Model Aquatic Health Code Network May Webinar

"Cryptosporidium in Public Swimming Venues: Recommendations for Reducing Crypto Risk in Swimming Pools"

Thank you for your interest and attendance!

Please use your computer speakers for the audio portion of this webinar.

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

We will begin at 12:00PM Eastern

May 24, 2017

NACCHO
National Association of County & City Health Officials

NACCHO Updates

- Next Webinar: July 2017
- Take a Dive into the Model Aquatic Health Code
  - ✓Learning lab at 2017 NEHA annual conference
  - ✓Facilitated discussion on various aspects
- Model Aquatic Health Code Network (MAHC) Webpage
  - ✓http://www.naccho.org/programs/environmental-health/hazards/water/model-aquatic-health-code-mahc-network
  - ✓Archived webinars & MAHC resources
  - ✓Join the MAHC Network today!

    mahcnet@naccho.org

NACCHO
National Association of County & City Health Officials

Questions……..

NACCHO
National Association of County & City Health Officials

MAHC NETWORK

May 24, 2017

CMAHC UPDATES

Douglas Sackett

Executive Director

Council for the Model Aquatic Health Code

CMAHC
COUNCIL for the MODEL AQUATIC HEALTH CODE
Driven by your expertise.

CMAHC UPDATES

- **180 Change Requests (CR'S) submitted**
  - Available for review at: https://cmahc.org/view-change-requests.php
- **Technical Review Committee (TRC) CR review process underway**
  - TRC CR Review Meeting Schedule available to members on CMAHC website under the "Find 2017 Info On" burgundy button at the top right
  - CMAHC members can join conference call but as "listen only".

CMAHC UPDATES

- **Member comment period for influencing TRC reviews and recommendations open until May 31, 2017**
  - The CMAHC encourages members to submit comments by opening the specific Change Request and selecting to add a comment as rapidly as possible to have the greatest chance of influencing the technical reviews.
  - Members may wish to submit a comment form based on/in response to TRC discussions during a TRC CR Review Meeting conference call
- **On-line *Vote on the Code* Conference Registration opened April 3.**

Contact Information

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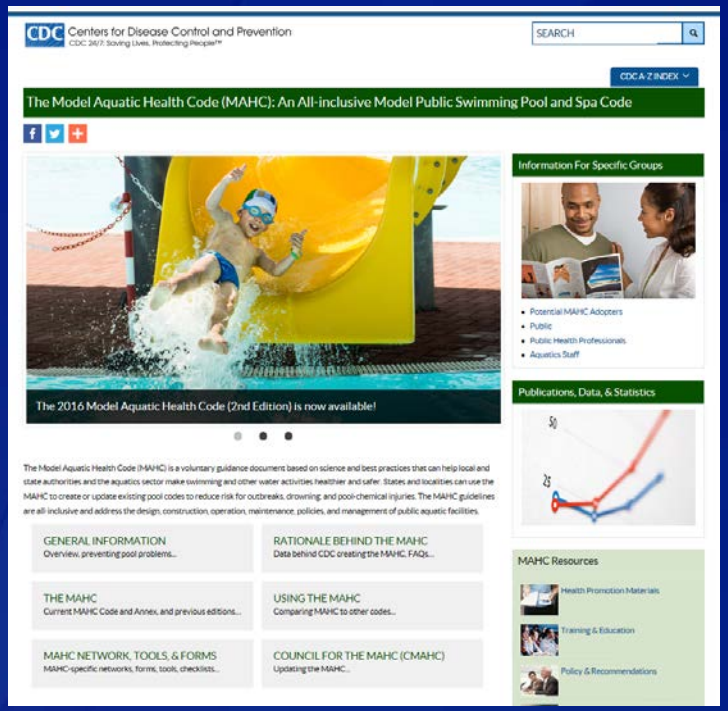
MAHC

More Information: Search on "CDC MAHC" or visit the Healthy Swimming MAHC Website: www.cdc.gov/mahc

