Slide 1: Slide 1

Welcome to Week 4, entitled “Outbreak Investigation, Part I”. This week there are 2 lectures. In lecture I, we will cover the steps in an outbreak investigation, as well as the difference in steps between a hospital outbreak and a community outbreak investigation.

Slide 2: Why Investigate Outbreaks?

If you remember from the first week of class, one of the most important reasons for doing surveillance is to detect an outbreak. Why investigate an outbreak should it happen? The first, foremost, and primary reason to investigate an outbreak is to control or prevent further transmission. There are other reasons to investigate an outbreak as well. One is because it might cause severe illness and risk to others. Another is that it is an excellent research opportunity to investigate an outbreak, particularly if it is a disease that’s new. Imagine the first people investigating the clusters of HIV disease when it emerged or when there is an outbreak with a new resistant organism. It is also a good opportunity for training, either for students or new employees. We had an outbreak of MRSA in our burn unit in California. We had the opportunity to invite U.C. Berkeley’s Epidemiology Director and some students in to conduct a case control study. They got to do research, they got to write it up, they helped us and the students got some hands on training. In terms of program considerations, it may be that your facility has a certain number of outbreaks that you can expect in a year and that should guide the staffing, the funding, or other policies issues that go along with that for planning your infection control program resources. Thus, outbreak investigations may affect the size of your program. Then there are always public, political, or legal concerns. A legal concern might be, for example, that yours is the premiere cardiac surgery hospital in the state and you have an outbreak related to a contaminated implant. There are certainly going to be legal issues with patients who got that implant. It can be a public reason, for example, you have the hospital that serves the underserved populations and you have an outbreak that is affecting their care. It can be someone using the existence of an outbreak in their political campaign. This is not a GOOD reason to investigate an outbreak but it is one that happens. All these reasons are why you want to investigate an outbreak, but the primary reason is prevention and control.
Slide 3: What’s Different with Healthcare Facility Outbreaks?

What is different between an outbreak in the hospital or healthcare facility versus an outbreak in the community or a statewide outbreak of a food borne illness? As we discussed last week, the hospital or healthcare settings have a large number of susceptible hosts, whose immune system is compromised. Their first line of defense, the skin, has been invaded by devices such as intravenous lines and catheters. In a healthcare setting, one particular disease or one particular organism may require immediate action. For example, a new resistant organism appearing in a patient or a case of varicella (chickenpox) breaking out in a hospitalized patient, requires immediate investigation and control measures. Also as we learned last week, patients, employees and visitors are involved which is a very complicated situation. All of this leads to the fact that you often need the first step in the outbreak investigation in a hospital situation to be verification of the diagnosis. There might be post-exposure prophylaxis at a large expense, there might be isolation of patients or work restrictions for employees. Before you start doing those actions, you want to make sure you have verified the diagnosis. This is different than what might happen if faced with a community outbreak, working up a foodborne illness outbreak for example, it is not as costly as giving medication or trying to follow people or finding out what nurses took care of what people or patients, and you might not have the ability to obtain a diagnosis. These are the things that make a hospital or healthcare facility outbreak different.

Slide 4: Traditional Outbreak Investigation: 10 Steps

The traditional ten steps in a regular outbreak investigation are the ones listed on this slide. The first is: Prepare for field investigation. Let’s say your community is experiencing an outbreak of an illness and the Health Department needs help. So they request the assistance of an Epidemic Intelligence Service Officer from the Centers for Disease Control & Prevention (CDC). That person will put together a kit, with their supplies, policies and procedures, and guide book. They do this to prepare for the field investigation they will be conducting when they arrive at the location of the outbreak. That is pretty much the only different step when comparing a hospital outbreak to a regular outbreak. After that, the steps are the same.

Even though you may find different numbers or order of steps on the internet, please use the steps on this and the next slide for this course.
Slide 5: Healthcare Facility Outbreak Investigation: The Steps

The traditional ten steps in a regular outbreak investigation are the ones listed on this slide. The first is: Prepare for field investigation. So let’s say your community is experiencing an outbreak of an illness and the Health Department needs help. So they request the assistance of an Epidemic Intelligence Service Officer from the Centers for Disease Control & Prevention (CDC). That person will put together a kit, with their supplies, policies and procedures, and guide book. They do this to prepare for the field investigation they will be conducting when they arrive at the location of the outbreak. They will look for what they think they are in for and will print materials on that before they get to the place that they are going to work. That is pretty much the only different step when comparing a hospital outbreak to a regular outbreak. After that, the steps are the same. By the time you review this material, you should have read the Required Readings for this week.

