What's in the Water?
What's in the Air?

Michele C. Hlavsa, RN, MPH
Water and Environment Activity Team
Division of Parasitic Diseases
Centers for Disease Control & Prevention

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 survey2[2]
  - 70% with FI <65 years old

1. Roy SL *et al.* 2006. J Water Health 4(Suppl 2):31–69.
2. Nelson R *et al*. 1995. JAMA 274(7):559–61.

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)[1]**

1. Gerba CP. 2000. Quant Microbiol 2(1):55–68.

Exposure to Recreational Water is High

- Swimming is the 2nd most popular exercise activity in the United States
  - ~ 350 million swimming visits each year[1]
    - Underestimate
      - ≥7 years of age
      - Swim ≥6 times in last year

1. US Bureau of the Census. 2005. Statistical Abstract of the United States. Arts, Recreation, & Travel: Recreation and Leisure Activities. www.census.gov/compendia/statab/cats/arts_recreation_travel/recreation_and_leisure_activities.html

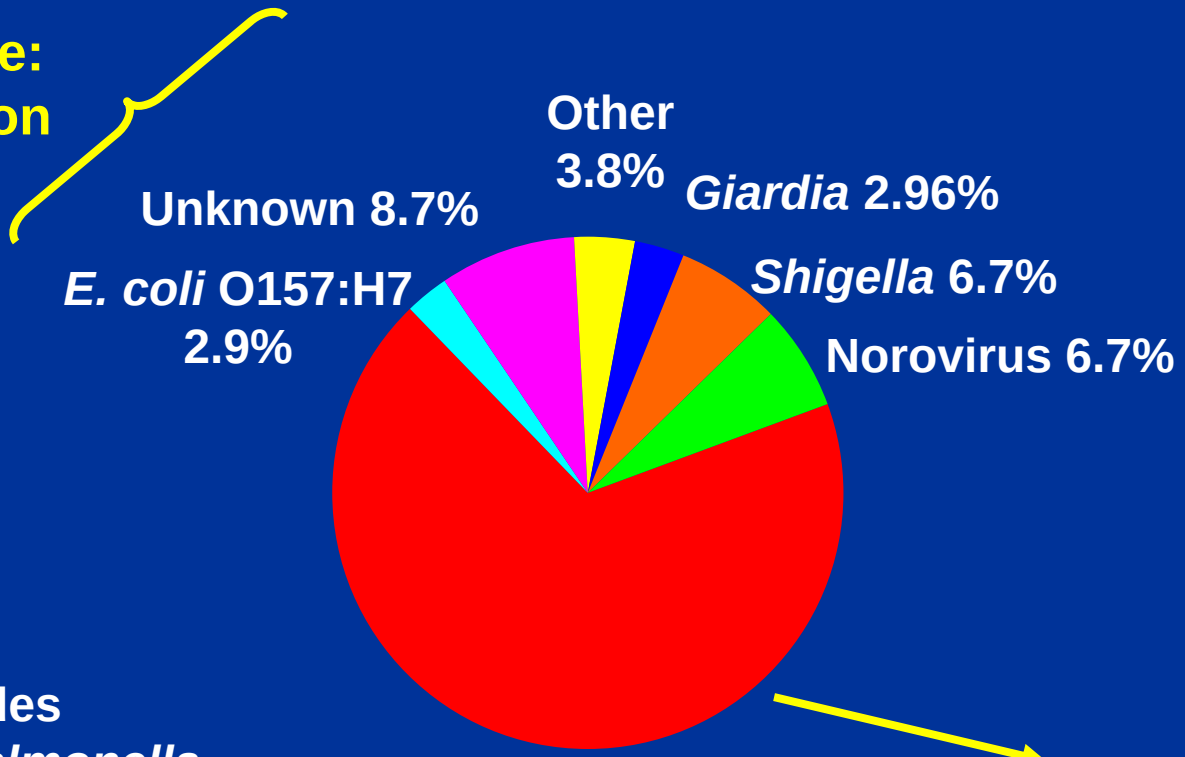
Inadequate Pool Operation and Maintenance is NOT Uncommon