Email: mahc@cdc.gov



CMAHC

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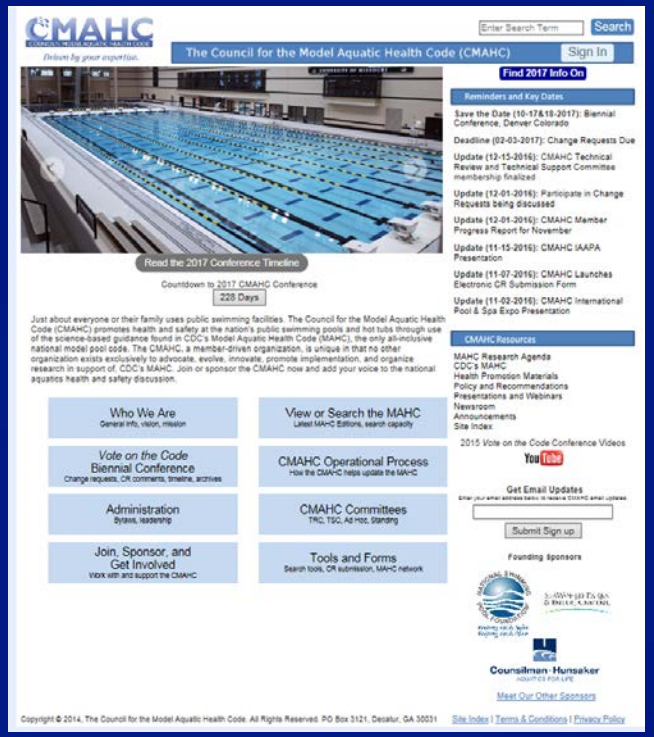

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Healthy and Safe Swimming Week 2017 Communication Tools

Michele Hlavsa, RN, MPH
Epidemiologist/Chief, Healthy Swimming
Waterborne Disease Prevention Branch

MAHC Network Webinar
May 24, 2017

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases

Healthy and Safe Swimming Week 2017

Diarrhea and Swimming Don't Mix!

May 22–28, 2017

- **Objective**
  - Increase awareness of recreational water–associated diarrhea outbreaks and steps to take to prevent them
- **Call to Action**
  - Don't swallow the water you swim in
  - Don't swim or let your kid swim if sick with diarrhea
  - Hyperchlorinate public aquatic venues www.cdc.gov/healthywater/swimming/aquatics-professionals/fecalresponse.html
- **Target Audiences**
  - Swimmers, parents of young swimmers, aquatics staff, and public health

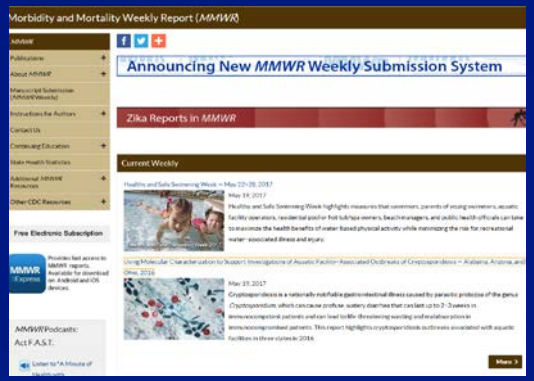
Healthy and Safe Swimming Week Communications Toolkit

- Community outreach suggestions
- List of resources/URLs
- Sample press release
- Sample op-ed
- Sample proclamation
- Social media message bank

www.cdc.gov/healthywater/observances/hss-week/response-tools-public-health.html

Outreach: Website, Social Media, Oh My

- MMWR report on recent crypto outbreaks linked to aquatic venues www.cdc.gov/mmwr/volumes/66/wr/mm6619a2.htm?s_cid=mm6619a2_w
- Updates to CDC website www.cdc.gov/healthyswimming
- Twitter chat – May 22
- MAHC Network webinar – May 24
- Radio Media Tour – May 25



Outreach: Website, Social Media, Oh My

- GovDelivery announcements
- *Did You Know?* and *Have You Heard?* emails
- Healthy Swimming Promotion Materials
  www.cdc.gov/healthywater/swimming/materials/index.html
  - HSSW buttons/badges
  - New posters
- Web content syndication
  https://tools.cdc.gov/syndication/

Printed Healthy Swimming Promotion Materials

- **Brochure**
  (English & Spanish)

FREE!

- **2 Pool Chemical Safety Posters**
  - **Use**
  - **Storage**
  (laminated posters in English & Spanish)

FREE!

