Case studies in
outbreak investigation

Facilitator's Guidebook

P is for Practice: Case studies in outbreak investigation
Second Edition

2016

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Table of Contents

Introduction

Welcome to the second edition of *P is for Practice*, the final part of the three-part training series from the UNC Center for Public Health Preparedness (UNC CPHP). This facilitator's guidebook contains scenarios and case studies that you can use to practice basic epidemiology and investigation skills learned in the first two parts of the training series.

These case studies are designed to be used for computer-based self-study, as a face-to-face teaching tool for trainers, or for lunch and learn seminars or in-service trainings. Each case study contains an outbreak scenario with detailed speaker's notes, guided discussion questions for individuals or groups, and additional resources. Each case study should take about 90-120 minutes to complete.

There are two ways to use these training materials:

Self-paced individual learning:	**Facilitated group training:**
At the beginning of each case study, complete a pre-test. Read each case study, taking time to answer each question. At the conclusion of the case study, complete a post-test and an evaluation online to receive your customizable certificate of completion.	Use the facilitator versions of the case studies with speaker's notes and guided discussion questions to provide training for a group, while participants follow along using the Student Guide. Before and after each case study, participants should complete the pre-test and post-test. When a case study is completed, participants may access an online evaluation associated with each case study to receive a certificate of completion.

When training is completed, participants may access an online evaluation associated with each scenario to receive a certificate of completion.

We hope that you enjoy this series and find the training materials useful. If you have questions or comments about these materials, please contact us at nciph@unc.edu.

Development Team

The UNC Center for Public Health Preparedness (UNC CPHP) is a program of the North Carolina Institute for Public Health at the University of North Carolina Gillings School of Global Public Health.

The materials in this CD-ROM and facilitator's guidebook were updated and revised in 2015 from the original curriculum by the following:

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For additional trainings on a wide variety of topics related to public health preparedness; epidemiology and surveillance; and outbreak detection and investigation, please visit our NCIPH Training Web Site at https://nciph.sph.unc.edu/tws.

UNC CPHP is funded as one of 14 Preparedness and Emergency Response Learning Centers (PERLCs) at accredited schools of public health. This publication was produced by the UNC PERLC via funding from the Centers for Disease Control and Prevention's Office of Public Health Preparedness and Response under Cooperative Agreement 1U90TP000415. The contents of this CD-ROM and facilitator's guidebook are solely the responsibility of the authors and do not necessarily represent the official views of CDC.

Facilitation Guidelines

If you plan to use these materials for training a group, you may want to review the following facilitation guidelines.

Prior to the session:

- Review the scenarios to become familiar with the content
- Duplicate materials needed by participants
- Establish ground rules
- Establish roles
- Organize the room to encourage active participation and discussion; check the equipment

Opening remarks:

- Welcome the participants
- Clarify the purpose of the discussion
- If participants do not know each other, allow time for introductions
- Introduce a warm-up question or comments to help participants focus on the topic of the discussion

Facilitators' roles:

- Move your group through the scenarios (please allow about 20 minutes for the completion of each section)
- Involve every group member
- Moderate discussion based on the answer key
- Ensure that key points are covered for each question
- Keep an eye on the clock

Reminder: *During the training, only the facilitators will have the answer key; small group participants have only the facts and questions. You may need to refer to both case study facts and information provided in the answer key when answering discussion questions.*

To ensure involvement of all participants:
Scenarios and questions will be **read aloud** sequentially by individual participants.

Facilitators should:

- Select one participant to read aloud the first set of the scenario and the first question
- Encourage that participant to attempt to answer the first question, regardless of his or her background
- Solicit input from other group members to answer the question
- Use the facilitator's answer key (if necessary) to cover the key point(s)
- After the first question is completed, move clockwise in sequence to have the next person read aloud the next question and attempt an answer as above

Suggested answers and relevant technical information should be provided for all participants at the end of the training program.

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Session Overview

Instructions
For this exercise, you will be asked to work in groups to participate in an investigation of an outbreak of respiratory disease. Information regarding the scenario will be provided to you in parts, each of which will be followed by related discussion questions.

Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to formulate answers to each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital, and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
90 minutes

Learning Objectives
- Identify challenges associated with the public health response to a complex emergency, such as a natural disaster combined with a potential outbreak of infectious disease
- Describe public health responsibilities to displaced persons during an emergency
- List the steps of an outbreak investigation and describe how to implement them as an outbreak investigation team
- Identify public health legal powers available for management of a complex public health emergency

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Pre-Test

1. Which of the following describe active public health surveillance in a shelter?
    a. Provide information about the occurrence of infectious diseases
    b. Identify health-related topics about which to educate shelter residents
    c. Monitor sanitation and determine the availability of shelter facilities such as water, toilets, electricity, and medical care
    d. A and B only
    e. All of the above

2. True or False: Public health departments can conduct medical screening before admitting any new people arriving to a shelter.

3. An epidemic curve can be used to provide information on a potential outbreak's:
    a. Pattern of spread
    b. Magnitude
    c. Time (exposure and/or disease incubation period)
    d. All of the above

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Student Guide

Situation

September 14th: A Category 3 hurricane with 125 mile per hour winds is approaching the coast. As the Beach County Health Director, you are using your phone tree to call nurses to staff the shelters that the Division of Emergency Management authorities have opened under a mandatory evacuation order. Shelters are located in schools, churches, and community centers across the county and can safely house up to a total of 10,000 people – about 20% of your county's population – for a few days. This will cover most residents who live in mobile homes or other substandard housing, as well as those who live in storm surge or flood-prone low lying areas.

Your county also has a mutual aid agreement with Island County to take any residents who can't be served by their limited local shelters. Based on experience, you know that most tourists have already gone home, and that many residents will prefer to stay in a hotel or with friends or family if possible. In your last Community Health Assessment survey, your health department found that 13% of residents said they would not evacuate if authorities announced a mandatory evacuation, so you are aware that some residents will choose to try to ride out the storm in their homes.

In setting up the shelters, you need to meet residents' basic needs for food and water. You also want to ensure that basic sanitary conditions will be met and that you have a system in place to cover basic medical care if needed and monitor for possible disease outbreaks. You also have a plan for documenting the names and addresses of each person staying at a shelter.

1. Consider what you know about the baseline rates of communicable diseases in your community based on regular reporting and surveillance activities. How would your knowledge of these baseline rates be applicable to the situation in the shelter?

2. As a health director concerned with the potential for disease outbreaks in an evacuation center, what would be your primary goals for establishing surveillance in the evacuation centers?

Update 1: Day 1

September 15th: The storm hit your community hard overnight and the impact on your county's infrastructure has turned out to be far worse than expected. Almost all of the nearly 50,000 county residents have no power. The municipal water system is not able to provide safe water, and a boil water order is in effect. Trees and power lines are blocking a number of county roads and communication is spotty.

The local hospital is running on generator power, but the main roads leading to the hospital have been flooded. Hospital staff are unable to get into work, so only those who stayed at the hospital overnight are able to provide assistance to the few people who can reach the facility. Some residents with severe injuries are being flown by helicopter to the hospital, but it is basically impossible for community residents to reach the hospital for treatment.

One of your shelters begins to receive a large number of people who did not evacuate prior to landfall, including members of the small homeless population who have been camping at a nearby vacant lot. Other residents are arriving who have walked through floodwaters to get to the shelter. Many who are arriving have minor injuries related to blowing debris and other hazards.

3. Because people arriving at the shelter may have communicable diseases, injuries, storm-related illnesses, or unmet chronic medical needs (e.g. oxygen, dialysis, prescription refills) that you are not equipped to provide assistance for, would you consider starting a medical screening program before admitting any new people to the shelter?

4. If you decide to use public health legal powers to isolate a portion of the shelter population based on medical screening, what must you legally provide to them?

Update 2: Day 2

September 16th: There are now about 750 people at the shelter. A large number of people are reporting respiratory symptoms to shelter staff and volunteers. Community members continue to arrive, including non-evacuees who can no longer stay at their homes and evacuees who initially went to other shelters who are now looking for friends and family from Island County who may have evacuated to Beach County. You're concerned that these new arrivals may be exposed to ill individuals at the shelter or that they may be ill themselves already.

In addition, you are concerned about stress among members of your community. Emergency management is not allowing citizens to go back to their homes because crews are working hard to open roads and repair power lines. People are starting to experience high stress levels wondering about the status of their homes and possessions.

5. What steps would you take to address potential mental health effects of the disaster?

Update 3: Day 2

Evening of September 16th: A growing number of people in the shelter are reporting worsening respiratory symptoms, including coughing, tight chest, and fatigue. You consider conducting a cot survey to determine the health status of everyone staying in the shelter, but wonder how your staff would be able to develop the questionnaire and perform the interviews in addition to all their other responsibilities.

You decide that you should first try to identify and define the cases to determine if this is really an outbreak or just a usual spike in non-specific respiratory symptoms that is often seen in shelters.

6. What basic steps of an outbreak investigation might you undertake at this time?

7. How would you assess the potential of a respiratory disease outbreak in the shelter?

8. How would you decide whether people are suffering from a respiratory illness contracted before they arrived at the shelter or an illness contracted during an outbreak at the shelter?

9. Discuss the elements of an epidemiologic curve or "epi curve" that you might be able to draw based on the results of your cot survey. Below you see two sample epi curves; on the left is an example of a point source epi curve (Fig. 1) and on the right is an example of a person-to-person epi curve (Fig. 2).

Figure 1. Point Source Epi Curve

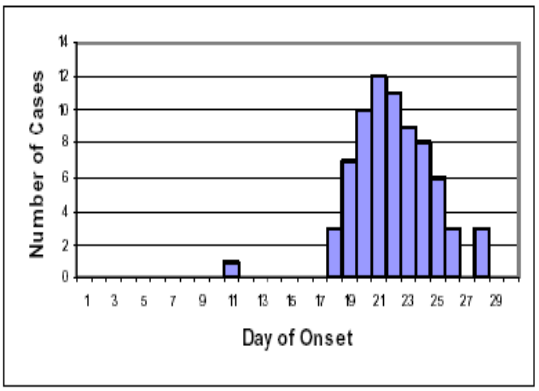
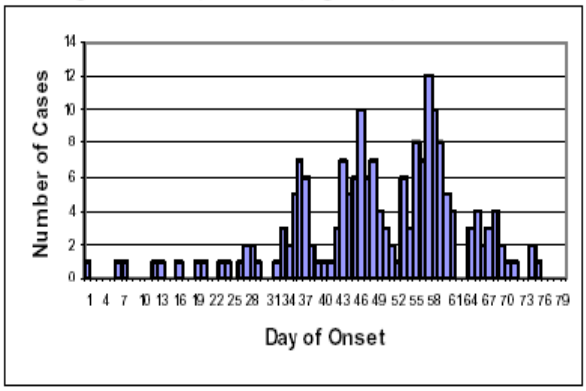


Figure 2. Person-to-Person Epi Curve



Update 4: Day 3

Morning of September 17th: Your hardworking staff and several volunteers are finishing a cot survey of a sample of the shelter residents. Based on this data, it seems that many respiratory symptoms have cleared up due to isolation, infection control practices, hand-washing, and other steps you implemented earlier.

Then your staff comes across a person with a productive and persistent cough, chest pain, fatigue, and lack of appetite. This person reports that he's been sick like this for at least 2-4 weeks but was fine before then. He had a chest x-ray about 1 week ago, but never heard from the clinic what the results were due to the storm coming. Your staff is concerned that this person may be the cause of the outbreak of respiratory illness.

11. What further information should you obtain from this person?

Update 5: Day 3

Afternoon of September 17th: While you are discussing whether it may be advisable to isolate this person from others in the shelter to prevent transmission of whatever illness he may have, one of your public health nurses realizes that the Beach County Health Department has a non-compliant TB patient with a name similar to the one of your ill shelter resident. She wonders if it is possible that this is the same person, or if he may have given a false name for fear of not being allowed into the shelter or being turned in to the authorities.

12. Even though you don't know if this is the same person, would you implement isolation of this person?

13. You know something about infection with TB, transmissibility, and TB disease because of the growing number of cases that you have been seeing in your health department. Is it appropriate to consider person-to-person transmission of TB in the shelter?

