Cryptosporidiosis in the United States; Changing Reporting and Ramifications for Public Health and the Aquatics Sector

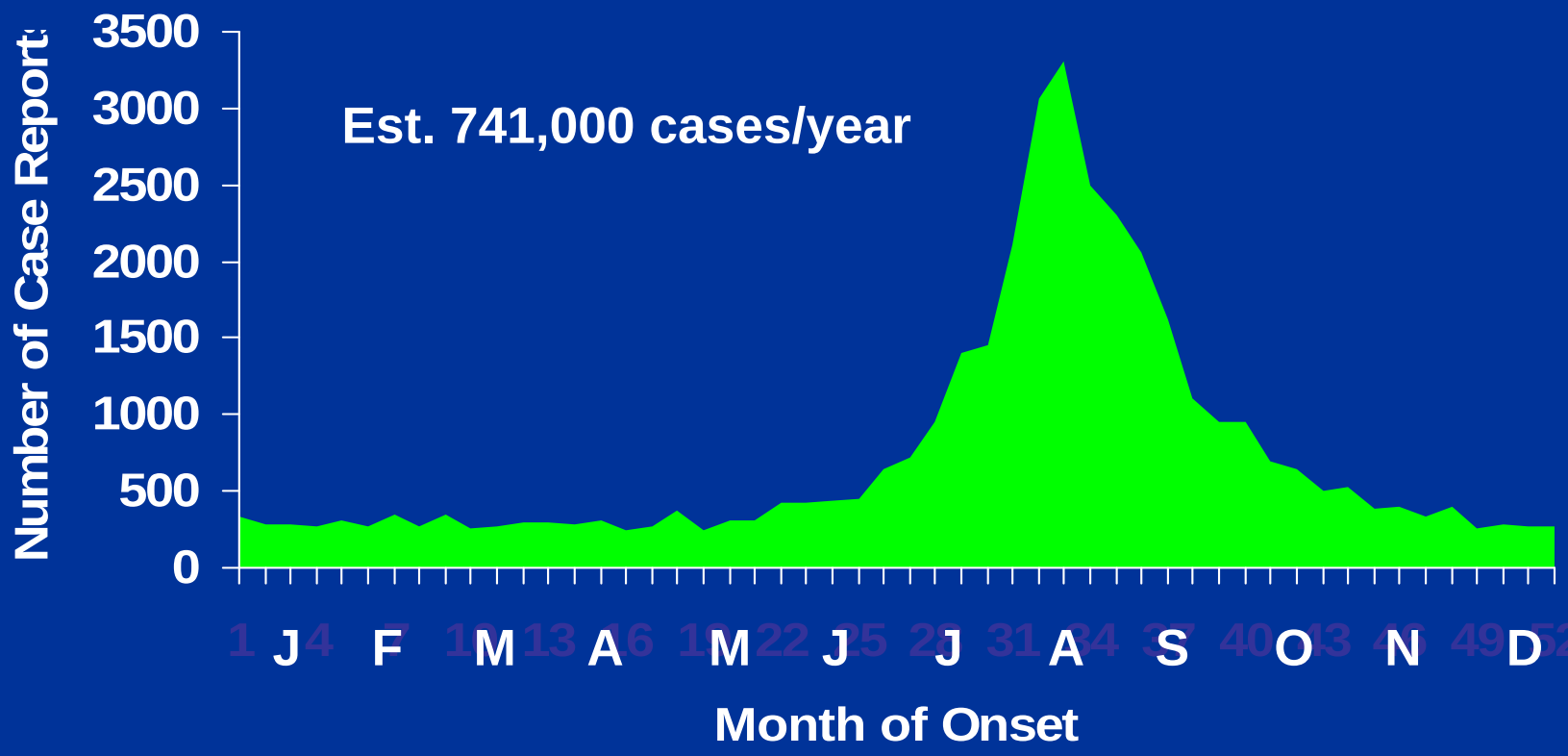
Michael J. Beach, CDC, Atlanta, GA

Swimming Pool & Spa International Conference 2009, London, March, 2009

Cryptosporidium: Importance in the U.S.

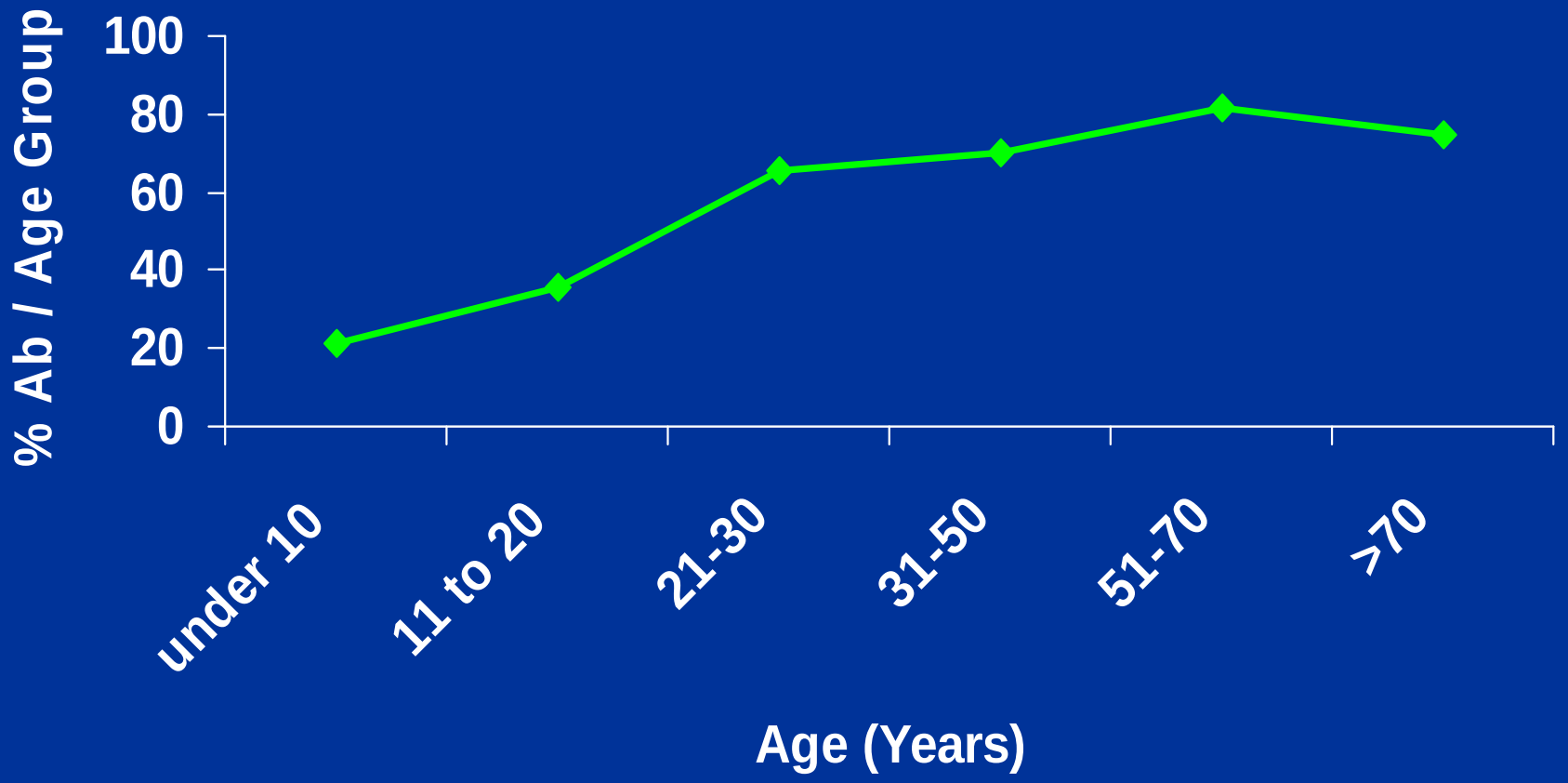
- Leading cause of waterborne disease outbreaks of GI illness in U.S.
  - Most surface water in U.S. contaminated
  - Recreational water, drinking water, person-to-person, animal-to-person outbreaks
- Opportunistic pathogen but cases dramatically down with HAART therapy
- No formal sample collection/genotyping in US
- What is basic epidemiology in the U.S.?
  - Nationally notifiable disease
    - Slightly more males (53%)
    - Ages: children, caregiver?

