Model Aquatic Health Code Network Webinar

Cyanuric Acid and the Fecal, Vomit, and Blood Response

Tuesday, September 19th

Thank you for your interest and attendance!

*Please use your computer speakers to listen to today’s presentation*

*Due to the number of attendees, please only submit questions and comments via the Chat box*

We will begin at 1:00PM Eastern
NACCHO Updates

• Next Webinar: November 2017
• Take NEHA’s Assessing Recreational Water Health (assessment of aquatic inspection and data use procedures)
  ✓ neha.org/node/59129
  ✓ To better understand the health hazards presented by recreational waters
• Model Aquatic Health Code Network (MAHC) Webpage
  ✓ Archived webinars & MAHC resources
  ✓ Join the MAHC Network today!
    MAHCnet@naccho.org
Questions
MAHC NETWORK
September 19, 2017
CMAHC UPDATES

Douglas Sackett
Executive Director
Council for the Model Aquatic Health Code
MAHC UPDATE PROCESS

- 178 Change Requests (CR’S) for member vote
- Technical Review Committee (TRC) evaluations/reports complete and posted
- CR’s and TRC evaluation reports available for review at: https://cmahc.org/view-change-requests.php
MAHC VOTE ON THE CODE CONFERENCE
October 17-18, 2017: Omni Interlocken Hotel, Denver, CO

- On-line Vote on the Code Conference Registration opened April 3.
- Livestream only now free!
  - must still register
- CMAHC Public Health members can take part in the MAHC update process to have their input heard by CDC
- You are encouraged to be on site at the conference for:
  - networking with your fellow CMAHC Public Health members including caucus discussions
  - discussion of all Change Requests, member comments, and Technical Review Committee recommendations
  - CMAHC annual updates
Contact Information

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DouglasSackett@cmahc.org
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MAHC
More Information: Search on “CDC MAHC” or visit the Healthy Swimming MAHC Website: www.cdc.gov/mahc
Email: mahc@cdc.gov

CMAHC
More Information: Search on “CMAHC” or visit the CMAHC Website: www.cmahc.org
Email: info@cmahc.org
Ocyanuric Acid and the Fecal, Vomit, and Blood Response

Michele Hlavsa, RN, MPH
Chief, Healthy Swimming
Centers for Disease Control and Prevention

Model Aquatic Health Code Webinar
September 19, 2017
Problem: Swimming is fun and a great form of physical activity, but it can lead to illness and injury

Solution: Work together to minimize risk of illness and injury
Outline

- Disinfection of
  - Chlorine-intolerant infectious pathogens
  - Extremely chlorine-tolerant Cryptosporidium
- Pool chemical safety
Outbreaks associated with Recreational Water (n=879), by Predominant Illness and Year — United States, 1978–2012

Abbreviations: The category of illness reported by ≥50% of ill respondents. AGI: acute gastrointestinal illness; Skin: illness, condition, or symptom related to the skin; ARI: acute respiratory illness; Other: includes bronchitis; illness, condition, or symptom related to the ears; illness, condition, or symptom related to the eyes; hepatitis; leptospirosis; meningitis; meningoencephalitis; and multiple predominant illnesses. All outbreaks of legionellosis (i.e., Legionnaires’ disease and Pontiac fever) are classified as ARI.

Source: Hlavsa MC et al. 2015. MMWR 64(24);668–72.
Outbreaks of Acute Gastrointestinal Illness associated with Recreational Water (n=452), by Year
United States, 1978–2012

Source: Hlavsa MC et al. 2015. MMWR 64(24);668–72.
Outbreaks of Acute Gastrointestinal Illness associated with Treated Recreational Water (n=198)
United States, 2003–2012

Chlorine intolerant: Poor pool operation & maintenance

- Cryptosporidium spp. 79.8%
- Other* 2.0%
- Shigella spp. 3.0%
- E. coli 2.5%
- Norovirus 4.0%
- Giardia 3.5%
- Unidentified 5.1%
- Extremely chlorine tolerant

*Other includes Campylobacter (n=1) and multiple etiologies (n=3).

