooms. However, when two or more water closets are required, the IPC will permit up to 67 percent of the FIXTURES to be replaced by urinals. For additional supporting information, see the booklet IPC: A Guide for Use and Adoption 1. Some of the differences between the two CODES on this issue are:

IPC

Utilizes a fixed fixture to occupant load ratio. Does not mandate urinals for men. Allows urinals to be substituted for water closets. Up to 67 percent of the requirement for WC's. Establishes a separate factor for both men and women. In some cases twice as many FIXTURES are required for women compared to men. No arbitrary parity requirement.

UPC

Utilizes a variable fixture to occupant load ratio. Requires urinals to be installed based on a fixture to occupant load ratio. Does not allow for one to one substitutions. For each urinal added over what is required, you may have one to one substitutions up to 2/3 of what is required. Requires the total number of WC's for women to be equal to the total number of WC's and urinals for men.

Restrooms need to be easily accessible & available to patrons of AQUATIC VENUES so that they will use restrooms rather than urinating or defecating in the venue water. Unlike other recreational facilities, people feel that it is more acceptable to “pee in the pool” than to not use sanitary facilities for these bodily functions and other locations. This may not be possible in a large water parks,

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However, they can possibly be located within 200 feet (61m) from the plunge pool or run out.

There are specific types of facilities that pose a greater risk to BATHERS such as wading pools, water activity pools, interactive water features, spray pads, or other AQUATIC VENUES designed primarily for DIAPER-AGED CHILDREN under five years of age. For these venues diaper changing areas should be located directly adjacent to the kiddie areas.

It is especially important that sanitary facilities be available to these high risk groups. Children less than five years of age have the highest incidence of diarrheal illness and are more likely to be a source of recreational water illnesses.

Diaper-Changing Stations

4.10.4.4 Diaper-Changing Stations

The material in this section addresses diapering of infants and young children. These are the groups most commonly involved in outbreaks of illness associated with recreational water. Although some older persons must wear diapers, the risk of infection from adults is much less than that from children and we do not believe that special regulations are needed. Current DIAPER-CHANGING UNITS do not supply all the features needed for sanitary and efficient diaper changing and clean-up to minimize spreading pathogens further in the AQUATIC FACILITY. The MAHC is now defining a DIAPER-CHANGING STATION as including diaper changing unit that also has an adjacent handwashing sink, soap dispenser, and trash receptacle and necessary cleaning materials for the DIAPER-CHANGING UNIT. There appear to be two different configurations of DIAPER-CHANGING UNITS currently available and suitable for this setting. One is a fold-down commercial unit and the other is a free-standing unit. The first is addressed by ASTM F2285-04 consumer performance standards for commercial DIAPER-CHANGING STATIONS while the second is addressed by Caring for Our Children: National Performance Standards for Out-of-Home Child Care (http://nrckids.org). A major difference between these two is that F2285-04 calls for restraining straps while CFOC prohibits the use of straps and relies on a 3 inch (8cm) lip to keep children from falling off. The

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		problem with straps is one associated with cleaning and possible hanging. The problem with a 3 inch (8cm) lip is that they are not available on fold-up units. Our CODE language does not discriminate between these two configurations but whatever unit used should conform to one of these two standards. Signage requirements were adapted from the diapering procedure laid out in CFOC.[16]
Unisex	4.10.4.4.2	Increasingly, many venues are providing family dressing areas and caregiver rooms to attend to family needs. This permits parents of the opposite sex to attend to the needs of small children.
Sink and Soap	4.10.4.4.6	Data shows that cold water doesn't affect efficacy of hand washing, but warm water may improve adherence to hand washing.
Trash Can	4.10.4.4.7	These receptacles are needed to help maintain cleanliness around the DIAPER-CHANGING STATION for any disposable changing table covers, diapers, sanitizing wipes, or disposable towels.
Non-Plumbing Fixtures	***4.10.4.5***	***Non-Plumbing Fixture Requirements***
Lockers	4.10.4.5.2	While some lockers, such as stainless steel, are designed to sit directly on the floor, other lockers may need to be elevated. This prohibits water accumulation beneath the lockers. Such accumulation can lead to the growth of mold, mildew, and slime build up.
Suits and Towels	**4.10.5**	**Suits and Towels**
Reusable Suits and Towels	4.10.5.1	Although providing reusable bathing suits is no longer common, many facilities provide patrons with towels. The purpose of this standard is to ensure that these facilities include provision for laundering and sanitizing these items in their design and construction.

[16] American Academy Of Pediatrics, American Public Health Association, and National Resource Center for Health and Safety in Child Care and Early Education (2002). *Caring for Our Children: National Health and Safety Performance Standards; Guidelines for Out-of-Home Child Care Programs, 2nd edition*. Elk Grove Village, IL: American Academy of Pediatrics and Washington, DC: American Public Health Association. Available at http://nrckids.org.