Cryptosporidium Seasonality: United States, 1995-2007



•N = 57,443; Onset date missing for 20,412 cases

Cryptosporidiosis Antibody Prevalence by Age Group, U.S.



•27 kDa antigen, NHANES III, Frost et al., 2004

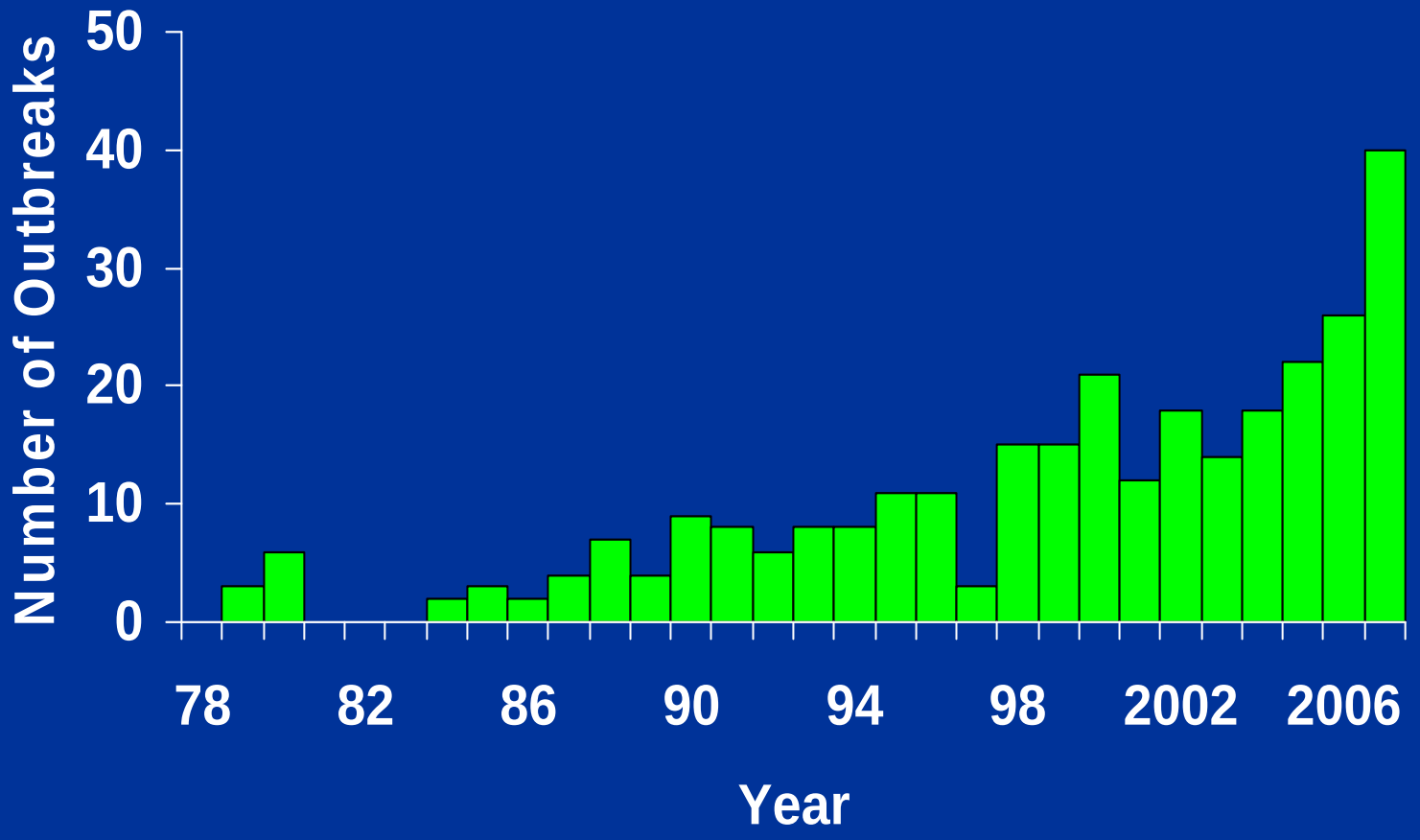
Cryptosporidiosis Outbreaks: What Do National Reporting Systems Track?

What Sources of Data Do We Have for *Cryptosporidium* in the United States?

- Waterborne Disease Outbreaks
- *Cryptosporidium* surveillance

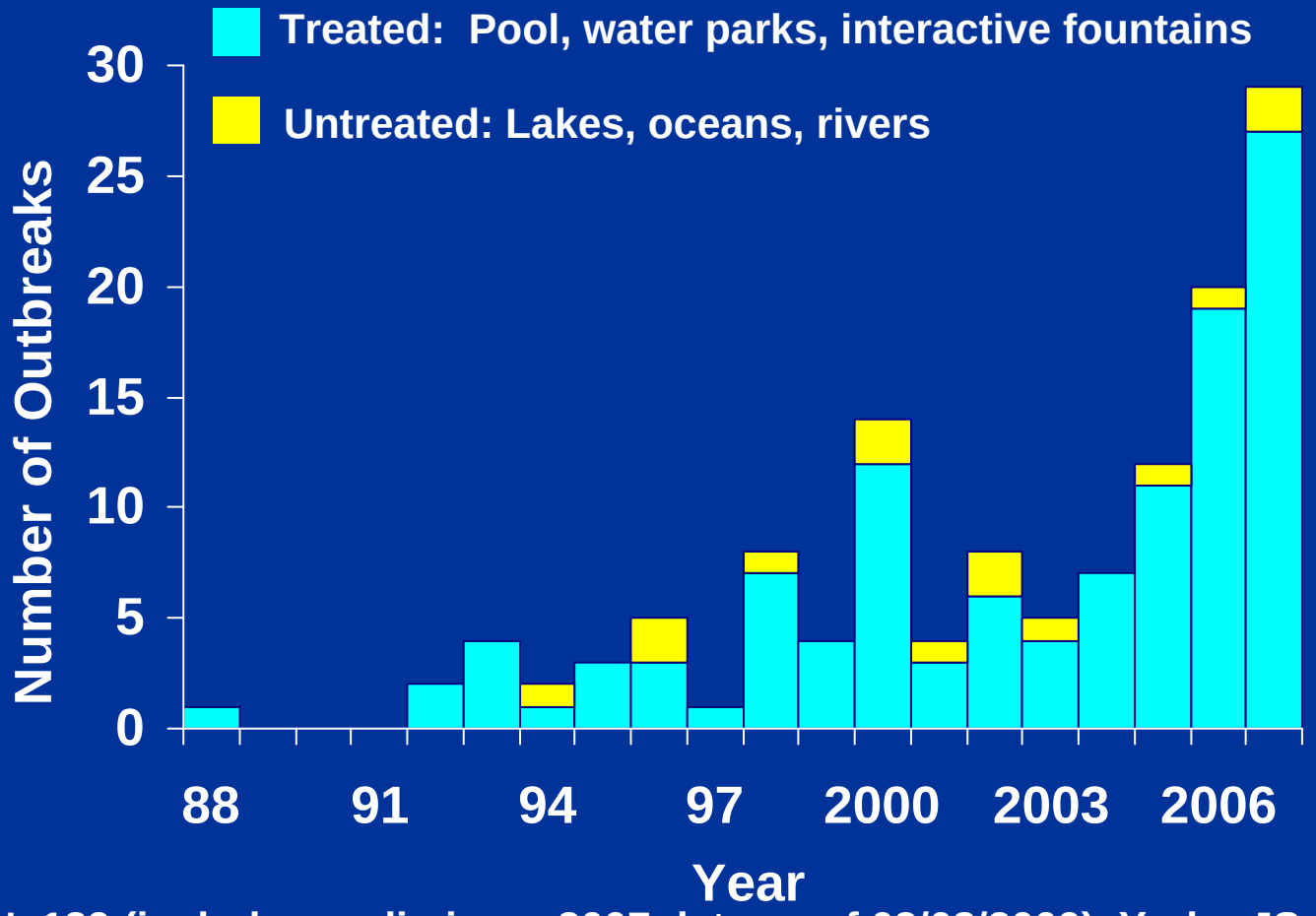
Child care programs well documented; foodborne outbreaks relatively infrequent

