Model Aquatic Health Code

Fecal/Blood/Vomit Contamination Response Module ANNEX Sections Modified after the First 60-day Review that Closed on 11/03/2008

Informational Copy: NOT Currently Open for Public Comment

This version of the MAHC Fecal/Blood/Vomit Contamination Response Module has been modified based on the first round of public comments received. It is being re-posted so users can view how it was modified but is not currently open to public comment. 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 public comments and MAHC responses can be viewed on the web at http://www.cdc.gov/healthywater/swimming/pools/mahc/structure-content/index.html

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.

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MAHC Fecal/Blood/Vomit Contamination Response Module Abstract

Health issues related to fecal contamination of aquatic facilities are well documented. The Fecal/Vomit./Blood Contamination Module contains requirements for planning, training, and response to contamination of aquatic facility water and surfaces by these biological fluids that include:

1) Response plans for vomit and formed or diarrheal stool contamination events.
2) Response plans for contamination of surfaces with blood.
3) Requirements for training in the fecal/vomit/blood contamination response plans.

The Fecal/Blood/Vomit Contamination Response CODE Module shows a Table of Contents giving the context of the Fecal/Blood/Vomit Contamination 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).

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 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 Fecal/Blood/Vomit Contamination Module, Code Section

Glossary Terms in this Module: See the Fecal/Blood/Vomit Contamination 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
Fecal/Blood/Vomit Contamination Response Module Annex

6.0 Policies and Management

Keyword	Section	Annex
	6.0	**Policies and Management**
	6.1	**Operator Training**
	6.2	**Lifeguard Training**
	6.3	**Facility Staffing**
Minimum	6.3.3.4.1	A staff member trained in fecal/vomit/blood contamination response should be on site during all operational hours. OSHA discusses occupational issues related to potential bloodborne pathogen exposure in the Bloodborne Pathogens Standard, 29 CFR 1910.1030[1] with further discussion under General Guidance[2] and the OSHA Fact Sheet: OSHA's Bloodborne Pathogens Standard[3].
	6.4	**Facility Management**
	6.4.1.3	***Recordkeeping***
Contamination Incidents	6.4.1.3.4.1	The Body Fluid Contamination Response Log is an important part of the administrative procedures for the venue and will document, in the case of a subsequent fecal, vomit, or blood contamination incident, that an appropriate response was conducted. A sample Body Fluid Contamination Response Log is provided below:

[1] OSHA. Bloodborne pathogens and needlestick prevention standards. Available at: http://www.osha.gov/SLTC/bloodbornepathogens/standards.html. Accessed: 5/1/2013.
[2] OSHA. Bloodborne pathogens and needlestick prevention. Available at: http://www.osha.gov/SLTC/bloodbornepathogens. Accessed: 5/1/2013.
[3] OSHA. Fact Sheet: OSHA's bloodborne pathogen standards. Available at: http://www.osha.gov/OshDoc/data_BloodborneFacts/bbfact01.pdf. Accessed: 5/1/2013.

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Body Fluid Contamination Response Log

Person Carrying out Contamination Response						
Supervisor on Duty						
Date of Contamination Response (mm/dd/yyyy)						
Time of Response						
Location Contaminated						
Number of People in Water (if applicable)						
Type/Form of Contamination: *Fecal Accident (Formed Stool or Diarrhea), Vomit, Blood*						
Time that Contaminated Area was Closed						
Is Stabilizer Used in the Water? (Yes/No) (if applicable)						
If Yes, Stabilizer Concentration at Time of Contamination Response						
	Water Quality Measurements					
Columns 1-4 are measurements spread evenly thru the closure time.	Level at Closure	1	2	3	4	Level Prior to Reopening
Free Residual Chlorine						
pH						
Date that Contaminated Area was Reopened (mm/dd/yyyy)						
Time that Contaminated Area was Reopened						
Total Contact Time *Time from when disinfectant reached target level to when disinfectant levels were reduced prior to re-opening*						
Remediation Procedure(s) Used and Comments/Notes						

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6.5 Fecal/Vomit/Blood Contamination Response

The following discussion gives the rationale behind the remediation recommendations. Fecal contamination of recreational water is an increasing problem in the United States and other countries. Since the mid 1980's, the number of outbreaks of diarrheal illness associated with recreational water has been increasing in the United States.[4] Of these outbreaks, disinfected, man-made swimming venues, the target of the MAHC, have had the greatest increase. These outbreaks are usually a result of people swimming while they have infectious, pathogen-containing diarrhea caused by pathogens such as *Cryptosporidium*, *Giardia*, *Shigella*, *Salmonella*, or *E. coli* O157:H7. Contamination of swimming water by infected persons and subsequent swallowing of contaminated water by other swimmers continues the spread of diarrheal illness.

