Module Objectives

By the end of this module, participants will be able to describe the various methods used to detect foodborne illness and determine if a response action is necessary.

- Identify the various surveillance systems available to detect foodborne illness.
- Compare and contrast pathogen-specific surveillance and complaint-based surveillance to detect foodborne illness.
- Identify initial outbreak response activities.

Performance Objectives

By the end of this module, participants will be able to describe the various methods used to detect foodborne illness and determine if a response action is necessary.
Enabling Learning Objectives
By the end of this module, the instructor shall accomplish the following learning objectives in support of the performance objective:

- Identify the various surveillance systems available to detect foodborne illness.
- Compare and contrast pathogen-specific surveillance and complaint-based surveillance to detect foodborne illness.
- Identify initial outbreak response activities.

Surveillance

Public health surveillance is a system that acquires, organizes, and interprets data for action to prevent and control disease in the population.
An effective disease surveillance system will have the following characteristics:

- **Acceptable.** The surveillance system will employ various approaches to capture data.
- **Positive predictive value.** This is the value of the system to identify illness when it is actually present.
- **Sensitive.** This is a measure of the surveillance system’s ability to detect disease as it is intended.
- **Simple.** This is a measure of the system’s ease of use.
- **Timely.** The ability of the system to acquire data rapidly enough to take action to prevent additional disease.

Foodborne illness surveillance is a part of a much larger public health surveillance system. Most foodborne outbreak response investigators involved with surveillance will receive reports of illness through a multitude of systems. These systems will be discussed throughout this module. The investigator must first interpret the information for its validity as true illness (positive predictive value) and then go through a process to classify the illness as foodborne. Many enteric diseases will be investigated in a similar fashion and it is only through the investigation process that a food vehicle may be recognized as the causative factor of illness.
Methods of surveillance may be passive or active. Active surveillance generally requires a high level of time and energy as investigators seek out disease in the community. Active surveillance may be activities looking for a sentinel event that may have an impact on the community or may be activities to find the incidence of disease in a community on an ongoing basis. Active methods of surveillance usually are timely and may provide a rather complete set of data at the case level of reporting. That is, active methods of surveillance provide information about the existence of disease at the case (person) level or the possibility of disease (sentinel events) very soon after it is recognized. Active methods of surveillance are not always an acceptable method of surveillance as they take valuable resources that may be expended on other valuable public health activities.

Many of our public health surveillance systems are passive in nature. As the name implies, investigators passively wait to acquire data. Methods of this nature may not provide data in a timely manner but are generally more acceptable as it does not take the same level of resource
expenditure as active methods. Some passive methods of surveillance can be enhanced by establishing strong, positive relationships with reporting entities so that they understand the importance of timely reporting.

**Types of Surveillance**

<table>
<thead>
<tr>
<th>Pathogen-specific (Laboratory)</th>
<th>Complaint-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentinel</td>
<td>Syndromic</td>
</tr>
</tbody>
</table>

Surveillance can be broken down into four categories: Pathogen-specific or laboratory surveillance; complaint-based surveillance, sentinel surveillance, and syndromic surveillance. **Pathogen-specific is the surveillance of actual illness. Complaint-based is the surveillance of complaints of illness. Syndromic is the surveillance of syndromes of illness and sentinel is the surveillance of a population to something related to disease in a greater population.** Each system is important but none are effective alone. Each type of surveillance may identify disease but the other types may also identify disease or verify the presence of disease. The surveillance system becomes more effective as each type of surveillance is optimized. Pathogen-specific and complaint-based surveillance will be covered generally in this section and more thoroughly in the discipline-specific sections.