Questions

Team Lead
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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Recommendations for reducing *Cryptosporidium* infection risk at swimming pools

Laura Suppes, REHS, PhD

Assistant Professor

University of Wisconsin – Eau Claire

Environmental Public Health Program

Model Aquatic Health Code Network Webinar

May 24, 2017

University of Wisconsin Eau Claire

Objectives

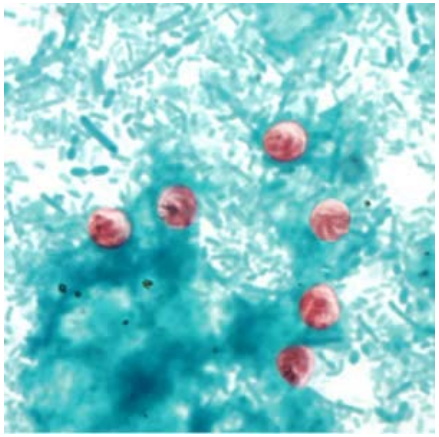
- Understand why there is risk of *Cryptosporidium* infection at swimming pools
- Explore methods for reducing *Cryptosporidium* infection risk at swimming pools
- Discuss the most feasible methods for Environmental Health Specialists to reduce *Cryptosporidium* infection risk at swimming pools

Why is there risk of *Cryptosporidium* infection at swimming pools?

University of Wisconsin Eau Claire

What do we know about *Cryptosporidium?*

- Cryptosporidiosis
  - Vomiting, diarrhea, nausea, death
  - Immunocompromised
    - 20% of U.S. population
    - Including children
- *Cryptosporidium* caused 50% of treated recreational water-associated outbreaks between 2011-2012
- Treated recreational water venues are ideal for *Cryptosporidium* outbreaks:
  - Oocysts highly resistant to chlorine (inactivation: 20 ppm for 12.75 hr)
  - Swimming ="community bathing"
  - Bathers can excrete up to 10^9 oocysts/fecal release
  - *Cryptosporidium* has low infectious dose
  - Oocyst release up to 50 days post-diarrhea cessation
  - Swimmers perceive pool water is sterile
  - Swimming pool water is recirculated



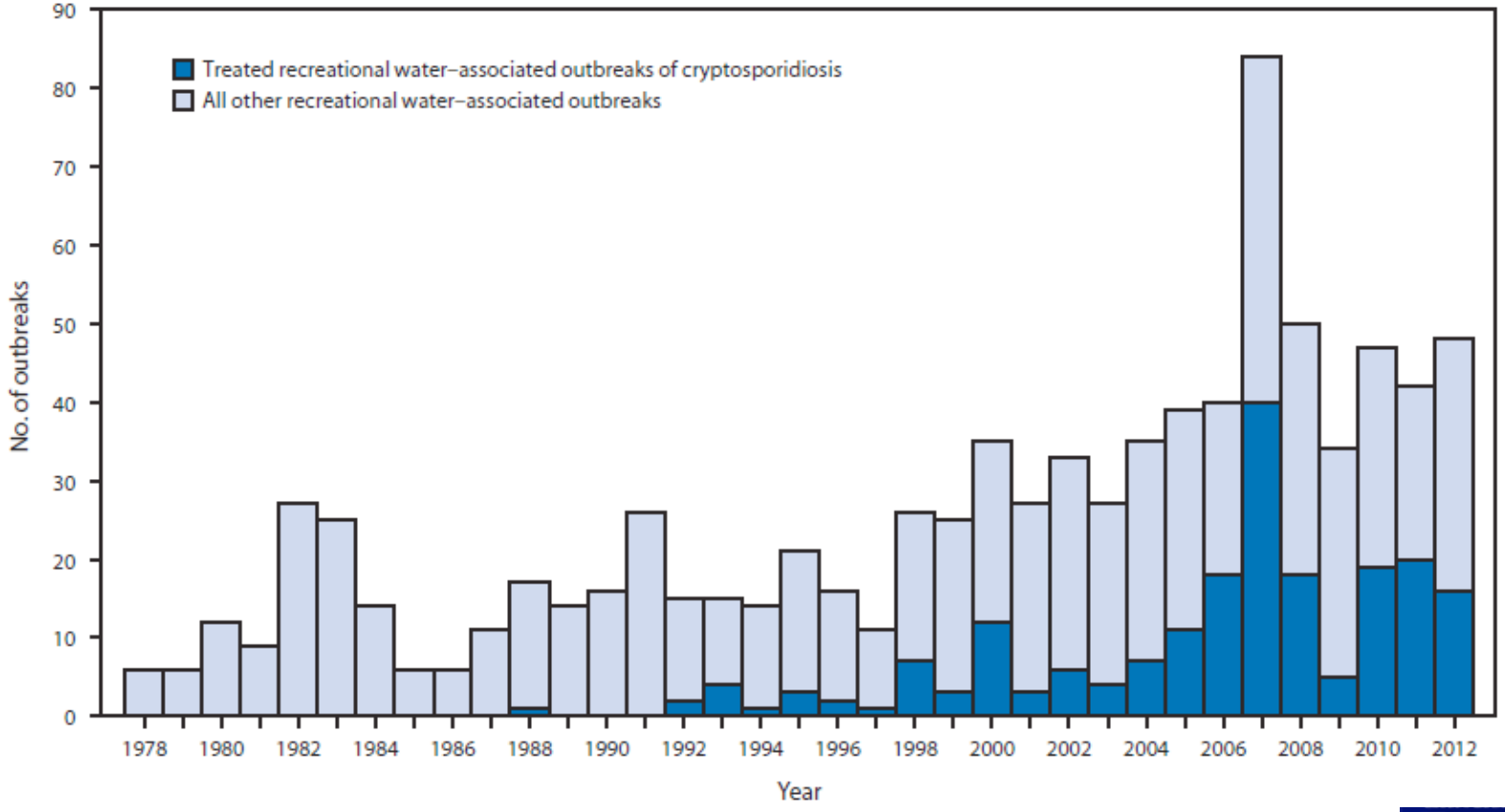
Cryptosporidium oocysts (CDC, 2013)

