

**Foodborne and Diarrheal Disease
Surveillance and Response in North Carolina
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Hello, I'm David Sweat, the lead foodborne disease epidemiologist in the Communicable Disease Branch with the North Carolina Division of Public Health. This is the lecture on foodborne and diarrheal disease surveillance and response.

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We have 3 learning objectives for this presentation. First, name 2 reasons why prompt local investigation of foodborne diseases matters; second, to locate and use the CIFOR guidelines for foodborne disease investigations; and third, to follow the NC Electronic Disease Surveillance System guidance for documenting foodborne disease investigations.

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Foodborne diseases matter. Foodborne diseases are common. 76 million cases occur each year in the United States. Foodborne and diarrheal diseases can also be devastating. Dehydration, kidney failure, and mortality among the immunocompromised, as well as fetal death, may occur.

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Large national outbreaks associated with commercially prepared foods are rare events. The CDC estimates that only 5-6% of outbreaks fall into this category. Although these outbreaks are rare, they do generate the majority of media attention and interest however, and these investigations present the most complex challenges for the national public health system.

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High profile outbreaks have serious consequences, even in states with few reported cases. In the 2009 Salmonella outbreak associated with PCA peanut products, there were only 6 documented cases in North Carolina. The outbreak still had a tremendous impact here though, because a major peanut butter cracker manufacturing facility in the state used these products as ingredients. Dozens of people were laid off from work while that plant was decontaminated over a period of several months, and the entire peanut growing agricultural sector of our economy declined as people across the country stopped eating peanut butter due to concerns about the safety of the product.

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Outbreaks get all the attention, and solving outbreaks is an important way to learn things about food safety that we still need to learn. Pathogens of all kinds continue showing up in places where we least expect them. No one imagined that raw cookie dough might contain E. coli O157:H7 until the Nestle Toll House Cookie Dough outbreak of 2009, for instance. This pathogen had been previously seen on fresh produce and in leafy greens, but is much more commonly associated with beef or raw

milk. Now, even manufactured foods must be considered plausible as vehicles for E. coli infection.

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While outbreaks get a lot of attention and take up a lot of our work time, the vast majority of cases occur as sporadic illnesses that are never linked to any recognized outbreak or cluster. We still investigate outbreaks because these events offer the best opportunity for us to identify new exposures and to establish proven disease risks that need to be eliminated to improve the health of our communities.

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As important as outbreaks are as learning opportunities, most of what we know about enteric and foodborne disease pathogens comes from reviewing data that's collected routinely by local health department nurses conducting surveillance activities every day. Although the national capacity for detection and conducting surveillance of diseases that are potentially foodborne has improved considerably in the past 20 years, our surveillance statistics reflect only a fraction of the cases that actually occur, because most people who are sick don't get healthcare or don't get diagnosed. For instance, studies from 1996–1997 suggest that only about 12% of persons with a diarrheal illness will seek medical care. Among those who did go to the doctor, only about 20% are asked by their physician to provide a stool specimen for culture, and of these, 90% comply with the request. This means that among all cases of people who got ill, less than 2% of them had a specimen collected for diagnosis. (Of course this percentage will vary with the illness and whether the illness is associated with other cases or an outbreak.) Since surveillance is largely based on laboratory-confirmed cases, we find out about only a very small proportion of all the cases that occurred, and those numbers grossly underestimate the burden of these diseases on our communities. Still, from these few people who are diagnosed and reported, they are vital to foodborne disease epidemiologists since they are the only cases we would normally ever know anything about. The data collected by nurses and entered into our electronic disease surveillance systems is the only data we have about these patients and their exposures outside of outbreak investigations.

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Bacterial cultures across the United States and in several other parts of the world receive special laboratory analysis to determine the DNA “fingerprint” of the bacteria that caused the patient's illness. The patterns are routinely compared and cases with similar fingerprints are reported to epidemiologists at the CDC and in the states. You may be asked to provide additional information or to enter all known exposure data for a patient you have interviewed, because they have been linked to a cluster either here in North Carolina, or somewhere else in the country by the PulseNet system.

