

Cryptosporidiosis

Recent life and times of crypto in North Carolina!

Presentation Outline

- Background
 - Characteristics
 - Lab methods
 - Case definition
 - Surveillance Data
- Outbreaks
 - Summer Camp
 - Traveling Church Group
 - The outbreak that wasn't
- Lessons Learned

Background

Crypto Characteristics

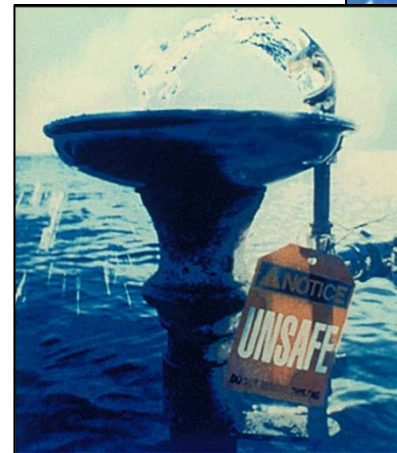
Lab methods

Case definition

Surveillance Data

What is Crypto?

- Oocyst-forming parasite
- Most prevalent species in humans
 - *C. parvum* (humans, cattle, other mammals)
 - *C. hominis* (humans)
- Long survival outside the human body, especially in moist environments
- Tolerant to chlorine
 - Can live for days in chlorine treated water
- Up to 75% of US population may have had exposure in their lifetime
- Largest outbreak in Milwaukee, 1993
 - Contamination of public water system
 - Estimated >400,000 illnesses



What are the symptoms of Crypto?

- Frequent, watery diarrhea
- Other symptoms can include:
 - Abdominal pain
 - Less often: nausea, vomiting, fever
 - Severe and chronic symptoms in immunocompromised patients
- Symptoms persist 2 to 20 days and can be intermittent
- Asymptomatic infections common
- Incubation period: 7 days (range: 2 - 14 days)



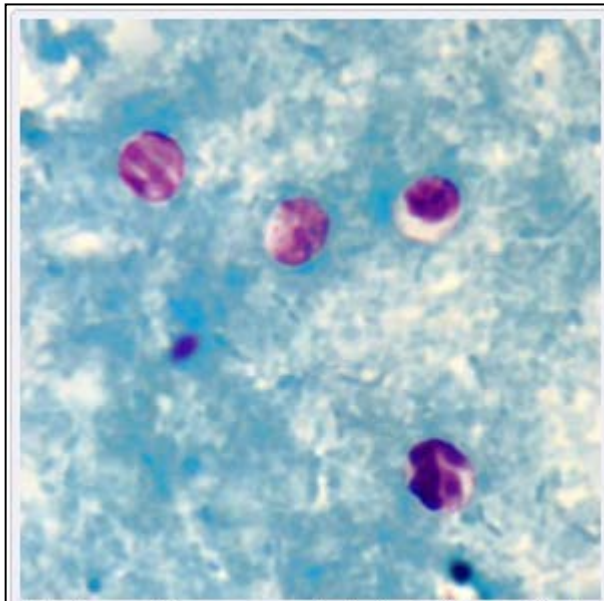


How will I know if I have Crypto?

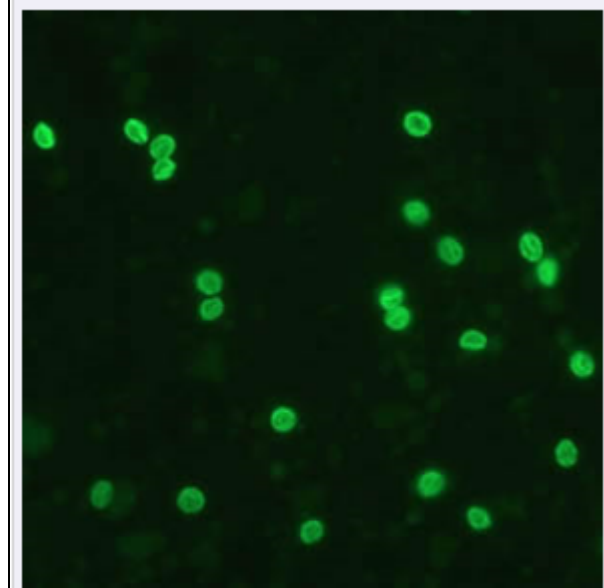
- Laboratory testing
- Crypto is not included in routine ova and parasite (O&P) testing
- Crypto has to be requested

Laboratory Options

- Microscopy (acid-fast)
- Direct Fluorescent Antibody (DFA)
 - Detection of oocysts
 - **Gold Standard**
- Enzyme Immunoassay (EIA)
 - Detection of antigen
- Polymerase Chain Reaction (PCR)
 - Sequencing and genotyping of Crypto



Cryptosporidium sp. oocysts stained with modified acid-fast.



Cryptosporidium sp. oocysts labeled with immunofluorescent antibodies. Image contributed by the Kansas Department of Health and Environment.

Laboratory Methods

NC Hospital / Commercial Labs

- Meridian Immunocard
- Ova and Parasite (O&P)
- EIA

NC State Lab of Public Health

- Meridian Immunocard



CDC

- Modified Acid Fast
- **DFA**
- Standard PCR
 - Genotyping / Subtyping

Laboratory Methods: Media Needed

NC Hospital / Commercial Labs

- Meridian Immunocard
- Ova and Parasite (O&P)
- EIA

NC State Lab of Public Health

- Meridian Immunocard
Formalin



CDC

- Modified Acid Fast
Formalin
- DFA
Formalin
- Standard PCR Cary Blair
 - Genotyping / Subtyping

Case Definition

Cryptosporidiosis (*Cryptosporidium* spp.)