DuPont et al., 1995; Chappell et al. 1996; Hlavsa et al. 2015; Hunter and Nichols, 2002; Okhuysen et al., 1999; Shields et al. 2008; Yoder and Beach, 2010

University of Wisconsin Eau Claire

What do we know about *Cryptosporidium?*

Number of outbreaks associated with recreational water, by year - United States, 1978 - 2012



Hlavsa et al. 2015

University of Wisconsin Eau Claire

What do we know about *Cryptosporidium?*

Per-swim and Annual Risk of *Cryptosporidium* Infection from Swimming in Treated Recreational Water

Table 3
Average, standard deviation, and 95th/99th percentile per-swim and annual *Cryptosporidium* infection risks from swimming in treated recreational water among sub-populations.

	Infection Risk Per-swim Event			Annual Infection Risk		
	Mean	SD	95th Percentile	Mean	SD	95th Percentile
All swimmers	2.6×10^{-4}	3.9×10^{-3}	$<4.5 \times 10^{-3}$ [a]	2.5×10^{-2}	6.1×10^{-2}	1.2×10^{-1}
Adults	2.5×10^{-4}	6.8×10^{-3}	$<2.3 \times 10^{-3}$ [a]	2.2×10^{-2}	6.6×10^{-2}	1.1×10^{-1}
Children	3.5×10^{-4}	5.4×10^{-3}	5.2×10^{-4}	2.9×10^{-2}	6.1×10^{-2}	1.3×10^{-1}

[a] 99th percentile risk value.

- Risk of *Cryptosporidium* infection in one year of swimming pool visits:
  - 29 infections per 1,000 child swimmers (≤18)
  - 22 infections per 1,000 adult swimmers

Suppes et al. 2016

University of Wisconsin Eau Claire

Methods for reducing *Cryptosporidium* infection risk

University of Wisconsin Eau Claire

How can we reduce *Cryptosporidium* infection risk at swimming pools?

- Treated water venues are ideal for *Cryptosporidium* outbreaks:

Oocysts highly resistant to chlorine (inactivation: 20 ppm for 12.75 hr)	→ Use alternative disinfectants
Swimming =“community bathing” Bathers can excrete up to 10^9 oocysts/fecal release *Cryptosporidium* has low infectious dose Oocyst release up to 50 days post-diarrhea cessation Swimmers perceive pool water is sterile	→ Stop introduction of oocysts
Swimming pool water is recirculated	→ Use more effective filtration techniques

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Use alternative disinfectants