Pathogen-specific surveillance has positive predictive value and may, or may not, be sensitive. Sensitivity of this type of surveillance is directly related to pathogenicity. Reporting of disease when disease is present will be greater when illness is more severe. This relationship will become more clear by understanding the burden of illness pyramid. This type of surveillance is oftentimes passive in nature and it may not always provide timely data. Pathogen-specific surveillance, such as the National Notifiable Disease Surveillance System (NNDSS), requires that certain diseases identified through laboratory analysis or healthcare provider recognition are reported to local or state public health systems. That is, if a disease agent is either highly pathogenic or highly virulent, or both, the reporting times are short. Reporting timeliness requirements run through the entire system (provider to local public health to state public health to the CDC).
The burden of illness pyramid is a graphical representation of how reportable disease case counts is lost through the surveillance and reporting system. On the very bottom of the pyramid is exposures in the population. Exposures to the population is 100%. Not all persons exposed, or presumed to be exposed, will become ill. Not all persons that become ill will seek care and if the medical care provider does not obtain a specimen the population becomes even smaller. Not all specimens will be tested for the correct organism or be suitable for analysis and not all laboratory-conformed cases will be reported through the local public health system to the CDC. It is hypothesized that for every 100% of exposures only 2% are reported to the top of the pyramid. As mentioned previously, the number of cases of illness that goes unreported for every diagnosed case reported through the public health system is generally dependent upon the severity of disease associated with a pathogen. According to Scallan et al in an article published in Emerging Infectious Disease (2011), the following list compares unreported cases for every diagnosed case for select pathogens:

The burden of illness pyramid is a graphical way to describe how unreported illness happens with our health care system. Instructors should ask participants how cases are lost to reporting as they move up the pyramid. Be sure to mention some of the ratios of diagnosed cases reported to those not reported. Ask participants what they would guess the ratio of reported cases versus cases unreported for norovirus and allow time for discussion.
• *Salmonella*: 29 cases unreported for every diagnosed case
• *E. coli* O157:H7: 26 cases unreported for every diagnosed case
• *Listeria monocytogenes*: Two cases unreported for every diagnosed case
• *Campylobacter*: 30 cases unreported for every diagnosed case
• *Vibrio*: 142 cases unreported for every diagnosed case

It is suspected that for every case of Listeriosis reported, 2 go unreported. This can be compared to Salmonellosis where for every case reported, 29 go unreported. The difference in picking up reported disease is likely due to severity of illness, especially when hospitalization occurs.

The type of surveillance with the greatest variability throughout the United States foodborne outbreak response system is complaint-based surveillance. This system is predicated on surveillance of complaints of illness – not of actual illness. Surveillance of this nature may not be very sensitive or have a positive predictive value but can be very timely. Data acquired generally needs considerable organizing, interpretation and follow-up to be meaningful. Acceptability of these systems also varies due to the somewhat spurious data mixed in with the high-quality data making review and cluster detection burdensome on the foodborne illness investigator. To compound the challenge, some jurisdictions require immediate field visits to any food establishment named in a complaint. Lack of coordination with the other disciplines and premature investigations may lead to the loss of quality information in advance of a coordinated foodborne outbreak response.

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**Syndromic Surveillance**

- Surveillance of health-related data prior to diagnosis
- Clinical or non-clinical
- Used continuously or for special events
- National Syndromic Surveillance Program
Syndromic surveillance applies to surveillance using health-related data that precede diagnosis and signal a sufficient probability of a case or an outbreak to warrant further public health response (CDC).

Syndromic surveillance is a type of surveillance where disease is considered for investigation based upon the syndromes of disease. Since this type of surveillance is not focused on disease it is not very sensitive and has a low positive predictive value. The value of a syndromic surveillance is that it may be an early indicator of disease and was an important component of CDC’s strategic plan of biological and chemical preparedness. Syndromic surveillance may be clinical and non-clinical and may be used continuously or it may be focused on a single event such as the Olympics.

Since 2003, the CDC, in partnership with several associations (ASTHO, CSTE, NACCHO), established an integrated national public health surveillance system for early detection and rapid assessment of bioterrorism-related events. By using cloud-based BioSense Platform, users are able to rapidly collect, evaluate, share, and store syndromic surveillance data.
Sentinel surveillance is an active surveillance system that involves a selected group of “reporters” such as laboratories, healthcare providers, or other entities that can provide high-quality data. These reporters are contacted on a routine and scheduled basis to provide information. This data can be specific to at-risk populations or can be used to make inferences regarding the general population. Although not foodborne illness related, public health agencies enlist healthcare providers to report influenza like illness (ILI) early into the influenza season and conduct laboratory analysis so that information is gathered to prepare for the season.

FoodNet, the Foodborne Diseases Active Surveillance Network, has been tracking trends of illness transmitted commonly through food since 1996. FoodNet estimates the number of foodborne illnesses, monitors trends in incidence of specific foodborne illnesses over time, and attributes illnesses to specific foods and settings. This CDC collaborative program includes 7 states, selected counties in 3 other states, as well as the FDA and USDA-FSIS and includes 15% of the US population. The states participating in FoodNet are California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee.

