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

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Swimming is fun and a great form of exercise, but... swimming can also lead to illness and injuries.
Recreational Water Illness (RWI)

- Diarrheal illness
- Eye and respiratory irritation
Diarrheal Illness is Common

- High incidence of diarrhea in U.S.
  - ~ 8% of general public had diarrhea in past month\(^1\)

- > 2% fecal incontinence (FI) in Wisconsin Family Health survey\(^2\)
  - 70% with FI <65 years old

Fecal Contamination of Recreational Water is Common

- Fellow bathers...
  - shared water / communal bathing
  - high bather loads
  - heavy use by diapered and toddler-aged children
  - fecal accidents common
  - ~ 0.14g of feces on peri-anal surface/person
    - range: 0.01g (adults)–10g (children)

Exposure to Recreational Water is High

- Swimming is the 2nd most popular exercise activity in the United States
  - ~ 350 million swimming visits each year
    - Underestimate
      - >7 years of age
      - Swim ≥6 times in last year

Inadequate Pool Operation and Maintenance is NOT Uncommon

- Pools / 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

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

Chlorine sensitive:
Poor pool operation & maintenance

Other includes
Campylobacter, Salmonella, Plesiomonas, mixed pathogens

Cryptosporidium 68.3%
Giardia 2.96%
E. coli O157:H7 2.9%
Shigella 6.7%
Norovirus 6.7%
Unknown 8.7%
Other 3.8%

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

Recreational Water–Associated Outbreaks of Cryptosporidiosis — United States, 2007*

* N=26, based on preliminary 2007 reports (as of 09/16/08)
Crypto is in Our Community.
Is it in Our Pools? Yes.

<table>
<thead>
<tr>
<th>Country</th>
<th>Crypto Positive % (n)</th>
<th>Giardia Positive % (n)</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% (9/153)</td>
</tr>
<tr>
<td>France³*</td>
<td>2.1% (1/48)</td>
<td>0.0% (0/48)</td>
</tr>
<tr>
<td>Italy⁴*</td>
<td>38.1% (8/21)</td>
<td>28.6% (6/21)</td>
</tr>
</tbody>
</table>

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

# Cryptosporidiosis Outbreaks Linked to Recreational Water, by country Worldwide, 1988–2005

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>80</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>53</td>
</tr>
<tr>
<td>Australia</td>
<td>6</td>
</tr>
<tr>
<td>Canada</td>
<td>3</td>
</tr>
<tr>
<td>Spain, Japan, New Zealand, Sweden</td>
<td>6</td>
</tr>
</tbody>
</table>

Community-wide Cryptosporidiosis Outbreak — Kansas, 2003

• Context
  • Swim team members and day camp attendees shared pool, ill with diarrhea
  • One swim team coach encouraged ill swimmers to compete

• Investigation
  • Multiple swim teams affected
    • 12–55% of swim team members
  • Multiple pools affected
    • One third of patients reported swimming in month after diarrhea began

• Outcome
  • >700 people ill, community-wide outbreak

Source: Fox LM et al. Epi-2: Epi-Aid #2003-66
Cryptosporidiosis Outbreak
New Mexico, 2008

- **Context**
  - Competitive swimmer practiced and competed while ill with diarrhea
    - State and city championships

- **Investigation (preliminary findings)**
  - About 50% of patients reported swimming while ill with diarrhea

- **Outcome**
  - >80 people ill
  - >20 additional team pools potentially contaminated across state

Source: Selvage D, Espinoza JA, Powers C.
Diarrhea and Swimming: The Solution

• Become an activist swimmer
  • Awareness
  • Action
  • Advocacy
Awareness

• Visit www.cdc.gov/healthyswimming
  • See webpage on prevention
    • www.cdc.gov/healthyswimming/prevention_materials.htm

• Learn about how you can help stop the spread of RWIs such as diarrheal illness
  • Don’t swim will ill with diarrhea
    • Don’t swim for 2 weeks after diarrhea has resolved if diagnosed with cryptosporidiosis
  • Avoid swallowing pool water
Action

- Check pool water yourself
  - Chlorine: 1–3 parts per million free chlorine
  - pH: 7.2–7.8

- Ask the pool operator
  - If chlorine and pH levels checked at least 2 times per day
    - More often when the pool is heavily used
  - For the latest inspection score
  - If he/she has specialized training in pool operation

- Talk to team members about diarrhea
Advocacy

- Encourage operators to take steps that known to kill Crypto
  - Add in-line ultraviolet radiation or ozone
  - Hyperchlorinate
    - Example: 20 ppm chlorine for 12.75 hours

