

Outbreak Investigations: The 10 Step Approach

Zack Moore, MD, MPH

SLIDE 1

Hi. I'm Zack Moore, medical epidemiologist with the North Carolina Division of Public Health. During this presentation, I'll discuss Outbreak Investigations, the 10 Step Approach.

SLIDE 2

At the end of this presentation, you should be able to list 3 reasons why outbreak investigations are important to public health, know the steps of an outbreak investigation, and be able to give an example of a single, over-riding communication objective, or SOCO.

SLIDE 3

There are several reasons why it's important to investigate outbreaks. First, it's important to be able to identify the source of the outbreak and, hopefully, eliminate it. It's also important to develop strategies to prevent future outbreaks from occurring. Outbreaks present an opportunity to evaluate existing prevention strategies and identify gaps. Outbreaks also can allow us to describe new diseases and to learn more about known diseases. Outbreak investigations are an important way in which public health departments can address public concerns. And, finally, if you are a communicable disease nurse in a local health department, it's your job.

SLIDE 4

When deciding when to investigate an outbreak, it's important to consider certain factors. First of all, the severity of illness. An outbreak that involves mild respiratory illness might be much less likely to prompt an investigation as compared to an outbreak involving hospitalizations or severe illness. Transmissibility and the apparent spread of disease is also important in making this decision. It's important to determine if there are unanswered questions. If an outbreak is from a known cause and proceeding along a well described path, it might be appropriate to move straight to control measures rather than focusing on investigation. But, if there are unanswered questions, the investigation may be more important. When deciding whether to investigate, it is important to determine if there are ongoing illnesses or exposures or if the outbreak appears to be in the past. And again, determining the level of public concern can help you make this determination.

SLIDE 5

The environmental investigation, including both inspection by industrial hygienists and environmental specialists, and environmental sampling, is a vital part of outbreak investigations. However, this should always be done with (and not instead of) the epidemiologic investigation.

SLIDE 6

Collection and testing of environmental samples should ideally happen in conjunction with the epidemiologic study so that the epidemiologic results can guide sample collection. However, due to time constraints, these activities often must take place at the same time. Your environmental testing results can support your epidemiologic findings, but positive or negative results can be misleading. For example, if salmonella is detected in the chicken from a restaurant kitchen, but no chicken was consumed by the case patients, this finding might not be helpful in your investigation.

SLIDE 7

Before I get into the steps of an investigation, I'd like to cover some basic principles of the outbreak investigation. First of all, be systematic. Follow the same steps for every type of outbreak. This will help you be sure you're not forgetting important components. Write down your case definitions as you go along and be aware that they might change as your investigation proceeds. Always ask the same questions of everybody to the extent possible, so you avoid a situation where many phone calls have been made, but the same information was not gathered from every person who was contacted. Stop often to reassess what you know. Using a line list and an epi curve can provide valuable information, and many investigations never need to go past this point. And lastly, coordinate with your partners; for example, coordinating the environmental and epidemiologic components of the outbreak investigation.

SLIDE 8

Now I will list 10 steps of an outbreak investigation. These 10 steps might be different in different presentations, but the important point is that you have a set of steps that you can follow and that you approach outbreaks systematically, whether it's with these particular steps or with a different set of steps.

1. First, identify the investigation team and resources.
2. Establish the existence of an outbreak.
3. Verify the diagnosis.
4. Construct a case definition.
5. Find cases systematically and develop a line listing.
6. Perform descriptive epidemiology and develop hypotheses.
7. Evaluate your hypotheses and perform additional studies, if necessary.
8. Implement control measures.
9. Communicate the findings of your investigation and,
10. Maintain surveillance.

Now, I will run through these steps one at a time.

SLIDE 9

The first step is to identify your investigation resources and team.

SLIDE 10

At the local level, this likely involves your Epi Team. At the state level, several resources are available, including the Communicable Disease Branch epidemiologists and subject

matter experts, as well as your CD nurse consultants. Regionally, Public Health Regional Surveillance Teams (PHRST) and Disease Investigation Specialists (DIS) may also be available to assist with outbreak investigations. Other resources might be called into play if needed, including Team Epi-Aid, which is an ad hoc group of volunteer MPH students at the University of North Carolina, or the Centers for Disease Control and Prevention in Atlanta.

SLIDE 11

The next step is to establish the existence of an outbreak. In order to do this, you need to be able to determine what is an outbreak.

SLIDE 12

Basically, an outbreak is any increase in cases above what's expected in that population in that area. Here are some examples...4 kids with cough and runny nose in a child care center in January is probably not an increase above what's expected, and in most cases, would not represent an outbreak. A woman who experiences vomiting after eating at Restaurant A also may or may not represent an increase above what's expected. However, 10 members of a swim team vomiting after eating at Restaurant A would certainly represent something beyond what's expected and therefore an outbreak. Similarly, one case of smallpox would represent an outbreak since this disease was eliminated during the late 1970's.

SLIDE 13

After establishing the existence of an outbreak, it is next important to verify the diagnosis.

SLIDE 14

This can be easier said than done if the etiology is unknown. It's important to obtain medical records and laboratory reports for every patient who is seen by a healthcare provider. Contacting the Public Health Epidemiologist or Infection Preventionist might be helpful if patients were hospitalized. Conducting additional clinical testing might be necessary and this can be done in consultation with the Communicable Disease Branch and with the State Laboratory for Public Health.

SLIDE 15

The next step is to construct your case definition.