- 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

1. CDC. 2003. MMWR 52(22):513–6.
2. CDC. 2004. MMWR 53(25):553–5.

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

Chlorine sensitive: Poor pool operation & maintenance

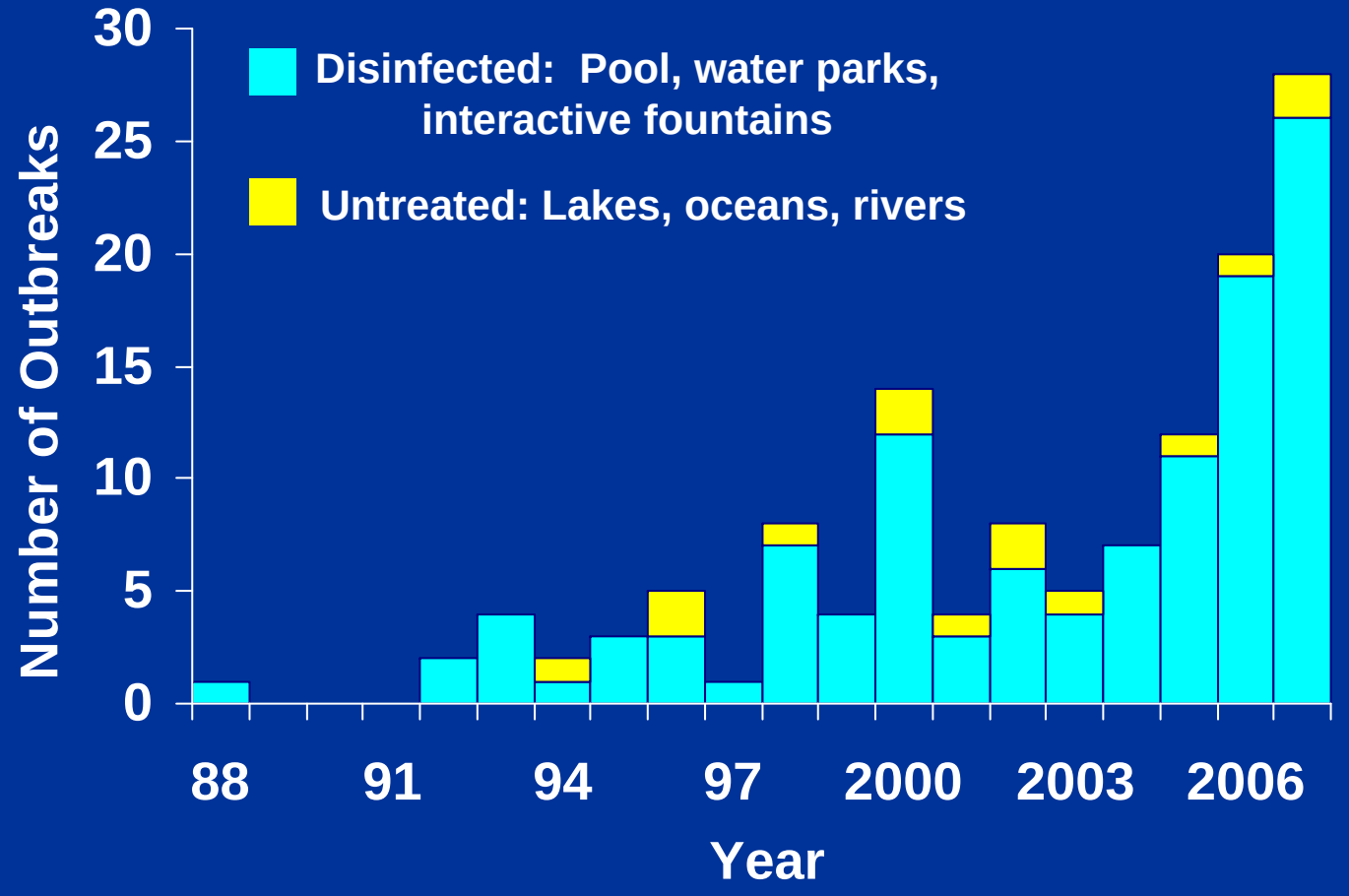


Chlorine resistant

Other includes *Campylobacter*, *Salmonella*. *Plesiomonas*, mixed pathogens

*** N=104, Yoder JS et al. 2008. MMWR 57(SS-9):1-38.**

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



* N =128; Yoder JS et al. 2008. MMWR 57(SS-9):1-38.

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.

Country	Crypto Positive % (n)	*Giardia* Positive % (n)
United States[1]	1.9% (3/160)	6.9% (11/160)
Netherlands[2*]	5.9% (9/153)	7.2% (9/153)
France[3*]	2.1% (1/48)	0.0% (0/48)
Italy[4*]	38.1% (8/21)	28.6% (6/21)

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

1. Shields JM *et al*. 2008. Emer Infect Dis 14(6):948–950.
2. Schets FM *et al*. J Water Health 2(3):191–200.
3. Fournier S *et al*. 2002. FEMS Immunol Med Microbiol 33(2002):209–13.
4. Olivieri R *et al*. 2006. Ann Ig 18(5):367–74.