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



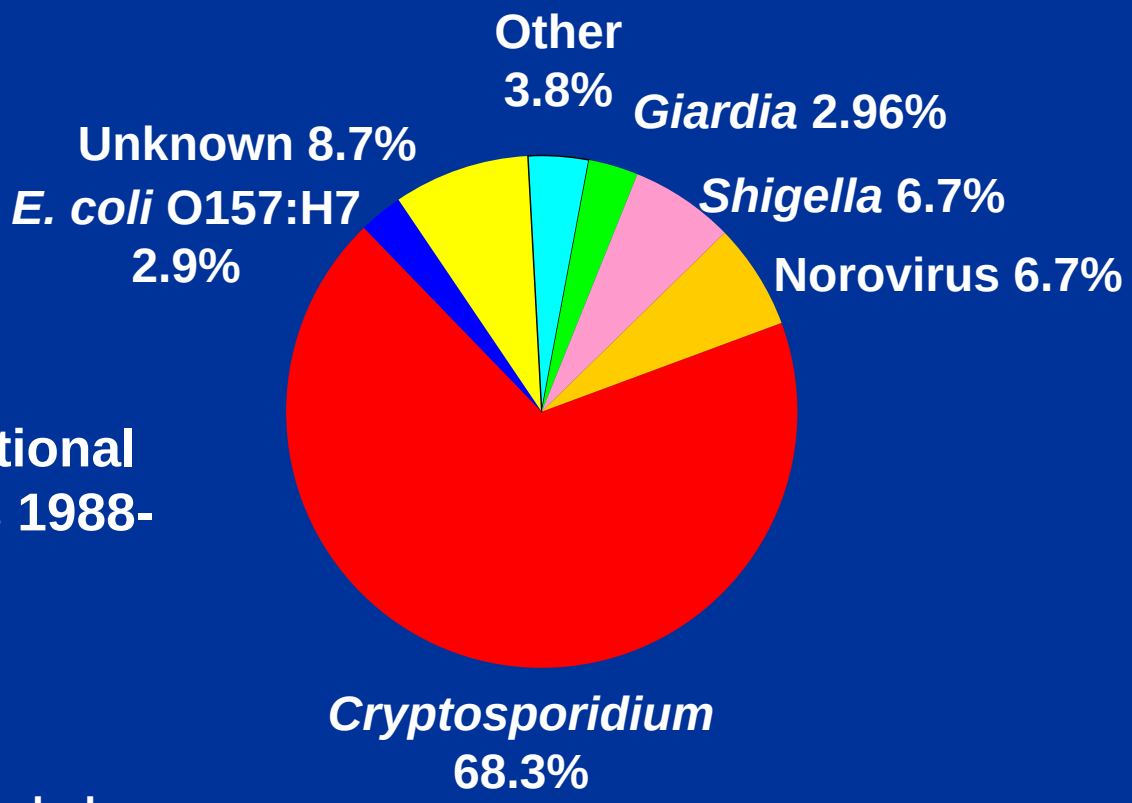
* N=296 (includes preliminary 2007 data as of 03/08/2009), Yoder JS *et al*. 2008. MMWR 57(SS-9):1–38.

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



* N=129 (includes preliminary 2007 data as of 03/08/2009), Yoder JS *et al*. 2008. MMWR 57(SS-9):1–38.

RWI Outbreaks, United States, 1997-2006; Diarrhea in Treated Venues (N=104)



100 U.S. recreational water outbreaks 1988-2006

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

MMWR (2006) 55(SS12):1-30

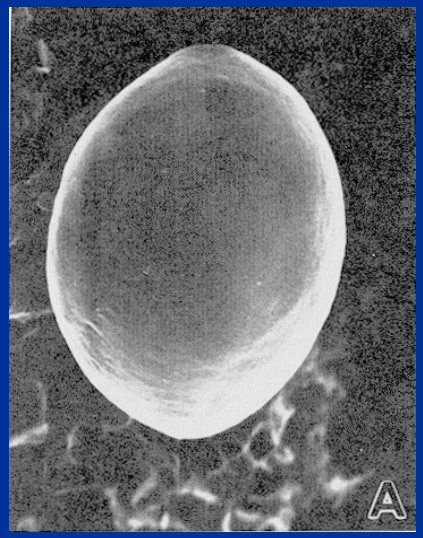
Crypto is in Our Community. Is it in Our Pools? Yes.

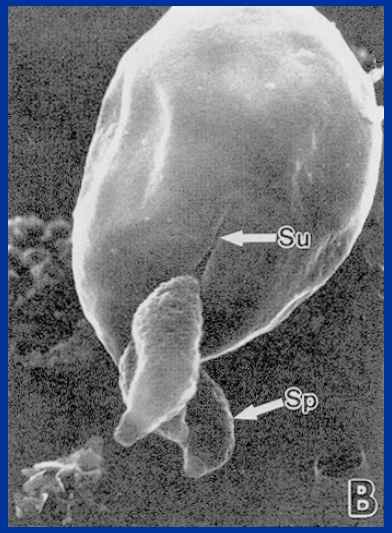
Country	Crypto Positive % (n)	*Giardia* Positive % (n)
United States[1]	1.9% (3/160)	6.9% (11/160)
Netherlands[2*]	5.9% (9/153)	7.2% (9/153)
France[3*]	2.1% (1/48)	0.0% (0/48)
Italy[4*]	38.1% (8/21)	28.6% (6/21)

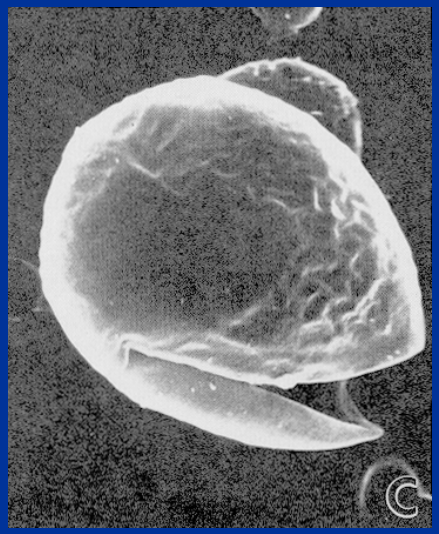
Yellow font in table indicates backwash samples.
* Indicates serial samples for given pools.

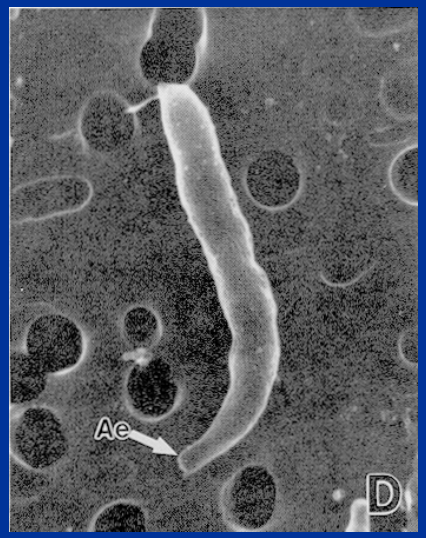
1. Shields JM *et al*. 2008. Emer Infect Dis 14(6):948–950.
2. Schets FM *et al*. J Water Health 2(3):191–200.
3. Fournier S *et al*. 2002. FEMS Immunol Med Microbiol 33(2002):209–13.
4. Olivieri R *et al*. 2006. Ann Ig 18(5):367–74.

What is Happening with Cryptosporidiosis Reporting?