Discipline-specific Surveillance
Each of the core foodborne outbreak response disciplines maintain surveillance systems. This following section will detail the various systems employed to identify foodborne illness.
Laboratory Surveillance Systems

### Instructional Note
Remind participants of the characteristics of effective surveillance and that sensitivity is the measure of the surveillance systems ability to detect disease as intended and positive predictive value is the value of the system to identify illness when it is actually present. Simple and timely should need no explanation.

Laboratory Surveillance Systems

- Pathogen-specific in nature
- High quality data
- Very sensitive and has a positive predictive value
- Not always procedurally simple or timely

Laboratory-based surveillance provides high quality information that identifies foodborne illness pathogens and their characteristics. Laboratory-based surveillance systems are extremely sensitive and have a high positive predictive value. This surveillance is not always simple or timely as demonstrated by the following example of a *Salmonella* foodborne illness being identified as part of a larger cluster by the PulseNet surveillance system.
Laboratory surveillance systems not only serve to detect disease, but they also serve as a primary response method to link additional cases of human illness to the original cluster of disease and to link a food or environmental surface sample to human illness. In much of the United States, it is also the most integrated of all surveillance as local, state and federal level laboratories work closely together to identify foodborne illness pathogens.
The four primary laboratory surveillance systems are PulseNet, CaliciNet, CryptoNet and the NARMS. These systems are coordinated by the CDC and the other federal partners but fully dependent upon the local public health systems to gather data (specimens) and push the information up to the state public health systems for further analysis.

Instructional Note
Slide 4-12 introduces the four main laboratory surveillance systems. Mention the four systems. Mention that these systems are coordinated by the CDC but are fully dependent upon local and state public health partners to operate optimally. It is important that participants understand that these systems not only detect disease but serve as an important reservoir of information regarding the epidemiology of disease caused by the organisms being surveilled. This information can be valuable during response activities.
PulseNet is a laboratory network that connects foodborne illness caused by bacteria. PulseNet started in 1996 and has improved our food safety system by detecting outbreaks early through cluster detection. PulseNet is made up of 83 public health and food regulatory laboratories. The PulseNet system may be referred to as molecular epidemiology and its output is often called DNA analysis as the methods employed by PulseNet can identify bacterial strains to the subtype level. This creates the ability to discern very slight differences within a bacterial genome making them distinguishable from other bacterial strains. In this fashion, laboratorians can link indistinguishable, or nearly indistinguishable, pathogens to each other and identify clusters of illness associated with each other, allowing PulseNet to detect multistate outbreaks of foodborne illness. PulseNet detects subtypes of *E. coli* (O157 and other Shiga toxin-producing *E. coli*), *Campylobacter, Listeria monocytogenes, Salmonella, Shigella, Vibrio cholerae, Vibrio parahaemolyticus*, and *Cronobacter* isolates. An important aspect of PulseNet is the partnership with the federal food regulatory partners – the FDA and USDA-FSIS. Federal regulatory partners are able to identify the bacterial subtypes that contaminate food, providing a valuable link to the causative agents of disease in humans.

Methodologies used by PulseNet are discussed in depth in the upcoming laboratory response module, but an important characteristic of this surveillance system is that bacterial isolates from culture-dependent methods are necessary to conduct laboratory analysis with the PulseNet system.

Since its inception, PulseNet has accomplished the following (Scharff et al 2016):

- **1 billion** pounds of contaminated food recalled since PulseNet was launched
- **$507 million** saved each year (medical costs and lost productivity) with quick outbreak detection
- **1 million** DNA fingerprints of foodborne bacteria in the PulseNet USA database
• **89,000** DNA fingerprints of bacteria submitted to PulseNet in 2015 – a record number

• **1,500** clusters of illness from *Salmonella*, *E. coli*, and *Listeria* infections annually identified by PulseNet member labs

• **280** multistate clusters of illness caused by *Salmonella*, *E. coli*, and *Listeria* infections identified by PulseNet each year

• **40** clusters of human illnesses tracked weekly

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**CaliciNet**

- Norovirus surveillance network
- Started in 2009
- Outbreak surveillance of norovirus at genetic level
- Monitors circulating norovirus strains
- 50% more norovirus illness in years when there is a new strain of the virus circulating

