

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 month¹
- > 2% fecal incontinence (FI) in Wisconsin Family Health survey²
 - 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 pool¹ and ~5,000 spa² inspections
- 8.3% (11%) of inspections resulted in immediate closure pending correction of violation

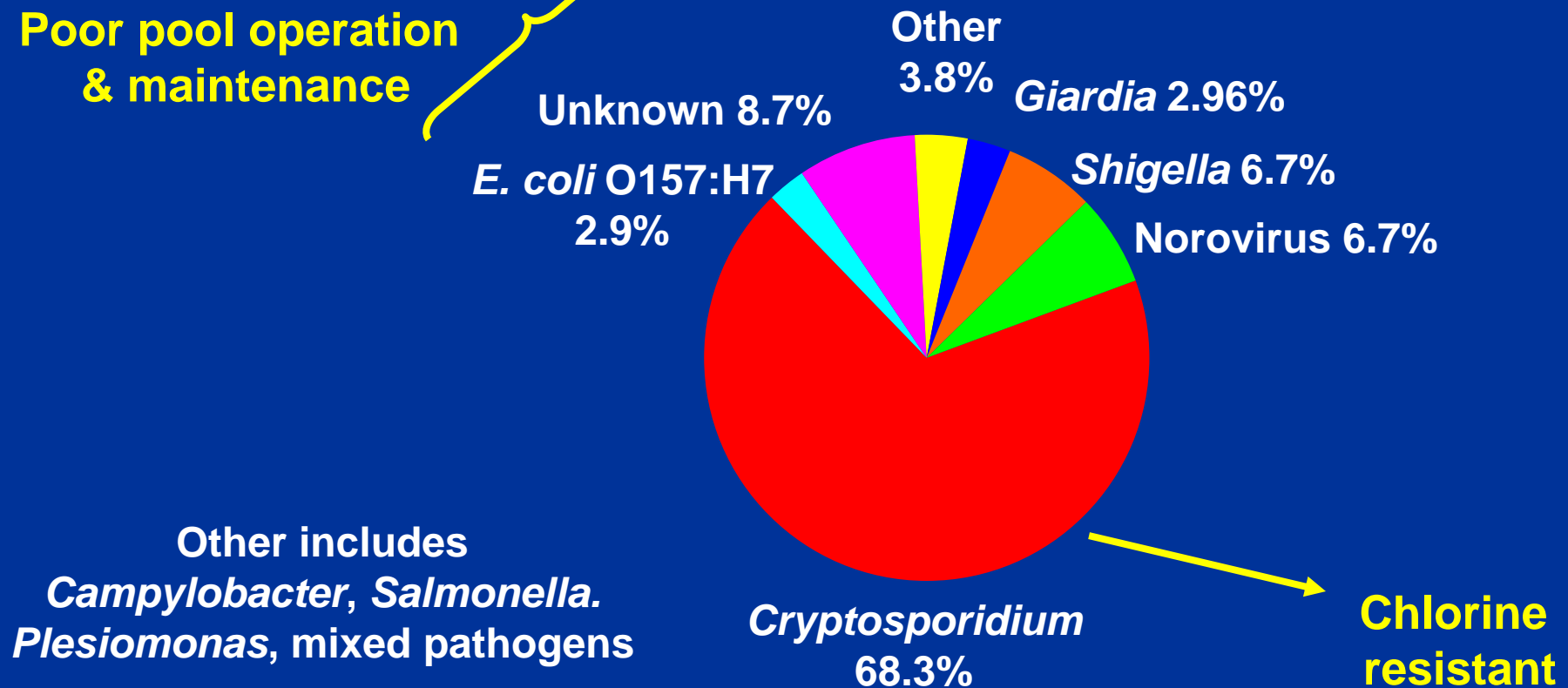


1. CDC. 2003. MMWR 52(22):513–6.
2. CDC. 2004. MMWR 53(25):553–5.



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

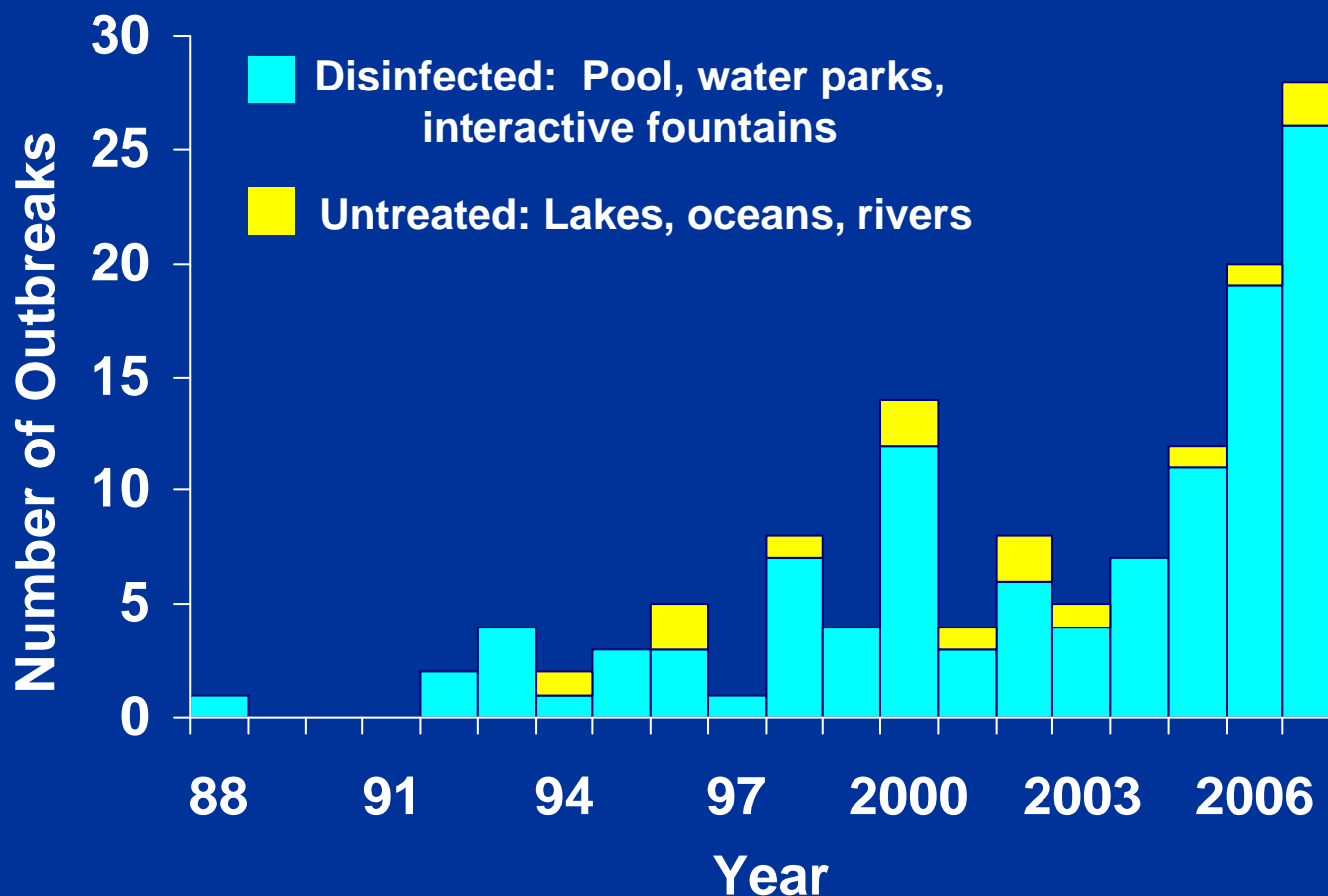
Chlorine sensitive:
Poor pool operation
& maintenance



* 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)	<i>Giardia</i> 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



CDC FACT SHEET

"Crypto" (krip-TOE)
Protection Against Recreational Water Illnesses (RWIs)

What is Crypto?
Crypto is a germ that causes diarrhea. Crypto, short for *Cryptosporidium*, is found in infected people's stool and cannot be seen by the naked eye. This germ is protected by an outer shell that allows it to survive for long periods of time and makes it resistant to chlorine disinfection found in pools.

Why should I be concerned about Crypto?
During the past two decades, Crypto has become recognized as one of the most common causes of recreational water illness in the United States. The germ is found in every part of the United States and the world.

How is Crypto spread?
Crypto is not spread by contact with blood. Crypto can be spread by:

- Swallowing recreational water contaminated with Crypto. Recreational water is water from swimming pools, hot tubs, jacuzzis, fountains, lakes, rivers, springs, ponds, or streams that can be contaminated with sewage or feces from humans or animals.
- Putting something in your mouth or accidentally swallowing something that has come in contact with the stool of a person or animal infected with Crypto.
- Swallowing Crypto picked up from surfaces (such as lounge chairs, picnic tables, bathroom fixtures, changing tables) contaminated with stool from an infected person.