Diarrheal illness is common in the United States with surveys indicating that 7.2-9.3% of the general public have had diarrhea in the previous month.[5] Additional studies demonstrated that people routinely have a mean of 0.14 grams (range = 0.1 to 10 grams) of fecal contamination on their buttocks and peri-anal surface.[6] The increase in outbreaks, the high prevalence of diarrheal illness in the public, and likelihood of frequent fecal contamination of pools by bathers raised the question of how to respond to overt fecal releases, particularly formed stools that were more visible, in pools. The need to develop a response plan was amplified by the emergence of the chlorine-resistant parasite *Cryptosporidium* as the leading cause of disinfected venue-associated outbreaks of diarrheal illness. First, formed stools were thought to be a significantly lower risk for spreading illness compared to diarrhea, since most pathogens are shed

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[4] Hlavsa MC, Roberts VA, Anderson AR, Hill VR, Kahler AM, Orr M, Garrison LE, Hicks LA, Newton A, Hilborn ED, Wade TJ, Beach MJ, Yoder JS. Surveillance for waterborne disease outbreaks and other health events associated with recreational water use — United States, 2007–2008. MMWR Surveill Summ. 2011;60:1-37.
[5] Jones TF, Mcmillian MB, Scallan E, Frenzen, Cronquist AB, Thomas S, Angulo FJ. A population-based estimate of the substantial burden of diarrhoeal disease in the United States; FoodNet, 1996–2003. Epidemiol Infect (2007); 135:293–301.
[6] Gerba CP. Assessment of enteric pathogen shedding by bathers during recreational activity and its impact on water quality. Quant Microbiol (2000); 2:55-68.

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in the greatest numbers in diarrhea. As the highest risk material, diarrhea was thought of as the worst case contamination scenario that could potentially contain *Cryptosporidium*. As a result, a response should require the extreme treatment conditions needed to inactivate *Cryptosporidium*. Formed stool was assessed as a lower risk than diarrhea but several questions remained. Should formed stools be treated as potentially infectious materials? If so, then should the stool be treated as a potential *Cryptosporidium* contamination event like diarrhea (i.e., longer inactivation time) or could it be treated to inactivate all other pathogens other than *Cryptosporidium* (i.e., shorter inactivation time).

To collect data relevant to answering the question above, a study to collect fecal releases from pools the United States was conducted in 1999. Pool staff volunteers from across the United States collected almost 300 samples from fecal incidents that occurred at water parks and pools.[7] The Centers for Disease Control and Prevention then tested these samples for *Cryptosporidium* and *Giardia*. Giardia was chosen as a representative for moderately-chlorine resistant pathogens like hepatitis A virus and norovirus. Using conditions to inactivate *Giardia* would inactivate most pathogens other than *Cryptosporidium*. None of the sampled feces tested positive for *Cryptosporidium*, but *Giardia* was found in 4.4% of the samples collected. These results suggested that formed fecal incidents posed only a very small *Cryptosporidium* threat but should be treated as a risk for spreading other pathogens such as *Giardia*. As a result of these data and the discussion above, it was decided to treat formed stools as potential *Giardia* contamination events, and liquid stool as potential *Cryptosporidium* contamination events.

It was thought that norovirus contamination posed the greatest threat from vomit contamination and that the virus would be inactivated by a formed stool response using *Giardia* inactivation times as discussed above. Further assessment also suggested that blood contamination of pool water posed little health risk due to the sensitivity of bloodborne pathogens (e.g., viruses, bacteria) to environmental exposure, dilution in

[7] CDC. Prevalence of Parasites in Fecal Material from Chlorinated Swimming Pools — United States, 1999. MMWR 2001;50(20):410–2.

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		the water, and chlorination. In addition, pool water exposures would lack the requisite bloodborne exposure routes needed to spread the pathogens to other people.
Contamination Response Plan	**6.5.1**	**Contamination Response Plan**
		The Fecal/Vomit/Blood Contamination Response plan is a vital part of the administrative procedures for the venue. All staff associated with the operation of the pool should be aware of the response plan and trained in implementation procedures. At least one responder should be available on- site during all hours of operation.
Water Contamination	**6.5.2**	**Water Contamination Response**
No vacuum cleaners	6.5.2.2.2	Questions are often received concerning the MAHC recommendation to **NOT VACUUM** fecal material from the pool. When the material is drawn through the vacuum, the vacuum itself is then contaminated and must be disinfected. At the present time, the MAHC is not aware of any manufacturer that has a decontamination protocol for disinfecting fecal, vomit or blood-contaminated pool vacuum units.
Treated	6.5.2.3	Temperature and pH levels were chosen because the original parasite inactivation data (*Giardia* for formed stool, *Cryptosporidium* for liquid stool) used these values. Many pools have a water temperature above 77^0F (25^0C) and maintain a pH of 7.5 or lower. If the pH is higher than 7.5, it should be adjusted to below 7.5. If the pH is lower than 7.5 it does not need to be raise since the efficacy of the chlorination process is dramatically improved by reduced pH.
		Pool temperatures above 77°F (25°C) will increase the effectiveness of disinfection; therefore, it is not necessary to lower the pool temperature when responding to fecal or vomit contamination of a pool.
Contamination Disinfection	**6.5.3***	**Pool Water Contamination Disinfection**
Formed-stool	6.5.3.1	For **formed-stool contamination**, a free chlorine value of 2 mg/L was selected to keep the pool closure time to approximately 30 minutes. Other chlorine concentrations or closure times can be used as long as the CT inactivation value is kept constant. The CT value is the concentration (C) of free available chlorine in mg/L multiplied by time (T) in minutes (CT