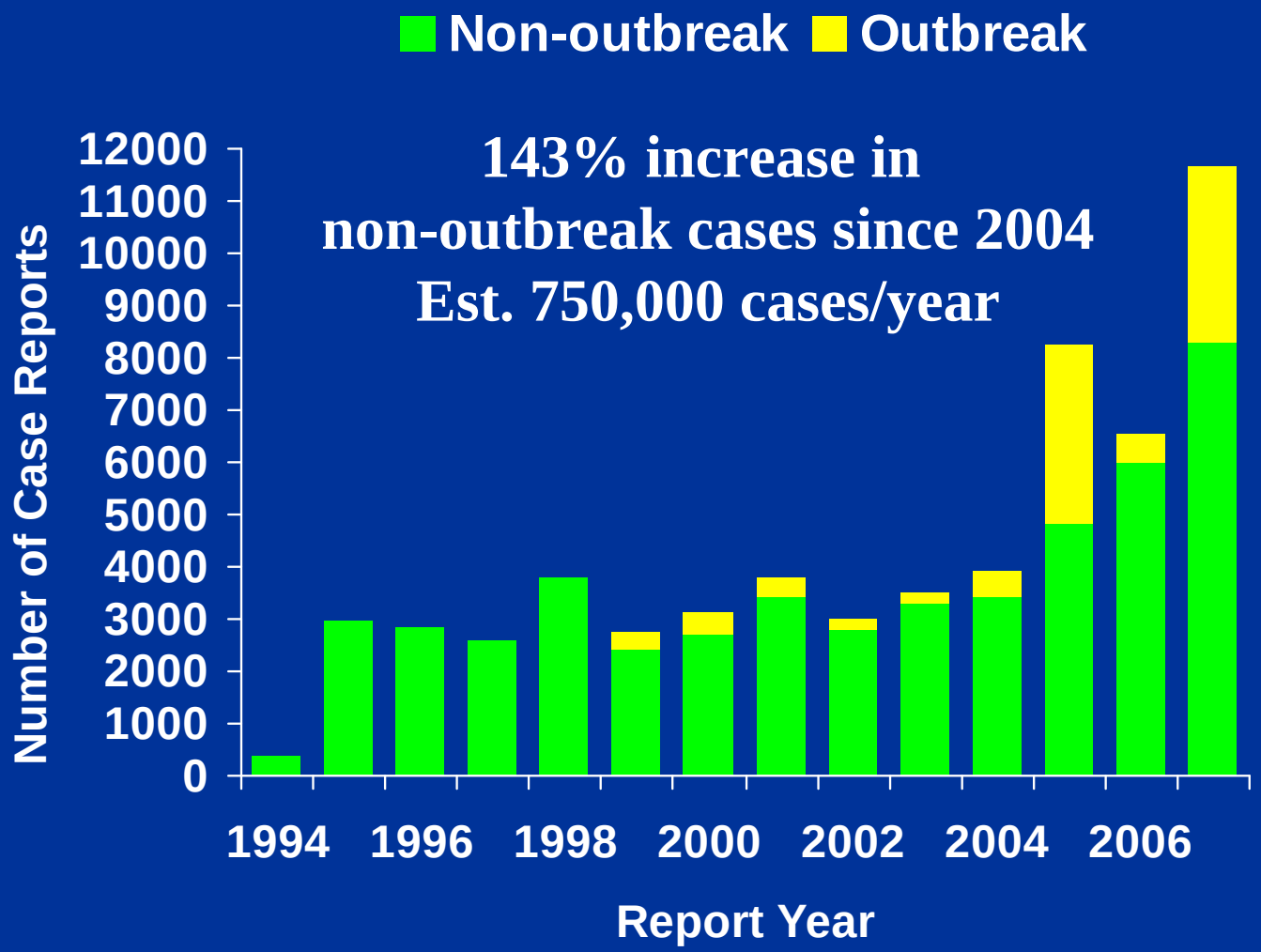








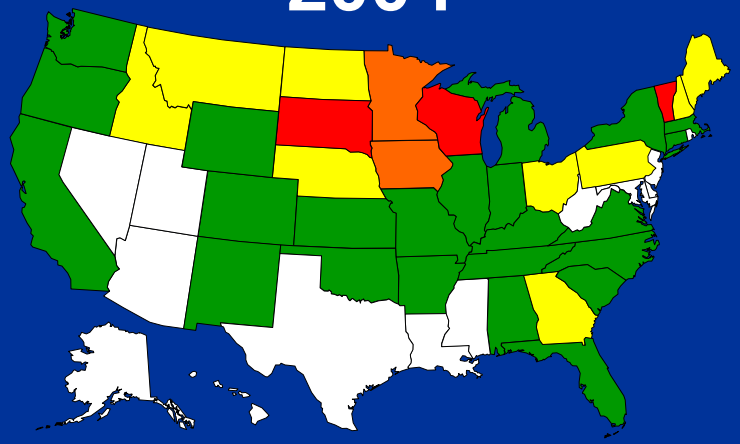
Cryptosporidiosis Case Reports: United States, 1994-2007*



*Yoder JS, Beach MJ. MMWR (2007) 57(SS-7):1-10. The 2007 data are provisional

Cryptosporidiosis Incidence: United States, 2004-2007

2004

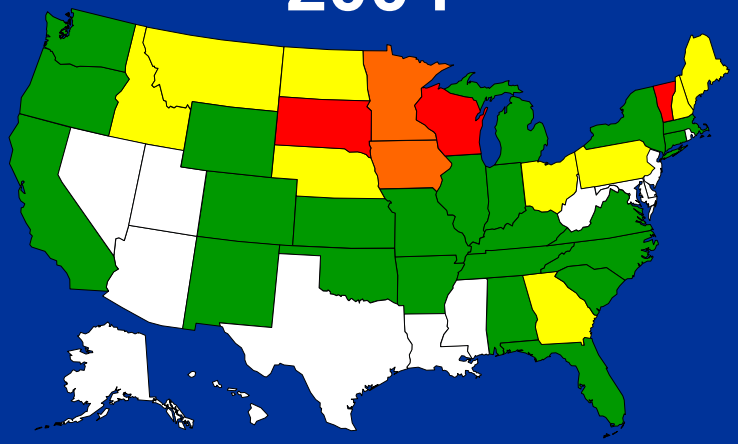


Cryptosporidiosis Incidence//100,000

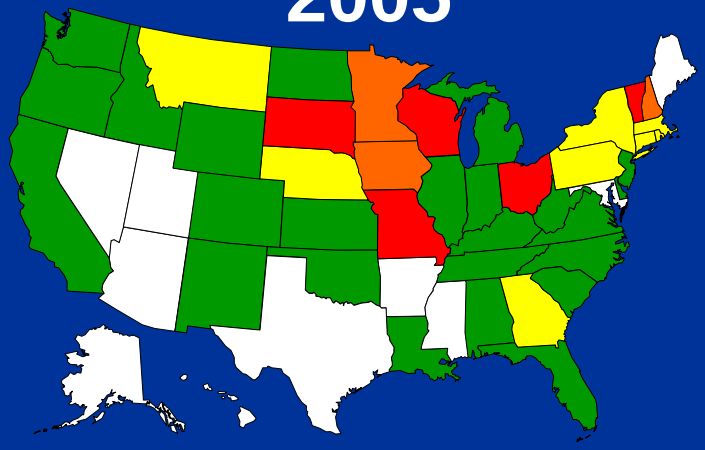
0.0 – 0.5	1.6 – 2.5
0.6 – 1.5	2.6 – 3.5
	≥3.6