14. Some of the people staying in the shelter are recent immigrants to your community. Should you consider the possibility of reactivation of long-latent TB among these new migrants? How might isolation of suspected cases impact the future willingness of immigrants to come to shelter?

Update 6: Day 4

September 18th: The people staying in the shelter are getting more and more anxious to go see their homes. Emergency management officials have said that they may allow citizens back into the community by this afternoon, but just to look at their houses and pick up some possessions. They will not be able to spend the night in their homes and a curfew will be in place at dusk. However, you can't guarantee that all those currently in the shelter will come back; some may leave the shelter to stay with family or friends outside the county.

15. How will you track everyone who leaves the shelter to update them on the diagnosis of the respiratory disease they may have been exposed to at the shelter and get them tested if necessary? Should you consider testing people at the shelter for TB?

16. What are your legal powers and responsibilities to protect the community? Can you keep people at the shelter until you can confirm the diagnosis of TB?

Conclusion

Most people left the shelter as soon as emergency management allowed. Only 25% returned to the shelter after going to survey damage to their property. Because of your suspicions about this potential case of TB, you confirmed contact information from everyone in the shelter so that you could contact them if they needed to be tested for TB.

The next day, the hospital admitted the man you suspected of having TB. A chest x-ray and other tests revealed that he was suffering from lung cancer (which, of course, would not be transmissible to others in your shelter or community). Several weeks later, you were relieved to be signing letters to all those who stayed in the shelter letting them know that they were not in danger of having contracted TB at the shelter.

References

Torok M. Epidemiologic Curves Ahead. *FOCUS on Field Epidemiology Vol 1, Iss 5*. MacDonald PDM, ed-in-chief; Alexander LA, Mejia GC, eds. Available at: https://nciph.sph.unc.edu/focus/vol1/issue5/1-5EpiCurves_issue.pdf. Accessed April 6, 2016.

Matthews GW, Abbott EB, Hoffman RE, et al. *Legal Authorities for Interventions in Public Health Emergencies in Law in Public Health Practice*. Goodman RA, ed. New York: Oxford University Press: 2007.

Infectious Disease and Dermatologic Conditions in Evacuees and Rescue Workers After Hurricane Katrina—Multiple States, August–September, 2005. *MMWR Morb Mortal Wkly Rep*. September 2005;54:961-964. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5438a6.htm. Accessed April 6, 2016.

Epidemiologic Notes and Reports Surveillance of Shelters After Hurricane Hugo—Puerto Rico. *MMWR Morb Mortal Wkly Rep*. 1990; 39:41-42, 47. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/00001545.htm. Accessed April 6, 2016.

N.C. Division of Public Health. Outbreak Investigations: Outbreak Steps. In: *North Carolina Communicable Disease Control Manual*. 2012. Available at: http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/toc.html. Accessed April 6, 2016.

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Facilitator Guide

Situation

September 14th: A Category 3 hurricane with 125 mile per hour winds is approaching the coast. As the Beach County Health Director, you are using your phone tree to call nurses to staff the shelters that the Division of Emergency Management authorities have opened under a mandatory evacuation order. Shelters are located in schools, churches, and community centers across the county and can safely house up to a total of 10,000 people – about 20% of your county's population – for a few days. This will cover most residents who live in mobile homes or other substandard housing, as well as those who live in storm surge or flood-prone low lying areas.

Your county also has a mutual aid agreement with Island County to take any residents who can't be served by their limited local shelters. Based on experience, you know that most tourists have already gone home, and that many residents will prefer to stay in a hotel or with friends or family if possible. In your last Community Health Assessment survey, your health department found that 13% of residents said they would not evacuate if authorities announced a mandatory evacuation, so you are aware that some residents will choose to try to ride out the storm in their homes.

In setting up the shelters, you need to meet residents' basic needs for food and water. You also want to ensure that basic sanitary conditions will be met and that you have a system in place to cover basic medical care if needed and monitor for possible disease outbreaks. You also have a plan for documenting the names and addresses of each person staying at a shelter.

1. Consider what you know about the baseline rates of communicable diseases in your community based on regular reporting and surveillance activities. How would your knowledge of these baseline rates be applicable to the situation in the shelter?

Suggested answer: *Although knowledge of the baseline rates in your community are useful, they may not be applicable in this situation where people are living in close quarters and may have been exposed to contaminated food or water. In the case of shelter surveillance, you should be concerned with any incidence (new cases) of disease, particularly diseases that may be easily transmissible from person to person or clusters of disease.*

2. As a health director concerned with the potential for disease outbreaks in an evacuation center, what would be your primary goals for establishing surveillance in the evacuation centers?

Suggested answer: *Public health staff may be responsible for conducting surveillance in shelters in an effort to rapidly identify potential outbreaks of highly contagious diseases, such as Norovirus or other diarrheal diseases.*

Active public health surveillance in the shelter should:

- *Provide information about the occurrence of infectious diseases*
- *Monitor sanitation and determine the availability of shelter facilities such as water, toilets, electricity, and medical care*
- *Identify health-related topics about which to educate shelter residents*

Update 1: Day 1

September 15th: The storm hit your community hard overnight and the impact on your county's infrastructure has turned out to be far worse than expected. Almost all of the nearly 50,000 county residents have no power. The municipal water system is not able to provide safe water, and a boil water order is in effect. Trees and power lines are blocking a number of county roads and communication is spotty.

The local hospital is running on generator power, but the main roads leading to the hospital have been flooded. Hospital staff are unable to get into work, so only those who stayed at the hospital overnight are able to provide assistance to the few people who can reach the facility. Some residents with severe injuries are being flown by helicopter to the hospital, but it is basically impossible for community residents to reach the hospital for treatment.

One of your shelters begins to receive a large number of people who did not evacuate prior to landfall, including members of the small homeless population who have been camping at a nearby vacant lot. Other residents are arriving who have walked through floodwaters to get to the shelter. Many who are arriving have minor injuries related to blowing debris and other hazards.

3. Because people arriving at the shelter may have communicable diseases, injuries, storm-related illnesses, or unmet chronic medical needs (e.g. oxygen, dialysis, prescription refills) that you are not equipped to provide assistance for, would you consider starting a medical screening program before admitting any new people to the shelter?

Suggested answer: *As the health director, it is your responsibility to protect those at the shelter against contagious diseases and other health risks that may threaten their safety. If you are concerned that these new arrivals may have a communicable disease, you may "order a specific individual who poses a real threat to undergo a physical examination, to provide information, or even to detain that person in a medical or other public facility" (Law in Public Health Practice,* Legal Authorities for Interventions in Public Health Emergencies*, p. 271).*

A screening program should be instituted if people coming to the shelter may have a communicable disease. Known infected persons, such as those with vomiting, diarrhea, or respiratory symptoms such as cough or fever may be admitted, but should be kept isolated from the general shelter population if possible.

All people reporting to the shelter should be provided with education about hand-washing, respiratory hygiene, and other efforts to prevent person-to-person spread of communicable diseases.

4. If you decide to use public health legal powers to isolate a portion of the shelter population based on medical screening, what must you legally provide to them?

Suggested answer: *Most state laws allow isolation or quarantine only if it is the least restrictive alternative available to control a public health emergency. Initially, courts will defer to medical judgment of public health officials about whether other options would work to contain a communicable disease.*

In this case, isolated citizens are already located at the shelter, and you are therefore already prepared to meet their needs in terms of food, water, shelter, and medical care. If your control measures appear to single out a particular ethnic, racial, or other group because of a conclusion that they had a high incidence of or susceptibility to disease (such as the homeless in this case) courts will view your measures with "strict scrutiny," the most rigorous standard of review. (Law in Public Health Practice, Legal Authorities for Interventions in Public Health Emergencies*, p. 273)*

Update 2: Day 2

September 16th: There are now about 750 people at the shelter. A large number of people are reporting respiratory symptoms to shelter staff and volunteers. Community members continue to arrive, including non-evacuees who can no longer stay at their homes and evacuees who initially went to other shelters who are now looking for friends and family from Island County who may have evacuated to Beach County. You're concerned that these new arrivals may be exposed to ill individuals at the shelter or that they may be ill themselves already.

In addition, you are concerned about stress among members of your community. Emergency management is not allowing citizens to go back to their homes because crews are working hard to open roads and repair power lines. People are starting to experience high stress levels wondering about the status of their homes and possessions.

5. What steps would you take to address potential mental health effects of the disaster?

Suggested answer: *If possible, provide access to a counselor or social worker or a staff member trained in psychological first aid to those staying in the shelter. Otherwise, provide shelter residents with information on self-care and coping with traumatic events. Assure residents that it is normal to feel stress at this time, and educate them about the signs and symptoms of longer-term effects of disasters, such as post-traumatic stress disorder. If possible, designate a children's area where children can play together and parents can have a break from child care.*

Also keep in mind that an additional stressor may be fear of separation from family and friends, which may result in shelter residents failing to report their illnesses. If you have isolated ill individuals in part of the shelter, take steps to reassure others at the shelter and encourage them to come forward if they are feeling ill.

Update 3: Day 2

Evening of September 16th: A growing number of people in the shelter are reporting worsening respiratory symptoms, including coughing, tight chest, and fatigue. You consider conducting a cot survey to determine the health status of everyone staying in the shelter, but wonder how your staff would be able to develop the questionnaire and perform the interviews in addition to all their other responsibilities.

You decide that you should first try to identify and define the cases to determine if this is really an outbreak or just a usual spike in non-specific respiratory symptoms that is often seen in shelters.

6. What basic steps of an outbreak investigation might you undertake at this time?

Suggested Answer: *The steps of an outbreak investigation may occur in almost any order, depending on the outbreak. These steps are:*

- *Verify the diagnosis and confirm that an outbreak is actually occurring*
- *Create a preliminary case definition and conduct active case finding*
- *Compile and review case information*
- *Implement preliminary control measures*
- *Formulate and test a hypothesis*
- *Plan and execute additional studies based on the preliminary result*
- *Implement and evaluate control measures*
- *Communicate findings*

In this case, you may first try to compile and review case information, continue implementing control measures (such as screening people at shelter entry, isolating ill individuals, and providing health education about hand hygiene, etc.), develop a hypothesis about the outbreak, and plan and execute an epidemiologic study.

7. How would you assess the potential of a respiratory disease outbreak in the shelter?

Suggested answer: *A cot survey could be conducted to collect exposure information from all those staying at the shelter. A systematic sample in which you collect information from every "n^{th}" person (for example, every 5^{th} or 10^{th} person depending on the population of the shelter) may be an appropriate technique. Remember to collect data from both sick and well people at the shelter. Collect information about person, place, and time, and remember to include questions about demographic information, symptoms, time of onset, and potential exposures.*

8. How would you decide whether people are suffering from a respiratory illness contracted before they arrived at the shelter or an illness contracted during an outbreak at the shelter?

Suggested answer: *This is where your knowledge of background rates of disease in your community comes in handy. Are observed rates much higher than expected given the baseline rates? In addition, knowledge of the seasonality of disease and the incubation time of most typical respiratory diseases will also be useful. Finally, if you are conducting a survey, you can ask people about the date their symptoms began, keeping in mind that the stressful events of the past few days may make it difficult for some people to remember.*

9. Discuss the elements of an epidemiologic curve or "epi curve" that you might be able to draw based on the results of your cot survey. Below you see two sample epi curves; on the left is an example of a point source epi curve (Fig. 1) and on the right is an example of a person-to-person epi curve (Fig. 2).