Slide 6: 1. Establish the Existence of an Outbreak

Let’s go through these steps. If the first step is to establish the existence of an outbreak you have to be very careful and ask these questions to make sure you don’t have something else going on. You could very well have the worst case scenario, which is a true outbreak of a disease or organism that has a common cause. Let’s use an example of a resistant Pseudomonas organism in the whirlpool system in the burn unit that is causing infections in many of the patients (a true outbreak with a common cause). There could be unrelated cases of the same disease, for example, if several patients come in with hepatitis, and you find out that they are not even the same types of hepatitis. You can have symptoms that are throwing you off, that is why you need more than just symptoms for this assessment. You can have similar but unrelated diseases. Let’s say it is winter and you have children who have been traveling in different areas during the holidays. There are numerous admissions with upper respiratory infections. It could be RSV, influenza, pertussis or parapertussis. These conditions all have similar symptoms but they are not related. So when you are establishing the existence of an outbreak, you want to find out what is the disease or illness or situation you are working with and look at what information you have about what should be the expected number. One way is to review the national reportable disease summary. Let’s say there is an influenza outbreak in your facility, and you want determine what the number of cases the numbers were, for the season, last year, nationally. You can ask the Health Department what the numbers were for influenza this quarter, the year, last year at this time, 2 years ago at this time. It is very important if you are in the hospital situation and you have a larger than expected number of infections, to find out what was the rate last year,
what is the rate in this unit compared to other units. If the case definition or reporting policies have changed this year. that may have resulted in the increased number of cases. All of these things factors can affect the expected number of cases.

**Slide 7: Step 1 continued**

So when you are on the step of establishing the existence of a true outbreak, the Public Health department should be notified. They may be able to tell you what is going on in the community. You can also ask for outside consultation. For those of you who took the summer class, it is a requirement that infection control program has the services of a Hospital Epidemiologist and in an outbreak if additional assistance is needed, it should be provided. Instituting early control measures, going back to the influenza example, Droplet Precautions for patients and strict hand hygiene measures may need to be implemented. Thus, there may be a need to institute early control measures. Another important action early in the investigation that is often missed, is saving specimens. You might have a unique situation going on if you saved the specimens and can later compare them, with PCR, biotyping, phage typing, etc. you can compare the results. It is important to budget in your infection control program, the space to be able to hold specimens if you need them. To summarize this step, the existence of a true outbreak needs to be established, with counting the number of cases.

**Slide 8: 2. Verify the Diagnosis**

The second step, or the first step in some situations, is to verify the diagnosis. You need to be able to look at clinical symptoms and compare them to laboratory findings to verify that the disease you are suspecting is the disease causing the outbreak. Some diseases can be tested for in a few hours (e.g., varicella or chickenpox), some of them take weeks. The latter situation is a big disadvantage and that is what affects verifying the diagnosis first or verifying the existence of an outbreak first. If you have symptoms that suggest pertussis (whooping cough), for an example, it is going to take a week or two to get culture results. You might have to start by get a case definition going, and start control measures, and that would be your first step. Alternatively, let’s say you have a rash illness with a couple of employees, and you’re suspecting varicella, or chickenpox, you can find out in two hours if someone has that. You definitely want to find out if someone has that before declaring chickenpox as the agent, before giving varicella immune globulin or varicella vaccine to exposed patients or employees. Because if you are wrong, you will have instituted some important and costly control measures for the wrong disease. It could turn out to be another rash illness requiring different control measures. So whenever it is possible to obtain a laboratory diagnosis very quickly, you should do that as the first step in an outbreak
Investigation. Another important action in a hospital is to talk to infected patients, if it is something affecting patients, or employees. They may be able to provide valuable information to help verify a diagnosis: timing, symptoms, possible sources, etc. The Infectious Disease Service is a resource, with one of their purposes to provide consultation for verifying diagnoses. For example, one time we received a call from the Employee Health Department, and they thought we had rubella in an employee. Well, Employee Health is expert in determining work restrictions, and exposures, and medications, and doing pre-employment physicals, etc. Infectious Diseases is expert in being able to diagnose rash illnesses. We sent the Infectious Disease consult over there and it was determined that it was a drug allergy and not rubella. Had we gone with just the word of the EH department and assumed it was rubella, it would have been very costly. Two other services that are very good at consultations regarding diagnosing rash illnesses, are Dermatology and Pediatrics.