Cryptosporidiosis Outbreaks Linked to Recreational Water, by country Worldwide, 1988–2005[1,2]

Country	Number of Outbreaks
United States	80
United Kingdom	53
Australia	6
Canada	3
Spain, Japan, New Zealand, Sweden	6

1. Beach MJ. Waterborne: Recreational Water. Fayer, Xiao L, eds. *Cryptosporidium* and cryptosporidiosis. 2nd edition. Boca Raton, FL: CRC Press; 2008:329–62.
2. Yoder JS et al. 2008. MMWR 57(SS-9):1-38.

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

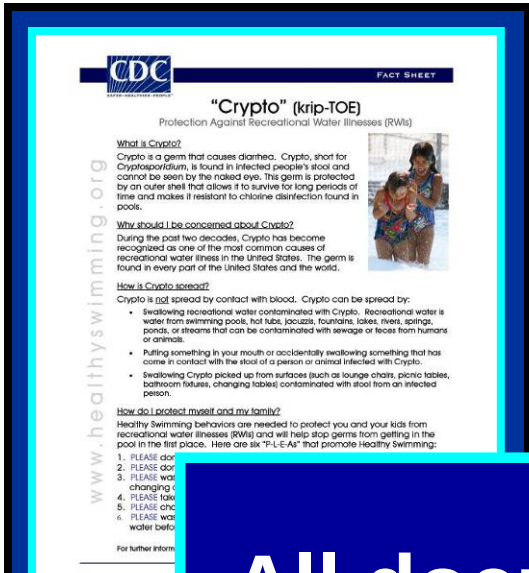
- Visit www.cdc.gov/healthyswimming
  - See webpage on irritants
    - www.cdc.gov/healthyswimming/irritants.htm
- Enforce good hygiene among swimmers
  - Shower with soap thoroughly before entering the water
  - Promote regular bathroom breaks

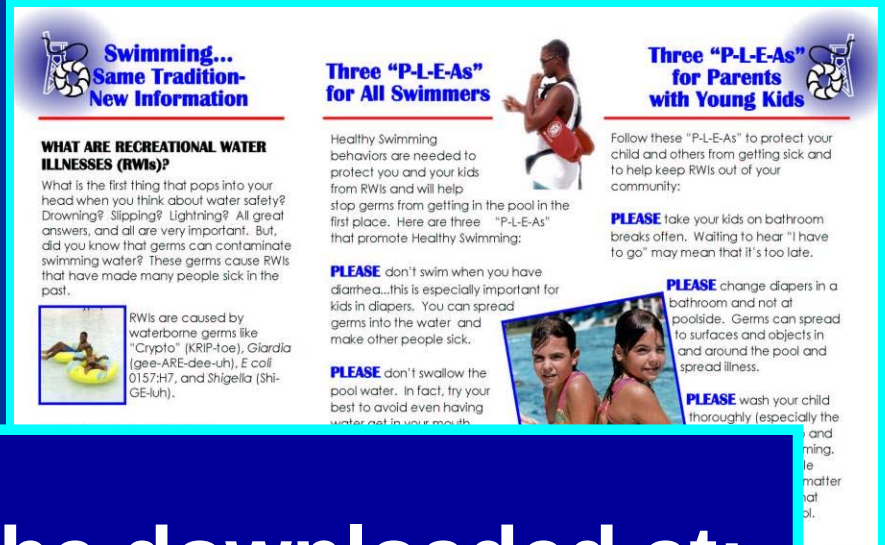
Action

- 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

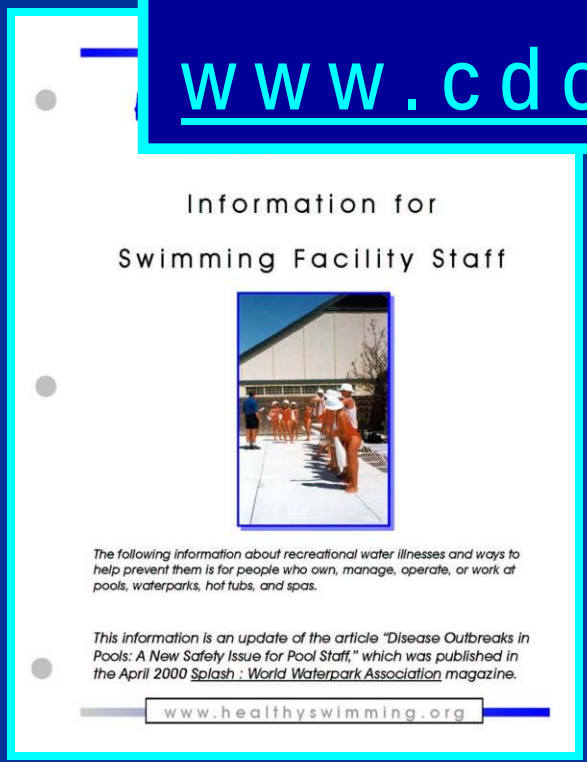
- Encourage operators to take steps known to decrease combined chlorine levels
  - Increase/improve ventilation
  - Add In-line ultraviolet radiation
  - Super-chlorinate
    - Increase free chlorine level to 10 times combined chlorine level under well-ventilated conditions
- Promote healthy pools
  - Advocate through USA Swimming
    - Talk to other swim teams
    - Collaborate with pool operators and public health