2012 Case Definition

CSTE Position Statement Number: 11-ID-14

Clinical Description

A gastrointestinal illness characterized by diarrhea and one or more of the following: diarrhea duration of 72 hours or more, abdominal cramping, vomiting, or anorexia.

Laboratory Criteria for Diagnosis

Confirmed

- Evidence of *Cryptosporidium* organisms or DNA in stool, intestinal fluid, tissue samples, biopsy specimens, or other biological sample by certain laboratory methods with a high positive predictive value (PPV), e.g.,
- Direct fluorescent antibody [DFA] test,
- Polymerase chain reaction [PCR],
- Enzyme immunoassay [EIA], or
- Light microscopy of stained specimen.

Probable

The detection of *Cryptosporidium* antigen by a screening test method, such as immunochromatographic card/rapid card test; or a laboratory test of unknown method.

Case Classification

Probable

- A case with supportive laboratory test results for *Cryptosporidia* spp. infection using a method listed in the probable laboratory criteria. When the diagnostic test method on a laboratory test result for cryptosporidiosis cannot be determined, the case can only be classified as probable, OR
- A case that meets the clinical criteria and is epidemiologically linked to a confirmed case.

Confirmed

A case that is diagnosed with *Cryptosporidium* spp. infection based on laboratory testing using a method listed in the confirmed criteria.

Comment

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Comment

NC State
Lab
uses rapid
card test



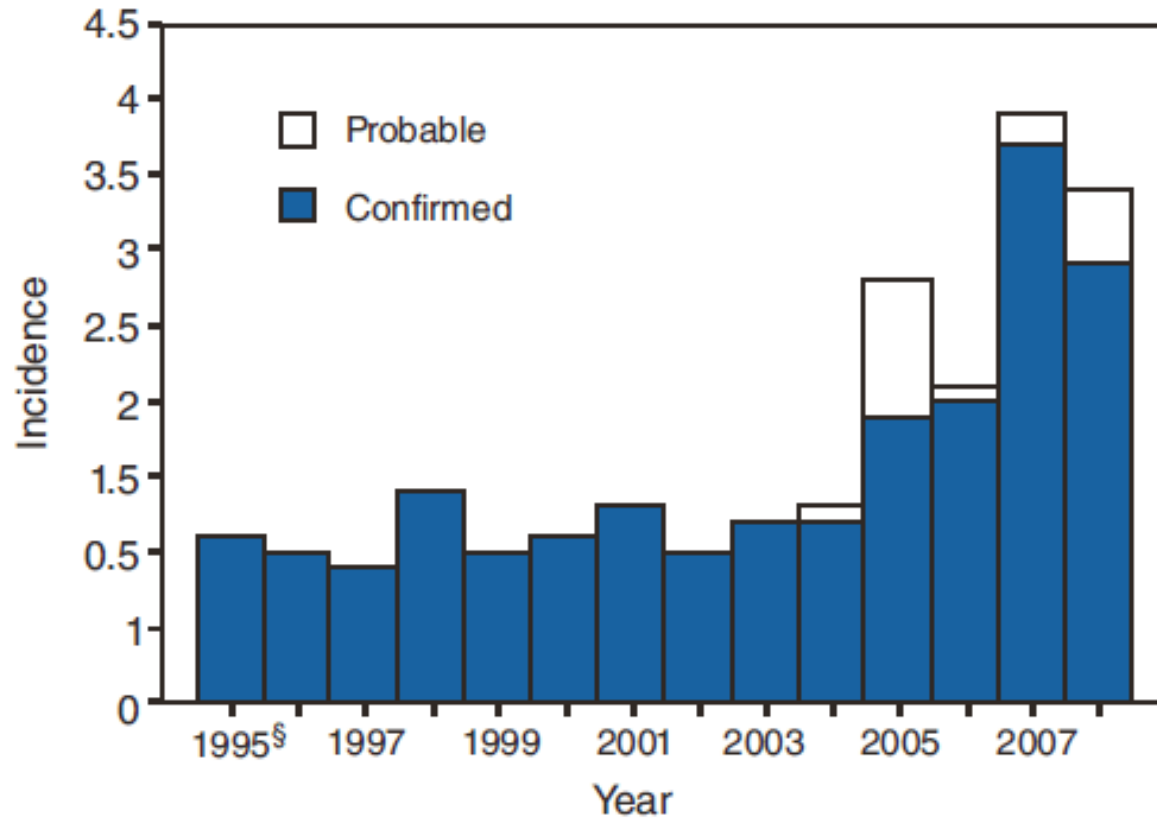
What are the control measures?

- Stay home until asymptomatic
- Do not use recreational water for 2 weeks after symptoms resolve
- Note about cleaning
 - Hand sanitizers not effective
 - Bleach-based cleaner not effective on surfaces; Peroxide or heat is effective.