**Slide 9: 3. Define & Identify Cases**

The third step is to define and identify cases. In that situation, if you are lucky enough to have a case definition for an established disease, you can use that, or you can have a standard set of criteria that you come up with because this is a unique illness that you have never had before or it is a unique situation. The important thing to remember is that there are 4 components in a case definition. It should include some clinical information about the disease or condition, characteristics about those infected, information about a location or place, and a specific time during which the outbreak occurred. Here are some examples. Clinical info could include fever, chills, headache. Characteristics about those affected: occurring in residents of a nursing home, or kids on a pediatric unit. Information about the location or place and time specification: in Unit B during the week of March 3rd through March 10th. Those are the things that should be included in the case definition.

**Slide 10: Examples**

Here are some additional examples of case definitions. First, nausea, vomiting and diarrhea in residents of Shady Rest nursing home with onset between July 5 – 8, 2006. Second: acute onset of fever, chills, and myalgia with employees of Unit B from September 1-3. Third, SARS started out with an initial case definition because this was a new disease, no one had ever seen it, they didn’t even identify the virus for about a year. There was no laboratory confirmation that could be done. Then, as more information was discovered, the definition evolved into several more revised case definitions.
Slide 11: 3 Case Classifications

To make things even more complicated, there are 3 classifications of a case: confirmed, probable, and possible. Sometimes you have the luxury of having all of these for a particular syndrome or situation, sometimes you only have a suspected case; sometimes you have two of the situations. With a confirmed case, most often a laboratory diagnosis is required. A probable case is defined as one that has typical clinical features it is not able to be confirmed in the laboratory. Then there is a possible case, with fewer of the clinical signs because maybe it isn’t in the main part of the incubation period yet, but it is temporary or spatially related to some other cases. Remember that a good case definition has the 4 components and 3 classifications.

Slide 12: Identify & Count Cases

During this step, it is important to communicate with practitioners to collect important information to identify the cases: demographic information, clinical and risk-factor information.

Slide 13: 4. Orient Data to Time, Place & Person

The fourth step in an outbreak investigation is to orient the data to time, place, and person.

Slide 14: Data Orientation

Orienting the data according to time can be accomplished with an epidemic curve, to place, with a spot map, and to person, with a line listing. Let’s next look at these three ways to orient the data, with some examples.
Slide 15: Epidemic Curve Example

The first example is an epidemic curve of the first recognized outbreak of Legionnaires when it happened in Philadelphia, Pennsylvania in 1976. This shows you the number of cases and date of hospital admission. Be aware that the date of hospital admission does not necessarily correspond to the onset of symptoms. It may have been publicized in the media on this day and then more affected persons reported to the hospital the next day. The date of onset of symptoms is important in identifying the causative agent in an outbreak.

Slide 16: Epidemic Curve: Onset of Anthrax Cases in Sverdlovsk

This is another epidemic curve example, representing an accidental release of anthrax from a facility in Sverdlovsk, former Soviet Union in 1979. The number of days after the accident are on the “x” axis and the number of new cases on the “y” axis. What actually happened was they had a bio-weapons facility that had an accident that produced and released anthrax. Anthrax can be manifested in a cutaneous form, a gastrointestinal form and an inhalational form. The last cases of cutaneous disease are represented by the green arrow and the last day of a new case of inhalational form represented by the blue arrow. The curve is consistent with the incubation periods of the two forms of disease that occurred. Cutaneous cases occurred first, with inhalational cases further out. That is why for post-exposure prophylaxis for inhalational anthrax, they recommend up to 60 days of antibiotics.

Slide 17: Spot Map Example

Does this look familiar to anyone? This is a view of Snow’s famous cholera spot map from the Broad Street pump. He mapped every place that was a water source and the number of cholera cases around it to determine that it was caused by contaminated water from one particular pump source.
**Slide 18: Spot Map Example**

Let’s look at another example of a spot map that might be used in a hospital or other healthcare facility, using a case example of an outbreak of methicillin-resistant Staphylococcus aureus or MRSA that occurs on hospital ward C. Ward C has 28 rooms and the rooms with MRSA cases are marked in red. The first thing one might suspect is the nursing personnel assignment because there are three cases in a row, three rooms in a row, and this might be one nurse’s assignment. This could happen when some staff are on break and there may be another nurse that filled in. That is one theory you can look at by having this spot map. You can also explore what other departments came in to do care with these patients. Can it be a common respiratory therapist? Another thing is if you didn’t know anything about this ward, what if it was a surgical ward and all of the patients happened to have surgery on the same day? Or they had surgery in the same room? Or they had the same OR staff taking care of them? This is how having a spot map can be very helpful.

