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Hi, this is Nicole Lee and Carl Williams and we will provide you with a basic introductory overview about foodborne disease surveillance and control. This presentation will provide you with enough information to get started but you will be required to identify and review additional resources in order to attain a more comprehensive understanding of foodborne disease surveillance.

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Overview

- Objectives
- Resources
- Routine Surveillance
  - Burden of Foodborne Illness
- Outbreak Surveillance
  - Logistics
  - Control measures
  - Key partners

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Objectives

- Know surveillance strategies (and their limitations)
- Describe your role in the surveillance process
- Characterize the enteric disease burden in NC
- Describe key pieces of outbreak investigation
- Know where to find appropriate control measures
- State key partners for outbreak investigation

## Slide 5-Resources

- NC Communicable Disease Manual
  - <http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/toc.html>
- North Carolina Food Code
  - [http://www.ncdhhs.gov/aging/food/NC\\_Food\\_Code\\_Manual\\_2009.pdf](http://www.ncdhhs.gov/aging/food/NC_Food_Code_Manual_2009.pdf)
- APHA Control of Communicable Diseases Manual
- MMWR April 16, 2004 / Vol. 53 / No. RR-4
- Diagnosis and Management of Foodborne Illnesses CDC:  
<http://www.cdc.gov/foodborneburden/>

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Shown here is the current edition of the manual of the American Public Health Association. This manual is adopted by reference as NC law per administrative code 10A NCAC 41A .0201. It contains a great deal of information and can be very helpful in developing control measures for foodborne illness.

The North Carolina food code is our states adoption of the FDA food code and provides very specific guidance for food service establishment, especially as it pertains to employee health and exclusion from work and readmission to work criteria. For issues involving food employees who may have a GI illness or have been diagnosed or exposed to a foodborne pathogen remember to always consult with an environmental health specialist and ensure appropriate measures (per the food code) are being taken.

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Foodborne illness is caused by consuming contaminated foods or beverages and likely represents a failure of the food safety process. This failure may occur at the level of food production, transport, retail sales to consumers, food service industry, or in the home.

Of course there are thousands of cases of foodborne disease reported every year in NC and it may not be possible to thoroughly and fully investigate every case of campylobacteriosis and salmonellosis due to their sheer volume. However it is important to be aware of all of these

cases in your county at any time. Often, especially with salmonella, it will be determined that one or more cases are associated with a nationwide outbreak (usually with only one or two cases in any given state) and we are called upon by the CDC to conduct a thorough and complete interview of the case in order to obtain very specific exposure information.

In contrast, cases of rare events like listeriosis and vibriosis require a thorough and complete investigation immediately. These diseases occur much less frequently yet the consequences of infection can be severe, up to and including death. As a result, any case of listeria or vibrio infection must be investigated immediately to ensure there is no possibility of a widespread contamination.

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Foodborne disease surveillance generally refers to the passive routine monitoring in a population for enteric disease for which a food vehicle may be involved. The actual vehicle is usually not known during the surveillance process, and transmission ultimately could be due to food, water, person to person spread or other vehicles.

This surveillance is based on the national case definition and is pathogen specific. For routine surveillance a laboratory test, primarily a culture result is all that is required to fulfill the case definition criteria. Quantifying cases of foodborne illness in this manner allows us to define the magnitude and burden of disease in the community and facilitates the understanding of the epidemiology of foodborne diseases.

One of the primary functions of foodborne disease surveillance and outbreak investigation is to detect problems in food and water production and delivery systems that might otherwise have gone unnoticed.

Spikes in numbers of cases in certain places and times likely represent an outbreak above the number of cases normally expected. Because these situations are often rapidly evolving public health actively searches for cases that meet the criteria in a specific outbreak case definition.

The outbreak case definition is locally derived and incorporates elements of person place and time that may not regularly be included in the surveillance case definition.

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Food-related disease threats are numerous and varied, involving biological and nonbiological agents. Foodborne illnesses can be caused by microorganisms and their toxins, marine organisms and their toxins, fungi and their related toxins, and chemical contaminants. During

the last 20 years, some foods that have been linked to outbreaks include milk (Campylobacter); shellfish (noroviruses); unpasteurized apple cider (Escherichia coli O157:H7), raw and undercooked eggs (Salmonella); fish (ciguatera poisoning); raspberries (Cyclospora); strawberries (hepatitis A virus); and ready-to-eat meats (Listeria).

Many of these are under surveillance at the state and national level through the national notifiable disease surveillance system.

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Listed here are key conditions that are reportable to the state health department and notifiable to the CDC.