Background

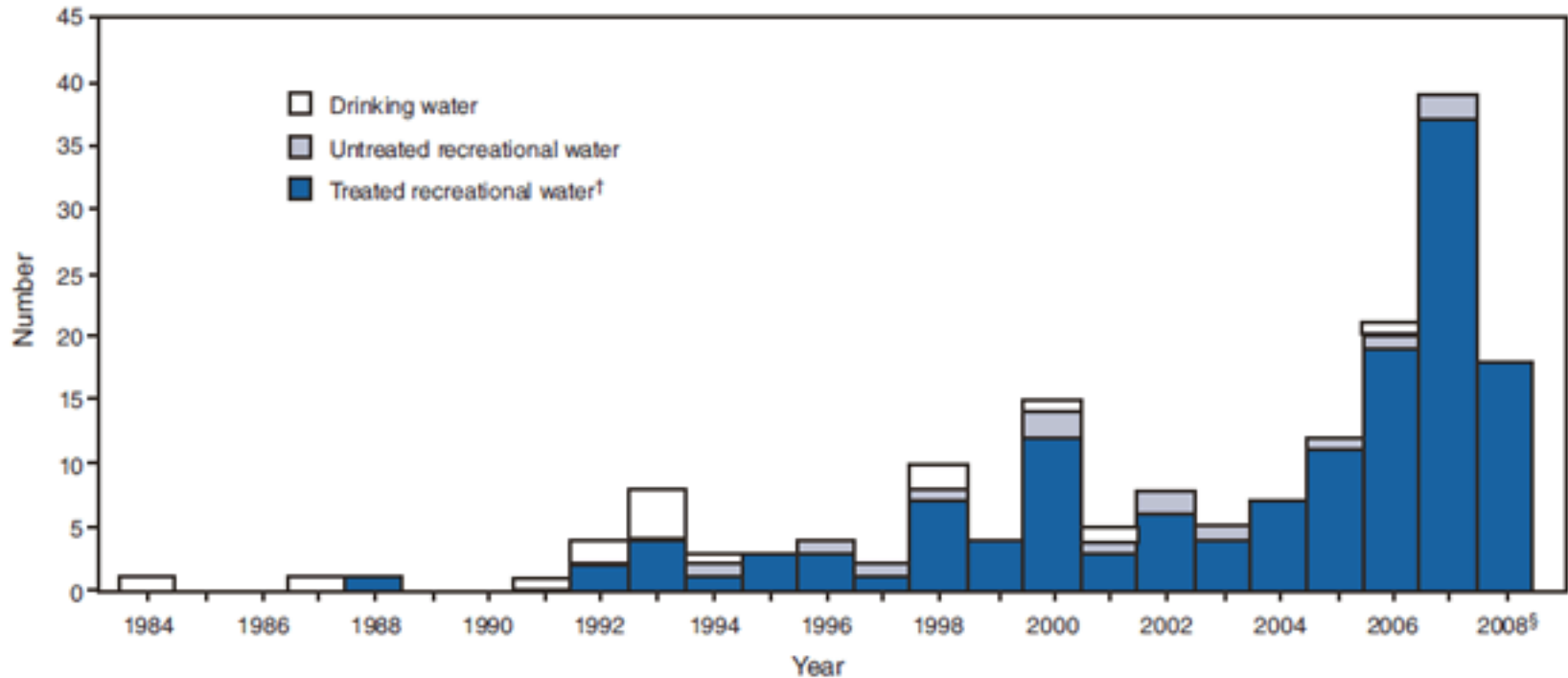
Surveillance Data

National Surveillance



MMWR Cryptosporidiosis Surveillance US 06-08; June 11, 2010 / 59(SS06);1-14

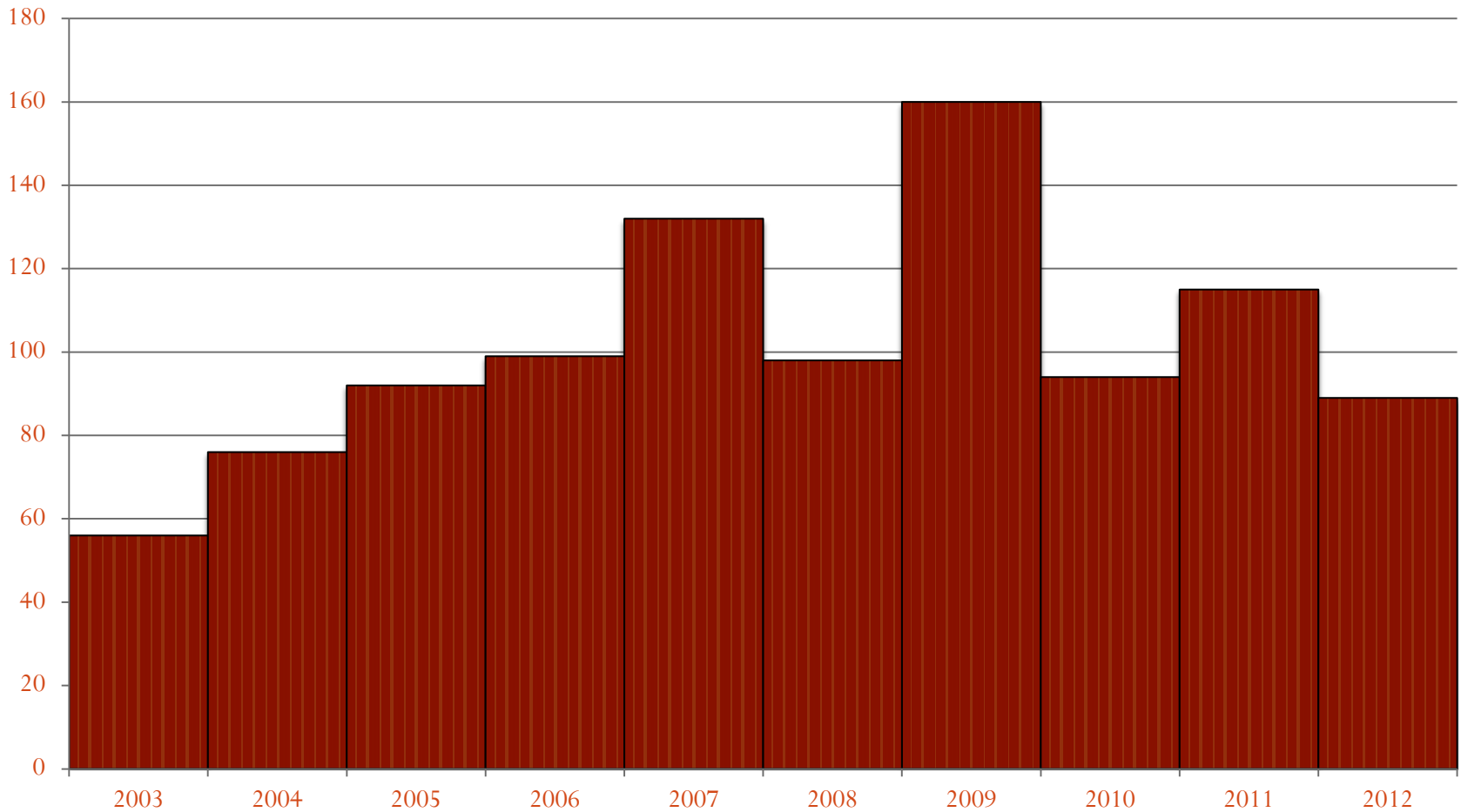
Number of Crypto Outbreaks Associated with Water