- Current free chlorine levels recommended in the Model Aquatic Health Code (MAHC) will not inactivate *Cryptosporidium* in a timeframe that reduces swimmer risk
  - *Cryptosporidium* C*t* = 15,300: It would take 10 days to achieve a 3 log reduction in oocysts at 1 ppm chlorine
- Higher levels of chlorine will inactivate *Cryptosporidium* faster
  - Hyperchlorination is recommended following a diarrheal fecal incident to inactivate *Cryptosporidium*

Use alternative disinfectants

- Problems with using hyperchlorination as a method to inactivate *Cryptosporidium*:
  - Must use *a lot* of chlorine
    - Added expense
      - Chlorine product
      - Closure time (CDC guidelines: 20 ppm chlorine for 12.75 h)
  - Must maintain 20 ppm the entire 12.75 h
    - Employee overtime
    - Test kit capability and reliability
    - Operator error
  - Must know if and when fecal incident occurred
  - Hyperchlorination does not work well in pools with high cyanuric acid concentrations

Use alternative disinfectants

- Hyperchlorination and cyanuric acid:

Environmental Science & Technology

Article

pubs.acs.org/est

Effect of Cyanuric Acid on the Inactivation of *Cryptosporidium parvum* under Hyperchlorination Conditions

Jennifer L. Murphy,*[,†] Michael J. Arrowood,[†] Xin Lu,[†] Michele C. Hlavsa,[†] Michael J. Beach,[†] and Vincent R. Hill[†]

[†]Waterborne Disease Prevention Branch, Division of Foodborne, Waterborne, and Environmental Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia 30333, United States

Murphy et al. 2015

Use alternative disinfectants

Inactivation of *Cryptosporidium* in chlorinated pool water

	No cyanuric acid	8 ppm cyanuric acid	50 ppm cyanuric acid	100 ppm cyanuric acid (MAHC limit is 90 ppm)
Chlorine (ppm)	20	20	20	20
pH	7.5	7.5	7.5	7.5
Temperature (°F)	77	77	77	77
Time (h)	**8**	**14**	**62 (2.5 days)**	**72 (3 days)**
Log reduction	3	3	1	0.8

Use alternative disinfectants

2016 CDC fecal incident response guidelines

	No cyanuric acid	1 - 15 ppm cyanuric acid	15 + ppm cyanuric acid: **drain pool to ≤15 ppm CYA**
Chlorine (ppm)	20	20	20
pH	≤7.5	≤7.5	≤7.5
Temperature (°F)	≥77	≥77	≥77
Time (h)	12.75	28	28

CDC, 2016

University of Wisconsin Eau Claire

Use alternative disinfectants

Approved alternative disinfectants to chlorine in MAHC

	Pro	**Con**
Bromine	Leaves a residual	No published C*t* values for *Cryptosporidium* inactivation
UV light	Inactivates *Cryptosporidium* quickly	No residual
Ozone	Inactivates *Cryptosporidium* quickly	No residual
Copper/silver ions	Leaves a residual	No published C*t* values for *Cryptosporidium* inactivation
Chlorine dioxide	Inactivates *Cryptosporidium* quickly Leaves a residual	Only for water quality remediation when swimmers are absent, produces carcinogens, dangerous to handle

CDC MAHC 2nd edition 2016; Murphy et al. 2014

Stop introduction of oocysts

- Is *stopping* introduction possible? Probably not, but we can *reduce* contamination by controlling sources
  - Some controls are better than others
    - Environmental Health Hierarchy of Controls:
      - Elimination
      - Substitution
      - Administrative
      - Engineering
      - Personal Protective Equipment

Stop introduction of oocysts

- Swimming =“community bathing”
  - Separate children and adults
  - Expose the truth about swim diapers
- Bathers can excrete up to 10^9 oocysts/fecal release
  - Do not allow ill swimmers into the pool
  - Make better swim diapers
  - Improve fecal incident observation and reporting by swimmers, parents of swimmers and pool staff
  - Enforce bathroom breaks
- *Cryptosporidium* has low infectious dose
  - Educate swimmers on the importance of avoiding pool water ingestion
    - Do parents allow kids to drink bathtub water?
- Oocyst release up to 50 days post-diarrhea cessation
  - Do not allow previously-ill swimmers into the pool
  - Enforce pre-swim showering
- Swimmers perceive pool water is sterile
  - Educate swimmers on pool water hazards
  - Educate swimmers on test kit use