Source: Hlavsa MC et al. 2015. MMWR 64(24);668–72.
Cyanuric Acid (CYA)

- **Products**
  - CYA: isocyanuric acid
  - Dichlor: dichloro-s-triazinetrione, sodium dichloroisocyanuric acid
  - Trichlor: trichloro-s-triazinetrione, sodium trichloroisocyanuric acid
- Add to water in aquatic venues to protect chlorine from degradation by sun’s ultraviolet light
- Increases contact time (CT) inactivation values or inactivation times of bacteria, parasites, viruses, and algae
**Staphylococcus Inactivation***

<table>
<thead>
<tr>
<th>CYA (mg/L)</th>
<th>CT (mg·min/L)*</th>
<th>Inactivation time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>2.6</td>
<td>5.2</td>
</tr>
<tr>
<td>25</td>
<td>3.8</td>
<td>7.6</td>
</tr>
<tr>
<td>50</td>
<td>5.2</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>6.3</td>
<td>13</td>
</tr>
</tbody>
</table>

* 3-log₁₀ (99.9%) CT inactivation value at chlorine 0.5 mg/L (water pH 7.5 and temperature 25°C)

- **CT inactivation value** = 
  Concentration of disinfectant (mg/L) 
  \( \times \) 
  Inactivation time (minutes)

* Preliminary CDC data. Source: personal communication with Jennifer L. Murphy.
MAHC 5.7.3.1.3.1: Cyanuric Acid

- Maintain CYA at \( \leq 90 \) ppm
- Do **not** use in newly constructed or substantial altered
  - Hot tubs/spas
  - Therapy pools
MAHC 5.7.3: Disinfection and pH Control

- Chlorine (hypochlorite)
  - Minimum: 1.0 ppm in aquatic venues not using cyanuric acid and 2.0 ppm in aquatic venues using cyanuric acid
    - Except: 3.0 ppm in hot tubs/spas
  - Maximum: 10.0 ppm at any time aquatic venue open to bathers
- Bromine
  - Minimum: 3.0 ppm in aquatic venues
    - Except: 4.0 ppm in hot tubs/spas
  - Maximum: 8.0 ppm at any time aquatic venue open to bathers
- pH: 7.2–7.8
MAHC: Other Disinfectants

- Compressed chlorine gas
  - Prioritize safety

- Salt electrolytic chlorine generators, brine electrolytic chlorine or bromine generators

- Copper/silver ions
  - Not to exceed 1.3 ppm copper and 0.10 ppm silver
  - Do not modify recommended chlorine and bromine concentrations

- Other disinfectants

- Chlorine dioxide
  - Prioritize safety
Giardia

- Study of formed stools from fecal incidents in water\(^1\)
  - Collect from 47 aquatic venues/facilities across United States during 1999 summer swim season
  - 4.4% (13/293) formed stools tested + for *Giardia*
  - 0.0% (0/293) formed stools tested + for *Cryptosporidium*

- 3-log\(_{10}\) (99.9%) cyst inactivation\(^2\) at water pH \(<7.5\) and temperature \(>25°C\)
  - 1.0 ppm: 45 minutes
  - 2.0 ppm: 25 minutes
  - 3.0 ppm: 19 minutes

MAHC 6.5.2: Response to Formed Fecal, Vomit, or Blood Contamination of Water

1. Close immediately aquatic venue to bathers
   • MAHC 6.5.3.4.1 (blood contamination): choose if close and treat as a formed stool contamination
   • Including any aquatic venue sharing recirculation system

2. Remove contaminating material and dispose of
   • Do not use vacuum cleaner
   • Clean item used to remove contamination and immerse in aquatic venue during disinfection