MMWR Cryptosporidiosis Surveillance US 06-08; June 11, 2010 / 59(SS06);1-14

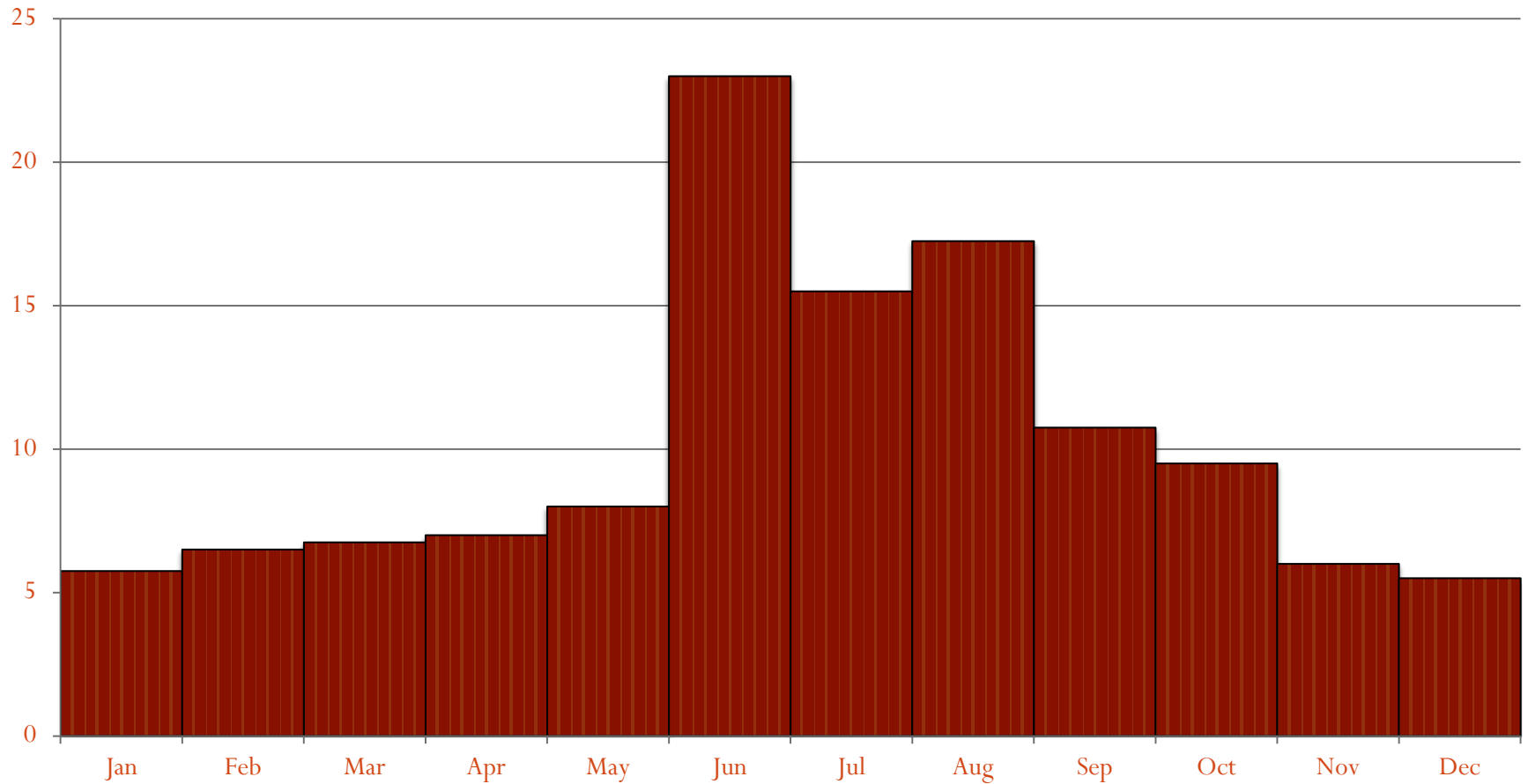
North Carolina Surveillance

Cryptosporidium Cases by Year of Onset, North Carolina



North Carolina Seasonality

Average Number of Cryptosporidiosis Cases by Month of Disease Onset, NC, 2008-12



Outbreaks

Summer Camp



2009 Summer Camp Outbreak

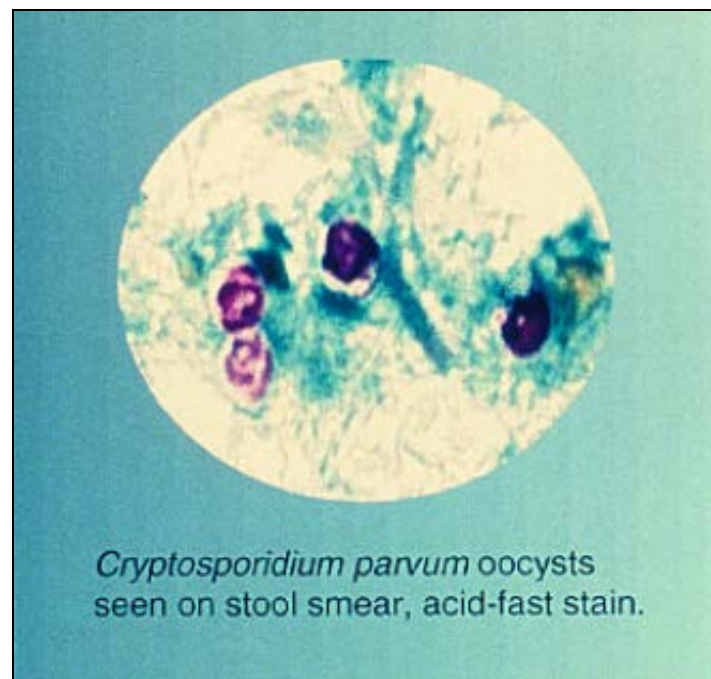
- By July 7, 56 total confirmed and probable cases
 - 10 laboratory confirmed
 - 46 probable cases
 - 3 hospitalized and discharged
- 25 (45%) staff, 31 (55%) campers
- Staff:
 - 4 laboratory confirmed
 - Age range: 19 – 51 years
 - 13 (52%) female, 12 (48%) male

2009 Summer Camp Outbreak

- 46 cases documented beginning on June 24
- Retrospective cohort study
- Two factors significantly associated with illness
 - Eating ham sandwich on 21 June (aPR=3.5)
 - Sharing cabin with ill person (aPR=2.8)
- Epidemic curve suggests point source outbreak

2009 Summer Camp Outbreak

- Laboratory Results
 - Crypto detected in stool from 12/46 patients
 - Crypto detected in stool from
 - 1/10 Jersey calves
 - 2/12 Holstein calves
 - 1/3 Goats and 1/2 pigs
 - Isolates from 7/12 humans and all but one animal were identical
 - *C. parvum* subtype IIaA17G2R1



2009 Summer Camp Outbreak