Effective public health surveillance begins at the local- and state-health department levels. You work with a variety of healthcare providers, including laboratories, hospitals, and private providers, to obtain case reports on many infectious and some non-infectious diseases. Each state has laws mandating that providers report cases of certain diseases to state and/or local health departments. These data provide the direction and scope of many state and local health department activities, from detecting individual cases and controlling outbreaks to implementing prevention and intervention activities. State health departments support national public health surveillance by voluntarily sharing a portion of their data with CDC. The data from states are used by CDC to monitor disease trends, assess the effectiveness of prevention and control measures, identify populations or geographic areas at high risk, formulate prevention strategies, develop public health policies, and work with the international community to identify and contain global outbreaks.

It is beyond the scope of this presentation to discuss all the enteric/foodborne communicable diseases. It is also beyond the scope of this presentation to discuss all aspects of these diseases so what we will present to you here is an introduction/overview.

For detailed information the 19th edition of the APHA Control of Communicable Diseases Manual is the single best resource to use. In that manual is a consistent presentation format for each disease that includes information about communicability and control measures.

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CDC's National Notifiable Diseases Surveillance System (NNDSS) is a multifaceted Public Health disease surveillance system that gives public health officials powerful capabilities to monitor the occurrence and spread of diseases. Facets of NNDSS are used by numerous state,

territorial, tribal, and local health departments; and by partner organizations, such as the Council of State and Territorial Epidemiologists (CSTE), to:

- facilitate collecting, managing, analyzing, interpreting, and disseminating health related data for diseases designated as nationally notifiable,
- develop and maintain national standards (for example, consistent case definitions for nationally notifiable diseases) applicable across states,
- maintain the official national notifiable diseases statistics,
- provide detailed data to CDC programs to aid in identifying specific disease trends,
- work with states and partners to implement and assess prevention and control programs, and
- publish summarized data findings from 57 state, territorial, and local reporting jurisdictions weekly and annually in the Morbidity and Mortality Weekly Report (MMWR).

A key component of NNDSS is the National Electronic Disease Surveillance System (NEDSS). NEDSS provides data and information technology (IT) standards, support, and leadership to state, local, and territorial health departments that in turn provide CDC with aggregate data on nationally notifiable diseases and conditions. NEDSS's capabilities are used to:

- support reportable disease surveillance by improving information sharing between healthcare providers and health departments and between states and CDC,
- support Electronic Laboratory Reporting as part of the Meaningful Use initiative to improve public health disease reporting, and
- increase information sharing and system interoperability between state health departments to improve multi-state disease detection and containment.

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The National Notifiable Disease Surveillance System, or NNDSS, tracks contagious diseases that laboratory professionals and doctors are required to report to the state or territorial public health agency. These agencies voluntarily submit the information to NNDSS, which CDC oversees. The general system has been in existence since 1878. Notifiable disease surveillance is "passive" (i.e., the investigator at CDC waits for disease reports from those required to report) and is susceptible to underreporting.

NCEDSS is the North Carolina reporting system that feeds into the national NNDSS.

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According to the CIFOR guidelines population based surveys only approximately 12% of persons with a diarrheal illness sought medical care. Among those who did seek care only 21% were asked by their physician to provide a stool specimen for culture, and 89% of those persons complied with the request.

As a result cases of foodborne illness are lost at each step in the diagnosis and reporting process and are thus not included in state and national statistics. The foodborne illness pyramid visually displays this disparity.

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The data shown here was derived from the TATP Source of Event CD report. As more laboratories come on line and more events are created by ELR submission, underreporting should diminish

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The diagnosis of acute gastroenteritis (AGE) has traditionally been based on culture results of feces from patients with diarrhea. Virtually everything we know about disease and the epidemiology of enteric pathogens, such as Salmonella spp., Shiga toxin-producing Escherichia coli (STEC), e.g., O157, and Campylobacter spp., has been generated from the study of patients with culture-confirmed infections. However, this pattern may be changing because AGE diagnostics are moving away from culture toward rapid nonculture methods. These infections are mainly foodborne and therefore preventable, and it is of paramount importance that public health surveillance for these infections is consistent and reliable.

While these tests are used for many conditions the problem is most keenly felt with regards to STEC (and Salmonella) as it can impact traceback and recall efforts for a serious disease. For clinical purposes, it is generally sufficient to know that an STEC is present because management of an individual case is seldom dependent on additional subtyping. An unfortunate consequence of the increasing use of nonculture diagnostic tests for AGE is that they do not provide isolates for additional testing by public health laboratories. Public health has traditionally relied upon cultured organisms for further characterization, including subtyping for epidemiologic purposes. PFGE, is a test that gives us the DNA fingerprint for various organisms, but an isolate is required. While this test has historically identified the common patterns of infectious agents between cases, this may become limited in the future without available isolates. For this reason, in 2009 the Centers for Disease Control and Prevention published

guidelines for the diagnosis of STEC by clinical laboratories (3). These guidelines recommend simultaneous culture for STEC O157 and for detection of Shiga toxin and forwarding of isolates or Shiga toxin–positive broths to public health laboratories for further characterization.