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value = C x T).

For formed-stool contaminated water the CT value for *Giardia* (45) is used as a basis for calculations:

Giardia Inactivation Time for Formed-stool Contamination	
Chlorine Levels (mg/L)	**Disinfection Time***
1.0	45 minutes
2.0	25 minutes
3.0	19 minutes
**These closure times are based on a 99.9% inactivation of Giardia cysts by chlorine, pH 7.5, 77°F (25°C). The closure times were derived from the Environmental Protection Agency (EPA) Disinfection Profiling and Benchmarking Guidance Manual. They do not take into account "dead spots" and other areas of poor pool water mixing.*	

Diarrheal-stool 6.5.3.2 For **diarrheal-stool contamination**, inactivation times are based on *Cryptosporidium* (Crypto) inactivation times. The CT value for Crypto is 15,300. If a different chlorine concentration or inactivation time is used, an operator must ensure that the CT values remain the same. For example, to determine the length of time needed to disinfect a pool at 20 mg/L after a diarrheal accident use the following formula: C x T = 15,300. Solve for time: T= 15,300 ÷ 20 mg/L = 12.75 hours. It would take 12.75 hours to inactivate Crypto at 20 mg/L. See table below:

Cryptosporidium Inactivation Time for Diarrheal Contamination	
Chlorine Levels (mg/l)	**Disinfection Time**
1.0	15,300 minutes (255 hours)
10.0	1,530 minutes (25.5 hours)
20.0	765 minutes (12.75 hours)

Pools containing 6.5.3.2.1 Note: Chlorine stabilizers such as cyanuric acid slow

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chlorine stabilizers		disinfection; therefore, higher chlorine levels may be necessary to reach the CT value for *Giardia* inactivation in pools using chlorine stabilizers. However, at this time there is no standardized protocol to compensate for chlorine stabilizers and no data determining how the inactivation of *Giardia* is affected by chlorine stabilizers under pool conditions is available. Many conventional test kits cannot measure free available chlorine levels up to 20 mg/l. Operators should use, in order of preference, a FAS- DPD titration test kit with or without dilutions using chlorine-free water, or use test strips that measure free available chlorine in a range that includes 20 mg/L. The inactivation time should only be started once testing indicates that the intended free chlorine level (20 ppm or other free chlorine concentration based on inactivation time in table above) has been reached in the pool. FAS-DPD should be used instead of a color comparator DPD test. Chlorine stabilizers such as cyanuric acid slow disinfection; therefore, higher chlorine levels may be necessary to reach the CT value for Crypto inactivation in pools using chlorine stabilizers. Limited data suggest that a 3-log inactivation of *Cryptosporidium* is possible in more extreme conditions when 50 ppm cyanuric acid was present in the water (pH of 6.5, free chlorine residual of 40 mg/L).[8] The level of cyanurate mentioned above (i.e., 50 ppm) was the concentration used in the experiment and should not be construed with suggested operating conditions; pool operators should not add additional cyanurate to a pool to reach 50 ppm. Higher levels of stabilization (i.e., >50 ppm) are not known to decrease disinfection efficacy further. It is important that the operator use a non-stabilized chlorine product when raising the free chlorine residual to 40 mg/L. If a stabilized product such as dichlor or trichlor were used, a high level of cyanuric acid would remain in the pool after the hyperchlorination process. The cyanuric acid level in pool

[8] Shields JM, Arrowood MJ, Hill VR, Beach MJ. The effect of cyanuric acid on the chlorine inactivation of Cryptosporidium parvum. J Water Health 2008;6 (4):513-20.