- Although livestock contact was not associated with illness in the cohort study...
- Molecular methods demonstrate that the *C. parvum* transmitted at the camp likely came from livestock on the farm
- Subtyping verified an epi link not implicated by traditional epi methods

Causes of 2009 Outbreak

- Parasite may have been introduced with calves
 - Arrival of calves to camp in relation to onset of illness
- Farm area lacked appropriate hand washing and hygiene measures
- Calf area located next to garden may have resulted in produce contamination
 - Ham sandwich may be a marker for contaminated produce

2009 Recommendations for Camp



North Carolina Department of Health and Human Services
Division of Public Health – Epidemiology Section
1902 Mail Service Center • Raleigh, North Carolina 27699-1912
Telephone: 919-733-3419 Fax: 919-870-4807

Beverly Perdue, Governor
Lanier Cansler, Secretary

Jeffrey Engel, MD
State Health Director

Date: 16 July 2009

To: Transylvania County Department of Public Health

From: Dr. Jean-Marie Maillard, Acting State Epidemiologist

Subject: Infection Control/Preventing Enteric Infections at NC Summer Camps with exposure to farm animals

- **Emphasis**
 - Removing ill animals, appropriate and frequent hand washing, and education of campers and staff about crypto transmission
- Essentially treating the “farm” as a petting zoo