How do I protect myself and my family?
Healthy Swimming behaviors are needed to protect you and your kids from recreational water illnesses (RWIs) and will help stop germs from getting in the pool in the first place. Here are six "P-L-E-A-S" that promote Healthy Swimming:

- PLEASE don't swim when you have diarrhea.
- PLEASE don't swim when you have a sore throat.
- PLEASE wash your hands before and after changing a diaper.
- PLEASE have your child change a diaper in a changing station.
- PLEASE change your child's diaper in a changing station.
- PLEASE wash your hands after changing a diaper.

For further information, visit www.healthyswimming.org



Swimming... Same Tradition- New Information

Three "P-L-E-A-s" for All Swimmers

Healthy Swimming behaviors are needed to protect you and your kids from RWIs and will help stop germs from getting in the pool in the first place. Here are three "P-L-E-A-S" that promote Healthy Swimming:

PLEASE don't swim when you have diarrhea... This is especially important for kids in diapers. You can spread germs into the water and make other people sick.

PLEASE don't swallow the pool water. In fact, try your best to avoid even having water get in your mouth.

Three "P-L-E-A-s" for Parents with Young Kids

Follow these "P-L-E-A-s" to protect your child and others from getting sick and to help keep RWIs out of your community:

PLEASE take your kids on bathroom breaks often. Waiting to hear "I have to go" may mean that it's too late.

PLEASE change diapers in a bathroom and not at poolside. Germs can spread to surfaces and objects in and around the pool and spread illness.

PLEASE wash your child thoroughly (especially the bottom) after swimming. It doesn't matter what you wear.

All documents can be downloaded at:
www.cdc.gov/healthyswimming

Information for Swimming Facility Staff



The following information about recreational water illnesses and ways to help prevent them is for people who own, manage, operate, or work at pools, waterparks, hot tubs, and spas.

This information is an update of the article "Disease Outbreaks in Pools: A New Safety Issue for Pool Staff," which was published in the April 2000 *Splash: World Waterpark Association* magazine.

www.healthyswimming.org

You wouldn't drink the water you **bathe** in.



Why would you drink the water you **swim** in?

www.healthyswimming.org



CDC Summer 2002 Volume 8 Issue 1

WAVE
What All Pool Staff Should Know about Recreational Water Illnesses

What are Recreational Water Illnesses (RWIs)?

Chlorine level
What is the first thing that pops into your head when you think about water safety?

Drowning? Slipping? Lightning? All good answers, and all are very important! But, did you know that germs can contaminate swimming water and make people sick? These germs cause recreational water illnesses (RWIs) that have made many people sick in the past.

RWIs are caused by waterborne germs like "Crypto" (KRIP-toe), *Giardia* (gee-ARE-dee-uh), *E. coli* (0157:H7), and *Shigella* (SHI-GELL-uh).

Life Guards Need to Know About pH and Chlorine Testing

During the hot summers, lifeguards sit in chairs observing the activities of pool patrons. When break-time finally comes, lifeguards are asked to test the pH and chlorine levels in the pool. Because testing is usually done during breaks (possibly implying that testing is not that important), it is critical that all life guards know why testing pH and chlorine is important for protecting patrons and staff from RWIs.

importance of testing pH and chlorine. CDC's Healthy Swimming 2002 project has a new fact sheet which discusses the importance of testing for chlorine and pH. Chlorine and pH are the first line of defense against germs that can make swimmers sick. Pool staff need to know that protecting swimmers and their families from RWIs is the reason they regularly check both the chlorine and pH levels.

Use this fact sheet to help your staff understand the importance of water testing and keeping swimmers safe from RWIs.

The fact sheet can be found at:
www.cdc.gov/healthyswimming/fact_sheets.htm

To help teach lifeguards about the disinfection fact sheet discusses how chlorine works and why pH is important for disinfection.

Use this fact sheet to help your staff understand the importance of water testing and keeping swimmers safe from RWIs.

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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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- Biolabs
- US Filter





Cryptosporidiosis Outbreak Minnesota, 1998¹

- **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

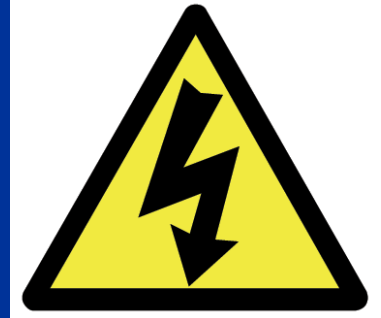
- **Context**
 - Child hospitalized in intensive care after swimming in indoor pool at Hotel A on Christmas Day
- **Magnitude**
 - 23 other persons ill with burning / watery eyes, sore throat, and cough
- **Findings**
 - Risk factors: entering pool area, swimming in pool
 - 26 violations: 0.8 ppm free 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