CaliciNet is a **norovirus outbreak surveillance network of local, state and federal public health laboratories**. Launched in 2009, this network collects data on norovirus outbreaks, monitors circulating strains, and identifies newly-emerging norovirus strains. The importance of CaliciNet lies in the fact that 58% of all annual foodborne illness is caused by norovirus. **In years when there is a new circulating strain, up to 50% more norovirus illness can be expected.**

As of 2016, 33 laboratories in 28 states and the District of Columbia participate in CaliciNet. CaliciNet utilizes culture-independent laboratory methods to isolate the pathogen and perform genomic sequencing to identify subtypes of norovirus.
In 2010, the CDC launched CryptoNet. This network tracks the genus *Cryptosporidium*, an enteric parasite noted for the largest waterborne outbreak in the United States in 1993. An estimated 750,000 cases of Cryptosporidiosis occur in the United States annually. Twenty-five years ago, Cryptosporidiosis was thought to be caused by a single species. Molecular analysis has revealed that there are 30 species of *Cryptosporidium* and multiple subtypes of *C. hominis* and *C. parvum*, the species that causes the predominance of disease in humans. All identified species and subtypes are morphologically indistinguishable by traditional clinical laboratory analysis. CryptoNet facilitates the real-time sharing of molecular epidemiologic information, leading to a more rapid response and a better understanding of the transmission characteristics of each of the identified parasitic microorganisms. CryptoNet utilizes culture-independent laboratory methods to isolate pathogen and perform genomic sequencing to identify species and subtypes of *Cryptosporidium*. 
The National Antimicrobial Resistance Monitoring System for Enteric Bacteria (NARMS) was established in 1996 at 14 sites and became nationwide in 2003, the NARMS is a collaborative effort of the CDC, FDA, USDA and state and local health department. The NARMS is a “national public health surveillance system tracks changes in the antimicrobial susceptibility of certain enteric (intestinal) bacteria found in ill people (CDC), retail meats (FDA), and food animals (USDA) in the United States” (CDC). This system tracks bacterial resistance and provides information about emerging bacterial resistance, the methods of spread of resistance, and how an infection caused by resistant bacteria differs from bacteria susceptible to antimicrobics. The NARMS provides information and recommendations regarding the judicious use of antimicrobial agents in the healthcare setting as well as in animals. The CDC NARMS routinely test for susceptibility to 18 antimicrobial agents in Salmonella, Shigella, E. coli, Campylobacter, and certain Vibrio species.
Epidemiologic surveillance systems are case-based and predominately pathogen-specific in nature. Surveillance of this nature is passive and requires information about illness to be provided to the epidemiologic investigator. Two primary sources of information are **clinical laboratory reports** and **medical care provider notification**. Clinical laboratory reporting has the highest sensitivity and positive predictive value. Medical care provider notification may be the result of laboratory testing or notification based upon syndromes of disease that may, or may not, be foodborne in nature. Sensitivity and positive predictive value may decrease significantly with medical care provider notification and challenge the epidemiologic investigator to find the source of illness.

The public health system of the United States is predicated on disease reporting and is a statutory requirement of state and local public health systems (CIFOR Law Project, 2013). These systems of disease reporting at state and local public health were established well over 100 years ago, in advance of the US Public Health service requirement to report (1928) and well before the CDC (originally the Communicable Disease Center) was established in 1942. In an effort to coordinate and standardize disease surveillance throughout the United States, a national notifiable disease system was established in 1951 by the Conference of State and Territorial Epidemiologist, now known as Council of State and Territorial Epidemiologists (CSTE). In 1961, the CDC assumed the responsibility of collecting and disseminating data regarding notifiable disease with the establishment on the Morbidity and Mortality Weekly Report (MMWR). The system is now known as the National Notifiable Disease Surveillance System (NNDSS) and, in coordination with the CSTE, maintains a list of nationally-reportable infectious and noninfectious diseases required to be reported to the CDC.
The NNDSS drives surveillance activities throughout the public health system. The CDC maintains a list of reportable “conditions”. In 2018, NNDSS numbered over 125 infectious disease conditions, 7 noninfectious conditions, and 2 outbreak conditions. The 31 major pathogens causing foodborne disease are listed in the NNDSS. The outbreak conditions listed are foodborne and waterborne disease outbreaks.