2011 Summer Camp Outbreak

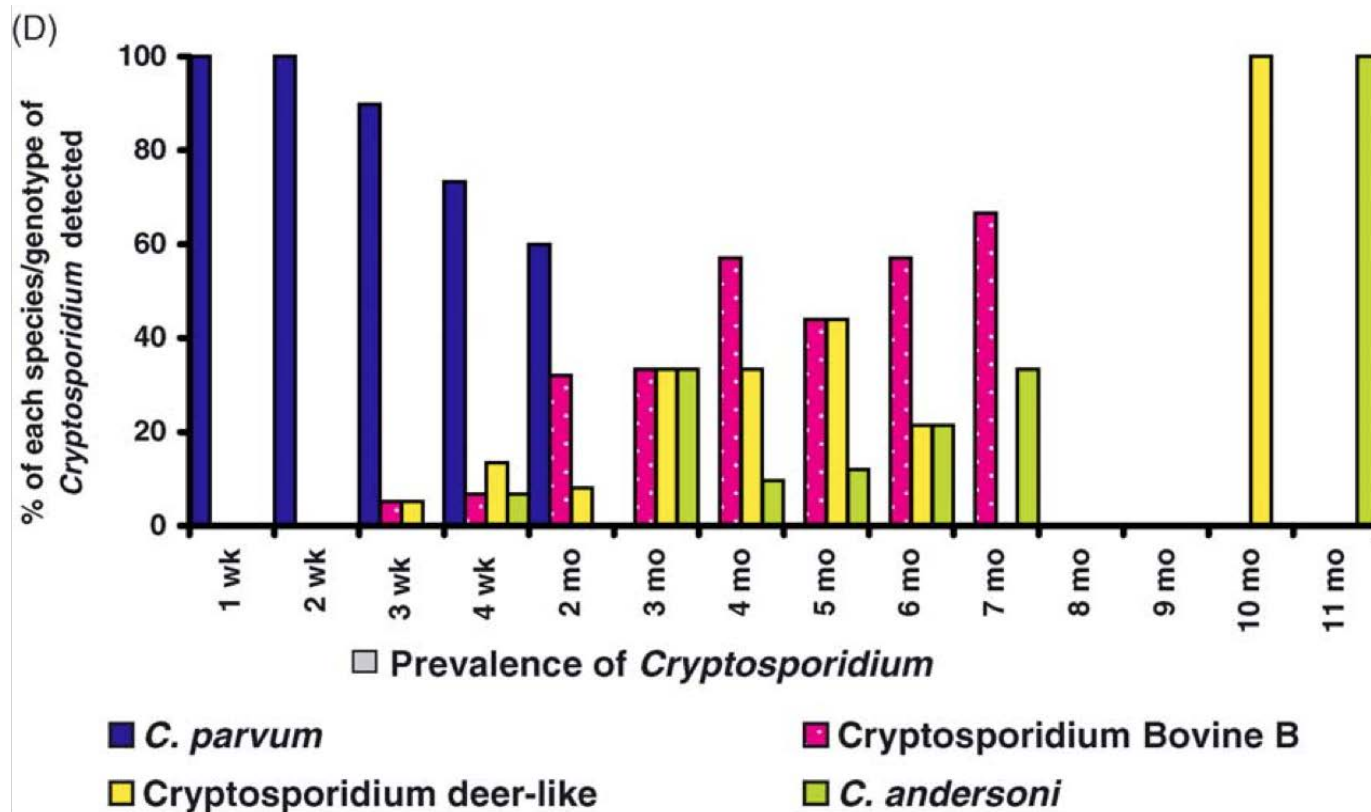
- 20 cases documented beginning May 30
- Case-control study showed that exposure to the farm and garden were significantly associated with illness
 - harvesting (OR 16.8)
 - gardening (OR 12.7)
 - calf contact (OR 12.0)
- Point source and person to person transmission likely based on wide range of onset dates

2011 Infection Control Observations

- Kitchen / food service: **appropriate**
 - hand sanitizer, large sink with running water and soap available near entrance area
- Farm / calf area: **inappropriate**
 - hand washing station not routinely used
 - staff & campers provided hydrogen peroxide for disinfection
 - no foot covers, foot baths, or coveralls
- Garden: **inappropriate**
 - no separation from calf area, campers & staff walk back and forth



What do we know about crypto shedding in calves?



Santin. (2004). Prevalence and age-related variation of *Cryptosporidium* species and genotypes in dairy calves. *Veterinary Parasitology*, 122, 103-117.

2011 Control Measure Recommendations

- Age of calves at acquisition
- Physical location / placement of calves on camp property
- Biosecurity measures when handling animals
- Foot baths
- Restriction of Goats
- Hutches