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		water can only be lowered by dilution of pool water with make-up water. Since chlorine products degrade over time, it is not recommended that non-stabilized chlorine products be stored in case of a fecal incident. The operator could either purchase a non-stabilized product at a pool supply store or buy unscented household bleach (sodium hypochlorite) product that has a label indicating it is EPA-approved for use as a drinking water disinfectant. Along with the pH level and free chlorine residual, the cyanuric acid level should be checked and adjusted if necessary prior to reopening the pool. Data are not currently available for remediation procedures with pools that contain stabilized chlorine or cyanuric acid. CDC has extrapolated current data and has the following suggestions for remediation. In pool water that contains chlorine stabilizer such as cyanuric acid under 50 mg/L, the pH should either be lowered to 6.5 and the free chlorine residual shall be raised to 40 mg/L using a non-stabilized chlorine product and maintained for at least 30 hours or an equivalent CT value as shown in the Annex 6.5.3.2.[8] Further data are being collected by CDC to better address the issue of hyperchlorination of *Cryptosporidium* in pools using stabilizers. Another method for remediation could be reached by dilution, draining the pool enough water to reach 50 mg/L stabilizer and then following the procedure above. If that cannot be accomplished, the pool could be drained completely and scrubbed.
Vomit	6.5.3.3	For **vomit contaminated** water, the CT value for norovirus is thought to be in the same range as *Giardia* so the same CT values are used as for a formed stool contamination.[9]

[9] Shin GA, Sobsey MD. Inactivation of norovirus by chlorine disinfection of water. Water Res. 2008 Nov;42(17):4562-8.

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Giardia Inactivation Time for Vomit Contamination	
Chlorine Levels (mg/L)	**Disinfection Time***
1.0	45 minutes
2.0	25 minutes
3.0	19 minutes
**These closure times are based on a 99.9% inactivation of Giardia cysts by chlorine, pH 7.5, 77°F (25°C). The closure times were derived from the Environmental Protection Agency (EPA) Disinfection Profiling and Benchmarking Guidance Manual. They do not take into account "dead spots" and other areas of poor pool water mixing.*	

Blood 6.5.3.4 If the chlorine or bromine residual and pH are in a satisfactory range, there is no public health reason to recommend closing a pool due to blood contamination. Data suggest that the risk posed by potential bloodborne pathogens is greatly diminished by dilution and normal free chlorine residual levels. However, the operator may wish to temporarily close the pool for aesthetic reasons or to satisfy patron concerns.

Procedures for brominated pools 6.5.3.5 There are no inactivation data for *Giardia* or *Cryptosporidium* for bromine or any developed protocols for how to hyperbrominate a swimming pool and inactivate pathogens that may be present in fecal matter or vomit. Therefore, pool operators should use chlorine in their disinfection procedures. It should also be noted that DPD test kits cannot differentiate between chlorine and bromine. This is because DPD undergoes the same chemical reaction with both chlorine and bromine. Therefore, it is important that the pool's bromine residual be measured <u>before</u> chlorine is added to the pool. This bromine residual should be taken into consideration when determining that the free chlorine residual necessary for the type of contamination has been met (i.e., the free chlorine residual measured minus the bromine residual should be equal to or greater than the intended free chlorine residual). If a DPD test kit with a chlorine comparator is used; the total bromine residual can be determined by multiplying the free chlorine residual by a factor of 2.2.

Supplemental Disinfection 6.5.3.6 It is recognized that some pools may use supplemental disinfection such as ultraviolet light or ozone generating

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		systems known to inactivate *Cryptosporidium*. Because of a wide variation of operating parameters, pool water circulation hydraulics, and a lack of standardization in some supplemental disinfection systems, a general recommendation on their use for fecal incident remediation cannot be provided at this time.
Surface Cleaning and Disinfection	**6.5.4**	**Surface Contamination Cleaning and Disinfection**
Limit access	6.5.4.1	Body fluids, including blood, feces, and vomit are all considered potentially contaminated with pathogens. Therefore, spills of these fluids on the pool deck should be cleaned up immediately. Visible contamination should be removed first, followed by disinfection of the contaminated surfaces.
Clean surface	6.5.4.2	The CDC protocol for cleaning body fluid spills from pool decks entitled “Cleaning up Body Fluid Spills on Pool Surfaces” can be found on the CDC Healthy Swimming/Recreational Water website at http://www.cdc.gov/healthywater/swimming/pools/cleaning-body-fluid-spills.html. These procedures are based on hospital infection control guidelines.[10]
Disposal	6.5.4.3	Currently, there are no standardized procedures for removing contaminants, particularly those found in biofilms/slime layers, in piping, or aquatic features that spray or dump water. All water features should be well drained and disinfected per manufacturer’s instructions. Development of appropriate guidelines deserves further investigation and data gathering.
Disinfect surface	6.5.4.4	The efficacy of disinfectants is greatly impacted by the organic load on the surface to be disinfected. Reducing the organic load as much as possible through cleaning and removal of all visible contamination BEFORE adding disinfectant is critical to successful disinfection. Contact times apply only if all visible organic material has been removed before disinfection.

[10] CDC. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). MMWR (2003);52 (No.RR-10.)

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6.6 Inspections

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.

Bibliography

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