Figure 1. Point Source Epi Curve

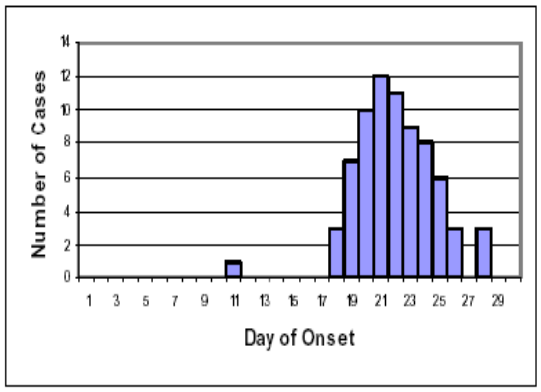
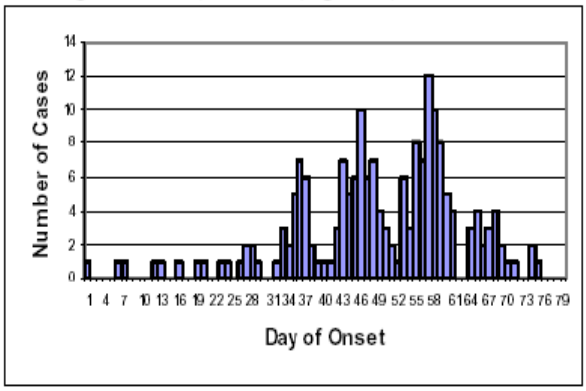


Figure 2. Person-to-Person Epi Curve



Suggested answer: *If you collect information about time of disease onset during your cot survey and you know something about possible incubation periods, you can draw an epi curve to represent the potential outbreak. An epi curve is a visual display of an outbreak's magnitude and time trend. It can be used to identify outliers (i.e., cases that stand apart). The x-axis is the time or date of illness onset among cases and the y-axis is the number of cases. Cases (represented by boxes) are placed along the x-axis according to when their symptoms began. If symptoms for more than one case occur on a particular date, the boxes are stacked one above the other.*

The unit of time for the x-axis is based on the incubation period of the disease under investigation and the length of time over which the cases are distributed. As a rule of thumb, the unit of time should be roughly one-quarter of the average incubation period. For example, in an outbreak of influenza with a usual incubation period of 1-3 days, you would use an x-axis unit of 8-12 hours.

The shape of the epi curve should indicate whether this is a point source outbreak, with a steep upward slope followed by a gradual downward slope, or a propagated outbreak spreading from person-to-person, characterized by several spikes in the date of symptom onset.

Update 4: Day 3

Morning of September 17th: Your hardworking staff and several volunteers are finishing a cot survey of a sample of the shelter residents. Based on this data, it seems that many respiratory symptoms have cleared up due to isolation, infection control practices, hand-washing, and other steps you implemented earlier.

Then your staff comes across a person with a productive and persistent cough, chest pain, fatigue, and lack of appetite. This person reports that he's been sick like this for at least 2-4 weeks but was fine before then. He had a chest x-ray about 1 week ago, but never heard from the clinic what the results were due to the storm coming. Your staff is concerned that this person may be the cause of the outbreak of respiratory illness.

11. What further information should you obtain from this person?

Suggested answer: *Potential follow-up questions may include:*

- *Is he currently taking any medication for this problem?*
- *Has he been exposed to wild or domestic birds that were ill or dead?*
- *Are any of his immediate family members or close contacts also ill?*
- *Has he recently traveled to or lived in a foreign country?*
- *Does he smoke, drink alcohol, or use illegal drugs?*
- *Does he have HIV or another immunosuppressant disease or condition?*
- *Is he homeless or living in shared housing of some type, such as a migrant camp or single room occupancy motel?*

Update 5: Day 3

Afternoon of September 17th: While you are discussing whether it may be advisable to isolate this person from others in the shelter to prevent transmission of whatever illness he may have, one of your public health nurses realizes that the Beach County Health Department has a non-compliant TB patient with a name similar to the one of your ill shelter resident. She wonders if it is possible that this is the same person, or if he may have given a false name for fear of not being allowed into the shelter or being turned in to the authorities.

12. Even though you don't know if this is the same person, would you implement isolation of this person?

Suggested answer: *You could isolate this person with the other shelter residents who have shown signs and symptoms of respiratory disease, but if this person actually does have TB, you don't want to expose others in the shelter. If possible, you should try to isolate him in a room alone.*

13. You know something about infection with TB, transmissibility, and TB disease because of the growing number of cases that you have been seeing in your health department. Is it appropriate to consider person-to-person transmission of TB in the shelter?

Suggested answer: *A person may be infected with TB for years and be free of symptoms until they suffer a change in health. The cause of this change in health may be another disease like AIDS or diabetes, abuse of drugs or alcohol, or a lack of health care due to homelessness.*

Although TB is spread through droplets in the air, close contact over an extended period of time is typically required for transmission. The usual incubation time for TB is 2-10 weeks.

It is possible that this person, if he has active TB disease, has infected others through coughing, sneezing, and close contact with others at the shelter. However, TB could not be the cause of the respiratory disease problems you have been seeing at the shelter because the incubation period of TB is too long and the infection would not have had time to progress to disease.

14. Some of the people staying in the shelter are recent immigrants to your community. Should you consider the possibility of reactivation of long-latent TB among these new migrants? How might isolation of suspected cases impact the future willingness of immigrants to come to shelter?

Suggested answer: *Nearly one-third of the world's population are carriers of TB, so it is possible that new immigrants to your community may be carriers of asymptomatic or latent TB infection. However, persons with a latent tuberculosis infection are not contagious because the mycobacterium is inactive or latent. These latent carriers do not know they are sick because they are not experiencing symptoms of disease.*

Keep in mind that any actions that separate or single out a population may cause fear, especially among populations that may be in the US illegally or come from countries in which "the government" cannot be trusted. You must be especially open and honest to prevent fear of deportation, imprisonment, or death from keeping these populations from using services like shelters in the future.

Update 6: Day 4

September 18th: The people staying in the shelter are getting more and more anxious to go see their homes. Emergency management officials have said that they may allow citizens back into the community by this afternoon, but just to look at their houses and pick up some possessions. They will not be able to spend the night in their homes and a curfew will be in place at dusk. However, you can't guarantee that all those currently in the shelter will come back; some may leave the shelter to stay with family or friends outside the county.

15. How will you track everyone who leaves the shelter to update them on the diagnosis of the respiratory disease they may have been exposed to at the shelter and get them tested if necessary? Should you consider testing people at the shelter for TB?

Suggested answer: *Update name and address records as people leave the shelter to ensure that you have the information necessary to contact them in the future.*

Testing at the shelter for TB would not be appropriate. If you feel that it is appropriate to test any of the residents at the shelter, the ideal time to do so would be about 8 weeks after exposure to ensure that you do not receive a false-negative result. After this amount of time has passed, most residents will be back in their homes and community.

16. What are your legal powers and responsibilities to protect the community? Can you keep people at the shelter until you can confirm the diagnosis of TB?

Suggested answer: *You may use your public health legal powers to prevent those in isolation from leaving the shelter. You will need to begin procedural legal processes and provide the isolated individuals with access to a due process hearing as soon as is practicable. However, once emergency management officials allow others to return to the community, you do not have the right to force everyone to stay at the shelter.*

Generally, if you explain the purpose of the isolation and its importance to the health and safety of the community, most citizens will voluntarily agree to isolation, particularly during an emergency. There are strong practical and logistic considerations for controlling disease spread through the least restrictive means possible, such as allowing people to stay home to avoid transmission of disease, rather than continuing to provide food, shelter, and medical care to those affected.

Conclusion

Most people left the shelter as soon as emergency management allowed. Only 25% returned to the shelter after going to survey damage to their property. Because of your suspicions about this potential case of TB, you confirmed contact information from everyone in the shelter so that you could contact them if they needed to be tested for TB.

The next day, the hospital admitted the man you suspected of having TB. A chest x-ray and other tests revealed that he was suffering from lung cancer (which, of course, would not be transmissible to others in your shelter or community). Several weeks later, you were relieved to be signing letters to all those who stayed in the shelter letting them know that they were not in danger of having contracted TB at the shelter.

References

Torok M. Epidemiologic Curves Ahead. *FOCUS on Field Epidemiology Vol 1, Iss 5*. MacDonald PDM, ed-in-chief; Alexander LA, Mejia GC, eds. Available at: https://nciph.sph.unc.edu/focus/vol1/issue5/1-5EpiCurves_issue.pdf. Accessed April 6, 2016.

Matthews GW, Abbott EB, Hoffman RE, et al. *Legal Authorities for Interventions in Public Health Emergencies in Law in Public Health Practice*. Goodman RA, ed. New York: Oxford University Press: 2007.

Infectious Disease and Dermatologic Conditions in Evacuees and Rescue Workers After Hurricane Katrina—Multiple States, August–September, 2005. *MMWR Morb Mortal Wkly Rep*. September 2005;54:961-964. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5438a6.htm. Accessed April 6, 2016.

Epidemiologic Notes and Reports Surveillance of Shelters After Hurricane Hugo—Puerto Rico. *MMWR Morb Mortal Wkly Rep*. 1990; 39:41-42, 47. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/00001545.htm. Accessed April 6, 2016.

N.C. Division of Public Health. Outbreak Investigations: Outbreak Steps. In: *North Carolina Communicable Disease Control Manual*. 2012. Available at: http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/toc.html. Accessed April 6, 2016.

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Post-Test

1. Which of the following describe active public health surveillance in a shelter?
    a. Provide information about the occurrence of infectious diseases
    b. Identify health-related topics about which to educate shelter residents
    c. Monitor sanitation and determine the availability of shelter facilities such as water, toilets, electricity, and medical care
    d. A and B only
    e. All of the above

2. True or False: Public health departments can conduct medical screening before admitting any new people arriving to a shelter.

3. An epidemic curve can be used to provide information on a potential outbreak's:
    a. Pattern of spread
    b. Magnitude
    c. Time (exposure and/or disease incubation period)
    d. All of the above

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Answer Key

1. Which of the following describe active public health surveillance in a shelter?
    a. Provide information about the occurrence of infectious diseases
    b. Identify health-related topics about which to educate shelter residents
    c. Monitor sanitation and determine the availability of shelter facilities such as water, toilets, electricity, and medical care
    d. A and B only
    e. All of the above

    Answer: e. All of the above

    Feedback: Active surveillance of shelters could be a responsibility for public health. In such a situation, active public health surveillance should include occurrence of infectious diseases to rapidly identify potential outbreaks of highly contagious diseases such as Norovirus or other diarrheal illness, providing health education, and monitoring sanitation and other environmental health concerns to help ensure the safety of shelter residents.

2. True or False: Public health departments can conduct medical screening before admitting any new people arriving to a shelter.

    Answer: True

    Feedback: Health directors have the responsibility to protect other residents of the shelter from exposure to contagious diseases or other health risks that can threaten their safety. The health director does have the ability to "order a specific individual who poses a real threat to undergo a physical examination, to provide information, or even to detain that person in a medical or other public facility" (Law in Public Health Practice, Legal Authorities for Interventions in Public Health Emergencies*, p. 271). A screening program should be instituted if people coming to the shelter may have a communicable disease. Known infected persons, such as those with vomiting, diarrhea, or respiratory symptoms such as cough or fever may be admitted, but should be kept isolated from the general shelter population if possible.*

3. An epidemic curve can be used to provide information on a potential outbreak's:
    a. Pattern of spread
    b. Magnitude
    c. Time (exposure and/or disease incubation period)
    d. All of the above

    Answer: d. All of the above

Feedback: An epidemic curve can provide information on an outbreak's magnitude (size), the pattern of spread (e.g., point source or propagated), and the exposure and/or disease incubation period.

Case Study 1: Acute Respiratory Disease Outbreak in a Hurricane Evacuation Center
Session Evaluation

Congratulations on completing Case Study 1 of the *P is for Practice* training.

To ensure the best learning experience possible for training participants, we would like your feedback. This feedback is carefully reviewed by staff to make continual improvements to training materials.

In addition, you must complete the evaluation in order to receive a certificate of completion or continuing education credit (if applicable) for this case study.

The evaluation for this training is available online at:
http://tiny.cc/pps1p

To begin the evaluation, you will need to log in to the NC institute for Public Health Training Website. If you have previously taken online trainings through the Training Website (including other trainings in the *E is for Epidemiology* or *I is for Investigation* curriculum), you may use your existing username and password to log in to this evaluation. If this is your first time visiting the Training Website, you must complete a short registration to create your username and password; instructions will be provided.

Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

Case Study 2: Mercury Poisoning in a Hispanic Community
Session Overview

Instructions
For the purposes of this exercise, you will be asked to work in groups to participate in a mercury poisoning investigation that is based on a true scenario. Information regarding the scenario will be provided to you in parts, each of which will be followed by related discussion questions.

Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to formulate answers to each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital, and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
90 minutes

Learning Objectives
- List common sources of mercury exposure
- Identify appropriate control measures to prevent additional cases of mercury poisoning
- Develop risk communication messages for the public

Case Study 2: Mercury Poisoning in a Hispanic Community
Pre-Test

1. Which of the following are questions to be asked when conducting an interview with a patient to assess his or her potential exposure to mercury?
    a. Do you take any vitamins, dietary supplements, alternative medicines or herbal remedies?
    b. Do you have any tattoos?
    c. Are you involved in the manufacturing of thermometers, barometers, thermostats, blood pressure machines, chlorine, batteries, fluorescent lights, or jewelry?
    d. What types of fish do you eat?
    e. All of the above
    f. A, C, D only

2. True or False: Health department employees are authorized to confiscate products with known health risks and prohibit a store from selling them.

3. Which of the following state and/or federal agencies should be notified if mercury has been found in a product?
    a. State health department
    b. FDA
    c. EPA
    d. Office of the Attorney General
    e. All of the above
    f. A and B only

4. True or False: Pilot-testing media messages with the intended audience can help to ensure the cultural appropriateness of your message.

Case Study 2: Mercury Poisoning in a Hispanic Community
Student Guide

Situation

You work in the environmental health unit of a local health department. This morning, you receive a call from LabTech, a private laboratory that conducts many laboratory tests for healthcare providers in your county. The lab is calling to report a mercury level of 90µg/L (micrograms per liter) in the urine of a 31-year-old woman. A mercury level of 10µg/L or above in urine or blood is considered to be elevated.

1. What information would you want from the laboratory that conducted the test?

Update 1

Before proceeding further, you conduct some basic research about mercury, including a search for journal articles about mercury exposure. Below is a brief summary of your findings. (Table 1)

Mercury is a toxic metal that can cause damage to the nervous system and kidneys, and is especially dangerous for fetuses, infants, and young children. Mercury testing is not routine, and is usually conducted only when mercury exposure has been suspected.

The forms of mercury and some common types of exposure are listed below. In general, high levels of mercury in the urine indicate **inorganic** mercury exposure (from occupational or other exposure, while high levels in the blood indicate **organic** mercury exposure from fish and shellfish consumption.

Table 1. Summary of Research Findings

Form	Exposures	Found In
Inorganic (including metallic)	◆ Accidental spills (e.g., broken thermometers) ◆ Inhalation from combustion of mercury-containing fuels or waste ◆ Occupational inhalation for workers ◆ Dental amalgam (for fillings) ◆ Creams and ointments used for antiseptic or skin-lightening purposes ◆ Use of elemental mercury in religious rituals and ceremonies	Urine Whole blood (only for recent exposures)
Organic (methylmercury)	◆ Fish and shellfish consumption	Whole blood Scalp hair (uncommon)

2. Based on the information provided, do you think the woman was exposed to organic or inorganic mercury? How does this information affect your assessment of likely source(s) of exposure? What additional test(s) could confirm the type of mercury?

3. What is the possibility that other people in the patient's household or workplace may also be exposed to mercury?

Update 2

According to LabTech, the urine testing was ordered by a local physician, Dr. Lockhart. You contact Dr. Lockhart, who explains that she requested the test because her patient, Maria Rivera, had been experiencing slight tremors for about a year. Dr. Lockhart had ruled out other causes and decided to test for heavy metal exposure as a last effort to determine the cause of the tremors. A urine test confirmed high levels of mercury. Dr. Lockhart is very concerned about finding the source of Maria's mercury exposure and provides you with Maria's phone number so you can contact Maria directly. You decide to conduct a telephone interview with Maria. Dr. Lockhart also agrees to conduct a blood test for mercury to confirm that the exposure is inorganic.

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What questions will you ask Maria to assess her potential exposures to mercury?

Update 3

You call Maria and learn that she primarily speaks Spanish, so you ask one of your bilingual colleagues to conduct the interview in Spanish. Maria is somewhat reluctant to participate in an interview over the phone, but your colleague is able to get some limited information (see below).

- Age: 31
- Health: good, no chronic health problems or current symptoms (other than tremors) reported
- Fish consumption: 2 meals weekly, includes albacore tuna and fresh tuna but no swordfish or shark
- Accidental spills: none recalled
- Occupation: floral arranging
- Country of origin: Mexico
- Family: husband and two children (ages 3 and 5)

Lab testing results show a blood mercury level of 15µg/L, which is slightly elevated, but within the expected range of 2-20µg/L found in people who consume fish.

5. How does this affect your hypothesis about Maria's probable source of mercury exposure?

6. What are the next steps you would take to narrow down the source of Maria's mercury exposure?

Update 4

You decide to conduct a home investigation to identify the specific source of Maria's exposure. You and a colleague take samples of the paint, air, and soil around her home. You ask Maria if she uses herbal remedies or skin creams. She shows you a bottle of herbal supplements, and a cream that she uses every night for skin lightening.

With her permission, you take both bottles to the laboratory, where testing reveals the skin-lightening cream contains mercury at 6,100 parts per million, far higher than the 1 ppm threshold allowed by the Food and Drug Administration for cosmetic products (21 CFR 700.13).

You contact Maria to share this information, advise her not to use the cream, and find out where she bought the cream. You realize that since mercury testing is not conducted routinely, there could be many other people in your community using the skin cream.

7. What strategies will you use to determine if there are additional cases of mercury poisoning in Maria's family or the community?

Update 5

Maria tells you that she bought the cream at a local Hispanic beauty supply store. You visit the store, and find several bottles of the same skin-lightening cream on the shelf. You also notice that there are two other types of skin-lightening creams, one with mercury salt listed as an ingredient, and the other without a list of ingredients.

8. You would like to ensure that the beauty supply store stops selling these skin creams. As a health department employee, do you have the authority to confiscate products with known health risks and prohibit the store from selling them?

9. Which state and/or federal agencies should you notify about this situation?

Update 6

Your health director decides to issue an order prohibiting the sale of any brand of skin-lightening cream containing mercury or mercury salts. This order will be distributed to all stores in the county that sell cosmetic products. However, since many people may already have skin creams at home, you would like to craft a message to the public warning them about the dangers of using such creams.

10. **Group Activity:** Work together to create a short message about the danger of mercury exposure from skin-lightening creams. When developing your message, consider your intended audience and method of delivery (e.g., television, radio, print or social media).

11. How can you ensure that your message is culturally appropriate for your intended audience?

12. Are you aware of groups in your own community that may be exposed to mercury through occupational exposure, use of mercury in products or rituals, or other sources?

Conclusion

You disseminate an advisory about the skin creams in both English and Spanish to the general public and post warnings about the skin creams in beauty-supply stores throughout the area. Your environmental health unit conducts inspections of local stores to ensure that the skin-lightening creams have been removed from the shelves. You also begin to work with your local Hispanic coalition to develop and pilot test health messages that are specifically focused on Spanish-speaking Latino populations.

Meanwhile, area laboratories report an increase in the number of mercury tests conducted, which you interpret as an indication of increased awareness of mercury poisoning among healthcare providers or the general public.

References

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for Mercury. Atlanta, Ga: U.S. Department of Health and Human Services, Public Health Service; 1999. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=115&tid=24. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Mercury (Inorganic) Case Definition. 2013. Available at http://emergency.cdc.gov/agent/mercury/mercinorgcasedef.asp. Accessed April 6, 2016.

Chan TY. Inorganic mercury poisoning associated with skin lightening cosmetic products. Clin Toxicol (Phila).2011;49(10):886-91.

Use of mercury compounds in cosmetics including use as skinbleaching agents in cosmetic preparations also regarded as drugs. Code of Federal Regulations, Title 21, Pt 700.13. Revised April 1, 2015. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=9f9565267f4d3fb9397fda43aa0a254b&mc=true&node=se21.7.700_113&rgn=div8. Accessed April 6, 2016.

Washam C. Beastly beauty products: exposure to inorganic mercury in skin-lightening creams. Environ Health Perspect. 2011;119(2):A80-A81.

Case Study 2: Mercury Poisoning in a Hispanic Community
Facilitator Guide

Situation

You work in the environmental health unit of a local health department. This morning, you receive a call from LabTech, a private laboratory that conducts many laboratory tests for healthcare providers in your county. The lab is calling to report a mercury level of 90µg/L (micrograms per liter) in the urine of a 31-year-old woman. A mercury level of 10µg/L or above in urine or blood is considered to be elevated.

1. What information would you want from the laboratory that conducted the test?

Suggested answer: *You would want demographic and contact information for the woman, contact information for the provider who ordered the test, and data about the accuracy of the test (e.g., the percent of false positive tests).*

Update 1

Before proceeding further, you conduct some basic research about mercury, including a search for journal articles about mercury exposure. Below is a brief summary of your findings. (Table 1)

Mercury is a toxic metal that can cause damage to the nervous system and kidneys, and is especially dangerous for fetuses, infants, and young children. Mercury testing is not routine, and is usually conducted only when mercury exposure has been suspected.

The forms of mercury and some common types of exposure are listed below. In general, high levels of mercury in the urine indicate **inorganic** mercury exposure (from occupational or other exposure), while high levels in the blood indicate **organic** mercury exposure from fish and shellfish consumption.

Table 1. Summary of Research Findings

Form	Exposures	Found In
Inorganic (including metallic)	◆ Accidental spills (e.g., broken thermometers) ◆ Inhalation from combustion of mercury-containing fuels or waste ◆ Occupational inhalation for workers ◆ Dental amalgam (for fillings) ◆ Creams and ointments used for antiseptic or skin-lightening purposes ◆ Use of elemental mercury in religious rituals and ceremonies	Urine Whole blood (only for recent exposures)
Organic (methylmercury)	◆ Fish and shellfish consumption	Whole blood Scalp hair (uncommon)

2. Based on the information provided, do you think the woman was exposed to organic or inorganic mercury? How does this information affect your assessment of likely source(s) of exposure? What additional test(s) could confirm the type of mercury?

Suggested answer: *Because the elevated mercury level was detected using a urine test, the woman was likely exposed to inorganic mercury. A blood test could rule out fish consumption as the source. Assuming the test confirms inorganic mercury exposure, you are less concerned with fish and shellfish consumption (which are associated with* ***organic*** *mercury), and more concerned with environmental sources of mercury exposure, including accidental spills, occupational exposure, cosmetic products, dental amalgams, and religious rituals using elemental mercury.*

3. What is the possibility that other people in the patient's household or workplace may also be exposed to mercury?

Suggested answer: *It is certainly possible. Several sources of mercury exposure are environmental sources that could result in exposure to more than one individual. You need to follow up with the patient to get more details about her potential exposures. Also, mercury can be passed between a mother and fetus, or between mothers and nursing infants, so you should be sure to find out whether the patient is pregnant or breastfeeding.*

Update 2

According to LabTech, the urine testing was ordered by a local physician, Dr. Lockhart. You contact Dr. Lockhart, who explains that she requested the test because her patient, Maria Rivera, had been experiencing slight tremors for about a year. Dr. Lockhart had ruled out other causes and decided to test for heavy metal exposure as a last effort to determine the cause of the tremors. A urine test confirmed high levels of mercury. Dr. Lockhart is very concerned about finding the source of Maria's mercury exposure and provides you with Maria's phone number so you can contact Maria directly. You decide to conduct a telephone interview with Maria. Dr. Lockhart also agrees to conduct a blood test for mercury to confirm that the exposure is inorganic.

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What questions will you ask Maria to assess her potential exposures to mercury?

Suggested answer: *You should ask about possible exposures in several categories:*

- *Product use – vitamins, dietary supplements, alternative medicines, herbal remedies, skin-lightening creams, silver metal to purify or cleanse the home, amulets with silver liquid, floor washes, visits to botanicas (a store where people buy herbs and religious items like candles and ask for advice)*
- *Occupational exposure – manufacturing thermometers, barometers, thermostats, blood pressure machines, chlorine, batteries, fluorescent lights, or jewelry; repairing medical equipment, removal of hazardous waste, repairing computers, or work in a laboratory or pharmacy.*
- *Environmental exposure –broken thermometer or fluorescent light, handling batteries*
- *Other exposures – dental fillings, vaccines, tattoos*
- *Fish consumption – types of fish (specifically albacore tuna, fresh tuna, swordfish, and shark), frequency of consumption, source (especially if caught rather than purchased in a grocery store or restaurant)*

You should also gather demographic information, including address, phone number(s), type of dwelling, country of birth, ancestry, travel outside U.S. in the past year, pregnancy and breastfeeding status.