Cryptosporidiosis Incidence: United States, 2004-2007

2004



2005

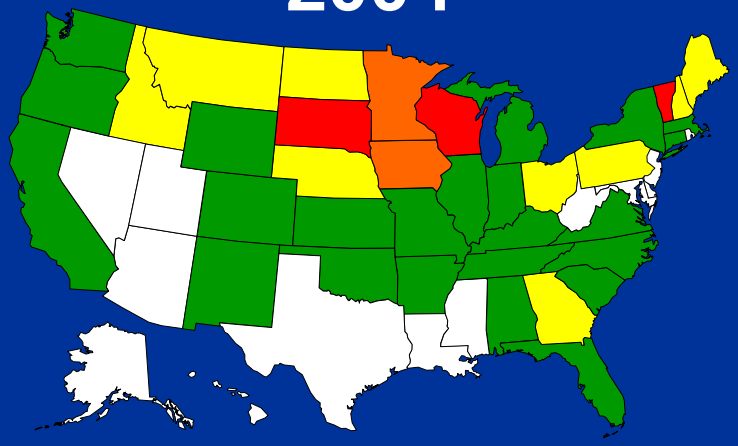


Cryptosporidiosis Incidence//100,000

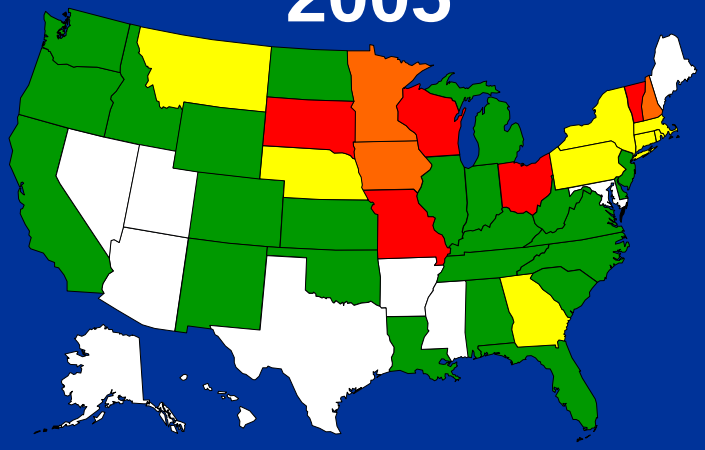
0.0 – 0.5	1.6 – 2.5
0.6 – 1.5	2.6 – 3.5
	≥3.6

