

# Recommendations for reducing *Cryptosporidium* infection risk at swimming pools

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# 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?

## 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"

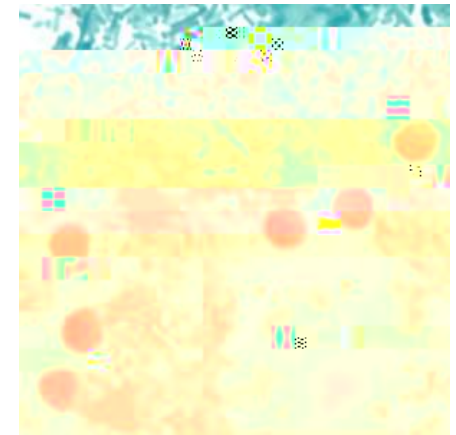
Bathers can excrete  $10^9$  oocysts/fecal release

*Cryptosporidium* has low infectious dose

Oocyst release up to 50 days post-diarrhea cessation

Swimmers perceive pool water is sterile

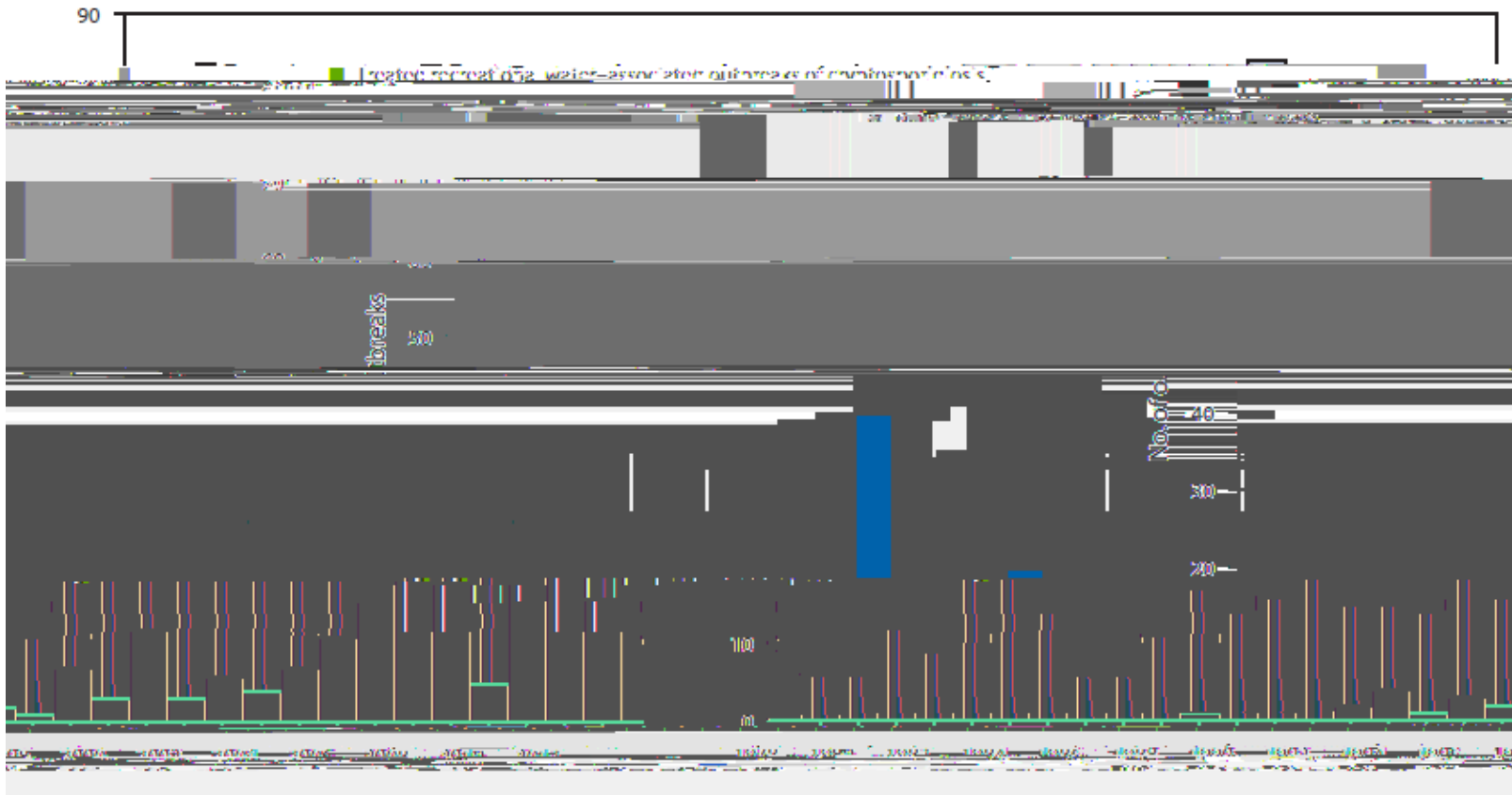
Swimming pool water is recirculated



*Cryptosporidium* oocysts  
([CDC, 2013](#))

# What do we know about *Cryptosporidium*?

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



# What do we know about *Cryptosporidium*?

Risk of *Cryptosporidium* infection in one year of swimming pool visits:

29 infections

# Methods for reducing *Cryptosporidium* infection risk

# 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

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Bathers can excrete  $10^9$  oocysts/fecal  
release

*Cryptosporidium* has low infectious dose  
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diarrhea cessation



Stop introduction of oocysts

Swimmers perceive pool water is sterile

Swimming pool water is recirculated



Use more effective filtration  
techniques