Update 3

You call Maria and learn that she primarily speaks Spanish, so you ask one of your bilingual colleagues to conduct the interview in Spanish. Maria is somewhat reluctant to participate in an interview over the phone, but your colleague is able to get some limited information (see below).

- Age: 31
- Health: good, no chronic health problems or current symptoms (other than tremors) reported
- Fish consumption: 2 meals weekly, includes albacore tuna and fresh tuna but no swordfish or shark
- Accidental spills: none recalled
- Occupation: floral arranging
- Country of origin: Mexico
- Family: husband and two children (ages 3 and 5)

Lab testing results show a blood mercury level of 15µg/L, which is slightly elevated, but within the expected range of 2-20µg/L found in people who consume fish.

5. How does this affect your hypothesis about Maria's probable source of mercury exposure?

Suggested answer: *The mercury level in the blood is not nearly as high as that in the urine, which would lead you to believe that she is being exposed to an inorganic, rather than organic, source of mercury. It appears as though her fish consumption is not the primary route of exposure.*

6. What are the next steps you would take to narrow down the source of Maria's mercury exposure?

Suggested answer: *Without conclusive evidence about a source of exposure from the telephone interview, you need to conduct a home investigation. The woman's urine mercury level (90ug/L) is well above the 10ug/L threshold considered to be elevated, so you need to be sure that the exposure is discontinued. Also, if she is being exposed through some environmental source, such as an accidental spill, paint, or contaminated soil, it is possible that others (including children) are also being exposed. You should recommend that the other members of the woman's household also be tested for elevated mercury levels. It is also recommended that someone fluent in*

Spanish conduct a follow-up in-person interview to talk in more detail about occupational exposures, cosmetics, and any religious rituals.

Update 4

You decide to conduct a home investigation to identify the specific source of Maria's exposure. You and a colleague take samples of the paint, air, and soil around her home. You ask Maria if she uses herbal remedies or skin creams. She shows you a bottle of herbal supplements, and a cream that she uses every night for skin lightening.

With her permission, you take both bottles to the laboratory, where testing reveals the skin-lightening cream contains mercury at 6,100 parts per million, far higher than the 1 ppm threshold allowed by the Food and Drug Administration for cosmetic products (21 CFR 700.13).

You contact Maria to share this information, advise her not to use the cream, and find out where she bought the cream. You realize that since mercury testing is not conducted routinely, there could be many other people in your community using the skin cream.

7. What strategies will you use to determine if there are additional cases of mercury poisoning in Maria's family or the community?

Suggested answer: *One initial strategy is to visit the store where Maria reported buying the skin cream to determine if it is still being sold there. Then it may be necessary to visit other area stores to determine if that cream or similar creams containing mercury are being sold throughout the area. You may try to contact the manufacturer or distributor to pull the product from the shelves. You may also want to post warnings in any stores that sell similar creams.*

It is unlikely that you will be able to get lists of people who have purchased the cream, so you will probably have to issue an advisory to the general public. Finally, you may want to ask Maria whether she has any relatives or friends who use the same skin-lightening cream, and if so, obtain their contact information so you can recommend that they stop using the cream and be tested for mercury.

Update 5

Maria tells you that she bought the cream at a local Hispanic beauty supply store. You visit the store, and find several bottles of the same skin-lightening cream on the shelf. You also notice that there are two other types of skin-lightening creams, one with mercury salt listed as an ingredient, and the other without a list of ingredients.

8. You would like to ensure that the beauty supply store stops selling these skin creams. As a health department employee, do you have the authority to confiscate products with known health risks and prohibit the store from selling them?

Suggested answer: *The United States Food and Drug Administration (FDA) has the authority to require that stores stop selling the products, so you should contact the FDA first. They may want to get involved and resolve the situation, since products containing mercury are NOT approved by the FDA, except in very specific and limited circumstances. If the FDA does not take action, you can ask stores to remove the products, but you cannot require them to remove the products from their shelves.*

9. Which state and/or federal agencies should you notify about this situation?

Suggested answer: *You should contact your state health department, because the state environmental health officer may want to issue a statewide advisory. Your state health department may also contact the FDA. Although the FDA does not approve cosmetic products before they go on the market, it does enforce certain regulations, including a requirement that cosmetics contain no more than 1 ppm mercury.*

Update 6

Your health director decides to issue an order prohibiting the sale of any brand of skin-lightening cream containing mercury or mercury salts. This order will be distributed to all stores in the county that sell cosmetic products. However, since many people may already have skin creams at home, you would like to craft a message to the public warning them about the dangers of using such creams.

10. **Group Activity:** Work together to create a short message about the danger of mercury exposure from skin-lightening creams. When developing your message, consider your intended audience and method of delivery (e.g., television, radio, print or social media).

Suggested answer: *The message should especially focus on the Hispanic community, and may be disseminated via social media, radio, television, print flyers, and community education. Issues to address include:*

- *products that contain dangerous levels of mercury;*
- *symptoms and health effects of mercury poisoning;*
- *where to go for testing of mercury poisoning;*
- *medical treatment for mercury poisoning; and*
- *how to safely dispose of products containing dangerous levels of mercury.*

11. How can you ensure that your message is culturally appropriate for your intended audience?

Suggested answer: *Some strategies include:*

- *involving people from the intended audience in message development;*
- *pilot-testing the message with the intended audience (Pilot testing helps to ensure messages are clear, appropriate, effective, and not offensive to the intended audience);*
- *ensuring that the message is at the appropriate reading level and translated into appropriate languages (Spanish in this case);*
- *ensuring any materials use culturally appropriate images; and*
- *disseminating the message through trustworthy sources in the community (consider partnering with Hispanic/Latino media outlets and/or pastors in the area who have expertise communicating with this population).*

12. Are you aware of groups in your own community that may be exposed to mercury through occupational exposure, use of mercury in products or rituals, or other sources?

Suggested answer: *Answers will vary. Encourage group members to share their own experiences.*

Conclusion

You disseminate an advisory about the skin creams in both English and Spanish to the general public and post warnings about the skin creams in beauty-supply stores throughout the area. Your environmental health unit conducts inspections of local stores to ensure that the skin-lightening creams have been removed from the shelves. You also begin to work with your local Hispanic coalition to develop and pilot test health messages that are specifically focused on Spanish-speaking Latino populations.

Meanwhile, area laboratories report an increase in the number of mercury tests conducted, which you interpret as an indication of increased awareness of mercury poisoning among healthcare providers or the general public.

References

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for Mercury. Atlanta, Ga: U.S. Department of Health and Human Services, Public Health Service; 1999. Available at: http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=115&tid=24. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Mercury (Inorganic) Case Definition. 2013. Available at http://emergency.cdc.gov/agent/mercury/mercinorgcasedef.asp. Accessed April 6, 2016.

Chan TY. Inorganic mercury poisoning associated with skin lightening cosmetic products. Clin Toxicol (Phila).2011;49(10):886-91.

Use of mercury compounds in cosmetics including use as skinbleaching agents in cosmetic preparations also regarded as drugs. Code of Federal Regulations, Title 21, Pt 700.13. Revised April 1, 2015. Available at: http://www.ecfr.gov/cgi-bin/text-idx?SID=9f9565267f4d3fb9397fda43aa0a254b&mc=true&node=se21.7.700_113&rgn=div8. Accessed April 6, 2016.

Washam C. Beastly beauty products: exposure to inorganic mercury in skin-lightening creams. Environ Health Perspect. 2011;119(2):A80-A81.

Case Study 2: Mercury Poisoning in a Hispanic Community
Post-Test

1. Which of the following are questions to be asked when conducting an interview with a patient to assess his or her potential exposure to mercury?
    a. Do you take any vitamins, dietary supplements, alternative medicines or herbal remedies?
    b. Do you have any tattoos?
    c. Are you involved in the manufacturing of thermometers, barometers, thermostats, blood pressure machines, chlorine, batteries, fluorescent lights, or jewelry?
    d. What types of fish do you eat?
    e. All of the above
    f. A, C, D only

2. True or False: Health department employees are authorized to confiscate products with known health risks and prohibit a store from selling them.

3. Which of the following state and/or federal agencies should be notified if mercury has been found in a product?
    a. State health department
    b. FDA
    c. EPA
    d. Office of the Attorney General
    e. All of the above
    f. A and B only

4. True or False: Pilot-testing media messages with the intended audience can help to ensure the cultural appropriateness of your message.

Case Study 2: Mercury Poisoning in a Hispanic Community Answer Key

1. Which of the following are questions to be asked when conducting an interview with a patient to assess his or her potential exposure to mercury?
    a. Do you take any vitamins, dietary supplements, alternative medicines or herbal remedies?
    b. Do you have any tattoos?
    c. Are you involved in the manufacturing of thermometers, barometers, thermostats, blood pressure machines, chlorine, batteries, fluorescent lights, or jewelry?
    d. What types of fish do you eat?
    e. All of the above
    f. A, C, D only

    Answer: e. All of the above.

    Feedback: When conducting an interview with a patient to assess his or her potential exposure to mercury, you should ask questions about product use; occupational and environmental exposure; other exposures such dental fillings, vaccines, tattoos; and fish consumption.

2. True or False: Health department employees are authorized to confiscate products with known health risks and prohibit a store from selling them.

    Answer: False

    Feedback: A health department employee can ask stores to remove the products, but cannot require the removal of the products from their shelves.

3. Which of the following state and/or federal agencies should be notified if mercury has been found in a product?
    a. State health department
    b. FDA
    c. EPA
    d. Office of the Attorney General
    e. All of the above
    f. A and B only

    Answer: f. A and B only.

    Feedback: The state health department and FDA should be notified if mercury has been found in a product. Both have the authority to prohibit the sale of products found to have more than 1 ppm mercury.

4. True or False: Pilot-testing media messages with the intended audience can help to ensure the cultural appropriateness of your message.

Answer: True.

Feedback: Pilot testing helps to ensure messages are clear, appropriate, effective, and not offensive to the intended audience. In addition to pilot testing, involving people from the intended audience in message development; ensuring that the message is at the appropriate reading level and translated into appropriate languages; ensuring any materials use culturally appropriate images; and disseminating the message through trustworthy sources in the community can also help to ensure the cultural appropriateness of your message.

Case Study 2: Mercury Poisoning in a Hispanic Community Session Evaluation

Congratulations on completing Case Study 2 of the *P is for Practice* training.

To ensure the best learning experience possible for training participants, we would like your feedback. This feedback is carefully reviewed by staff to make continual improvements to training materials.

In addition, you must complete the evaluation in order to receive a certificate of completion or continuing education credit (if applicable) for this case study.

The evaluation for this training is available online at:
http://tiny.cc/pps2p

To begin the evaluation, you will need to log in to the NC institute for Public Health Training Website. If you have previously taken online trainings through the Training Website (including other trainings in the *E is for Epidemiology* or *I is for Investigation* curriculum), you may use your existing username and password to log in to this evaluation. If this is your first time visiting the Training Website, you must complete a short registration to create your username and password; instructions will be provided.

Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Session Overview

Instructions
For the purposes of this exercise, you will be asked to work in groups to participate in a Hepatitis B investigation. Information regarding the scenario will be provided to you in parts, each of which will be followed by related discussion questions. Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to formulate answers to each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital, and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
90 minutes

Learning Objectives
- Identify populations vulnerable to infectious diseases
- Discuss outbreak investigation within a vulnerable population
- List methods to conduct investigations in vulnerable populations
- Employ alternate information-gathering techniques when cases may not be able to deliver reliable information

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Pre-Test

1. Which of the following categories of vulnerable populations may an elderly resident in a nursing home fall into?
    a. Institutionally vulnerable
    b. Deferentially vulnerable
    c. Economically vulnerable
    d. Medically vulnerable
    e. Socially vulnerable
    f. Communicatively/cognitively vulnerable
    g. All of the above
    h. A, D, and F only

2. Which of the following sources of information can be used to assess case-patient activities, when he or she is incapable of providing enough information?
    a. Family members
    b. Nursing home staff
    c. Medical records
    d. Nursing home activity schedules
    e. Guest lists
    f. All of the above
    g. A, B, and C only

3. True/False: It is unnecessary to obtain informed consent before testing contacts in a nursing home.

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Student Guide

Situation

Nursing homes are fertile ground for outbreaks of infectious disease because residents are often frail elders who may be vulnerable to infection and share sources of food, water, and medical resources. Conditions are often crowded, with many residents sharing a common living space. In addition, many people passing through the facility may introduce pathogens, including staff, visitors, and even the residents themselves. The most common outbreaks in nursing homes involve respiratory or gastrointestinal agents, but several outbreaks of Hepatitis B in nursing homes and long-term care facilities have been described in recent publications.