Cryptosporidiosis Incidence: United States, 2004-2007

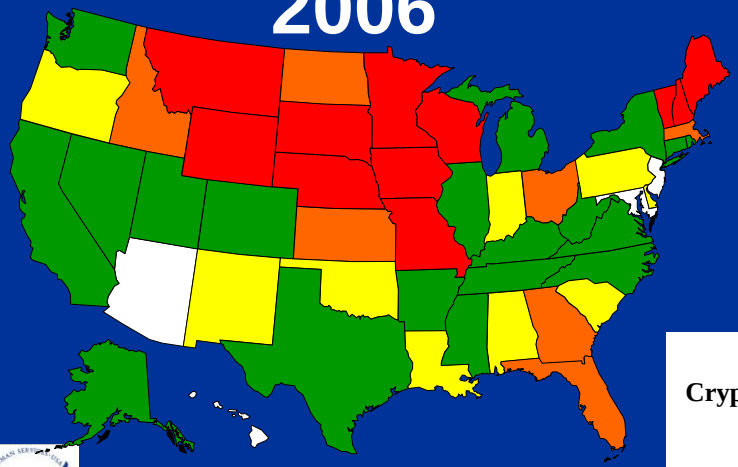
2004



2005



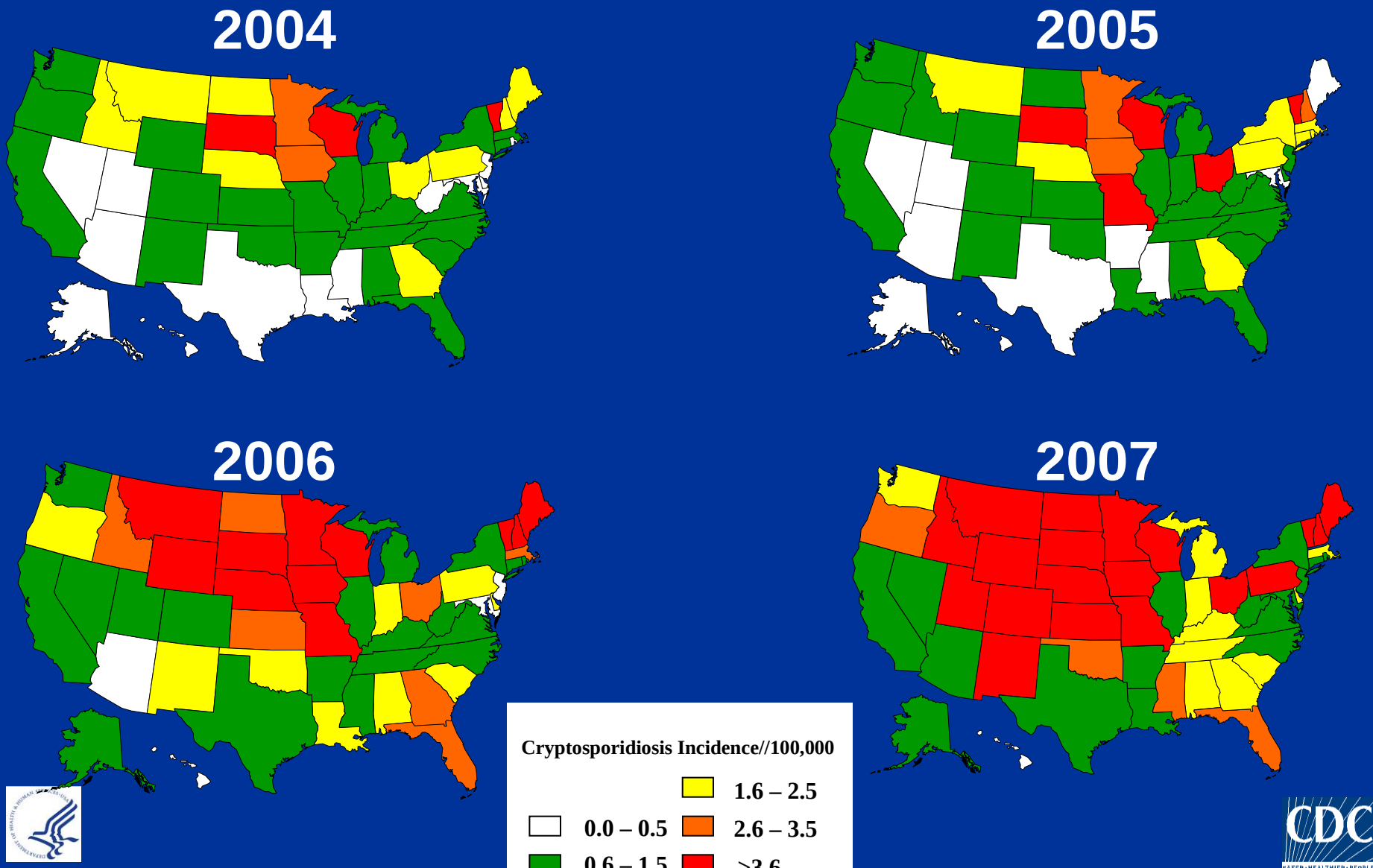
2006



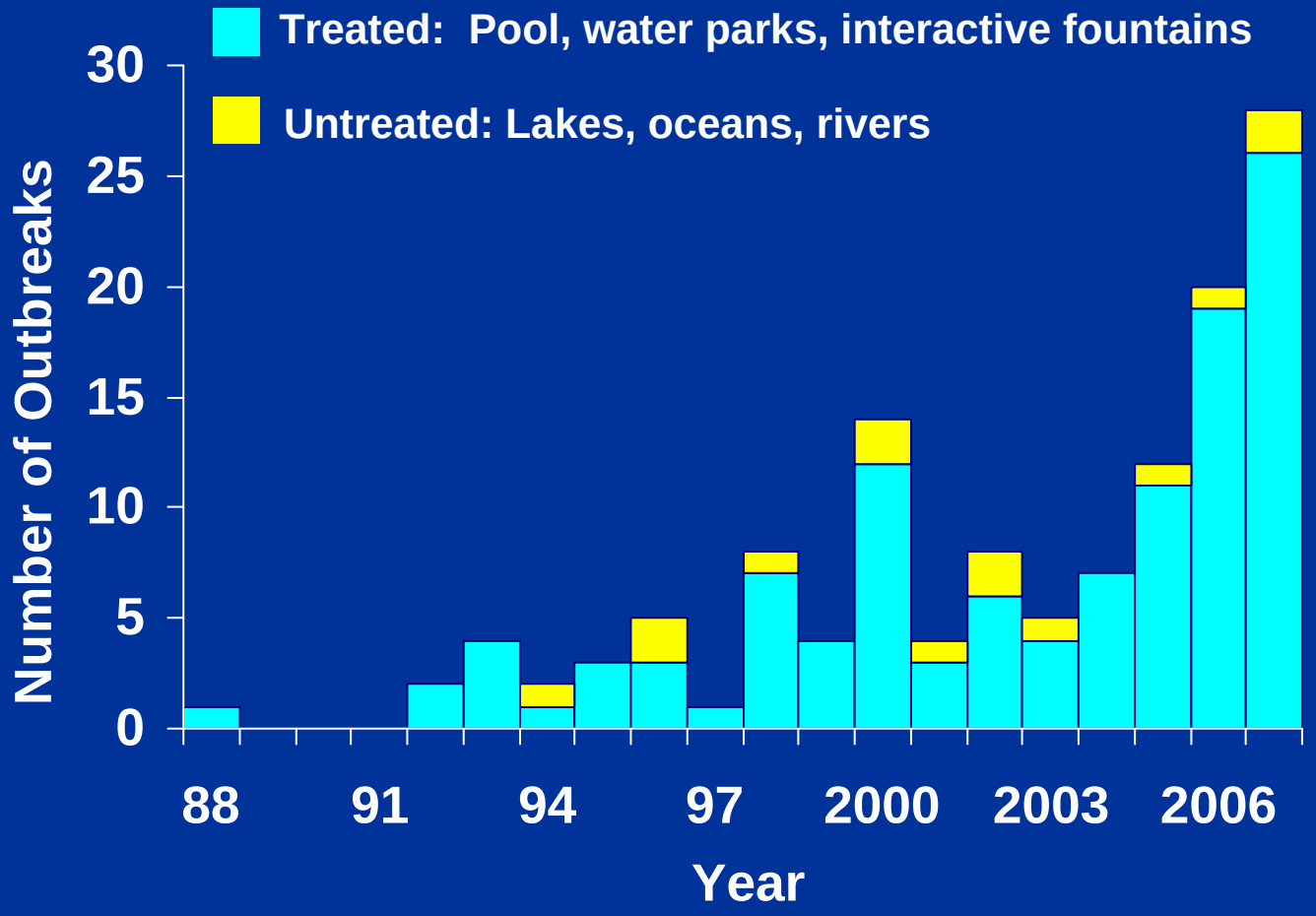
Cryptosporidiosis Incidence//100,000

	1.6 – 2.5
0.0 – 0.5	2.6 – 3.5
0.6 – 1.5	≥3.6

Cryptosporidiosis Incidence: United States, 2004-2007

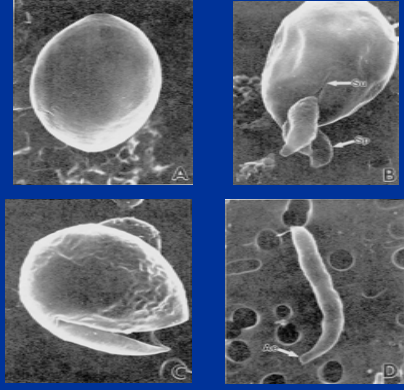


Recreational Water–Associated Outbreaks of Cryptosporidiosis, by Water Treatment United States, 1988–2007*



•N=128, Yoder JS *et al*. 2008. MMWR 57(SS-9):1–38.
2007 data preliminarily based on CDC Logs, not verified by states

Hypotheses



- Real increase in transmission
- Improved surveillance
- Improved awareness about cryptosporidiosis and pool exposures
- Changing healthcare testing practices
  - 2002: New children's formulation of drug approved (only drug ever approved)
  - 2004: adult formulation approved
- Combination of all of the above
- **Bottom Line:** State partners are asking for assistance in understanding transmission—need molecular surveillance information

Impact of U.S. Waterborne Cryptosporidiosis Outbreaks

Observed Trends: Community Transmission of Cryptosporidiosis

Community-wide Cryptosporidiosis Outbreak — Kansas, 2003

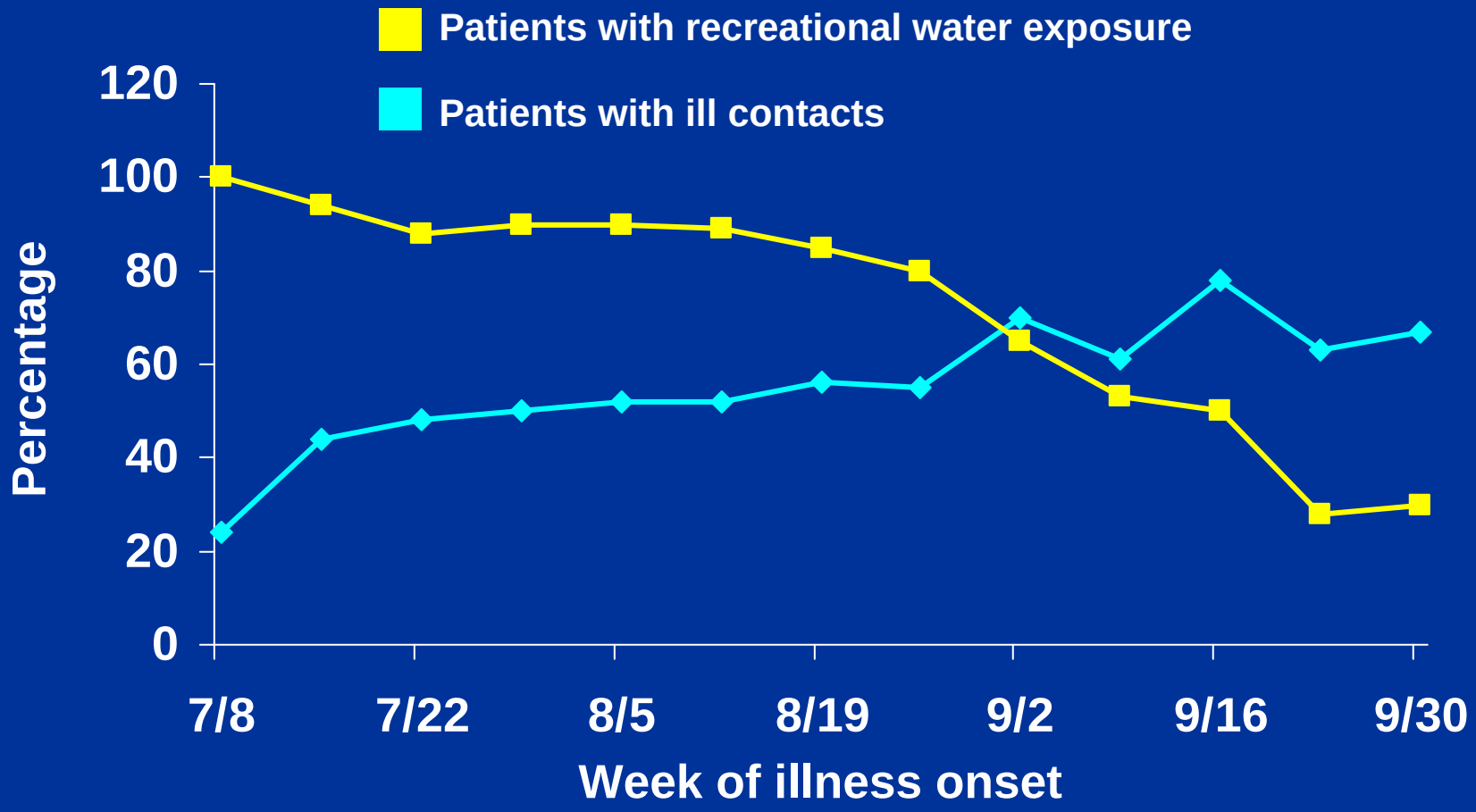
- Context
  - Swim team members and day camp attendees shared pool, ill with diarrhea
  - One swim coach encouraged ill swimmer to compete
- Investigation
  - Multiple swim teams affected
    - 12–55% of swim team members
  - Multiple pools affected
    - 1/3 swam in month after diarrhea began
- Outcome: >700 people ill, community-wide