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Now, PulseNet is an international system. This system of integrated laboratories shares information and data across even international boundaries. And any case can become important in somebody's investigation somewhere in the world. A few years ago here in

North Carolina, we had a child who had an illness that was linked by the DNA fingerprint with an outbreak that was going on in Amsterdam in Europe. When we received the phone call from the epidemiologist in Europe, wanting to know about the exposure history of a child in Durham, North Carolina, that shows the true power of the international PulseNet system.

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Now, although we have developed standardized methods in our public health laboratories in the United States that allow us to collaborate effectively in comparing isolates and specimens, when it comes to coordinating our investigations and response activities, there is a lot of room for improvement. Congress and the public often question why it takes so long to figure out that peanut butter, spinach, cookie dough or frozen pizza is what is making everyone sick in a particular outbreak. The answer is that the investigation steps, the interview questions that are asked, and other activities, are not conducted the same way or as thoroughly throughout the nation everywhere and to the same degree. It takes time in multijurisdictional investigations to get the same information from enough scattered cases to begin to discover patterns. The National Council to Improve Foodborne Outbreak Response (CIFOR) developed guidelines, published in 2009, intended to help standardize how investigations are conducted and make it easier to compare data across different health departments around the country. All North Carolina local health departments have been given copies of these guidelines, and we encourage you to become very familiar with them.

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The chapters in the guidelines describe key steps of outbreak investigations, explain the rationale for why we recommend things be done a certain way, and combine input from all three major disciplines – laboratory, epidemiology and environmental health. The book also includes lists of contacts and references and has several tools built in to make your job easier. The CIFOR Guidelines describe the overall approach to foodborne disease outbreak response. They are divided into chapters reflecting the major functions that should occur before and during most foodborne outbreaks, including planning and preparation, disease surveillance and outbreak detection, investigation, and control measures. Each chapter provides useful background information on the functions covered, the rationale for various activities, and details on recommended practices related to the function. The Guidelines describe the roles of all key agencies and organizations involved in the response to foodborne outbreaks, whether local, state, and federal, and the resources available to them. The Guidelines provide recommendations for processes to improve communication and coordination among multiple agencies during these investigations. The Guidelines also have a chapter on performance indicators, which are measurable indicators of the effectiveness of surveillance and outbreak detection, investigation, and control activities. These indicators are a means by which health departments can evaluate their own performance and the performance of their food safety programs and identify areas where things can be improved. As such, the Guidelines are comprehensive, covering a lot of different types of information, but they are not stand-alone. They reference other sources of information that are also important for the operation of foodborne disease

programs. And, as detailed as they are, they do not typically provide specific instructions for implementing any particular recommendation. In other words, they cover the general principles.

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When investigating a case or outbreak of anything, it is best to begin by getting organized and becoming familiar with the pathogen that you're concerned about. Review the case definition, review summaries of the natural history of the organism, control measures, and appropriate laboratory tests. All of this information can be looked at to begin with in the investigation. Also, it's important to figure out if it's a reportable disease. If so, print out the appropriate corresponding NC EDSS forms and have them ready to go before collecting data, so you know what information you need to obtain. If you have questions or concerns, check with your nurse consultant or call the epidemiologist on call to review critical information before you get started.