Hepatitis B (HBV) is a viral disease. Symptoms include nausea, vomiting, loss of appetite, and rash, and may progress to jaundice. Common modes of transmission are blood, blood products, saliva, and contaminated surfaces. HBV is transmitted much like HIV, but HBV is easier to catch because it is up to 100 times more concentrated in blood and can exist on surfaces outside the body. Acute HBV can be fatal (case fatality rate of 1%), especially in people over the age of 40 years; however, only a small percentage of acute HBV infections are clinically recognized. The most common method of control is the HBV vaccine.

Update 1: Day 1

You are a public health nurse at the local health department in charge of area outbreak investigations. You receive a telephone call from a local lab worker who reports two confirmed cases of HBV at a local nursing home. Although calls for influenza or other respiratory outbreaks in nursing homes within the region are somewhat routine, the local health department has never experienced an HBV outbreak in this population. Last year, there were five confirmed HBV cases in your community, all among people who shared a common risk factor of intravenous drug use.

You call the nursing home to gain more information about the cluster, and they refer you to the home's on-call physician, Dr. Susan Roberts.

1. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What information do you want to obtain from the physician over the phone?

Update 2: Day 1

You ask Dr. Roberts why she did not report the suspect cases, and she explains that she is only the on-call physician. Every patient can choose a private physician, but she responds to urgent care situations at the nursing home. Because the two cases had their own private physicians and HBV was not immediately suspected due to differential diagnoses, the lab tests for HBV were delayed.

Dr. Roberts is unsure of the source and requests help from a health department epidemiology team to conduct an investigation. Dr. Roberts is also worried about four other residents who have been exhibiting symptoms of nausea, vomiting, and rash over the last week. She has submitted specimens to the lab, but has not yet received any results. Because there are at least two cases with potentially the same exposure, you assemble an epidemiologic team to visit the nursing home. Before leaving, you meet quickly to discuss the situation.

2. Would you consider the patients in this setting a vulnerable population? What makes this population potentially vulnerable or not vulnerable?

3. If they are considered a vulnerable population, what challenges may arise during the investigation? How may this investigation differ from other epi investigations?

Update 3: Day 1

The epi team arrives at the nursing home in the early afternoon. Dr. Roberts has asked the head of nursing to meet you and provide some background about the facility:

- The nursing home holds 160 residents, 1-2 to a room on 4 floors.
- The residents are cared for by approximately 100 staff members.
- The floors are divided by need for care:
  - Independent Living
  - Assisted Living (may need help bathing, dressing, etc.)
  - Nursing (residents may have dementia, Alzheimer's disease, etc.)
  - Hospice (end of life, palliative care)
- Each unit has a strict separation of staff and care tools.
- Visiting hours are 9 am to 5 pm daily.

The head of nursing arranges for you to speak with the nursing staff who have contact with the patients.

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What information would you need to know from the nursing staff to create a case definition for this outbreak? (A case definition should include information about person, place, and time.)

5. What are some of the known risk factors for HBV infection?

6. What other information would you collect from the nursing staff?

7. Why is it important to ask open-ended questions of cases and staff about potential risk factors?

Update 4: Day 1

Interviews with the nursing staff reveal that the two case-patients are not confined to one area in the building; they live on separate floors and have multiple medical conditions. Nursing staff also tell you that residents receive epidermal injections for many purposes, including B12 shots, iron supplements, blood glucose monitoring, and more, but assure you that medical supplies and nursing staff are isolated to each floor. The nurses indicate that neither of the case-patients has been vaccinated against HBV, although a portion of the residents are vaccinated. At this point, you ask to interview the case-patients about potential risk factors.

8. **Group Activity.** Divide into pairs and conduct a mock interview with case-patients. One person should play the role of the interviewer using the questionnaire topics discussed above, and the other person should play the role of either Case-Patient #1 or Case-Patient #2 using the information provided in Table 1 below. What information would the investigator want to collect, and how might the case-patient respond?

   Be sure that both case-patients are "interviewed." After each pair has practiced the interviews, discuss the interviewing process as a group.

Table 1. Case-Patient Information

Case-Patient #1	**Case-Patient #2**
Mrs. Johnson is an 84 year old widowed white female. She has senile dementia, along with other mental and physical disorders, and lives on the nursing floor. The nursing staff tells you that Mrs. Johnson often experiences paranoia as part of her dementia.	Mr. Sanchez is a 75 year old Hispanic male. He is fairly independent and lives on the assisted living floor. He has been admitted to the hospital intensive care unit and finds it difficult to answer questions.

9. Is it still important to interview patients even if they do not give you much information? Why or why not?

Update 5: Day 1

Interviews conducted with patients reveal little information. Case-Patient #1 does not recall much, but does mention a man who is stealing things from her room. Case-Patient #2 was unavailable for questioning. It is now late in the afternoon. Before leaving, you meet with your team to discuss plans for the next day.

10. Since interviews with case-patients did not reveal much information, what other sources of information on case-patient activities could you investigate?

11. Because a major risk factor for HBV infection is close contact with someone who has HBV, it is important to identify close contacts of known patients. How will "close contacts" differ for people on more care-intensive floors (i.e., nursing and hospice)? Would risk factors also differ based on the patient's vulnerability?

12. Would active case finding be important, given this population? Why or why not? Who would you test? Who might you exclude?

Update 6: Day 2

The team returns the next morning to continue investigations. Medical records for the two case-patients indicate that both patients are treated by the same practitioner. They receive injections of vitamin B-12 and are both diabetic. While reviewing their records as part of the epidemiologic investigation, you also begin performing a serological investigation on staff and close contacts of all case-patients (suspected and confirmed) as part of active case finding, since many acute HBV infections can go unrecognized.

13. Is it necessary to obtain informed consent before testing contacts? What if residents are unable to give informed consent because of mental health conditions?

14. At this stage, would you take any other action steps, such as vaccination of other residents and/or staff? Why or why not?

Update 7: Day 5

A total of 96 patients and 45 staff members were tested for serological markers of HBV infection. Tests reveal 9 new acute infections among the resident population and 0 cases among the staff.

15. What's next in the investigation? What procedures do you use to investigate the 9 new cases?

Conclusion

Over the next week, a total of 30 case-patients are confirmed through laboratory tests. One death is confirmed due to HBV. As a result of your epidemiologic investigation, diabetic blood glucose monitoring was identified as a common risk factor. An unmatched case-control study statistically linked cases to blood glucose monitoring for patients with diabetes mellitus on a certain day.

Although proper infectious control practices were used for needle care during the capillary blood sampling, environmental sampling revealed the most likely source of contamination was the alcohol dispenser, which was located near the diabetic blood glucose samples and may have been contaminated. Healthcare-acquired infections are a common context for HBV.

16. How would you protect a vulnerable population such as the elderly living in an institution from future healthcare-associated (nosocomial) infections or other threats?

References

De Schrijver K, et al. An outbreak of nosocomial Hepatitis B infection in a nursing home for the elderly in Antwerp (Belgium). *Acta Clin Belg*. 2005;60:63-69.

Dreesman JM, Baillot A, Hamschmidt A, Monazahian M, Wend UC, Gerlich WH. Outbreak of hepatitis B in a nursing home associate with capillary blood sampling. *Epidemiol Infect*. 2005;5:760-772.

Perz, JF, Fiore AE. Hepatitis B virus infection risks among diabetic patients residing in long-term care facilities. *Clin Infect Dis*. 2005;40(7):990-6.

Thompson ND, Perz JF, Moorman AC, Holmberg SD. Nonhospital health care-associated hepatitis B and C transmission: United States – 1998-2008. *Ann Intern Med*. 2009;150(1):33-9.

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Facilitator Guide

Situation

Nursing homes are fertile ground for outbreaks of infectious disease because residents are often frail elders who may be vulnerable to infection and share sources of food, water, and medical resources. Conditions are often crowded, with many residents sharing a common living space. In addition, many people passing through the facility may introduce pathogens, including staff, visitors, and even the residents themselves. The most common outbreaks in nursing homes involve respiratory or gastrointestinal agents, but several outbreaks of Hepatitis B in nursing homes and long-term care facilities have been described in recent publications.

Hepatitis B (HBV) is a viral disease. Symptoms include nausea, vomiting, loss of appetite, and rash, and may progress to jaundice. Common modes of transmission are blood, blood products, saliva, and contaminated surfaces. HBV is transmitted much like HIV, but HBV is easier to catch because it is up to 100 times more concentrated in blood and can exist on surfaces outside the body. Acute HBV can be fatal (case fatality rate of 1%), especially in people over the age of 40 years; however, only a small percentage of acute HBV infections are clinically recognized. The most common method of control is the HBV vaccine.

Update 1: Day 1

You are a public health nurse at the local health department in charge of area outbreak investigations. You receive a telephone call from a local lab worker who reports two confirmed cases of HBV at a local nursing home. Although calls for influenza or other respiratory outbreaks in nursing homes within the region are somewhat routine, the local health department has never experienced an HBV outbreak in this population. Last year, there were five confirmed HBV cases in your community, all among people who shared a common risk factor of intravenous drug use.

You call the nursing home to gain more information about the cluster, and they refer you to the home's on-call physician, Dr. Susan Roberts.

1. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What information do you want to obtain from the physician over the phone?

Suggested answer: *You would want to gain information that includes the following:*

- *Cases: symptoms, date of onset, status, current treatment, other health conditions, date of nursing home entry*
- *Nursing home: how many residents, whether residents are screened for any diseases, whether vaccines are required, living conditions (number per room, etc.), whether any routine procedures are performed at the home (blood draws, etc.)*
- *Other residents: whether any other residents are displaying symptoms or have known HBV infection.*

Update 2: Day 1

You ask Dr. Roberts why she did not report the suspect cases, and she explains that she is only the on-call physician. Every patient can choose a private physician, but she responds to urgent care situations at the nursing home. Because the two cases had their own private physicians and HBV was not immediately suspected due to differential diagnoses, the lab tests for HBV were delayed.

Dr. Roberts is unsure of the source and requests help from a health department epidemiology team to conduct an investigation. Dr. Roberts is also worried about four other residents who have been exhibiting symptoms of nausea, vomiting, and rash over the last week. She has submitted specimens to the lab, but has not yet received any results. Because there are at least two cases with potentially the same exposure, you assemble an epidemiologic team to visit the nursing home. Before leaving, you meet quickly to discuss the situation.

2. Would you consider the patients in this setting a vulnerable population? What makes this population potentially vulnerable or not vulnerable?

Suggested answer: *Vulnerable populations can be hard to define, but generally can be classified into the five categories below (from literature review of vulnerable populations during an emergency by Phyllis Gray, MPH, North Carolina Division of Public Health).*
Elderly residents in a nursing home fall into many of these categories.

- *Communicatively/cognitively vulnerable: those unable to sufficiently understand or comprehend information, deliberate, and make decisions*
- *Institutionally vulnerable: those who exist under the formal authority of others for food, shelter, medical care, and social interaction (e.g., nursing home)*
- *Deferentially vulnerable: those dependent on the informal authority and independent interests of others (e.g., frail elders dependent on family member)*

- *Economically vulnerable: those with limited resources*
- *Medically vulnerable: those with existing medical conditions (including mental illness and persons with drug and/or alcohol dependence)*
- *Socially vulnerable: those for whom social factors and forces create the susceptibility to harm, which can affect their ability to respond to a health crisis (e.g., racial/ethnic minorities, the homeless, tourists unfamiliar with an area)*

3. If they are considered a vulnerable population, what challenges may arise during the investigation? How may this investigation differ from other epi investigations?