Source: Fox LM *et al*. Epi-2: Epi-Aid #2003-66

Cryptosporidiosis in the Community -- Utah, 2007

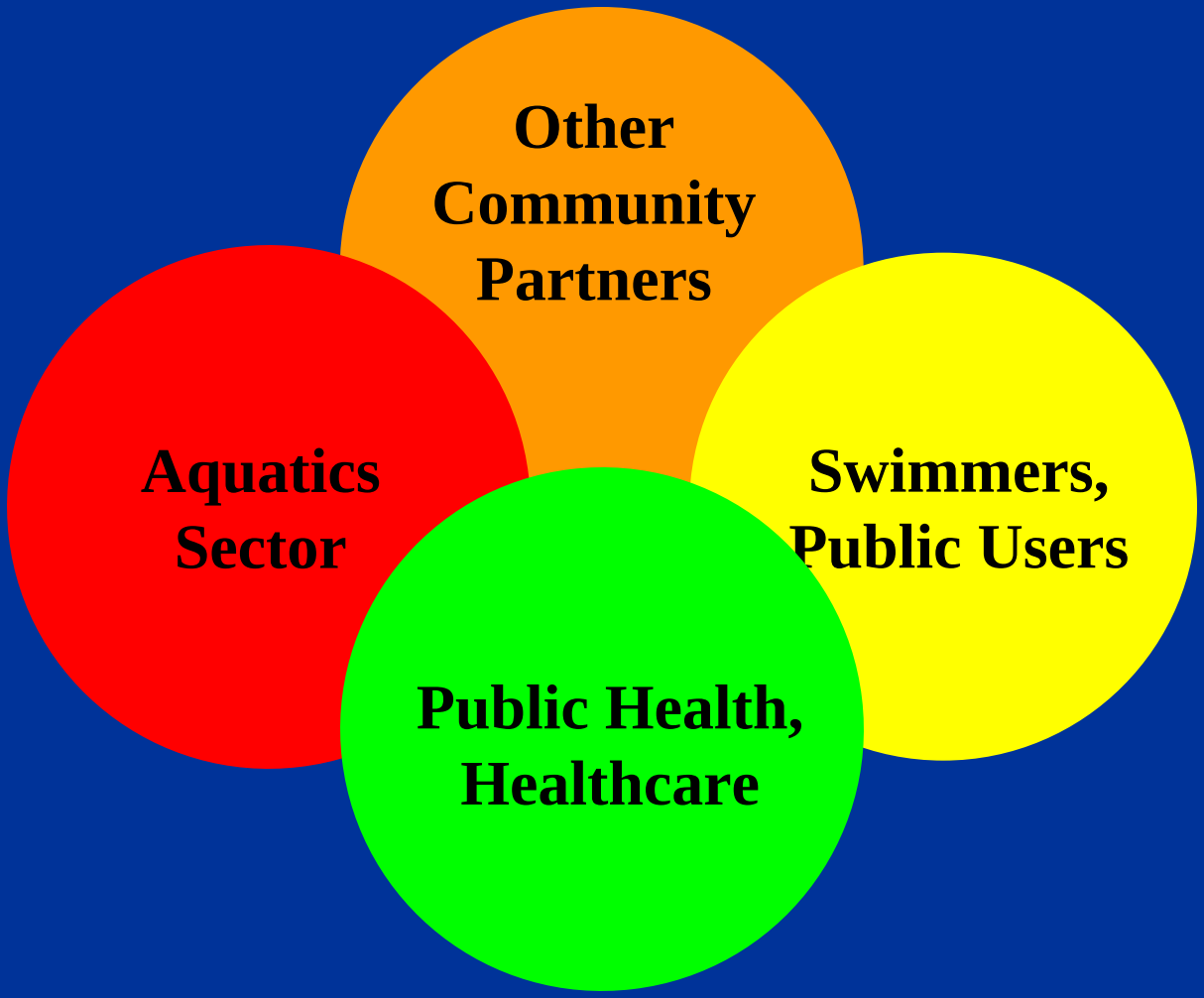
- Context
  - Increased reporting of cases to Health Dept.
- Magnitude
  - Multiple counties and cities; spread community-wide
    - >1,900 laboratory–confirmed cases
    - >450 recreational water venues implicated
  - Highest case rate among children <5 years
- Response
  - Alerted public, pools, healthcare providers, etc.
  - Banned children <5 years from public swimming

Percentage of Patients Who Reported Ill Contacts or Recreational Water Exposure, by Illness Onset — Utah, July 8–October 6, 2007[1]

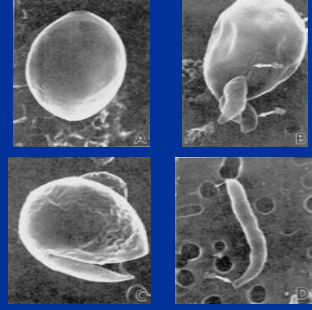


1. CDC. 2008. MMWR 57:989–93.

Can We Prevent the Community-Wide Spread Of Cryptosporidiosis?

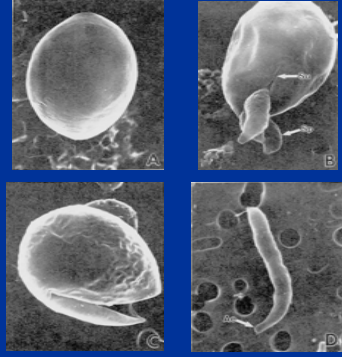


A Tale of Three States: Response Lessons Learned After Large Outbreaks



- UT >1900 cases, ID >700 cases, PA County >120 cases
  - Large 2007 community-wide Crypto outbreaks
  - Concerted effort to reduce 2008 cases
- Prepared before summer swim season
- Setup multi-jurisdictional/disciplinary taskforce
- Prepare health comm. materials before season
  - TV spots and air time funded
- Design/upgrades
  - UV: approval streamlined, municipal installation

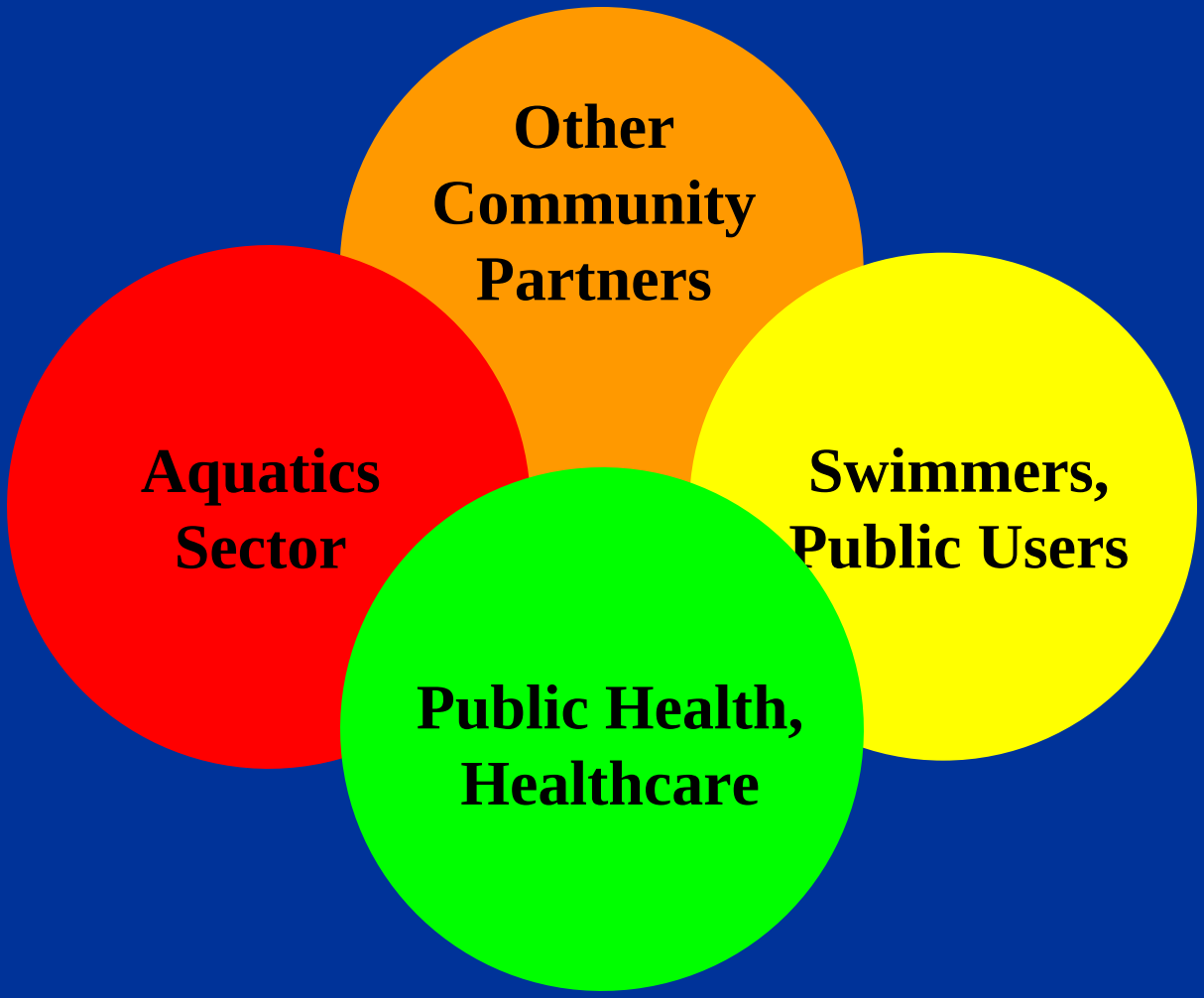
A Tale of Three States: Response Lessons Learned After Large Outbreaks