State public health systems will have regulatory requirements to report disease in a timely manner. Generally, these requirements are imposed upon the medical care system to report to their local public health or state public health entity and local public health to report to the state public health system. Time to report is based on the severity of illness although the system is passive. Based upon the passive nature of the system and the reluctance of taking legal action on surveillance partners, reporting delays are common. The system was not established to pick up clusters of illness as the system is based upon individual reporting of illness at the local and state level and oftentimes laboratory reporting associated with NNDSS type surveillance only provides the presence of the disease-causing agent. Epidemiologic laboratory investigation is necessary to establish if disease is part of a cluster.
Foodborne Illness Complaint Surveillance

- Based on complaints of illness
- Coordination and follow-up enhances the system
- Need for uniform practice of investigation across jurisdictions

Instructional Note

When reviewing the material on slide 4-19, mention the Minnesota system and their practices of follow-up of complaints. Between 2000 and 2012, 74% of foodborne outbreaks were detected state-based system using university students and health department staff to interview complainants. This outbreak detection of foodborne illness includes a 94% detection rate of toxin-mediated and norovirus outbreaks – illness that is non-reportable as a single, isolated illness.

A public health surveillance system often associated with the environmental health discipline is complaint-based surveillance. As mentioned previously, this system is the surveillance of complaints of illness. There is no nationally-recognized platform for the reporting of complaints of illness and the systems may be different from jurisdiction to jurisdiction. There also may be no regulatory standard for the intake and response to complaints. Properly constructed and coordinated between the disciplines, it can be a powerful tool for the identification of foodborne illness. The power of the surveillance system to detect foodborne illness when it is actually present (positive predictive value) is a function of the effort placed on the system.

It is estimated that 81% of local health departments have some form of complaint-based surveillance system (Li et al. 2010). The likelihood that a jurisdiction maintains a system is
based on the population served. 91% of jurisdictions with populations of over 1,000,000 maintain a complaint system as compared to a low of 76% for local health departments with a population of 50,000 or less. Where local complaint-based systems were not in place the majority (64%) of these local jurisdictions were covered by a state-level system. The presence of a complaint-based surveillance system is not predictive of the ability to detect disease outbreaks. These systems can be greatly enhanced by the use of electronic databases to better review incoming data, sharing information across small jurisdictions, and applying uniform practices of investigation (Li et al. 2010).

By the application of the system enhancements mentioned above, Minnesota (a largely centralized system) has demonstrated the effectiveness of complaint-based systems for detecting outbreaks. Through an electronic complaint database and a cadre of interviewers, Minnesota’s complaint system identified 74% of all foodborne outbreaks identified for the 2000 – 2012 reporting period (Minnesota COE). During that same reporting period, 94% of all outbreaks were detected that involved toxin-mediated foodborne illness and foodborne illness caused by norovirus.

The use of electronic and social media has become more popular as an enhancement to foodborne illness complaint surveillance. **Foodborne Chicago is a website that connects people that complain on Twitter about foodborne illness** to the Chicago Department of Public Health. **I Got Sick – Utah is a web-based reporting system.** The system allows the submittal of general illness information and a 5-day food history. **New York City Health initiated a program that scans Yelp reviews for key words associated with foodborne illness.** The system was jointly created with Columbia University’s Department of Computer Science and from 2012 to the beginning of 2018, the system has identified and investigated approximately 28,000 complaints of foodborne illness and 10 outbreaks were identified solely through this system.
Gathering Information Through the Interview Process

The interview is the primary tool to gather information from complainants and case-patients regarding possible exposures, leading to the identification of the source of foodborne illness. Interview tools can vary from a general approach utilizing a food history interview tool with complaint investigations to a more detailed, pathogen-specific approach when a pathogen has been identified through laboratory methods.

The information gathered from surveillance may guide the interview process and prior to undertaking any interviews, the outbreak investigation team should meet and, utilizing all information known, develop the interview tool and standardize the approach to the interview process. Early on in the investigation process, the interviewing of case-patients and complainants may lead to the high risk individuals who may spread illness to others. High-risk individuals include food workers, day care workers, and health care providers. Once these high-risk individuals are identified, proper control measures can be taken immediately to mitigate the threat of disease transmission associated with the interviewed individual. These interviews are also an important component of the hypothesis generation process, a process that will be discussed in Module 6.