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Stop introduction of oocysts

- Elimination
- Substitution
- Administrative
- Engineering
- Personal Protective Equipment

- Elimination controls
  - Do not allow ill swimmers into the pool
  - Do not allow previously-ill swimmers into the pool
    - Signage – do not swim if you have diarrhea
    - Group education on recreational water illness – swim teams, water aerobics, swim classes
    - Waivers – open swim, fitness facility users, swim classes, swim teams, water aerobics

Stop introduction of oocysts

- Administrative controls
  - Expose the truth about swim diapers
    - Signage – swim diapers are the same as a bathing suit
    - Group education on recreational water illness – swim teams, water aerobics, swim classes
  - Educate swimmers on the importance of avoiding pool water ingestion
  - Educate swimmers on pool water hazards
    - Group education on recreational water illness – swim teams, water aerobics, swim classes
  - Educate swimmers on test kit use
    - Group education on recreational water illness – swim teams, water aerobics, swim classes
    - Require pool facilities to provide test strips and make water chemistry standards available to swimmers
  - Improve fecal incident observation and reporting by swimmers, parents of swimmers and pool staff
    - Group education on recreational water illness – swim teams, water aerobics, swim classes
    - Train lifeguards on indicators of diarrheal release
      - Indicators should be researched
  - Enforce bathroom breaks
    - Swim teams, open swim – everyone out of the pool every hour (CDC recommendation)
  - Enforce pre-swim showering
    - Hire staff to check if swimmers entering pool area have wet hair or clothing

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Stop introduction of oocysts

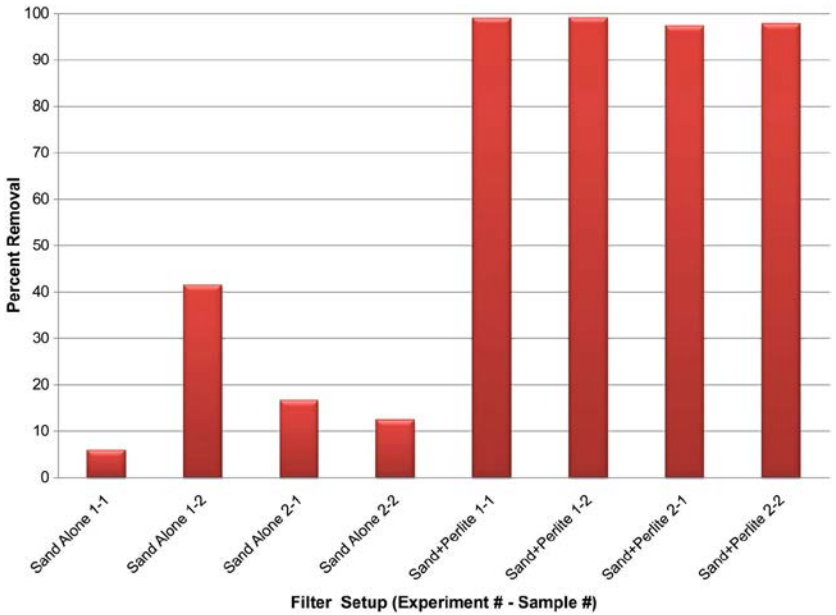
- Engineering/PPE controls
  - Separate children and adults
    - Build separate pools for adults and children
      - Perhaps easier to control *Cryptosporidium*
        - Child pool, routine treatment to remove *Cryptosporidium* from pool water
  - Make better swim diapers
    - Current swim diapers release 50 – 97% of *Cryptosporidium* oocysts into pool water within 5 min of swimming after diarrhea

Amburgey, Anderson and Brian, 2011

Use more effective filtration techniques

- Swimming pool water is recirculated
  - Use secondary disinfection (UV or ozone)
  - Maximize efficiency of the pool filter
    - Sand
      - Polyaluminum chloride coagulants at appropriate flow rates with deep sand
      - Add thin layer of precoat media

Percent particle removal for different sand filtration scenarios



Amburgey 2011

Amburgery, 2011; Amburgey et al., 2012; Lu and Amburgey, 2016; Amburgey (unpublished)

