Treated Recreational Water–Associated Outbreaks of Cryptosporidiosis

Charles Otto & Michele Hlavsa
Healthy Swimming Program
Centers for Disease Control & Prevention

Outline

• Info for environmental health specialists
  • Pool inspectors
• Why CDC is focusing on RWIs?
• Recreational water–associated outbreaks of cryptosporidiosis
• Lessons learned from outbreak investigations

Swimming is an all-American sport, fun, and great exercise, but…swimming can also lead to illness and injuries
**Definitions**

- **Treated recreational water**
  - Water having undergone disinfection or treatment process to make safe for recreation
  - Examples: chlorination, filtration

- **Recreational Water Illness (RWI)**
  - Illness transmitted by swallowing, inhaling vapors of, or having contact with contaminated water in pools, water parks, interactive fountains, spas, lakes, rivers, or oceans

**RWIs: Spectrum of Illness Associated with Using Recreational Water**

- Diarrheal illness
- Skin infections
- Ear infections
- Eye infections and irritation
- Respiratory infections and irritation
- Neurologic infections
- Urinary tract infections?

**Factors Contributing to Transmission of Pathogens in Treated Swimming Venues**

- Water-loving pathogens commonly cause infection and can cause diarrhea
- Diarrheal illness is common
- Exposure to recreational water is common
- Swimming is communal bathing
- Fecal contamination of recreational water is common
- Swallowing recreational water is common
- Inadequate pool operation and maintenance not uncommon
Diarrheal Illness is Common

- 5% of general public had diarrhea in past month
- 0.6 episodes of diarrhea/person/year
- 0.1–3.5 cases of diarrhea/person/year (higher for young children)


Exposure to Recreational Water is Common:
Americans Swim...a Lot

- Swimming is the 2nd most popular exercise activity in the United States
- ~339 million swimming visits each year
  - Underestimate
  - >7 years of age
  - Swim >6 times in last year

Swimming is Communal Bathing

- Swimming = Sharing the water and contaminants in it
- Actions of pool operator and swimmers affect others

Fecal Contamination of Recreational Water is Common

- Heavy use by diapered and toddler-aged children
- >2% fecal incontinence (FI)\(^1\)
  - 70% with FI < 65 years old
- Fecal incidents common
  - 293 formed stools in 47 pools, etc.\(^2\)
  - ~0.14g of feces on peri-anal surface/person
    - Range: 0.01g (adults)–10g (children)\(^3\)

Swallowing Recreational Water is Common: Water Swallowed While Swimming, by Age Group\(^1\)

<table>
<thead>
<tr>
<th>Group</th>
<th>Average Amount of Water Swallowed (mL)*</th>
<th>Range (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td>16 (0.5 fluid ounces)</td>
<td>0–53</td>
</tr>
<tr>
<td>Non-adults</td>
<td>37 (1.3 fluid ounces)</td>
<td>0–154</td>
</tr>
</tbody>
</table>

* Swimmers stayed in pool and actively swam for >45 minutes.

Inadequate Pool Operation and Maintenance is NOT Uncommon

- Pool/spa inspection data from 5 U.S. sites
  - CA, FL, MN, PA, WY
  - ~22,000 pool\(^1\) and ~5,000 spa\(^2\) inspections
- 8.3% (11%) of inspections resulted in immediate closure pending correction of violation


Outbreaks: What’s in the Water? What’s in the Air?

San Alfonso del Mar in Chile
Length: 3,323 ft long
Depth: 115 ft (deep end)
Volume: 66 million gallons

RWI Outbreaks, United States, 1978–2007*
Recreational Water–Associated Outbreaks of Gastroenteritis — United States, 1978–2007*

* N=301 (includes preliminary 2007 data as of 06/03/2009), Yoder JS et al. 2008. MMWR 57(SS-9):1–38.

Cryptosporidium

Recreational Water–Associated Outbreaks of Gastroenteritis and Treated Venues
United States, 1997–2006*

Recreational Water–Associated Outbreaks of Cryptosporidiosis, by Water Treatment United States, 1988–2007*

<table>
<thead>
<tr>
<th>Year</th>
<th>Treated: Pool, water parks, interactive fountains</th>
<th>Untreated: Lakes, oceans, rivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>88</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>91</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>94</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2000</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>2003</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>2006</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>


Crypto is in Our Community.
Is it in Our Pools? Yes.

<table>
<thead>
<tr>
<th>Country</th>
<th>Crypto Positive</th>
<th>Giardia Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States1</td>
<td>1.9% (3/160)</td>
<td>6.9% (11/160)</td>
</tr>
<tr>
<td>Netherlands2</td>
<td>5.9% (9/153)</td>
<td>7.2% (11/153)</td>
</tr>
<tr>
<td>France2</td>
<td>2.1% (1/48)</td>
<td>0.0% (0/48)</td>
</tr>
<tr>
<td>Italy4</td>
<td>28.6% (6/21)</td>
<td>38.1% (8/21)</td>
</tr>
</tbody>
</table>

Yellow font in table indicates backwash samples. * Indicates serial samples for given pools.


