Waterborne Disease: Cryptosporidiosis
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SLIDE 1-TITLE

SLIDE 2-

Hello, my name is Carl Williams and I will be speaking to you during this session on a reportable disease classically associated with waterborne transmission, cryptosporidiosis. However, as we will discuss waterborne transmission is but one way that cryptosporidium parasites may be transmitted to people.

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As with all diseases it is important to be able to identify the reservoir and means of transmission as this will help in the development of appropriate control measures. In addition to being reportable in NC cryptosporidiosis is nationally notifiable and we will discuss the basis and rationale for that.

Cryptosporidiosis case classification is very dependent on the laboratory method used to identify infection. It is important to be able to explain and recognize the different laboratory test methods and appropriately enter that information into NC EDSS and assign the correct case classification.

Cryptosporidiosis is also a disease that will test your ability to conduct outbreak investigations. While sporadic cases are commonly identified, large outbreaks are not uncommon and have occurred in many states, including NC.

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I would now like to introduce you to what cryptosporidium species, and the disease cryptosporidiosis, are.

Cryptosporidium is a microscopic protozoa that causes the diarrheal disease cryptosporidiosis. Both the parasite and the disease are commonly known as "Crypto." However be careful not to confuse cryptosporidiosis with cryptococcus neoformans, an AIDS indicator organism. People commonly refer to both as “crypto” but they are very different.

There are many species of Cryptosporidium that infect humans and animals. The parasite is protected by an outer shell that allows it to survive outside the body for long periods of time and makes it very tolerant to chlorine disinfection.

While this parasite can be spread in several different ways, water (drinking water and recreational water) is the most common method of transmission. Cryptosporidium is one of the most frequent causes of waterborne disease among humans in the United States.

Low infectious dose and extreme chlorine tolerance also make Cryptosporidium ideally suited for transmission through drinking water.

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Symptoms usually last about 1 to 2 weeks (with a range of a few days to 4 or more weeks) in persons with healthy immune systems. Occasionally, people may experience a recurrence of symptoms after a brief period of recovery before the illness ends. Symptoms can come and go for up to 30 days.

While the small intestine is the site most commonly affected, Cryptosporidium infections could possibly affect other areas of the digestive tract or the respiratory tract.

People with weakened immune systems may develop serious, chronic, and sometimes fatal illness.

Examples of people with weakened immune systems include: people with AIDS; those with inherited diseases that affect the immune system; and cancer and transplant patients who are taking certain immunosuppressive drugs. The risk of developing severe disease may differ depending on each person's degree of immune suppression.

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The number of reported cases and cost of cryptosporidiosis in the United States continue to be substantial. Approximately 748,000 cryptosporidiosis cases occur annually (52). Each year, hospitalizations resulting from cryptosporidiosis cost an estimated $45.8 million; additionally, each ambulatory care visit for cryptosporidiosis costs $267–$757, depending on the patient's type of health-care insurance coverage (53). The high incidence and cost of cryptosporidiosis

underscores the need for a better understanding of cryptosporidiosis epidemiology in the United States, particularly of risk factors, to optimize prevention and control.

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In NC the number of cases reported is fairly similar over the years with an obvious exception in 2009 associated with a large outbreak in Transylvania County.

SLIDE 8

Nationally, a five-fold increase in cryptosporidiosis symptom onset during the summer, similarly observed in previous reports from the U.S. and other countries, is consistent with increased use of treated recreational water venues during the summer, particularly among younger children. A similar seasonal distribution is seen in NC though it is unclear if the increase in our state is due to recreational water use, though it is plausible.

Cryptosporidium has become the leading cause of reported treated recreational water–associated outbreaks of gastroenteritis. Transmission through recreational water is facilitated by the substantial number of Cryptosporidium oocysts that can be shed by a single person, the extended periods of time that oocysts can be shed, the low infectious dose, and the tolerance of Cryptosporidium oocysts to chlorine.

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Unlike some other conditions with a similar incidence rate, cryptosporidiosis in NC seems to affect all age groups at roughly the same rate.

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Surveillance is conducted so that Local, state, and federal public health agencies can use cryptosporidiosis surveillance data to characterize the epidemiology of cryptosporidiosis in the United States, establish public health priorities (e.g., research) to improve cryptosporidiosis prevention and control, and design and evaluate efforts (e.g., health communication and policy) to prevent and control the transmission of Cryptosporidium.

Should we say something specific to the disease like “waterborne illnesses are a high risk for affecting masses of people so we want to keep a close watch on illnesses caused by something

in our water supply. Water for human consumption, as well as recreational water is of interest to public health when it may be a source of illness."

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A case definition is set of uniform criteria used to define a disease for public health surveillance. Case definitions enable public health to classify and count cases consistently across reporting jurisdictions, and should not be used by healthcare providers to determine how to meet an individual patient's health needs.

With cryptosporidiosis you may generally classify a case as confirmed or probable on the basis of laboratory evidence alone. A clinically compatible illness would certainly be expected in a person who tests positive, yet is only required for case classification when there is no laboratory evidence of infection and the case is epidemiologically linked to a confirmed case.