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Outbreaks of anything are always reportable, but for sporadic cases, that is not true. When receiving a report of illness from a doctor's office, the public, or reviewing a laboratory result that comes across your fax machine or desk, the first question to ask is whether or not that case represents a sporadic case or is part of an outbreak. If there is no evidence that it is part of an outbreak, consult the Communicable Disease Manual website to make sure whether it is a reportable condition. If it is or may be a reportable disease case, start first by reviewing what is known about the patient already. Has the patient been seen by a health care provider? Has any laboratory testing been performed? What are the results of lab tests, and were the appropriate lab tests conducted? If the patient was seen medically, try to review the clinic notes, and for hospitalized patients, read the admission and discharge summaries. When interviewing the patient or the caregiver for patients who are children, be sure to determine the exact onset date for the first symptoms, collect information about the symptoms that they had, and risk or exposure history. Assess the patient to see if other people may also be at risk, and evaluate whether there are appropriate control measures that need to be applied. Food handlers, health care workers, and child care providers should be excluded from work if they are ill with any symptoms of gastroenteritis. Children who are ill with vomiting or diarrhea need to be kept out of school or daycare while having those symptoms. All the information should be compiled on the appropriate NC EDSS form and filed after entering data into NC EDSS. The information collected through the data entry wizard in NC EDSS is required information that must be entered, but additional information may also be entered. Please maintain the paper interview forms for at least one year, in case the patient is found to be part of a national cluster or a local cluster and we need to review the additional information, or ask you to put all that additional information that you've gathered into the disease system.

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Among the information that is important to collect immediately is the clinical information. What was the onset date? What was the onset time? What is the profile of symptoms? Were the patients hospitalized? Was anyone diagnosed by a physician, or did anyone

seek health care? If they did, reading the admission and discharge summaries and getting the physician's or nurse's impression of the illness can be really helpful in pointing you in the right direction. These can help you determine what pathogens to suspect and what kinds of specimens to collect for further testing. Also, look for evidence that helps establish the case definition. Do the patients have fever or not? Are they vomiting? Do they have diarrhea? Is the diarrhea explosive, is it frequent, is it bloody, is it watery? All those different clues can point us in the right direction to understand better which pathogen is going on here and what's the potential source of the exposure, and what appropriate control measures need to be taken now.

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Now, this case definition is very specific to salmonellosis. It is the 2005 CDC case definition for salmonella cases. The clinical description is "an illness of variable severity commonly manifested by diarrhea, abdominal pain, nausea, sometimes vomiting. Asymptomatic infections can occur and the organism can cause extraintestinal infection". So the key clinical things there are the common symptoms, but it is also possible to have laboratory evidence (positive laboratory cultures from stool samples, urine samples or blood samples) in a patient who does not have symptoms. If you have these symptoms and a positive culture, or you don't have these symptoms, but you do have a positive culture, all of those would be appropriate cases to report, to investigate, and to do further surveillance around. Laboratory criteria for diagnosis is laboratory isolation of the organism from a clinical specimen. The specimen can be from stool, but could also be from other sites, in other words, urine or blood. Probable cases are clinically compatible, epidemiologically linked cases to confirmed cases, and the confirmed cases either meet the laboratory criteria for diagnosis, or meet both the laboratory and clinical criteria for diagnosis. So, in other words, a person who is a probable case is linked to a confirmed case, has the symptoms, but maybe wasn't tested, for instance. They still might be an important case to report as a probable case of illness.

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When you have an unknown pathogen, one of the most important things to do is try to establish what is the cause of illness. Looking at laboratory evidence is a good way to understand better what the pathogen might be. Were samples taken? If they were taken, what kinds of tests were ordered and what kinds of test results were received? If no samples have yet been taken or if all the tests that have been run so far are negative, what other samples can be obtained? Once again, you can consult with the epidemiologist on call or with your nurse consultant in the Communicable Disease Branch to discuss submitting samples for testing at the state lab, to understand better what kinds of media, transport requirements, or special considerations or concerns that might be appropriate when you are trying to figure out the right tests to do for certain types of situations. Now, some kinds of test cannot actually be run here in North Carolina, and we may need to coordinate with other laboratories. For certain toxin tests, we either have to send samples to the Food and Drug Administration or to the Centers for Disease Control and Prevention in Atlanta, Georgia to have tests run. Botulism, for instance, is not a test that we can run here in North Carolina at the state

lab. If we suspect botulism, we need to coordinate with the lab in Atlanta and get instructions to the physicians on how to submit the appropriate samples for testing. On the other hand, if it is a suspected viral gastroenteritis, that's testing that *can* be done here in North Carolina at the state lab, but there are certain requirements about the number of specimens that need to be submitted in order to get that test run. Checking with the epidemiologist on call or your nurse consultant, is a good way to find out what those considerations are, what the requirements are if there's anything special, and we can help guide you through that process. So please, give us a call.