Reported Cryptosporidiosis Outbreaks Associated with Treated Recreational Water United States, 2007*

* N=28, based on preliminary 2007 reports (as of 06/03/2009)
Statewide Cryptosporidiosis Outbreak
Utah, 2007¹

- **Context**
  - Increased reporting of cases

- **Magnitude: Statewide**
  - Multiple counties and cities
    - >1,900 laboratory–confirmed cases
    - ~450 recreational water venues potentially contaminated
  - Highest case rate among children <5 years

- **Response**
  - Alerted public, pool operators, etc.
  - Banned children <5 years of age from public pools


Laboratory-Confirmed Cryptosporidiosis Cases, by Date of Illness Onset
Utah, May 23–November 11, 2007¹

- Intensified control measures implemented
  - Majority of seasonal pools closed

Source: Calanan RM and Rolfs, RT. Utah Department of Health

Percentage of Patients Who Reported Ill Contacts or Recreational Water Exposure, by Illness Onset — Utah, July 8–October 6, 2007¹

Source: Calanan RM and Rolfs, RT. Utah Department of Health
Banning <5 Year Olds from Public Pools

- Control measure for only extreme situations
- Inability to evaluate efficacy
- Enforceability?
  - Notification of all pool operators
  - Parents sometimes uncooperative
  - Revenue lost by pool managers/operators
  - Opposition from the public
- Feasibility long term?
- Possible negative public health consequences

Cryptosporidiosis Outbreak
New Mexico, 2008

- Context
  - Competitive swimmer practiced and competed while ill with diarrhea
  - State championships: 370 athletes
  - City championships: 270 athletes
- Magnitude
  - 92 people ill
  - 25 pools, 1 water park potentially contaminated
- Findings
  - >30% reported swimming while ill with diarrhea

Swimming While Ill with Diarrhea
New Mexico, 2008

- 57% (17/29) responded to web-based survey
- 60% (9/15) didn’t know that chlorine doesn’t instantly kills germs
- 25% (4/16) reported unsure if OK to swim if have diarrhea

Source: Selvage D, Espinoza JA, Powers C. NM Department of Health (NMDOH)
Source: Hlavsa MC, Balaji A, Beach MJ. CDC; Nichols M, Selvage D. NMDOH
Swimming While Ill with Diarrhea
New Mexico, 2008

• Common Themes
  • Lifeguarding responsibilities required entering water
  • Competitive swimming
  • Symptom free while swimming
  • Social event or vacation

Source: Hlavsa MC, Balaji A, Beach MJ, CDC; Nichols M, Selrve D.

Cryptosporidiosis Outbreak
California, 2004

• Context
  • Concerned parent reported to health department that daughter and 11 friends ill with diarrhea after attending party at water park

• Magnitude
  • >250 people ill

• Findings
  • Some water park employees ill with diarrhea before patrons
  • No policies to keep ill employees out of water


Outbreak-related Cryptosporidiosis Cases in Water Park Patrons and Employees, by Illness Onset Date — California, 2004

What's the Plan? What Can We Do?

Cannot be successful unless public health, aquatics sector, and swimmers work together

Healthy Swimming

Public Health
Aquatics Sector
Swimmers

Outbreaks in the United States: Working Premise

- Most potential outbreaks prevented by good pool operation and maintenance
- Reported outbreaks fall into 2 categories
  - Short-lived
    - Short chlorine inactivation, chemical fumes dissipate, swimmer ignorance
  - Prolonged
    - Poor maintenance, chemical accumulates, swimmer ignorance
    - Chlorine resistance (Cryptosporidium)

Health Communications Research

- What are swimmers thinking?
### CDC Parent Focus Groups: Summary

- Don’t consider swimming in pool as communal bathing/shared water
- No clue about potential for disease transmission
  - “chlorine kills everything”, “pool water is sterile”
- Willing to contemplate changing behavior
- Want education to enable informed decision making

### 2004 USA National Consumer League Poll

- 14% believe pool water is sterile
- 40% believe they are “somewhat” or “very” likely to get ill from swimming in a pool
- 82% believe you should never swim when ill with diarrhea
  - What are the other 18% thinking???

### Public Health’s Role

- Demonstrate leadership
- Standardize pool codes and operation criteria
  - Model Aquatic Health Code (MAHC) effort
- Conduct concerted and coordinated effort to raise awareness with the public
  - Use RWI Prevention Week
  - Engage operators of aquatic facilities and child care programs, healthcare providers, swim coaches, etc.
- Improve outbreak response
National Model Aquatic Health Code (MAHC)

- Partnership between public health and aquatics sector
- Data-driven, knowledge-based
- Uniform guidelines for pool design, construction, operation, and maintenance
- Sustainable like FDA Food Code

Effect Change and Promote Healthy Swimming

Volunteer to participate on a technical committee
www.cdc.gov/healthyswimming/MAHC/mahc_technical_comm.htm

To Participate or Not to Participate?