- Plan in place for summer season action
- Early dissemination of materials to partners
  - Aquatics, child care, general advisories
  - Used RWI Illness Prevention Week as platform
- Worked on amending pool code
- Let operators know that guidelines would become code

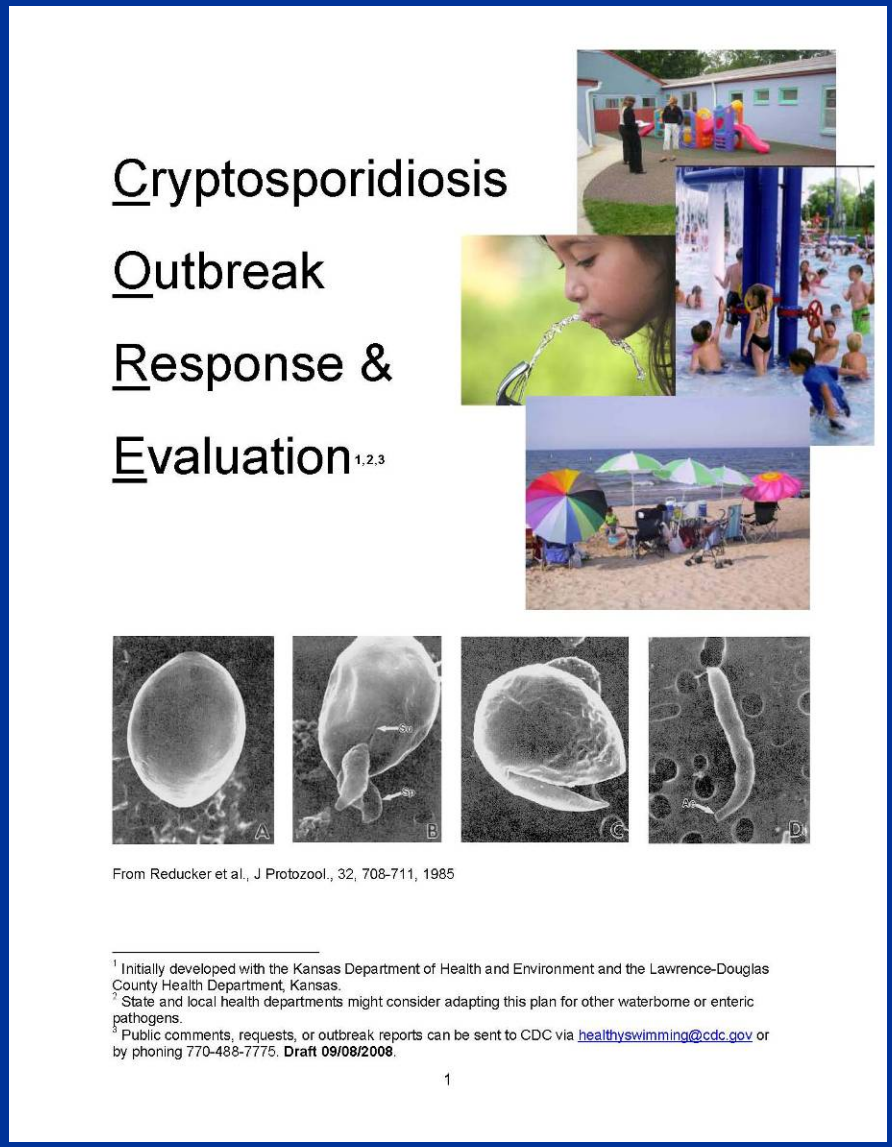
- Results 2008
  - UT (< 40 cases), ID (~50 cases) , PA (< 10 cases)

What's the Plan to Prevent the Community-Wide Spread Of Cryptosporidiosis?



Cryptosporidiosis Outbreak Response and Evaluation: The CORE*

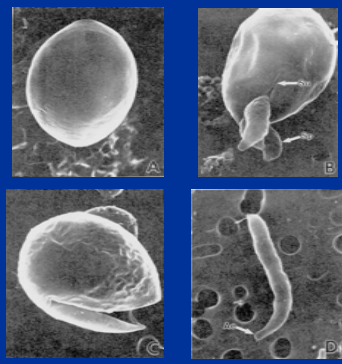
- Intent: prevent community- wide spread of Crypto
- Grew out of lessons from Crypto in Kansas, 2003



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

CORE Principles

- Prepare before an increase in disease occurs
  - Set disease action threshold (action not dependent on knowing outbreak source)
  - Set up community health alert network (e.g., pools, child care programs)
- Act after the disease action threshold is exceeded
  - Alert key groups about increased reports
    - Implement enhanced control measures
      - Patron education at pools
      - Diarrhea exclusion in daycares
      - Media assistance in relaying public messages



- Post-event evaluation
  - Evaluate response for learning lessons-retool

Swimming and Cryptosporidiosis: Working on a Solution

- Technological improvements: Paradigm shift
  - Supplemental disinfection (U.V., ozone)
  - Flocculation, improved filtration
  - Water replacement
- Behavioral change
  - Don’t swim when ill with diarrhea
  - “AAA” Program
  - Awareness, Action, Advocacy
- Harmonize pool regulation
  - Different from state to state
  - National model aquatic health code in process

Conclusions

- Recreational water
  - Swimming pools increasing problem
  - Requires improved technology, behavioral, and regulatory change
  - Paradigm shift for aquatics sector
- Progress
  - Rising public health and aquatics interest
  - Rising public awareness
  - MAHC underway
  - Expanding interest in academic research

Conclusions: Community Transmission

- Community-wide transmission growing
  - Requires multi-disciplinary partnership
  - Public health, healthcare
  - Community groups at risk (i.e., pools, child care)
  - Expanding interest in academic research
- Progress
  - Key examples of success
    - Need to be propagated

Acknowledgements

CDC Partners

- Jonathan Yoder
- Lihua Xiao
- Michele Hlavsa
- Vince Hill
- Joan Shields
- Virginia Roberts
- Charles Otto

MAHC Partners

- Doug Sackett
- Amanda Long
- Lee Tate
- MAHC Steering Committee
- MAHC Technical Committees

Other Partners

- NSPF, Tom Lachocki
- ARCH Chemical
- Water Technology
- Kiefer and Associates
- Trojan Technologies
- Biolabs
- US Filter

Newly 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“

Questions