3. Raise chlorine to 2.0 ppm (if <2.0 ppm) for ≥25 minutes*
   • Test chlorine and pH at multiple sampling points
   • Add only non-stabilized chlorine
   • Double inactivation time if CYA in aquatic venue water

* Verify and maintain water pH <7.5 and temperature ≥25°C.
MAHC 6.5.4: Surface Contamination
Cleaning and Disinfection

1. Limit access to area contaminated by bodily fluid, such as feces, vomit, or blood
2. Clean and remove all visible contaminant with disposable cleaning products before disinfection
3. Dispose of contaminant in sanitary manner or as required
4. Disinfect contaminated surfaces using
   • 1:10 dilution fresh household bleach with water or
   • Equivalent U.S. EPA registered disinfectant approve for bodily fluids
5. Soak affected area for minimum 20 minutes or as directed by disinfectant label
6. Remove disinfectant by cleaning and dispose of in sanitary manner or as required
Outbreaks associated with Recreational Water (n=879), by Predominant Illness and Year — United States, 1978–2012

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Outbreaks of Acute Gastrointestinal Illness associated with Recreational Water (n=452), by Type of Exposure and Year
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Chlorine intolerant:
Poor pool operation & maintenance

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Unidentified 5.1%

Cryptosporidium spp. (“Crypto”) 79.8%

Norovirus 4.0%

*Giardia* 3.5%

*Shigella* spp. 3.0%

*E. coli* 2.5%

Other* 2.0%

Source: Hlavsa MC *et al.* 2015. MMWR 64(24);668–72.
MAHC 4.7.3.3, 4.7.3.4, & 5.7.3.2: Secondary or Supplemental Disinfection Systems

- New construction or substantially altered increased-risk aquatic venues
  - Increased risk of microbial contamination (e.g., designed for children ages <5 years)
  - Used by people more susceptible to infection
- Secondary versus supplemental disinfection systems
  - $3\cdot\log_{10}$ (99.9%) inactivation of Cryptosporidium oocysts
- Ultraviolet light and ozone
  - Use of does not modify any other water quality recommendations
MAHC 6.5.2: Response to Diarrheal Contamination of Water Without CYA

1. Close immediately aquatic venue to bathers
   • Including any aquatic venue sharing recirculation system
2. Remove contaminating material and dispose of
   • Do not use vacuum cleaner
   • Clean item used to remove contamination and immerse in aquatic venue during disinfection
3. Raise chlorine to 20.0 ppm for >12.75 hours or equivalent*
   • Test chlorine and pH at multiple sampling points
   • Add only non-stabilized chlorine
   OR
   Circulate water through secondary disinfection system to reduce number of infectious Cryptosporidium oocysts to 1 oocysts/100 mL

* Verify and maintain water pH <7.5 and temperature >25°C.
Cryptosporidium Inactivation with CYA ≤16 ppm

<table>
<thead>
<tr>
<th>Average chlorine concentration (mg/L)</th>
<th>Average CYA concentration (mg/L)</th>
<th>Average estimated CT* (mg·min/L)</th>
<th>Average inactivation time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.6</td>
<td>0</td>
<td>10,500</td>
<td>8.2</td>
</tr>
<tr>
<td>21.1</td>
<td>8</td>
<td>17,800</td>
<td>14.1</td>
</tr>
<tr>
<td>19.1</td>
<td>16</td>
<td>31,500</td>
<td>27.5</td>
</tr>
<tr>
<td>40.6</td>
<td>0</td>
<td>12,400</td>
<td>5.1</td>
</tr>
<tr>
<td>40.9</td>
<td>9</td>
<td>15,300</td>
<td>6.2</td>
</tr>
<tr>
<td>38.3</td>
<td>15</td>
<td>19,400</td>
<td>8.4</td>
</tr>
</tbody>
</table>

* 3-log\(_{10}\) (99.9%) CT inactivation value at water pH 7.6 and temperature 25°C