SLIDE 16

The case definition has 3 main components—person, place, and time. Person generally refers to the type of illness; for example, a person with vomiting, a person with respiratory illness, etc. Place refers to the location of the suspected exposure, and time is usually based on the incubation period of the disease agent, if known.

SLIDE 17

Here's an example of a case definition for a hepatitis A outbreak that was investigated by the Division of Public Health in 2006. The *person* was an acute illness involving

jaundice or elevated liver function tests. *Place* was occurring after visiting or residing on Property A, the property that was linked with disease. *Time* was the time during May through August of 2006, or approximately 15-50 days before the onset of identified cases.

SLIDE 18

After constructing a case definition, it's important to find cases systematically and to develop your line listing. Line lists are quite simple and they are very helpful in accessing the information you have during the course of your outbreak investigation.

SLIDE 19

A line list should involve, at a minimum, clinical symptoms, including the type and duration of symptoms, onset dates or times, demographic information, and exposure information. Again, the line list can be used to summarize the information that you're gathering during the course of your investigation.

SLIDE 20

The next step in the outbreak investigation is to perform descriptive epidemiology and to develop some hypotheses about what might be causing the outbreak.

SLIDE 21

Descriptive epidemiology consists, again, of person, place, and time. Your line list and your epi curve are very useful in helping you develop hypotheses.

SLIDE 22

Epi curves can suggest the type of exposure; for example, a point source versus a person-to-person outbreak.

SLIDE 23

In this example, cases shown on the Y axis occur in a fairly tight cluster of time with a single peak and a rapid decrease after the peak. This is most likely consistent with a point source type of exposure.

SLIDE 24

In this epi curve, by contrast, cases arise rapidly but then continue to occur for some time, which is more likely consistent with a propagated or person-to-person outbreak.

SLIDE 25

Epi curves can suggest the type of exposure...point source or person-to-person, but they can also suggest a time of exposure if the agent is known, or the possible agent, if the time of exposure is known.

SLIDE 26

In this epi curve, the time of exposure was already known. This might be true with an outbreak following, for example, a wedding banquet or conference. If the time of exposure is known, you can look at the peak onset of illness and determine the average

incubation. If this is a matter of hours, you may be talking about a staph toxin poisoning. If this is a matter of days, you may be talking about a salmonella or e. coli outbreak.

SLIDE 27

By contrast, if the agent is known but the time of exposure is not, the epi curve can be helpful in determining possible times of exposure. If you look at the peak of illness onset, you can use the maximum incubation and the minimum incubation to calculate an estimated exposure period.

SLIDE 28

The next step is to evaluate your hypotheses and to perform additional studies if necessary.

SLIDE 29

The basic types of additional studies that you might perform include cohort and case control studies. These studies are both designed to assess exposures equally among ill and non-ill persons.

SLIDE 30

A cohort study must include everyone who could've been exposed and can only be used if a complete list of exposed persons is available. This can be done with meeting attendees, students, long-term care facility residents, etc. The measure of association in a cohort study is the relative risk.

SLIDE 31

A relative risk of one ($RR=1.0$) indicates the risk of illness was the same in exposed and unexposed. Relative risk of greater than one ($RR >1.0$) indicates higher risk among exposed, and a relative risk of less than one ($RR < 1.0$) indicates the risk is lower among exposed persons.

SLIDE 32

Case control studies compare exposures among ill persons, also known as case patients, and non-ill persons, also known as controls. These studies can be used when a complete list is not available or is too large to allow for interviewing all persons exposed. These can be used for restaurant outbreaks or for some large national outbreaks, such as the recent e. coli spinach outbreaks or national salmonella outbreaks. In a case control study, the measure of association is the odds ratio.

SLIDE 33

Interpretation of the odds ratio is very similar to the relative risk. An odds ratio of one ($OR =1.0$) indicates the same odds of exposure among ill and non-ill. An odds ratio greater than one ($OR >1.0$) indicates higher odds of exposure among the ill. An odds ratio of less than one ($OR < 1.0$) indicates a lower exposure among ill persons.

SLIDE 34

The next step of the outbreak investigation is to implement control measures. This step can actually occur at any point during the outbreak as soon as clear control measures are apparent.

SLIDE 35

Control measures might include isolation, cohorting, or product recall, depending on the specific situation. Deciding when to implement control measures involves a balance between preventing further disease and protecting the credibility of your public health institution and the reputation of the institution involved in the outbreak. Your decision should be guided by epidemiologic results in conjunction with your environmental investigation.

SLIDE 36

The next step in the outbreak investigation is to communicate your findings. As with control measures, this can occur at any point during the investigation.

SLIDE 37

In general, the public and the press are not aware of most outbreak investigations. Media attention might be desirable if public health action is needed to try to stop the outbreak. Your response to media attention is very important in addressing public concerns about the outbreak. And when you're responding to these questions, you should try to remember that interactions with the media are a chance for you to present your single overriding communication objective, or SOCO....usually, what you'd like the public to do in order to protect themselves or to help stop this outbreak. Please remember that the results of your investigations are public information and can be requested at any time.

SLIDE 38

The last step of the outbreak investigation is to maintain surveillance.

SLIDE 39

Maintaining surveillance is very important for deciding whether the outbreak is truly over as well as for documenting the effectiveness of the control measures that were put in place as part of your outbreak investigation.

SLIDE 40

In conclusion, epidemiologic investigations of outbreaks are essential to determine the source. It is important to be systematic when you approach outbreak investigations so as not to forget important parts. And, follow the steps, whether they be these 10 steps or other 10 steps. Thank you.