- Reduce burden on individual health departments
- Ensure voice is heard
  - Additional acts like Virginia Graeme-Baker Pool and Spa Safety Act?

Public Health Response: Stopping Community-Wide Spread

- Establish communication network or community health alert system BEFORE outbreak
- Educate and update community partners
- Collaborate with community partners to educate public

Cryptosporidiosis Outbreak Response and Evaluation (CORE)

www.cdc.gov/crypto/pdfs/core_guidelines.pdf

Public Health’s Role

- Improve RWI outbreak response
  - Upgrade and expand response plans
  - Coordinate with colleagues within and in surrounding jurisdictions
- Lower intervention threshold for pools and child care programs
  - Don’t need to know where it’s coming from to know where it’s going
  - Hyperchlorinate pools, reopen ASAP
- Investigate outbreaks thoroughly so lessons can be learned and shared
  - Offer to answer the bigger questions
Crypto Outbreak Alert System

Sign up at www.nspf.org

Dear Aquatic Operator and Manager,

The Centers for Disease Control and Prevention (CDC) has notified NSPF of a cryptosporidiosis (or "Crypto") outbreak in XXXX. Disinfection is the most important way to protect your patrons from Crypto. In the following link, you can find out how to protect your patrons from Crypto.

http://www.cdc.gov/ncidod/CID/Press/releases/022401.html

Remember, Crypto is transmitted through the water in the pool. Thus, it is important to educate patrons and employees to stay out of the water if they have diarrhea. Outbreak investigations show that illness can continue to spread even during outbreaks as the pool is not being disinfected properly. Illness can also spread because of poor hygiene and improper disinfection.

Contact time: 15,300 for 99.9% inactivation
- 20 ppm free chlorine for 12.75 hours
- Cyanurates in pool delay complete inactivation even under more extreme conditions

Circulation-dependent alternatives
- Flocculent/filtration data promising, some effective in lab but ? in pools
- UV/ozone effective, need clear specifications to evaluate effectiveness
- Chlorine dioxide?

Aquatic Sector’s Role

- Demonstrate leadership
- Engage fully in efforts to standardize pool codes and operation criteria
- MAHC effort
- Be proactive and work with health departments (HD’s) to establish community health alert system
- Provide contact lists of operators’ contact info
- Update regularly
- If aquatics wants info then engage HD’s and create system
**Aquatic Sector’s Role**

- Train staff to operate and maintain the facility optimally
  - Need to know consequences of poor operation
  - Need to be able to engage and inform public
  - Create ill-employee policy and make it OK for staff to admit they have diarrhea
- Put latest technology and practices in place
  - Without it facilities are at greater risk

---

**Aquatic Sector’s Role**

- Let go of myth that this can work without engaging swimmers — it can’t
  - Set tone for discussion by initiating the conversation
  - Informing swimmers about the issues will not stop them from swimming
  - Public = source of contamination
    - Must be engaged in change process
    - Must change behavior

---

**Aquatic Sector’s Role**

- “The best defense against a waterborne outbreak in recreational water facilities is a combination of information — for patrons and management — about the risks of fecal contamination and the use of available technologies to guard against ... contamination.”

  - Bruce Clark of Marler Clark LLC, Seattle, WA
  - Food- and Waterborne Outbreak Litigators

Translation: If you don’t inform the public AND install the latest technology we will be suing you.

Public Health’s and Aquatic Sector’s Role

- Support the “Activist Swimmer”
  - People who know the issues may be the key to communicating with the truly uninformed who are contaminating the pools
  - Engage them to help rather than viewing them as pests
    - Season pass holders, parents groups, daycare operators

What Should We Do Different?

- More interaction with public
  - RWI Prevention Week for public health needs should be expanded to include aquatics facility operators
  - Cover all facilities with health communication materials (e.g., brochures, posters)
  - Proactive communication with patrons all season long
  - Build your own activist group to dispel mythology
  - Participate in MAHC process
- Build partnerships
To sign up, email Virginia Roberts at evf1@cdc.gov

Also available in Spanish

All documents can be downloaded at: www.cdc.gov/healthyswimming
Required Disclaimer from the Department of Health and Human Services
(Please Interpret as You See Fit)

• “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.”

Contact Information

Michele Hlavsa
acz3@cdc.gov
770.488.7787

Acknowledgements

DPD
• Michael Beach
• Jonathan Yoder
• Sharon Roy
• Joan Shields
• Vince Hill
• Mike Arwood
• James Amburgey

EPO/PMR/EIS
• Charlotte Wheeler
• NSPF, Tom Lachocki, Tracynda Davis
• ARCH Chemical
• Water Technology
• Kiefer and Associates
• Trojan Technologies
• Biolabs
• US Filter

NCEH/EHHS
• Charles Otto