# 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

# Use alternative disinfectants

Problems with using hyperchlorination as a method to inactivate *Cryptosporidium*:

- Must use *a lot* of chlorine

  - Expensive

    - 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



# Use alternative disinfectants

## 2016 CDC fecal incident response guidelines

	No cyanuric acid	1 - 15 ppm cyanuric acid	15 + ppm cyanuric acid:
Chlorine (ppm)	20	20	20
pH	7.5	7.5	7.5
Temperature (°F)	77	77	77
Time (h)	12.75	28	28

Use alternative disinfectants

# Stop introduction of oocysts

Is *stopping* introduction possible? Probably not, but we can *reduce* contamination by controlling





# 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

## 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

# 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

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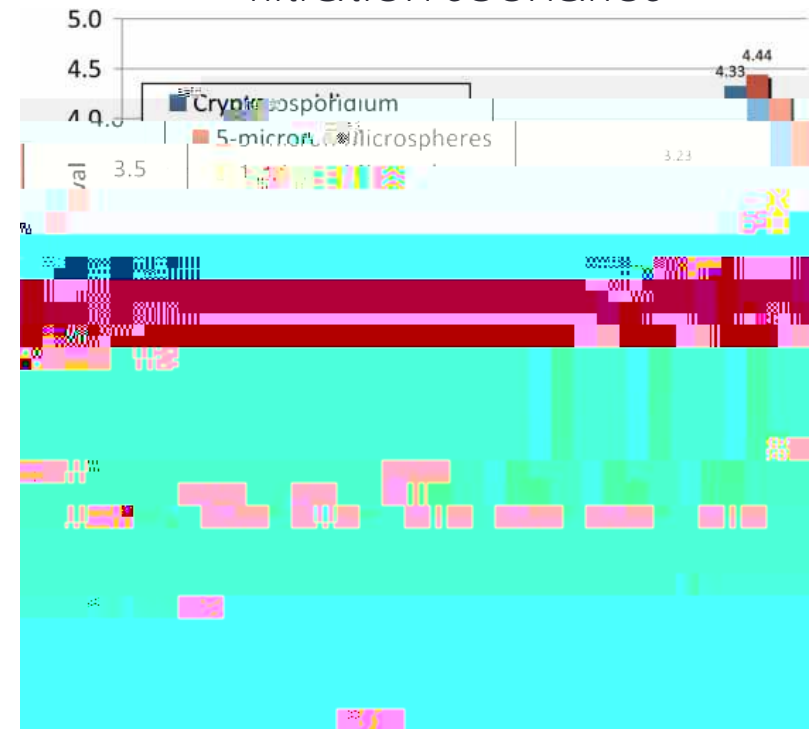
Add thin layer of precoat media

Precoat media

Perlite media

Diatomaceous Earth

Log particle removal for different filtration scenarios



Amburgey et al., 2012

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

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

A combination of controls must be used to reduce risk of *Cryptosporidium* infection:

# 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



## 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

Amburgey, J. E. (2011). Removal of Cryptosporidium-Sized Polystyrene Microspheres