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As you can see there are many different laboratory methodologies available for the diagnosis of cryptosporidiosis. For surveillance it is essential that you know not only the test method being used, but also the manufacturer of the test, as that can be very informative.

We will go over these in the next few slides.

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Positive Predictive Value (PPV) of Results of Diagnostic Tests for Cryptosporidium Used by Clinical Laboratories in Minnesota, 2008

Immunochromatographic lateral-flow immunoassays (rapid assays) have previously been associated with false-positive Cryptosporidium results, leading to difficulties in public health surveillance

Therefore, more frequent use of rapid assays could artificially inflate reported cryptosporidiosis case numbers through the inclusion of cases with false-positive test results.

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Modified acid-fast staining technique is a simple and effective method: the oocysts stain bright red against a background of blue-green fecal debris and yeasts. This is a slide showing oocysts of Cryptosporidium parvum stained by the modified acid-fast method. Against a blue-green

background, the oocysts stand out in a bright red stain. Sporozoites are visible inside the two oocysts to the right.

Some hospital laboratories still perform this test. Check with reporting laboratories to ensure you know if this method has been used and enter in NCEDSS as ova and parasite preparation if not already done.

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Direct Fluorescent Antibody (Ab) testing also known as DFA was developed as the first alternative to acid fast staining. The acid-fast nature of the oocysts makes it difficult to differentiate from other non-cryptosporidial acid-fast organisms of comparable size.

The test utilizes the principle of direct immunofluorescence. The Detection Reagent contains a mixture of FITC labeled monoclonal antibodies directed against cell wall antigens of Cryptosporidium oocysts and Giardia cysts. A prepared fecal specimen is treated with the Detection Reagent and a Counterstain. The monoclonal antibodies attach to Cryptosporidium or Giardia antigens present in the specimen. The slides are rinsed to remove unbound antibodies, and examined for apple green color and characteristic morphology of Cryptosporidium oocysts and Giardia cysts using a fluorescent microscope. Background material in the specimen is counterstained dull orange to red.

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According to the package insert…Diagnosis of Cryptosporidium and Giardia infection has traditionally been done by microscopic examination of stools. More recently, the detection of Giardia and Cryptosporidium antigens in stool specimens using enzyme immunoassays has become an accepted approach to diagnosis. [Note this is not an EIA test] The ImmunoCard STAT! Crypto/Giardia assay detects similar antigens using a qualitative immunochromatographic assay.

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We see a lot of Cryptosporidium events in NCEDSS with the lab method listed as “culture.” There is no culture for Cryptosporidium.

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The total number of cases reported annually and disease incidence increased during 2006--2008 and has increased dramatically since 2004. Whether this increase reflects changes in reporting patterns and diagnostic testing practices or an actual change in infection and disease caused by Cryptosporidium is unclear but was clearly influenced by outbreak-related case reporting.

However, outbreak-related probable case reporting does not account for the entire increase in reporting. This increase also follows the introduction of nitazoxanide, the first licensed treatment for the disease, which was licensed in 2002 for children aged 1--11 years and in 2004 for children aged >11 years and adults. Because treatment for cryptosporidiosis now is available, health-care providers might be more willing to request Cryptosporidium testing, leading to an increase in subsequent case reports.

Milwaukee April 1993 an estimated 400,000 persons acquired cryptosporidiosis from municipal water supply; at time did not treat for cryptosporidiosis

The source is likely to have been rainwater carried oocysts from cattle farms / slaughterhouses that ran into Lake Michigan near the water intake.

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SLIDE 21

Cryptosporidiosis was identified as the cause of a 2009 outbreak. The camp has a sustainable agriculture mission and uses pre-weaned calves to educate campers. The farm area lacked appropriate hand washing and hygiene measures. The calf area located next to garden may have resulted in produce contamination.

The ham sandwich may be a marker for contaminated produce in this event.

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Our investigation suggests two methods of disease transmission occurred in this outbreak: point source (calf) and person-to-person. Laboratory results identified Cryptosporidium parvum in both humans and bovine stool specimens. Data analysis identified that exposure to animals, in particular pre-weaned calves, and the garden was associated with cryptosporidium infection. The fact that cases continued to occur following implementation of control measures, indicates the possibility of person-to-person transmission.

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It is important to note that not all cattle pose the same zoonotic disease risk with respect to cryptosporidium infection. A large study of cattle on the east coast of the US demonstrated that the prevalence of Cryptosporidium species appeared to be age related between pre- and post-weaned calves. C. parvum, the only zoonotic species, constituted 85% of the Cryptosporidium infections in pre-weaned calves but only 1% of the Cryptosporidium infections in post-weaned calves (Santin, 2004). A table from that study demonstrates that as cattle age they pose less of a zoonotic disease risk because they shed less C. parvum. While they do continue to shed other species of Cryptosporidium, they are not zoonotic.

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