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As previously mentioned, routine ongoing surveillance allows us to establish ongoing trends and rates of infection so that we may target prevention and control efforts to the most vulnerable populations.

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Data from 2008 to 2012 taken from NCEDSS report "LHD demographic distribution CD" by year. Data from 2003 to 2007 taken from [ncpublichealth.com](http://ncpublichealth.com)

Includes confirmed and probable cases

Increasing numbers of salmonella and campylobacter cases but remember these are numbers, not rates. As the population of NC has increased over the same time period the actual rate of infection may be stable or decreasing.

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Data from 2008 to 2012 taken from "LHD demographic distribution CD" by year. Data from 2003 to 2007 taken from [ncpublichealth.com](http://ncpublichealth.com)

Includes confirmed and probable cases.

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Independent of the population based rate, we can see here that there is a strong seasonal distribution for enteric disease cases, especially salmonella.

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The spike of STEC cases in October reflects both the 2011 and 2012 fair outbreaks. Independent of fair outbreaks you can discern that there is a trend of increasing cases in the summer months.

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IR calculated using 2010 census data for NC from [www.census.gov](http://www.census.gov)

- Includes confirmed and probable cases.
- All three predominantly affect the youngest age groups, but salmonella more so.

#### **Slide 22-**

IR calculated using 2010 census data for NC from [www.census.gov](http://www.census.gov)

- Shiga Toxin Producing E. coli (STEC) is highest among the young.

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Now we'll talk about outbreak surveillance. We'll cover three logistical steps that need to take place, control measures that are to be considered, and the key partners that are imperative to work with during an outbreak.

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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 physician's office, the public, or reviewing a laboratory result, the first questions to ask are whether it is a sporadic case or part of an outbreak? If there is no evidence of an outbreak, consult the Communicable Disease Manual website to make sure whether it is a reportable disease. 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 lab tests appropriate? If seen medically, try to review the clinic notes and for hospitalized patients read the admission and discharge summaries. When interviewing the patient or caregiver for patients who are children, be sure to determine the onset date for first symptoms, collect information about the symptoms and risk or exposure history. Assess the patient to see if other people may 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 ill with vomiting or diarrhea need to be kept out of school or daycare while having symptoms. All the information should be compiled on the appropriate NCEDSS form and filed after entering data in to NCEDSS. The information collected through the data entry wizard is required information that must be entered; additional information may be entered. Please maintain the paper interview form for at least one year, in case the patient is found to be part

of a cluster and we need to review the additional information or ask you to enter it into the record.

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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 their illness can be really helpful in pointing you in the right direction. These can 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 they have a fever, or not? Are they vomiting? Do they have diarrhea? Is the diarrhea explosive, is it frequent, is it bloody, and is it watery? All of these different clues can point us in a direction to understand better what the pathogen is, what the potential source of exposure is, and what are the appropriate control measures that need to be taken now.

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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 may be. Were samples taken? If they were taken, what kinds of tests were ordered and what kinds of 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? You can consult, once again, with the epidemiologist on call with Communicable Disease Branch to discuss submitting samples for testing at the State Lab, understand better what kinds of media, transport requirements, or any special considerations or concerns that might be appropriate when you are trying to get testing done for certain things. For instance, certain kinds of test cannot be run here in North Carolina. For certain kinds of 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. Botulism for instance is not a test that we can run at the State Lab. If we suspect botulism we need to coordinate with the labs 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 is 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 Epi on call is a good way to find out what are those considerations, what are those requirements and if there is a special pathogen that has particular requirements we can help guide you through that process.

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Once a 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, and it may require case-control or cohort studies, epidemiology studies to generate odds ratios to better describe the particular source of exposure that is associated with a particular outbreak or 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 that you suspected might be the source of the outbreak. By interviewing a large group of people and comparing the information learned from both people who got sick and people who did not get sick it is possible to calculate odds ratios to demonstrate statistically the differences between the ill and non-ill groups.

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 any restriction to freedom of movement or action, like excluding a child with diarrhea from child care or excluding a food handler from working while ill. 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 early in the investigation.