FoodCORE has developed a model practice for initial case-patient interviewing. The practice can be accessed at: https://www.cdc.gov/foodcore/pdfs/initial-case-patient-interviewing.pdf and provides for important information (elements) to be included in the interview. These elements include:

- Demographics
- Clinical History
- Travel
- Risks to others
- Local Cluster/Events, Finding Additional Cases
- Food Sources/Diet Information
- Other Exposures (animal, water, environmental, etc.)

Whether a pathogen has been identified or not, these elements must always be included in the interview tool.
As you prepare for the interview, some rules should be followed to keep interviews standardized. Practice the interview with the investigation team. This will alleviate any mispronunciations and assure everyone understands how to fill out the form. Find a quiet place to conduct the interview. Noise from the work setting will be distractive for the person being interviewed and impact the interviewer’s ability to hear responses. Ensure that the person being interviewed understands that the information provided will remain confidential. Keep the interview to the questions on the interview. Redirect the interviewee when they stray from the questions and avoid making judgmental comment as they may inhibit the free exchange of information requested. Probe for additional information when answers are vague. Associating events with food consumption or using a calendar to prompt recall. Don’t give medical or legal advice, even when requested. Accurately record what the interviewee says as it may lead to additional information.

Translation services may be necessary. In some jurisdictions this may be a significant challenge. As mentioned in module 2, identifying team members such as translation services should be an activity conducted well in advance of the outbreak response.
Always thank the person being interviewed. **Remind them of the importance of their information** and that if circumstances change they may need to provide additional information. This is an opportunity to get additional contact information from the complainant or case-patient.

**Activity**

This table group exercise will demonstrate how to conduct an interview using a food history form. Choose a person to be interviewed and an interviewer. The remaining members of the table group will be evaluators.

This activity should take 15 minutes. Instructors will be available to assist as necessary.

**Instructional Note**

A five-day food history form should be provided to each table group or identified activity group. In each group, a person should be the interviewer and the person to be interviewed. The remainder of the group will be evaluators of the process. The next slide will be a whole-class discussion on the activity.
The following activity will involve the review of a foodborne illness complaint log to determine what approach you would take on the list of complaints on page 4-20 received at the Health Department. Things to consider would be if a field visit should be conducted immediately or if a follow-up phone call is needed. Explain your intended activity based on the information provided.
and name a suspected pathogen if the information drives you to consider one. Work in your table groups and record your thoughts below.

<table>
<thead>
<tr>
<th>Date</th>
<th>Type of Complaint</th>
<th>Date of Illness onset</th>
<th>Number ill in party</th>
<th>Symptoms</th>
<th>Suspected Source</th>
<th>Place/date of meal consumed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/13/18</td>
<td>Illness</td>
<td>2/11/18</td>
<td>1</td>
<td>nausea vomiting</td>
<td>Ham Sandwich</td>
<td>2/11/18</td>
<td>starting to feel better</td>
</tr>
<tr>
<td>2/13/18</td>
<td>illness</td>
<td>2/12/18</td>
<td>8</td>
<td>nausea vomiting diarrhea</td>
<td>wedding buffet</td>
<td>Buffet on 6th 2/10/18</td>
<td>Most of the party is sick now</td>
</tr>
<tr>
<td>2/13/18</td>
<td>Unsanitary conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Joe's Beer Barn need cleaned</td>
</tr>
<tr>
<td>2/14/18</td>
<td>illness</td>
<td>2/13/18</td>
<td>1</td>
<td>double vision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/14/18</td>
<td>illness</td>
<td>2/13/18</td>
<td>2</td>
<td>bloody diarrhea</td>
<td>chicken</td>
<td>That BBQ Place South of Town 2/9/18</td>
<td>spouse not sick</td>
</tr>
<tr>
<td>2/14/18</td>
<td>illness</td>
<td>2/13/18</td>
<td>3</td>
<td>nausea vomiting diarrhea</td>
<td>all you can eat night</td>
<td>Buffet on 6th 2/11/18</td>
<td></td>
</tr>
<tr>
<td>2/15/18</td>
<td>illness</td>
<td>2/14/18</td>
<td>1</td>
<td>vomiting</td>
<td>no recall</td>
<td>no recall</td>
<td></td>
</tr>
<tr>
<td>2/15/18</td>
<td>illness</td>
<td>2/13/18</td>
<td>4</td>
<td>diarrhea fever chills</td>
<td>oysters</td>
<td>House of Seafood 2/12/18</td>
<td></td>
</tr>
<tr>
<td>2/16/18</td>
<td>illness</td>
<td>2/14/18</td>
<td>1</td>
<td>bloody diarrhea</td>
<td>cobb salad</td>
<td>That BBQ Place South of Town 2/9/18</td>
<td></td>
</tr>
<tr>
<td>2/17/18</td>
<td>illness</td>
<td>2/16/18</td>
<td>2</td>
<td>facial flushing mouth burns</td>
<td>sushi</td>
<td>House of Seafood 2/15/18</td>
<td>called in by Dr. J. at ED</td>
</tr>
<tr>
<td>2/17/18</td>
<td>unsanitary conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Joe's Beer Barn no glove use</td>
</tr>
<tr>
<td>2/18/18</td>
<td>illness</td>
<td>2/17/18</td>
<td>1</td>
<td>diarrhea</td>
<td>hamburger</td>
<td>Joe's Beer Barn 2/17/18</td>
<td></td>
</tr>
</tbody>
</table>
Moving to Response – Cluster Detection