Keyword	Section	Annex
Foot Baths	**4.10.6**	**Foot Baths**
Prohibited	4.10.6.1	FOOT BATHS with standing water allow the buildup of organic material and bacterial growth.
Sharps	**4.10.7**	**Sharps**
Biohazard Action Plan	4.10.7.1	This was included to address those venues that provide patrons with sharps, especially razors, so that safe disposal is assured. Approved sharps containers are rigid, leak-proof, puncture resistant boxes of various sizes made of hard red plastic, with a lid that can be securely sealed to keep contents from falling out, and clearly marked with the bio-hazard symbol. OSHA regulations describe the design and use of sharps containers for a variety of settings.

Model Aquatic Health Code
Hygiene Facilities Module
5.0 Operation and Maintenance

Keyword	Section	Annex
	5.0	**Operation and Maintenance**
	5.1	**Plan Submittal**
	5.2	**Materials**
	5.3	**Equipment Standards**
	5.4	**Pool Operation and Facility Maintenance**
	5.5	**Pool Structure**
	5.6	**Indoor/Outdoor Environment**
	5.7	**Recirculation and Water Treatment**
	5.8	**Decks and Equipment**
	5.9	**Filter/Equipment Room**
Hygiene Facilities	**5.10**	**Hygiene Facilities**
General	**5.10.1**	**General**
Cleaned Daily	5.10.1.1	Toilets and showers should attract BATHERS to use them.[17] Although we are not aware of any work in this particular setting, studies in child care settings, schools, long term care facilities and food service establishments all support the importance of surface cleaning. We feel that daily cleaning in this setting is reasonable for aesthetics as well as health and safety.
	5.10.2	**Location [N/A]**
	5.10.3	**Bathhouse Design [N/A]**
	5.10.4	**Fixture Requirements**
	5.10.4.1	***General Requirements***
	5.10.4.2	***Showers***
Cleaned and	5.10.4.2.1	The effectiveness of most halogen-based disinfectants is

[17] Pool Water Treatment Advisory Group. Swimming pool water; Treatment and quality standards for pools and spas. 2nd edition, 2009. Micropress Printers Ltd.

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Sanitized		reduced by the presence of organic material. Also, fecal contamination of the perianal area is common. This contamination may include infective stages such as oocysts that are not inactivated by routine disinfectant levels in AQUATIC VENUES. The purpose of these showers is to reduce the organic and fecal load introduced into pools.
No soap at Rinse showers	5.10.4.2.5	Soap is not needed at RINSE SHOWERS. It can have a deleterious effect on pool chemistry.
Toilets and Urinals	***5.10.4.3***	***Toilets and Urinals***
Diaper-Changing Stations	***5.10.4.4***	***Diaper-Changing Stations***
Maintenance	5.10.4.4.1	It is the responsibility of patrons to clean diaper changing surfaces after each use. This is consistent with practice in other public settings where diapering takes place. However, staff should keep an eye on these and step in when necessary.
Non-Plumbing Fixtures	***5.10.4.5***	***Non-Plumbing Fixture Requirements***
Wooden Racks	5.10.4.5.4	Associations between swimming pools and disease outbreaks have been documented in the literature. Though an outbreak has never been connected to play features or materials specifically, the possibility could exist, and more likely if the AQUATIC FACILITY was not maintained properly. Biofilms are bacteria that can attach to cells or non living surfaces. Once established, they provide a home for a variety of microbes and are hard to remove. Biofilm associated bacteria are much more resistant to hypochlorous acid compared to free swimming microbes. Design options as well as sanitizing systems with effective validation, could be useful for prevention and remediation of bacteria growth and biofilms. Ozone sanitizing systems are currently utilized to sanitize food processing plants, and may be a useful way of sanitizing these features in the future.
Shared Equipment	**5.10.5**	**Suits, Towels, and Shared Equipment**
Shared Equipment	5.10.5.2	Research has demonstrated that play features, mat materials, and other shared equipment found at AQUATIC

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FACILITIES and water parks can harbor bacteria, even while submerged in chlorinated water. Damp materials that were not submerged in water contained the highest populations of bacteria. Damp play features designed for infants and toddlers, were found to be likely vehicles for transference of gastrointestinal bacteria. The array of organisms isolated from damp features suggests that features need to be sanitized on a routine basis using a combination of chemical and physical methods, preferably as recommended by the manufacturer.[18]

Associations between swimming pools and disease outbreaks have been documented in the literature. Though an outbreak has never been connected to play features or materials specifically, the possibility could exist, and more likely if the AQUATIC FACILITY was not maintained properly. Biofilms are bacteria that can attach to cells or non living surfaces. Once established, they provide a home for a variety of microbes and are hard to remove. Biofilm associated bacteria are much more resistant to hypochlorous acid compared to free swimming microbes. Design options, as well as sanitizing systems with effective validation, could be useful for prevention and remediation of bacteria growth and biofilms. Ozone sanitizing systems are currently utilized to sanitize food processing plants, and may be a useful way of sanitizing these features in the future.

[18] Davis, T *et al*. Bacteriological analysis of Wisconsin water parks. J Water Health 2009;7(3):452-463.

A Note about Resources:

The resources used in all MAHC modules come from peer-reviewed journals and government publications. No company-endorsed publications have been permitted to be used as a basis for writing code or annex materials.

Hygiene Facilities Module Bibliography

Codes Referenced

- 2000 International Building Code Section 1209.1
- ASTM F2285-04

References Cited in Module

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