- Plastic hutches for calves
- Changing footwear / outerwear

- Hand washing station
- Specified entrance / exit



2 Outbreaks in 3 Years: Exposure Assessment

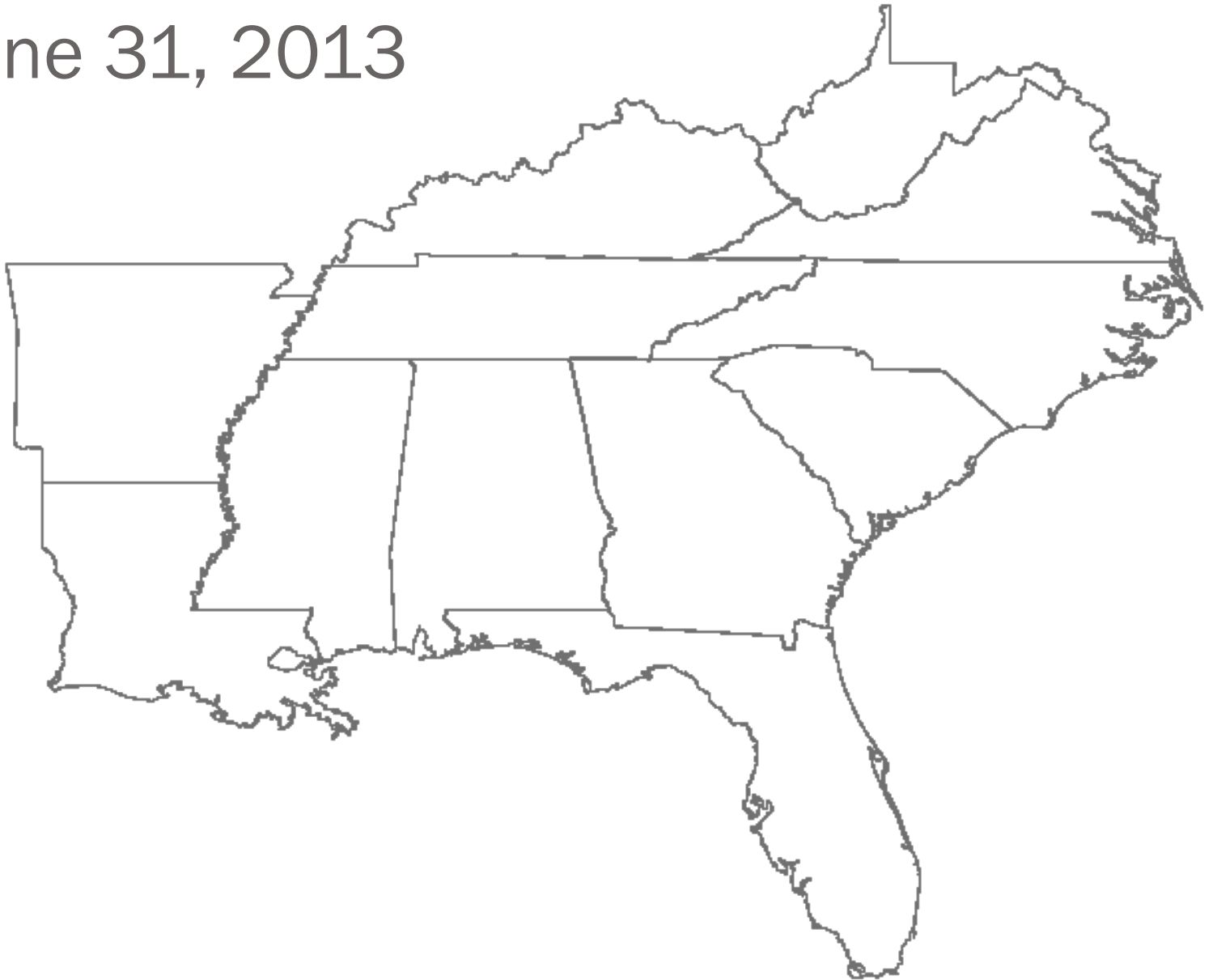
- 2009
 - Traditional epi supports food as vehicle
 - Molecular epi indicates livestock are source
- 2011
 - Traditional epi supports livestock and garden contact as source
 - Molecular epi supporting though subgenotyping not available
- It is biologically plausible that livestock are the source of infection in both outbreaks

Outbreaks

Traveling Church Group (2013)

Initial Notification

June 31, 2013



On the road again...



On the road again...



On the road again...



On the road again...



On the road again...



On the road again...



On the road again...



Tennessee Camp

Characteristics

- Week long sessions
- Recreational water activities
- Animals
- Agriculture

July 21 – July 27th Session

- Food and food workers provided by NC & SC church groups
- NC & SC church raised money to sponsor camp event for local kids
- No camps scheduled after 7/27/13

Investigation

- NCDHHS was notified on July 31, 2013 or two church groups experiencing GI illness
- Church secretary contacted by Surry County for names and addresses of camp attendees.
- Notified by the Surry County CD Division of potential person with related GI illness living in Stokes County
- Stokes County Communicable Disease Nurse notified all individuals involved from Stokes County

Initial Reports

- NC Residents
 - 12 / 48 GI illness
 - No vomiting
 - Onsets: 7/24 – 7/29
- SC Residents
 - 8 / 16 GI illness
 - No vomiting
 - Onsets: 7/25 - 8/1
- Lab
 - 1 + for Crypto
 - Rapid test at Baptist Hospital
 - 2 labs from NC pending

Verbal Control Measures

- Implemented to each individual that was symptomatic:
 - Avoid public recreational water
 - No food preparing for other individuals
 - Wash hands with soap and water
 - Food handlers, child care workers and hospital workers must notify their supervisor