### Cryptosporidium Inactivation with CYA $\leq 48$ ppm

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</tr>
</thead>
<tbody>
<tr>
<td>21.6</td>
<td>0</td>
<td>3,500</td>
<td>2.7</td>
</tr>
<tr>
<td>21.2</td>
<td>48</td>
<td>76,500</td>
<td>61.9</td>
</tr>
<tr>
<td>40.6</td>
<td>0</td>
<td>4,100</td>
<td>1.7</td>
</tr>
<tr>
<td>38.5</td>
<td>46</td>
<td>40,000</td>
<td>17.2</td>
</tr>
</tbody>
</table>

* $1-\log_{10}$ (90%) CT inactivation value at water pH 7.6 and temperature 25°C

**Cryptosporidium Inactivation with CYA ≤48 ppm**

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<tr>
<th>Average chlorine concentration (mg/L)</th>
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* $1\log_{10}$ (90%) CT inactivation value at water pH 7.6 and temperature 25°C

Could not achieve 3-log$_{10}$ (99.9%) inactivation in reasonable time frame (<24 hours) with 46-48 mg/L CYA

Cryptosporidium Inactivation with CYA 100 ppm

- $0.8\cdot\log_{10}$ (84%) reduction with chlorine 20 mg/L for 144 hours (6 days)
- $0.8\cdot\log_{10}$ reduction with chlorine 40 mg/L for 24 hours
- $1.4\log_{10}$ (96%) reduction with chlorine 40 mg/L for 72 hours
- $1\cdot\log_{10}$ (90%) CT inactivation values could not be calculated
MAHC 6.5.2: Response to Diarrheal Contamination of Water With CYA

1. Close immediately aquatic venue to bathers
   - Including any aquatic venue sharing recirculation system
2. Remove contaminating material and dispose of
   - Do not use vacuum cleaner
   - Clean item used to remove contamination and immerse in aquatic venue during disinfection
3. Lower CYA to <15 ppm (drain and refill), raise chlorine to 20.0 ppm for >28 hours, 30 ppm for >18 hours, 40 ppm for >8.5 hours, or equivalent*
   - Test chlorine and pH at multiple sampling points
   - Add only non-stabilized chlorine
   OR
   Circulate water through secondary disinfection system to reduce number of infectious Cryptosporidium oocysts to 1 oocysts/100 mL
   OR
   Drain aquatic venue completely and refill

* Verify and maintain water pH <7.5 and temperature >25°C.
Pool Chemical Safety
Estimated Annual Emergency Department Visits for Pool Chemical–associated Injuries, by Year United States, 2003–2012

Source: Hlavsa MC et al. MMWR 2014;63(19);427–30.
Common Themes

- Injuries frequently occurred in 2012 when
  - Handle chemicals without using personal protective equipment (e.g., goggles)
  - Add chemicals directly to water just before patient enters
    - Frequently in hotel/motel or residential pools
  - Fail to secure chemicals away from children

- Contributing factors: human error and equipment failure
  - Pool operators and residential pool owners lack knowledge of basic pool chemical safety
  - Standard pool equipment allows for situations where concentrated chlorine and acid mix
MAHC on the 3 E’s of Pool Chemical Safety

- **Engineering**
  - 4.7.3.2.1.3 and 5.7.3.5.1.2: Electrical interlock between chemical feed and recirculation systems
  - 4.9.2: Chemical storage space design and construction

- **Education**
  - 6.0.1: Training staff storing and handling chemicals
  - 6.1.2.1.4.6: Operator training on chemical safety

- **Enforcement**
  - 4.1.2.2.6: Design report includes chemical storage space schematic layout
  - On-site inspections: model MAHC inspection form
Resources

2 posters in English and Spanish FREE from CDC thanks to the American Chemistry Council

FREE video available in English and translated into Spanish

https://www.cdc.gov/healthywater/swimming/aquatics-professionals/preventing-pool-chemical-events.html
Contact Information

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The findings and conclusions in this presentation have not been formally disseminated by CDC and should not be construed to represent any agency determination or policy.