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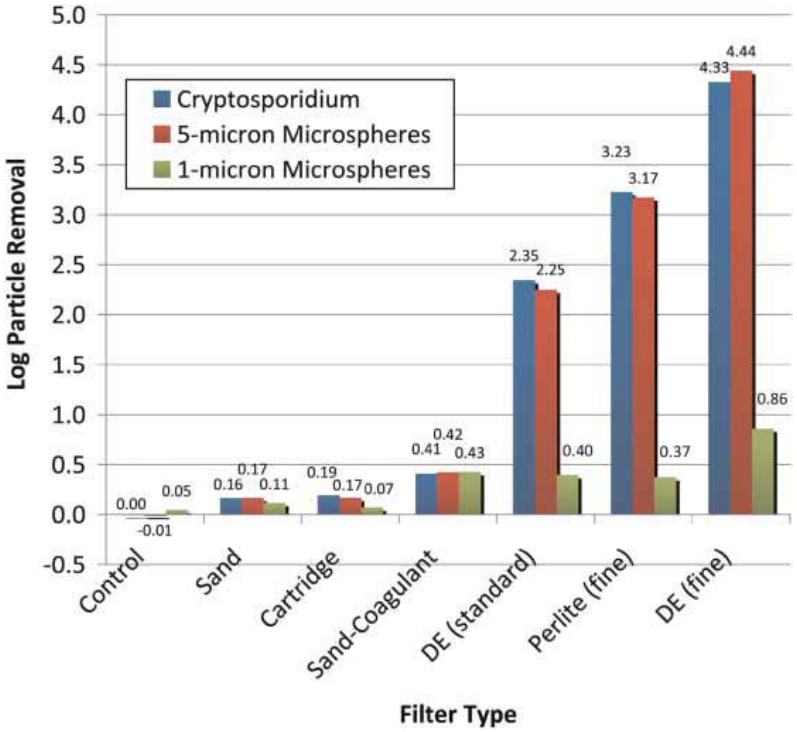
Use more effective filtration techniques

- Swimming pool water is recirculated
  - Use secondary disinfection (UV or ozone)
  - Maximize efficiency of the pool filter
    - Sand
      - Polyaluminum chloride coagulants at appropriate flow rates with deep sand
      - Add thin layer of precoat media
    - Precoat media
      - Perlite media
      - Diatomaceous Earth

Log particle removal for different filtration scenarios



Amburgey et al., 2012

Amburgery, 2011; Amburgey et al., 2012; Lu and Amburgey, 2016

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What are the most feasible methods for Environmental Health Specialists to reduce *Cryptosporidium* infection risk?

University of Wisconsin Eau Claire

What are the most feasible methods for reducing *Cryptosporidium* infection risk?

- A combination of controls must be used to reduce risk of *Cryptosporidium* infection:
  - Group education on recreational water illness
    - Environmental Health Specialists
      - Provide education materials (fact sheets, videos, handouts) to aquatic venues that host groups of swimmers, and encourage or require organized trainings
      - Provide trainings to groups of swimmers

What are the most feasible methods for reducing *Cryptosporidium* infection risk?

- Waivers as a form of education
  - Environmental Health Specialists
    - Provide waiver examples to aquatic facility staff
      - By swimming in this pool, you agree not to:
        - Swim until two weeks after diarrhea has stopped
        - Intentionally swallow pool water
        - Allow children with diarrhea to swim in bathing suits or swim diapers since neither control diarrheal releases
        - Intentionally pee or poop in the pool water
        - Splash other swimmers in the face (associated with pool water ingestion)
        - Enter the pool without showering for at least 60 sec. (recommended minimum pre-swim shower length)
        - Fail to report a diarrheal release into pool water

Keuten et al. 2014; Suppes et al. 2014

What are the most feasible methods for reducing *Cryptosporidium* infection risk?