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Once the case definition has been developed and applied, it is important to determine what control measures need to be applied to break the chain of transmission. How do you limit the spread of this disease? How do you intervene and prevent more cases from occurring? One of the reasons to conduct any investigation is to try and determine the source of exposure and that may require specific types of investigation. It may require restaurant inspections; it may require the collection of food samples for further testing; it may require conducting a case-control or cohort study, some other epidemiology study to generate odds ratios or statistics that better describe the particular source of exposure associated with a particular outbreak to determine the chain of transmission. Sometimes it is not obvious. Sometimes it requires interviewing many cases and also controls (people who are not ill, but had the opportunity to be exposed). In a case-control study for instance, you would take all the people who attended a particular event together, or all the people who ate at a particular restaurant at a particular point in time. And interviewing a large group of people like that and comparing the information learned from both people who did get sick and people who did not get sick, we can calculate odds ratios to demonstrate statistically the differences between the ill and non-ill groups. That clues us in on what exposure or food item may be causing the outbreak. Sometimes the control measures that need to be implemented are actually very obvious, and it doesn't require a great deal of investigation to determine what those may be. Some examples might be restricting the freedom of movement or action of someone with an illness, like excluding a child with diarrhea from attending child care or excluding a food handler from working while they're sick. Those types of control measures can be applied even before you know what the pathogen is. Whether the pathogen is viral, bacterial, parasitic, or whatever, you can determine some appropriate control measures and apply them very early in the investigation.

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Once the control measures have been put in place, that does not mean the investigation stops. There are still other steps that need to be completed before the investigation can be considered closed or the public health response can be considered done. It is important to report all outbreaks and individual cases for diseases with public health importance for which we do surveillance, using appropriate forms. This is important so these cases can be counted and so we have the opportunity to learn more about these pathogens and how to better control them. A brief, written report summarizing any outbreak investigation should be submitted to the Communicable

Disease Branch within 30 days of finishing your investigation. Once the control measures are in place, the chain of transmission has been broken, and rates of disease have returned to normal, writing a brief summary (3-5 pages) that just tells the story, “Here is what happened, this is what affected the people who were the cases, this is what we think caused the outbreak, here are the control measures we put in place, and here is our evidence that the outbreak is over.” That’s basically the information that needs to be in the summary. Submitting the report of the outbreak complies with all the surveillance laws, but it also helps us understand these pathogens better and provides documentation for all the work that local health departments are doing around the state.

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In conclusion, foodborne and diarrheal disease investigations can be high profile events, and they can also be stressful events. The worst outbreaks involve hundreds of case patients and may involve deaths. Responding to these events can be the defining moment of your career or the defining moment for your public health department. These outbreaks can also be the opportunity for your health department to shine. That may sound a little corny, but the truth is, everyday public health departments are engaged in a wide range of activities that are designed to improve the health and welfare of your community. Most of the time those efforts are often invisible. When you have hundreds of people sick or even dozens of people sick and it is in the press, it’s on the radio, it’s on TV, it is on people’s minds, then this becomes an opportunity for the rest of your community to see the work you’re doing in your health department. In the event of a foodborne and diarrheal disease outbreak, we do encourage you to consult early and often with your nurse consultant and the epidemiologist on call at 919-733-3419. We’ll help you be successful in your investigation efforts, help you identify the pathogens, the exposures, and control measures that will make your response to these events in your community the best it can be. Thank you.

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Sources

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Acknowledgements

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Notes on images