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Here is a reminder about the resources mentioned earlier in this presentation. The online communicable disease manual's investigation steps section will help you know the various steps in the process of responding to each of North Carolina's reportable conditions. There is a wealth of additional information there as well, including resources for other types of outbreaks, communicable disease laws, case definitions, etc.

Chapter 2 of the North Carolina Food Code will identify the scenarios that require reporting to a person in charge as well as the length of time required for exclusion.

The American Public Health Association has a communicable disease manual as well that serves as our go to resource for all things communicable disease.

CDC publishes the morbidity and mortality weekly report, also known as MMWR. The article listed here is a great reference for responding to foodborne illnesses

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Here are what the covers of the North Carolina Food Code and the American Public Health Association Communicable Disease Manual look like.

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When we think about what partners need to be involved, we think about the three-legged stool example. This stool cannot support any weight put on it without all three legs being present. In our case the weight we experience is that of an outbreak.

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All three of these legs are needed to support the weight of an outbreak.

The three legs are the laboratory partner who identifies the specific pathogen that may be the cause of the outbreak based on stool samples submitted.

Environmental health is another leg of the stool that assists with processes and investigation of the food establishments.

Epidemiology is a third leg of the stool where we put together the pieces of information from the other legs of the stool in addition to our own characterization of the outbreak. We include here the clinical work of the local health department nurses and support staff who allow us to better characterize the outbreak based on the information they collect.

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We wouldn't be very confident in this stool if one of the legs were missing. In the same way, all three components are important for us to be confident in the outbreak investigation of food and lodging establishments.

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The strength of this stool is in all three legs being in place and used, just as a strong outbreak team consists of laboratory, environmental health, and epidemiology partners.

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Here is the reason why we need these three specific partners:

Laboratory partners identify what specific agent may be causing the outbreak. While someone may have general gastrointestinal illness, it is the result from the laboratory that can verify what agent is the likely cause of those symptoms.

Environmental Health-menu review, invoices, anything different than normal, who was working the day in question, sick employees, employees with exposure opportunities, laboratory results can narrow down where to start the assessment sick employee vs contamination, source, temperature abuse.

Epidemiology partners use the information gathered from laboratory results, environmental health results, and epidemiology information to try to identify a likely source.

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The activities of each partner vary greatly. Some activities occur simultaneously while others rely on the completion of a previous step before it can begin.

For our laboratory partners, testing stool is broad and includes receiving a specimen, trying to grow an isolate, and then doing biochemical tests, subtyping, and PFGE. These steps take time, anywhere from a few hours to a few days, which is why it is important to obtain satisfactory specimens as soon as possible so that these laboratory steps can get underway. This piece of the puzzle is an important one because without an isolate we can't do PFGE and without PFGE we can't really link cases from a laboratory perspective.

For our environmental health partners, assessing the food facilities processes and employees are critical steps in foodborne outbreak investigations. Environmental health specialists are not serving as regulators during an outbreak, but as partners and consultants to try to identify possible sources of infection and transmission. They don't go into a facility with a pre-filled form at this point, but with a blank page instead that they can use to record the circumstances and processes occurring in a food establishment that could contribute to a foodborne disease outbreak.

Epidemiology partners are actively involved in every step of the process because the activities of all involved are coordinated by epidemiology. In order to characterize the outbreak in terms of symptoms, duration of illness, and exposures, interviews have to be completed and specimens collected. The activities of epidemiology require clear communication and delegation of activities in order to manage an outbreak and recognize the appropriate control measures.

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All three of the groups are partners who are all working towards one common goal of stopping the outbreak and preventing future outbreaks. The activities of these three groups are very different but the purpose of their efforts are all towards the same cause.

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Let's review our objectives and make sure that we've reached them.

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Foodborne surveillance relies on the reporting of illnesses from laboratories, physicians, and the community as well. This reliance on this type of reporting means that not all reports may reach the health department. This under-reporting is recognized and perhaps electronic laboratory reporting will improve reporting.

Your role in surveillance includes completion of the NCEDSS forms for individual reports of illness caused by reportable conditions that are part of routine surveillance.

Can you characterize the enteric disease burden in North Carolina? Know that Salmonella is the condition that is reported most often and is usually seen most often during the summer. Cryptosporidium is next in line followed by STEC, Campylobacter, Shigella, and Listeria.

The key pieces of an outbreak investigation include: identifying if the condition is reportable and verifying the diagnosis, collecting clinical information, obtaining laboratory evidence, and implementing control measures.

We hope that this information is helpful to you. Good luck in your outbreak investigations and remember that in addition to your book and online resources, you TATP nurse consultant as well as the on call epidemiologist are available to assist. The on call number is 919-733-3419.

Thank you!