**Slide 19: Line Listing Example**

Orienting the data from an outbreak according to person can be accomplished using a line listing. The line listing example form on this slide has numerous categories of information that can be collected on the cases, including ID number, the date of onset, address, occupation or place of work, date of hospital admission, lab results, etc.

**Slide 20: 5. Develop Hypothesis**

The fifth step is to develop a hypothesis. Here is where the chain of links in the infectious disease process are examine. What are the agent, reservoir, portal of entry, mode of transmission, portal of exit and host? Thus, you need to be asking ought to be asking: Who, What, Where, When, and How to develop your hypothesis. This is an important step and what you come up with may change later depending on whether the initial hypothesis was right or not.
Slide 21: 6. Evaluate, Test, & Refine Hypothesis

The sixth step is to evaluate, test, and refine the hypothesis. In the classic form of outbreak investigation, ideally some type of analytical epidemiology should be conducted (such as a case-control or a cohort study). However, this is not always practical or feasible in the hospital or healthcare situation. In our burn unit MRSA outbreak, we had the luxury of having an expert group come in and conduct a case control study. I can tell you that was not the first thing on my mind at the time. We were trying to prevent additional burn patients from getting MRSA. The need to conduct such studies must be weighed with the need for control measures and continued case finding.

Slide 22: 7. Implement Control & Prevention Measures

Earlier I mentioned, if you strongly suspect a particular disease or condition early on, you may need to start control measures right away. These control measures are essential in hospital outbreaks and here is a whole list of examples of control measures: using isolation/precautions for an established disease, posing work restrictions on employees who are infected, giving post exposure prophylaxis to patients, employees and visitors, and restricting visitors. We had a Serratia outbreak in our neonatal intensive care unit and that was making the neonates very ill. So we decided it was a good time to restrict visitors. Infection control may have to use more prohibitive policies at times of outbreaks. The Infection Department and the Epidemiologists have to have that ability. Cohorting of patients and employees, babies who are infected with staff who have taken care of the infected ones, and maybe cohort the babies who aren’t infected with staff who haven’t worked with infected ones. Or you can just cohort the babies, or you can just cohort the staff. Recalling products is a control measure and we have sure seen a lot of examples of that in the food industry in the last 2 years with the outbreaks of salmonella and botulism that we had in the U.S. The change in hand washing example I would like to give you relates to the Serratia outbreak in the neonatal intensive care unit. This was during the time that the gold standard for hand hygiene was to wash hands with soap and water. The way the unit was designed, there were 4 sinks in the unit at opposite ends, but they weren’t between bassinets and we were very concerned that people were going to neglect the hand washing step if an alarm went off on one bassinet when it was next to another. So we allowed individual containers of alcohol hand rub to be used by the nurses in lieu of walking to a sink to use soap and water, as a change in policy to control the outbreak.
Slide 23: 8. Evaluate Efficacy of Control Measures

Step number eight is to evaluate the efficacy of the control measures. This can be accomplished by asking several questions. Are cases and transmission still occurring? Do we need to impose stricter work restrictions on affected employees? Do we need to limit or prohibit visitors? Does there need to be a change in hospital or healthcare facility policy? If a particular type of isolation and post exposure prophylaxis is not effective, then perhaps the correct condition has not been verified. Maybe this disease is transmitted by more than one mode of transmission. That is what happened with SARS. They starting thinking that one type of isolation was okay and then some other cases occurred that they couldn’t explain except by respiratory transmission. This is how you evaluate your control measures.

Slide 24: 9. Communicate Findings

The ninth and final step is to communicate the findings from the outbreak investigation. Often this step is left out, when it is a very important and necessary one. Feeding information back to those who need to know is an important surveillance concept and it is essential in hospital outbreaks. This is essential in a hospital outbreak because it could require a policy change or it could be something that has a major impact on the hospital in the future. It is important to write up the report and submit it to the Health Department, present it to those in the hospital, and even to the public it this is something that is important for the public to know. We had something call the Epidemic Management Committee in our facility and activated it during any outbreak. A report should be written for the Infection Control Department, Performance Improvement personnel, and the Risk Manager. In this section, we have covered the 9 essential steps in a hospital or healthcare facility outbreak investigation. We talked about preparing field work as the first step in other outbreak investigations that is not included in the hospital outbreak. Be sure you can differentiate when to verify the diagnosis as the first step and when to establish the existence of an outbreak as the first step in a healthcare outbreak investigation, given case examples.

This concludes the first lecture for week 4.