As surveillance activities move toward initial response, all investigators must ask themselves and their response teams: **what do you know? what don’t you know? and what are the next steps to start to gain the information necessary to determine if you are investigating a cluster?**

Surveillance identifies illness or the conditions of illness. Through routine follow-up of surveillance activities, associations between cases may be recognized, resulting in the identification of a cluster of disease and warrant investigation. Pathogen or case-specific
information may need to be compared with complaint information to identify clusters. Both routes of obtaining information have strengths and weaknesses.

Cluster detection with pathogen specific surveillance information generally provides strong information regarding the agent of disease and the case. Laboratory investigators may identify a pathogen within a few hours to a few days of stool submittal but it may take weeks to identify the pathogen as part of a cluster where others are sick from apparently the same source. Recall that PulseNet is a cluster detection method employing DNA analysis, also known as advanced molecular detection (AMD) by the use of whole genome sequencing. These analyses take time as you may recall from slide 4-11.

The next channel of information is reporting by the healthcare provider or the laboratory that a person is ill with a pathogen identified through culture-independent laboratory diagnostic testing (CIDT). The epidemiologic investigator now has a pathogen but does not have the information necessary to link the case to other cases by DNA analysis. There is no evidence at this point that a cluster of illness has occurred without an epidemiologic investigation to link the person to other cases with temporal and geographic similarities or further laboratory analysis. CIDT-identified illness may be lost for cluster detection if there is no process in place to provide a specimen to culture, providing an isolate for DNA analysis. The epidemiologic investigator should reinforce the need to submit specimens to the public health lab for further laboratory analysis. CIDT laboratory results will generally prompt investigation with pathogen-specific questionnaires seeking to build association with other cases.
Complaint-based Cluster Identification

- Good record keeping and prompt response necessary
- Good for the identification of:
  - Illness with short incubation periods
  - Illness isolated to a single jurisdiction – usually a single event
- Recall bias – last meal bias
- Focus on food histories and geographic information
- Provider notification without laboratory identification handled as a complaint

Complaint-based surveillance can be an effective method of identifying clusters where incubation periods are short or when illness is localized to a single jurisdiction, usually a single event. The investigator must keep good records of complaints and be willing to follow-up in a timely manner. The challenges associated with the initial investigation are due to complainants’ lack of recall if long periods of time pass before interview and the biases of the complainant usually associating their illness to the last meal consumed. Initial questionnaires are general in nature, focusing on food histories that are reflective of the symptom(s) provided by the complainant.

During the initial stages of an investigation, information must be exchanged with response team partners. Associated cases may have been identified through other surveillance activities and it is only through this sharing process that cases may be linked. Additionally, complainants must be encouraged – compelled! - to provide stool specimens for testing whenever possible.

Reporting of disease to the epidemiologic investigator by the healthcare provider should be handled as a complaint. The epidemiologic investigator may be provided information from a healthcare provider of a case of illness believed to be associated with an enteric pathogen thought to be foodborne in nature. This diagnosis may be the result of an association with another case, considered epi-linked, or it may be purely presumptive by the healthcare provider based upon information provided by the case-patient.
Summary

- Identified the various surveillance systems available to detect foodborne illness
- Compared and contrasted pathogen-specific surveillance and complaint-based surveillance to detect foodborne illness
- Identified initial outbreak response activities

Coming Up Next

- Laboratory Investigation