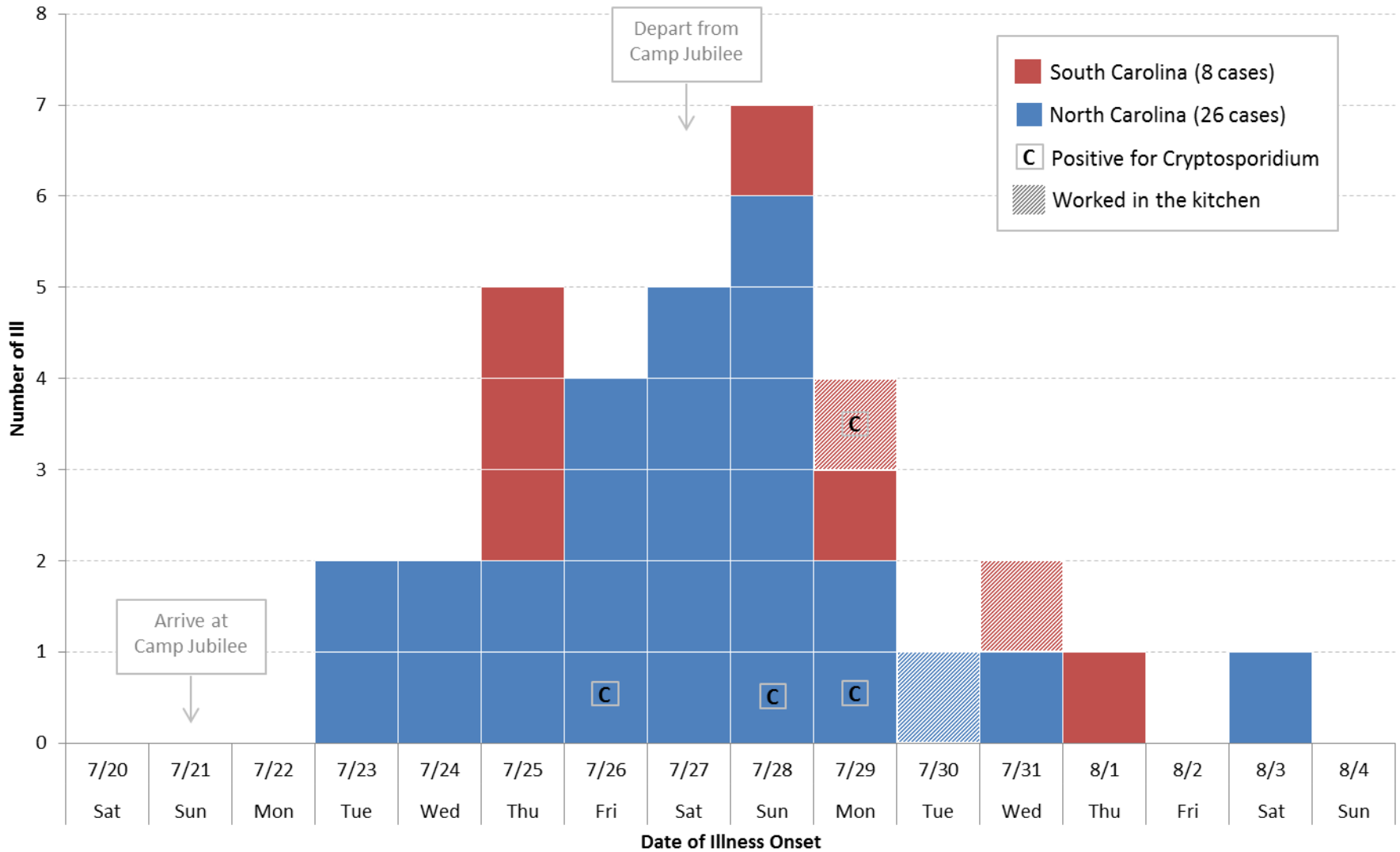
Specimen Collection

- Two of fifteen individuals submitted stool samples
 - One physician ordered crypto test and one other physician did not
- Cryptosporidium must be ordered as an individual test, it is not included in stool culture or Ova and Parasite test methods.

Onset of Illness by Date and State of Residence

Possible Multistate Cryptosporidiosis Outbreak

August 9, 2013 (10:00am)



Findings

- Lab
 - Four specimens (+) for crypto
 - *Cryptosporidium parvum* identified in a stool specimen from South Carolina, meaning this was an animal source
- Environmental
 - Kitchen and bath specimens (-) for coliform
 - ≥ 200 CFU in specimen from spring
 - Water samples from spring box, kitchen tap, bathhouse, and outdoor tap all (-)
- Epi
 - No exposures identified that were both statistically significant and biologically plausible

Conclusion

- “Cryptosporidium was the causative agent of gastrointestinal illness among Camp Jubilee attendees with four persons testing positive for the parasite. The outbreak of cryptosporidiosis among North Carolina and South Carolina church groups **likely occurred after exposure to a point source during the trip to or shortly after arrival at Camp Jubilee.** Despite an epidemiological and environmental investigation including survey and analysis of potential exposures and assessment and sampling of Camp Jubilee facilities and water, **no definitive point source of infection could be found.**”

Recommendation

- Washing hands with soap and water
- Use bottled water for drinking and cooking while camping

Outbreaks

The “Crypto” Outbreak that Wasn’t

If it looks like a duck...

Friday, Feb 21st

- 12 ill
 - 5 Dunkin Donut employees
 - N/V/D
 - Duration of diarrhea
 - Median = 9 days
 - Range = 5 – 10 days
 - 7 household contacts to Dunkin Donut employees
 - N/V/D
 - Duration of diarrhea
 - Median = 7 days
 - Range = 2 – 10 days

➤ Sewage backup on 1/31/14 (opening day)

 - Employees cleaned and service continued via drive-thru window

It might not be a duck
(aka Crypto)

Laboratory Results

- 6 / 10 samples positive for **norovirus**
- 5 / 5 samples negative for enterics
- 3 / 3 samples negative for cryptosporidium and giardia

Lessons Learned

Camp Outbreaks

- Those who have animals that will have contact with the public need to understand disease transmission
- Keep calves separate from gardens

Traveling Church Group Outbreak

- Splitting stool samples is helpful for ensuring additional testing can be conducted by CDC

The Crypto Outbreak that Wasn't

- Laboratory testing continues to be a crucial part of outbreak response
 - State lab staff quickly responded and worked over the weekend

Take away...

- Crypto outbreaks are most often waterborne
- Laboratory testing is important and crypto must be specifically requested.
- If sending specimens to the state lab for testing during a Crypto outbreak— split the sample into Cary Blair and Formalin containers
- *C parvum* = animal source
- *C hominus* = human source

Slides adapted from presentations by:

- Jennifer MacFarquhar
- David Sweat
- Carl Williams

*Many thanks to the CD Nurses,
Environmental Health Specialists, Lab, and
CDB staff that worked on the crypto (and
the “We thought it was crypto”) outbreaks

Acknowledgements

Thank you for your time!

Any additional questions?