Model Aquatic Health Code

8.0 Annexes
Fecal/Vomit/Blood Contamination Response Annex
(6.0 Policies and Management)

Annex

6.0 Policies and Management

6.1 Operator Training

6.2 Lifeguard Training

6.3 Facility Staffing

6.4 Facility Management

6.4.1.3 Recordkeeping

The Fecal/Vomit/Blood contamination response log is an important part of the administrative procedures for the venue and will document, in the case of a subsequent incident, that an appropriate response was conducted. A sample Body Fluids Contamination Response Log is provided below:

BODY FLUID CONTAMINATION RESPONSE LOG

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

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 (Yoder J, Hlavsa M, Craun GF, Hill V, Roberts V, Yu P, Hicks LA, Alexander NT, Calderon RL, Roy SL, Beach MJ. (2008) Surveillance for waterborne disease and outbreaks associated with recreational water use and other aquatic facility-associated health events — United States, 2005–2006. MMWR Surveill Summ 57:1-38.). 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 (Jones TF, Mcmillian MB, Scallan E, Frenzen, Cronquist AB, Thomas S, Angulo FJ. 2007. A population-based estimate of the substantial burden of diarrhoeal disease in the United States; FoodNet, 1996–2003. Epidemiol Infect 135:293–301.). 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 (Gerba CP. 2000. Assessment of enteric pathogen shedding by bathers during recreational activity and its impact on water quality. Quant Microbiol 2:55-68.). 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 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 (CDC. Prevalence of Parasites in Fecal Material from Chlorinated Swimming Pools — United States, 1999. MMWR 2001;50(20):410–2). 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 the water, and chlorination. In addition, pool water exposures would lack the requisite bloodborne exposure routes needed to spread the pathogens to other people.

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 must be aware of the response plan and trained in implementation procedures.

6.5.2 Water Contamination Response

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 now contaminated and must be disinfected. At the present time, MAHC is not aware of any manufacturer that has a decontamination protocol for disinfecting fecal, vomit or blood-contaminated pool vacuum units.

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.

6.5.3 Pool Water Contamination Disinfection

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 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.	

Note: Chlorine stabilizers such as cyanuric acid slow 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.

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)

Many conventional test kits cannot measure free available chlorine levels up to 20 mg/l. Operators should use chlorine test strips that can measure free available chlorine in a range that includes 20 mg/L or make dilutions using chlorine-free water for use in a standard DPD test kit. The inactivation time should only be started once the chlorine level is reached in the pool.

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) (Shields JM, Arrowood MJ, Hill VR, Beach MJ. The effect of cyanuric acid on the chlorine inactivation of *Cryptosporidium parvum*. J Water Health 2008; in press). 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.

6.5.3.3 For **vomit contaminated** water, the CT value for norovirus is thought to be 58 (Shin, G.A., D. Battigelli, and M.D. Sobsey, Reduction of norwalk virus, poliovirus 1 and coliphage MS2 by free chlorine, chlorine dioxide, and ozone disinfection of water. unpublished). This is in the same range as Giardia so the same CT values are used as for a formed stool contamination.

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.	

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.

6.5.3.5 There are no inactivation data for *Giardia* or Crypto 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 before 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.

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

6.5.4 Surface Contamination Cleaning and Disinfection

These procedures are based on hospital infection control guidelines (Centers for Disease Control and Prevention. 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).

6.5.4.2 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.

6.6 Inspections