- Environmental Health Specialists can also:
  - Require pool facilities provide swimmers with test strips and handouts or signage on pool water quality standards
  - Suggest implementation of mandatory breaks for open swim or swim teams every hour to high-use facilities
  - Explain the purpose and importance of the new CDC Fecal Incident Response Guidelines to pool operators
    - Make sure operators understand how to respond appropriately to a diarrheal release
  - Require pool facilities install secondary disinfection
  - Suggest operators with sand filters routinely apply a coagulant
    - Operators should follow manufacturers instructions when dosing pool water with a coagulant
  - Adopt parts of the Model Aquatic Health Code when updated with recommendations for improving filtration and disinfection techniques to remove *Cryptosporidium* from pool water

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- Amburgey, J. E. (2011). Removal of Cryptosporidium-Sized Polystyrene Microspheres from Swimming Pool Water with a Sand Filter with and without Added Perlite Filter Media. *Journal of Environmental Engineering-Asce, 137*(12), 1205-1208.
- Amburgey (Unpublished). Sand filtration: Using coagulants to improve pathogen removal. World Aquatic Health Conference, 2016.
- Amburgey, J. E., & Anderson, J. B. (2011). Disposable swim diaper retention of Cryptosporidium-sized particles on human subjects in a recreational water setting. *Journal of Water and Health, 9*(4), 653-658.
- Amburgey, J. E., Walsh, K. J., Fielding, R. R., & Arrowood, M. J. (2012). Removal of Cryptosporidium and polystyrene microspheres from swimming pool water with sand, cartridge, and precoat filters. *Journal of Water and Health, 10*(1), 31-42.
- CDC (Centers for Disease Control and Prevention), 2016. Fecal Incident Response Guidelines. Atlanta, GA: Centers for Disease Control and Prevention. Available: http://www.cdc.gov/healthywater/swimming/pdf/fecal-incident-response-guidelines.pdf [accessed 1 December 2016].
- CDC (Centers for Disease Control and Prevention), 2016. Model Aquatic Health Code: A national swimming pool and spa code. Atlanta, GA: Centers for Disease Control and Prevention. Available: http://www.cdc.gov/mahc/index.html [accessed 1 December 2016].
- Dupont H.L., Chappell C.L., Sterling C.R., Okhuysen P.C., Rose J.B., Jakubowski W., 1995. The infectivity of *Cryptosporidium parvum* in healthy volunteers. *New England Journal of Medicine,* 332, 855-859.
- Hlavsa, M.C., Roberts, V.A., Kahler, A.M., Hilborn, E.D., Mecher, T.R., Beach, M.J., al. (2015) Outbreaks of illness associated with recreational water – United States, 2011–2012. MMWR 64:668–672.
- Hunter P.R., de Sylor M.A., Risebro H.L., Nichols G.L., Kay D., Hartemann P., 2011. Quantitative microbial risk assessment of cryptosporidiosis and giardiasis from very small private water supplies. *Risk Analysis,*31, 228-236.
- M., Schijven, J. F., Verberk, J., & van Dijk, J. C. (2012). Definition and quantification of initial anthropogenic pollutant release in swimming pools. *Water Research, 46*(11), 3682-3692.
- Murphy, J. L., Arrowood, M. J., Lu, X., Hlavsa, M. C., Beach, M. J., & Hill, V. R. (2015). Effect of Cyanuric Acid on the Inactivation of Cryptosporidium parvum under Hyperchlorination Conditions. *Environmental Science & Technology, 49*(12), 7348-7355.
- Murphy, J. L., Haas, C. N., Arrowood, M. J., Hlavsa, M. C., Beach, M. J., & Hill, V. R. (2014). Efficacy of Chlorine Dioxide Tablets on Inactivation of Cryptosporidium Oocysts. *Environmental Science & Technology, 48*(10), 5849-5856.
- Okhuysen P.C., Chappell C.L., Sterling C.R., Jakubowski W., DuPont H.L., 1998. Susceptibility and serologic response of healthy adults to reinfection with *Cryptosporidium parvum*. *Infection and Immunity.* 66, 441-443.
- Shields J.M., Hill V.R., Arrowood M.J., Beach M.J., 2008. Inactivation of *Cryptosporidium parvum* under chlorinated recreational water conditions. *Journal of Water and Health*,.6, 513-520
- Suppes, L. M., Abrell, L., Dufour, A. P., & Reynolds, K. A. (2014). Assessment of swimmer behaviors on pool water ingestion. *Journal of Water and Health, 12*(2), 269-279.
- Suppes, L. M., Canales, R. A., Gerba, C. P., & Reynolds, K. A. (2016). Cryptosporidium risk from swimming pool exposures. *International Journal of Hygiene and Environmental Health, 219*(8), 915-919.
- Yoder J.S. and Beach M.J., 2010. *Cryptosporidium* surveillance and risk factors in the United States. *Experimental Parasitology.* 124, 31-39.

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