- Promote healthy pools
  - Advocate through USA Swimming
    - Talk to other swim teams
    - Collaborate with pool operators and public health
What’s In the Water/Air at Indoor Pools?
Chloramines, etc.
Chloramines or Combined Chlorines: The Problem

- Form in water when free chlorine combines with urine or sweat
  - Cause causes eye irritation

- Evaporate from water and enter air
  - Produce strong smell
  - Cause respiratory irritation, possibly asthma

- Linked to poorly maintained indoor pools and poor ventilation
Swimming Competition — Event A

- **Context**
  - >1,000 athletes
  - Competitors experienced breathing problems and headaches and had red, watery eyes

- **Investigation**
  - All exhaust fans shut down on first day

- **Outcome**
  - Brandon Hansen: “If you go in the pool for 10 minutes, it kills you. Right now, I can’t breathe in deep because I know I’ll cough.”
    - Missed best time in 200 meter backstroke by almost 2 seconds
  - Exhaust fans repaired before second day
Swimming Competition — Event B

- **Context**
  - Back-to-back competitions
    - Approximately a total of 2,000 athletes in 11 days

- **Investigation**
  - Water quality good in racing pool
  - Difficulty maintaining water quality in practice pool
    - Lifeguards stationed on deck and at windows under surface to safely monitor all swimmers

- **Outcome**
  - <10% of competitors reported symptoms
Awareness

- Visit www.cdc.gov/healthyswimming
  - See webpage on irritants
    - www.cdc.gov/healthyswimming/irritants.htm

- Enforce good hygiene among swimmers
  - Shower with soap thoroughly before entering the water
  - Promote regular bathroom breaks
Action

- Check pool water yourself
  - Total chlorine = free chlorine + combined chlorine
  - Most states allow 0.2–0.4 parts per million combined chlorine

- Ask the pool operator
  - If chlorine and pH levels checked at least 2 times per day
    - More often when the pool is heavily used

- Talk to team members about combined chlorines
Advocacy

- Encourage operators to take steps known to decrease combined chlorine levels
  - Increase/improve ventilation
  - Add In-line ultraviolet radiation
  - Super-chlorinate
    - Increase free chlorine level to 10 times combined chlorine level under well-ventilated conditions

- Promote healthy pools
  - Advocate through USA Swimming
    - Talk to other swim teams
    - Collaborate with pool operators and public health
All documents can be downloaded at:
www.cdc.gov/healthy swimming
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.”
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- Kiefer and Associates
- Trojan Technologies
- Biolabs
- US Filter
Cryptosporidiosis Outbreak Minnesota, 1998

- **Context**
  - Report of diarrheal illness among swimmers

- **Investigation**
  - 26 cases among different types of swimmers
  - 41% (16 of 26 interviewed) competitive swimmers ill
    - Spent more time in pool than other swimmers
  - No lapses in pool operation identified

Cryptosporidiosis in the Community
Utah, 2007

- **Context**
  - Increased reporting of cases

- **Magnitude**
  - >1,900 laboratory-confirmed cases
  - Multiple counties and cities
  - Highest case rate among young children

- **Response**
  - Alerted public, pools, healthcare providers, etc. locally
    - Spread community-wide
  - Banned children <5 years of age from swimming in public pools
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
Indoor Air Quality, Chemical Exposure
Nebraska, 2007

• Context
  • Child hospitalized in intensive care after swimming in indoor pool at Hotel A on Christmas Day

• Magnitude
  • 23 other persons ill with burning / watery eyes, sore throat, and cough

• Findings
  • Risk factors: entering pool area, swimming in pool
  • 26 violations: 0.8 ppm free chlorine, 4.2 ppm combined chlorine, pH 3.95
  • Ventilation fan turned off

Buss et al. 2007. MMWR 56(36):929–32.
Chemical Mixing Accident, Chemical Exposure — New York, 1990

- **Context**
  - Recirculation pump shut down after power failure, feed pumps continued running
  - Undiluted chlorine and acid surged into shallow end of pool and released gas

- **Magnitude**
  - 21 children taken to hospital for difficulty breathing

- **Findings**
  - Inspection: no violations
  - County Pool Code revised
    - Electrical interlock between recirculation and chemical feed pumps
    - Alarm to indicate recirculation pump has shut off
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???
Hypotheses

- Real increase in transmission
- Improved surveillance
- Alinia (nitazoxanide or NTZ)
  - New and only approved drug to treat Crypto approved for
    - 1–11 years of age in 2002
    - >12 years of age in 2004
  - Changing healthcare requests for testing?
- Increased awareness about link between cryptosporidiosis and pool exposures

- Bottom Line: Outbreaks are more likely to be detected in the future