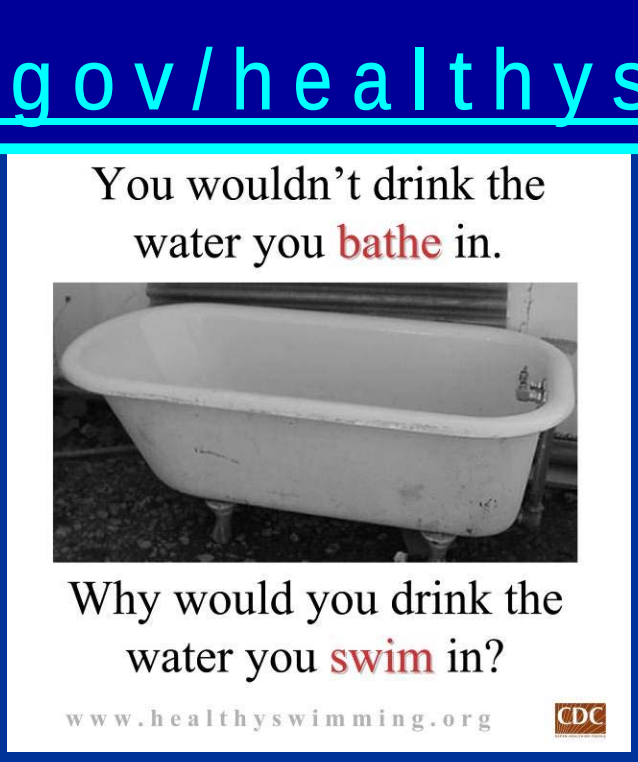


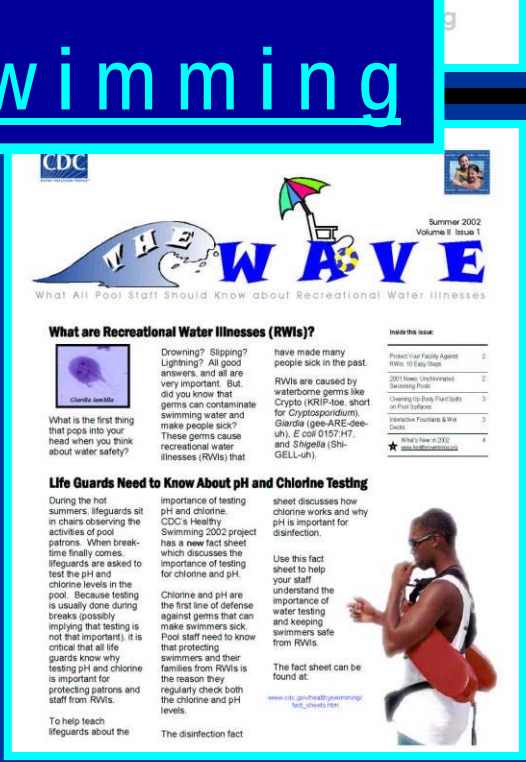


All documents can be downloaded at:

www.cdc.gov/healthyswimming







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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."**

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Cryptosporidiosis Outbreak Minnesota, 1998[1]

- 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

1. Lim LS *et al*. 2004. J Environ Hlth 67(1):20.

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

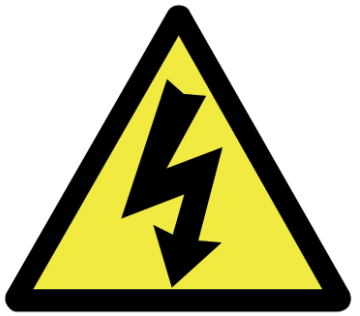
- Control measure for only extreme situations
- Inability to evaluate efficacy
- Enforceability?
  - Notification of all pool operators
  - Parents sometimes uncooperative
  - Revenue lost by pool managers / operators
  - Opposition from the public
- Feasibility long term?
- Possible negative public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