Suggested answer: *Communication may be the biggest challenge in this investigation. Depending on several factors, including the patient's mental and physical condition (e.g., auditory or visual difficulties), it may be difficult to obtain information directly from the patient about potential risk factors. Secondly, the residents are the formal responsibility of the nursing home. This may present both a challenge of having to navigate the bureaucracy of the home, and an advantage if good records are kept as part of nursing home protocols.*

Update 3: Day 1

The epi team arrives at the nursing home in the early afternoon. Dr. Roberts has asked the head of nursing to meet you and provide some background about the facility:

- The nursing home holds 160 residents, 1-2 to a room on 4 floors.
- The residents are cared for by approximately 100 staff members.
- The floors are divided by need for care:
  - Independent Living
  - Assisted Living (may need help bathing, dressing, etc.)
  - Nursing (residents may have dementia, Alzheimer's disease, etc.)
  - Hospice (end of life, palliative care)
- Each unit has a strict separation of staff and care tools.
- Visiting hours are 9 am to 5 pm daily.

The head of nursing arranges for you to speak with the nursing staff who have contact with the patients.

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What information would you need to know from the nursing staff to create a case definition for this outbreak? (A case definition should include information about person, place, and time.)

Suggested answer: *Every case definition should include elements related to the person, place, and time. Some possible characteristics to consider when creating the case definition are:*

- *Person: age, gender, co-morbidities, required procedures (e.g., dialysis), other relevant characteristics where applicable (occupation, sexual orientation, etc.)*
- *Place: floor, room, wing of nursing home where exposure was thought to take place*
- *Time: dates during which exposure is thought to have been possible*

A case definition can emphasize getting all possible cases or only those with the exact illness you are investigating. You generally start with a "loose" definition early in the investigation, which lends itself to identifying anyone who might possibly be a case. It is better to gather too much information than too little.

5. What are some of the known risk factors for HBV infection?

Suggested answer: *HBV is spread through blood, blood products, saliva, and contaminated surfaces. Risk factors include close contact with HBV-positive people, unprotected sexual behavior, injection drug use, manicures/pedicures, breast milk, acupuncture, and medical and dental procedures.*

6. What other information would you collect from the nursing staff?

Suggested answer: *Because the nursing staff are in close contact with the residents, it would be a good idea to obtain some preliminary information from the staff about any resident exposures to risk factors, infection control practices during routine medical resources, which visitors are allowed close contact with residents, any symptoms among staff, any procedures performed by nursing home staff, what equipment is used, etc.*

7. Why is it important to ask open-ended questions of cases and staff about potential risk factors?

Suggested answer: *Patients and nursing staff may identify important risk factors particular to this population that might otherwise have been overlooked (e.g., the nursing home brought in a hair stylist to cut residents' hair last month).*

Update 4: Day 1

Interviews with the nursing staff reveal that the two case-patients are not confined to one area in the building; they live on separate floors and have multiple medical conditions. Nursing staff also tell you that residents receive epidermal injections for many purposes, including B12 shots, iron supplements, blood glucose monitoring, and more, but assure you that medical supplies and nursing staff are isolated to each floor. The nurses indicate that neither of the case-patients has been vaccinated against HBV, although a portion of the residents are vaccinated. At this point, you ask to interview the case-patients about potential risk factors.

8. **Group Activity.** Divide into pairs and conduct a mock interview with case-patients. One person should play the role of the interviewer using the questionnaire topics discussed above, and the other person should play the role of either Case-Patient #1 or Case-Patient #2 using the information provided in Table 1 below. What information would the investigator want to collect, and how might the case-patient respond?

   Be sure that both case-patients are "interviewed." After each pair has practiced the interviews, discuss the interviewing process as a group.

Table 1. Case-Patient Information

Case-Patient #1	**Case-Patient #2**
Mrs. Johnson is an 84 year old widowed white female. She has senile dementia, along with other mental and physical disorders, and lives on the nursing floor. The nursing staff tells you that Mrs. Johnson often experiences paranoia as part of her dementia.	Mr. Sanchez is a 75 year old Hispanic male. He is fairly independent and lives on the assisted living floor. He has been admitted to the hospital intensive care unit and finds it difficult to answer questions.

Suggested answer: *Given that Mrs. Johnson suffers from paranoia and dementia, she may not be able to recall many events due to memory loss. Furthermore, she may be highly suspicious and paranoid about events that do not have an impact on the investigation. Periods of dementia are mixed with periods of normal behavior, so it may be hard for investigators to tell whether the patient is lucid or not.*

Given that Mr. Sanchez has difficulty answering questions, he may be able to provide limited or no information. In addition, he may have difficulty understanding or communicating in English. If Mr. Sanchez does not come from an English-speaking background, there may be cultural barriers to the investigation as well.

9. Is it still important to interview patients even if they do not give you much information? Why or why not?

Suggested answer: *Opinions may vary, but for a population dependent on institutional care, being excluded from involvement in their own medical care can be a disempowering experience.*

Update 5: Day 1

Interviews conducted with patients reveal little information. Case-Patient #1 does not recall much, but does mention a man who is stealing things from her room. Case-Patient #2 was unavailable for questioning. It is now late in the afternoon. Before leaving, you meet with your team to discuss plans for the next day.

10. Since interviews with case-patients did not reveal much information, what other sources of information on case-patient activities could you investigate?

Suggested answer: *Given that all case-patients so far are residents of the nursing home, there are several common resources that the team could use to gain more information. Family members and staff could become "proxy" interviewees, but it would be important to note this on the questionnaire for comparison later. Medical record review could also provide vital sources of information if the patients share common medical risk factors, particularly if the disease is acquired through health care procedures. Other sources of information that could be used include activity schedules for the nursing home and guest lists from the front desk.*

11. Because a major risk factor for HBV infection is close contact with someone who has HBV, it is important to identify close contacts of known patients. How will "close contacts" differ for people on more care-intensive floors (i.e., nursing and hospice)? Would risk factors also differ based on the patient's vulnerability?

Suggested answer: *Close contacts would certainly differ depending on the level of assisted living patients were experiencing. Someone in independent living could potentially have a greater variety of social contacts, while someone confined to a dementia ward would have supervised guest visits and more frequent medical care and contact with staff.*

Risk factors could potentially be different as well. A resident in independent living may engage in sexual behavior while patients in nursing care may experience more frequent medical procedures. However, the data thus far indicate that case-patients are not confined to one floor.

12. Would active case finding be important, given this population? Why or why not? Who would you test? Who might you exclude?

Suggested answer: *Active case finding is important in this outbreak because a large percentage of acute HBV infections are not identified clinically. The residents, who may be considered a vulnerable population, may not be able to make decisions, deliberate, or communicate effectively about their own medical status. Finally, identifying more cases could help determine a common risk factor or exposure and reduce future cases.*

Update 6: Day 2

The team returns the next morning to continue investigations. Medical records for the two case-patients indicate that both patients are treated by the same practitioner. They receive injections of vitamin B-12 and are both diabetic. While reviewing their records as part of the epidemiologic investigation, you also begin performing a serological investigation on staff and close contacts of all case-patients (suspected and confirmed) as part of active case finding, since many acute HBV infections can go unrecognized.

13. Is it necessary to obtain informed consent before testing contacts? What if residents are unable to give informed consent because of mental health conditions?

Suggested answer: *It is important to gain consent for medical procedures. If contacts are unable to give consent due to mental or physical health conditions, medical records should indicate a proxy for medical decision-making. During an outbreak, public health officials can compel persons to accept testing, treatment, and immunization, but voluntary cooperation with an investigation is always preferred.*

14. At this stage, would you take any other action steps, such as vaccination of other residents and/or staff? Why or why not?

Suggested answer: *Vaccination would only act as a preventive measure, and would not cure asymptomatic or symptomatic patients. However, nursing home outbreaks of HBV are not infrequent. If not already required by the nursing home, vaccination could be a good precautionary measure against future outbreaks, especially because there is no cure for HBV.*

Update 7: Day 5

A total of 96 patients and 45 staff members were tested for serological markers of HBV infection. Tests reveal 9 new acute infections among the resident population and 0 cases among the staff.

15. What's next in the investigation? What procedures do you use to investigate the 9 new cases?

Suggested answer: *It is important to collect information from the new cases using multiple (and creative) methods, just as with the original case-patients. These sources may include interviews, medical records, and proxy interviews. Once exposure history is collected for the cases, a case-control study can be used to determine risk factors.*

Conclusion

Over the next week, a total of 30 case-patients are confirmed through laboratory tests. One death is confirmed due to HBV. As a result of your epidemiologic investigation, diabetic blood glucose monitoring was identified as a common risk factor. An unmatched case-control study statistically linked cases to blood glucose monitoring for patients with diabetes mellitus on a certain day.

Although proper infectious control practices were used for needle care during the capillary blood sampling, environmental sampling revealed the most likely source of contamination was the alcohol dispenser, which was located near the diabetic blood glucose samples and may have been contaminated. Healthcare-acquired infections are a common context for HBV.

16. How would you protect a vulnerable population such as the elderly living in an institution from future healthcare-associated (nosocomial) infections or other threats?

Suggested answer: *Vaccination and/or screening upon entry into the nursing home could help protect this population. When investigating a population that may have communication or other vulnerabilities, it is important to broaden the investigation using multiple methods and resources to gain information about the outbreak.*

References

De Schrijver K, et al. An outbreak of nosocomial Hepatitis B infection in a nursing home for the elderly in Antwerp (Belgium). *Acta Clin Belg*. 2005;60:63-69.

Dreesman JM, Baillot A, Hamschmidt A, Monazahian M, Wend UC, Gerlich WH. Outbreak of hepatitis B in a nursing home associate with capillary blood sampling. *Epidemiol Infect*. 2005;5:760-772.

Perz, JF, Fiore AE. Hepatitis B virus infection risks among diabetic patients residing in long-term care facilities. *Clin Infect Dis*. 2005;40(7):990-6.

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Case Study 3: Hepatitis B Outbreak in a Nursing Home
Post-Test

1. Which of the following categories of vulnerable populations may an elderly resident in a nursing home fall into?
    a. Institutionally vulnerable
    b. Deferentially vulnerable
    c. Economically vulnerable
    d. Medically vulnerable
    e. Socially vulnerable
    f. Communicatively/cognitively vulnerable
    g. All of the above
    h. A, D, and F only

2. Which of the following sources of information can be used to assess case-patient activities, when he or she is incapable of providing enough information?
    a. Family members
    b. Nursing home staff
    c. Medical records
    d. Nursing home activity schedules
    e. Guest lists
    f. All of the above
    g. A, B, and C only

3. True/False: It is unnecessary to obtain informed consent before testing contacts in a nursing home.

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Answer Key

1. Which of the following categories of vulnerable populations may an elderly resident in a nursing home fall into?
    a. Institutionally vulnerable
    b. Deferentially vulnerable
    c. Economically vulnerable
    d. Medically vulnerable
    e. Socially vulnerable
    f. Communicatively/cognitively vulnerable
    g. All of the above
    h. A, D, and F only

    Answer: g. All of the above.

    Feedback: Elderly residents in a nursing home may fall into many of these categories. Some residents may be considered classified as vulnerable in all of these categories.

2. Which of the following sources of information can be used to assess case-patient activities, when he or she is incapable of providing enough information?
    a. Family members
    b. Nursing home staff
    c. Medical records
    d. Nursing home activity schedules
    e. Guest lists
    f. All of the above
    g. A, B, and C only

    Answer: f. All of the above.

    Feedback: Several resources could be used to gain more information. Family members and staff could become "proxy" interviewees, and reviews of medical records may show shared common medical risk factors. Activity schedules for the nursing home and guest lists from the front desk can also be used.

3. True/False: It is unnecessary to obtain informed consent before testing contacts in a nursing home.

    Answer: False

    Feedback: It is important to gain consent for medical procedures. If contacts are unable to give consent due to mental or physical health conditions, medical records should indicate a proxy for medical decision-making. During an outbreak, public health officials can compel persons to accept testing, treatment,

and immunization, but voluntary cooperation with an investigation is always preferred.

Case Study 3: Hepatitis B Outbreak in a Nursing Home
Session Evaluation

Congratulations on completing Case Study 3 of the *P is for Practice* training.

To ensure the best learning experience possible for training participants, we would like your feedback. This feedback is carefully reviewed by staff to make continual improvements to training materials.

In addition, you must complete the evaluation in order to receive a certificate of completion or continuing education credit (if applicable) for this case study.

The evaluation for this training is available online at:
http://tiny.cc/pps3p

To begin the evaluation, you will need to log in to the NC institute for Public Health Training Website. If you have previously taken online trainings through the Training Website (including other trainings in the *E is for Epidemiology* or *I is for Investigation* curriculum), you may use your existing username and password to log in to this evaluation. If this is your first time visiting the Training Website, you must complete a short registration to create your username and password; instructions will be provided.

Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

Case Study 4: Addressing Birth Outcomes
Session Overview

Instructions:
For this exercise, you will be asked to work in groups to participate in a project to address birth outcomes. Information regarding the scenario will be provided to you in parts, each of which will be followed by related discussion questions.

Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to formulate answers to each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
120 minutes

Learning Objectives
- Describe strategies to engage community partners to address birth outcomes
- Discuss surveillance data related to birth outcomes
- Interpret surveillance data to determine the existence of a public health problem
- Define evidence-based prevention and identify resources for evidence-based programs addressing birth outcomes
- Modify an evidence-based program to address birth outcomes in a local area

Case Study 4: Addressing Birth Outcomes
Pre-Test

1. Which of the following are examples of community stakeholders who may be affected by a public health problem or goal?
    a. Service providers
    b. Affected community members
    c. Advocacy and faith organizations
    d. Media
    e. All of the above
    f. A, B, and C only

2. True or False: When engaging stakeholders you should focus your efforts on presenting your own interests and needs of the project.

3. Which of the following is a method in which to prioritize risk factors?
    a. Rank factors on their importance and changeability and choose those that are most important and most changeable
    b. Choose factors which have the highest return on investment
    c. Choose factors of particular interest to stakeholders
    d. Identify the most urgent problem
    e. All are methods in which to prioritize risk factors
    f. A, B , and D only

4. True or False: Evidence-based strategies can be modified to a local population.

Case Study 4: Addressing Birth Outcomes
Student Guide

Situation

You are the Director of Nursing at the Evergreen County Health Department. Last week you learned that all local health departments in the state will receive state funding to address birth outcomes over a 5 year period. The goals are to reduce premature birth and infant mortality. To receive the initial funding, your health department must convene a group of community stakeholders, identify specific objectives to address, and choose an evidence-based intervention. You decide to begin by meeting with a small group of health department staff members, including the Coordinator of the WIC program and the Health Educator. Your goal for the meeting is to identify community partners or stakeholders that could participate in this initiative.

1. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** Which community members or groups should be involved in this new initiative?

2. Once you have identified possible stakeholders, what are some strategies you can use to invite and engage them?

Update 1

You have spent the last several weeks contacting potential stakeholders and inviting them to participate in a kickoff meeting. As the Nursing Director, one of your agenda items at the kickoff meeting is to present the trends of infant mortality in Evergreen County. In preparation for the meeting, you compile some background information on the county from the most recent Census. Then you gather surveillance data on infant mortality for Evergreen County and the state as a whole (see both Table 1 and Figure 1 below). You and your health department colleagues review the data to present at the meeting.

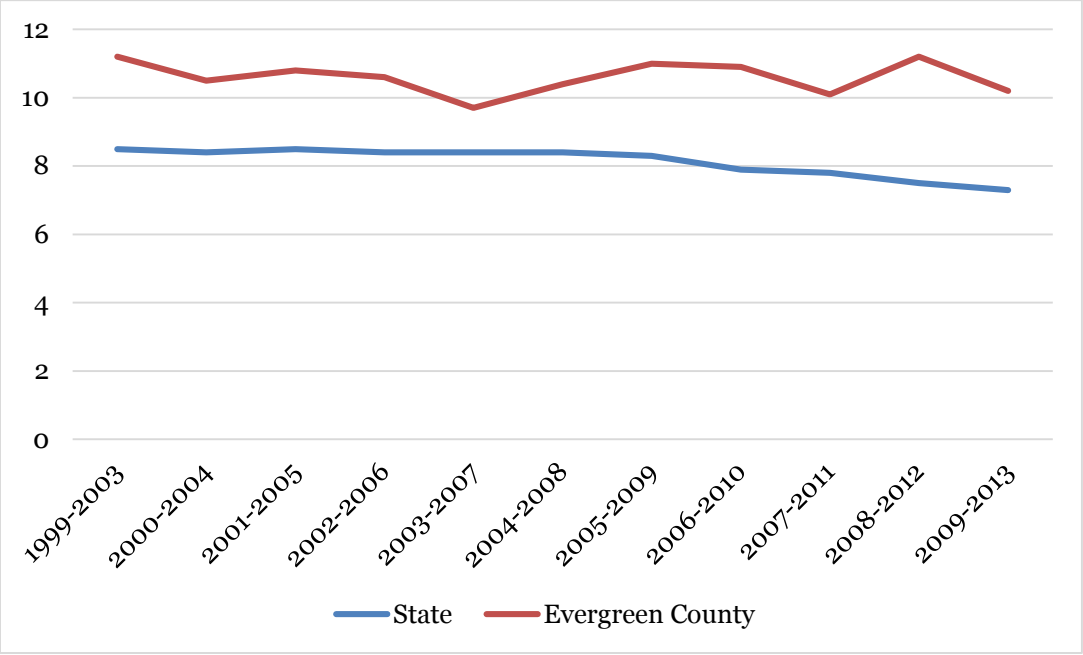
- Population: 168,148 (60% White, 34% African American, 2% Asian, 6% Hispanic/Latino)
- Median Income: $40,718 ($5,000 lower than the state average)
- 25% of population lives in poverty, compared to 18% in the state overall
- 86% have at least a high school education
- 7% speak a language other than English at home
- 18% did not have health insurance in 2010, prior to the implementation of the Affordable Care Act (ACA or Obamacare)
- County includes the urban area of Cobalt, and the surrounding rural farmland

Table 1. Infant (<1 Year) Death Rates per 1,000 Live Births, State and County, 2009-2013

	Total Infant Deaths		White Infant Deaths		Black Infant Deaths		Other Non-Hispanic Infant Deaths		Hispanic Infant Deaths	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
State	4,441	7.3	1,850	5.4	1,967	13.6	178	5.7	446	4.8
Evergreen County	111	10.2	30	5.9	76	17.1	1	-	4	-

Note: Rates based on small numbers (< 20 cases) are unstable and are not reported.

Figure 1. Infant mortality rates, state and county, 5-year averages, 1999-2013.



3. Complete the following questions to summarize the data.

   a) What is the baseline infant mortality rate in Evergreen County? How does it compare to the state rate?

   b) What are the county and state trends (are rates increasing, decreasing, or remaining steady)?

   c) Are there racial disparities in Evergreen County?

4. **Discuss the data.** What strikes you as most important to address? Why?

5. The data presented above is largely focused on the problem (infant mortality). How do you determine what assets already exist in the community, region, or state to

address this issue? Once you identify the assets, how can you leverage those existing efforts for your current initiative?

Update 2

Infant mortality can be related to risk factors before and during pregnancy, during labor and delivery, and after birth. Some examples of risk factors during each period include:

- Preconception: Poor maternal nutrition (including low folic acid intake), overweight/obesity, use of tobacco and other substances, low socioeconomic status, sexually transmitted infections, short inter-pregnancy interval, poor mental health, lack of access to family planning and health care providers
- Pregnancy: Insufficient or excess gestational weight gain, use of tobacco or other substances, lack of social support, inadequate prenatal care, hypertension, diabetes
- Labor and Delivery: lack of insurance, delivery complications, hypertension, cesarean section delivery
- Birth Outcomes: low and very low birthweight, preterm and very preterm, birth defects

County data on some risk factors is included below (See Table 2).

Table 2. Certain Risk Factors for Infant Mortality

	Evergreen County			State		
	Total	**White**	**African-American**	**Total**	**White**	**African-American**
Number of Live Births	2,111	977	883	118,983	66,181	28,865
% Low Birth Weight (<2,500 g)	7.2	5.7	10.1	8.8	7.3	13.4
% Very Low Birth Weight (< 1,500 g)	2.7	1.8	4.1	1.7	1.2	3.2
% Preterm (<37 weeks gestation)	14.4	11.4	18.3	11.4	9.8	15.6
% Maternal Age < 18 years	2.7	0.5	4.8	2.1	1.3	3.4
% Maternal Education < High School	17.1	5.9	22.8	17.0	8.6	16.6
% Multiple Births	5.0	5.1	5.3	3.5	3.6	4.1
% No or Unknown Prenatal Care	5.7	2.7	8.1	3.8	3.2	4.7
% Smoked	11.6	11.7	14.2	10.3	13.0	9.8
% Not Breastfed at Discharge	26.0	15.7	41.3	22.0	18.2	36.6

6. Given all of the information available on possible determinants of infant death in Evergreen County, how do you decide which risk factors to address?

Update 3

Your health department has recently starting using mapping software to identify areas of particular need. Below are two maps of Evergreen County; the map on the left shows the percent of babies who are low birthweight (≤2500 grams) by zip code (Fig. 2), while the map on the right shows the percent of families living in poverty by Census tract (Fig. 3).

Figure 2. Percent of Babies with Low Birthweight

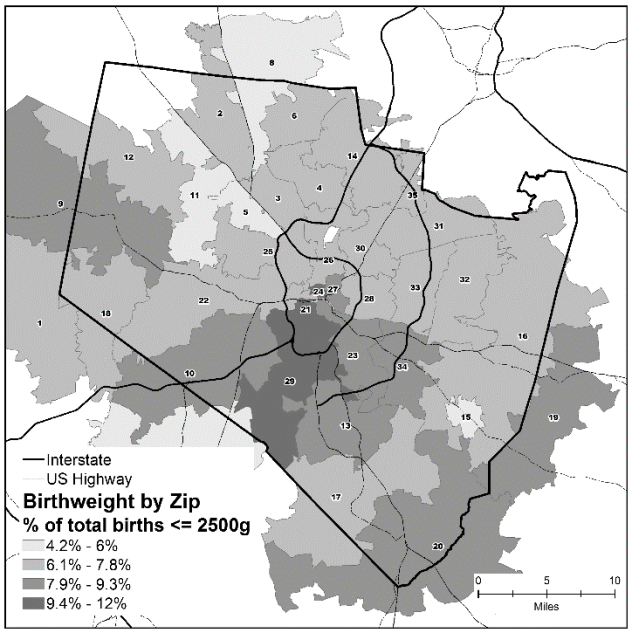
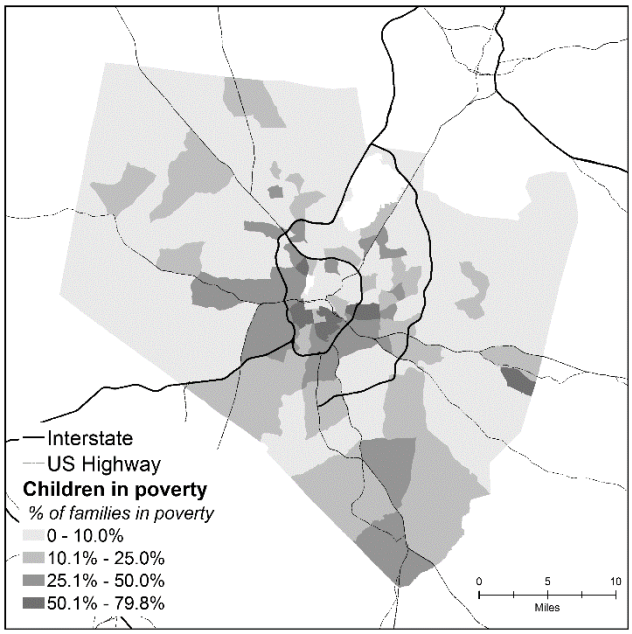


Figure 3. Percent of Families Living in Poverty



Map credit: Matt Simon, NCIPH

7. How does this information help to inform the new initiative?

Update 4

The kickoff meeting happened yesterday. The group chose a name for itself – Evergreen Healthy Births, Healthy Babies (EHBHB). In addition to health department staff, the following stakeholders attended:

- Local health care providers (a neonatologist from the hospital, an OB/GYN with an interest in prenatal care, a pediatrician from private practice, and a nurse practitioner from a community health clinic)
- Non-profits
  - -Local United Way manager
  - -Executive director of Inspire, a group advocating for educational opportunities, healthcare access, and employment for girls and women in poverty
  - -Pastor of a local church in an area with high rates of teen pregnancy
- Other
  - -Professor of Maternal and Child Health from a nearby university

Unfortunately, there were no members of the affected community (women at high risk for having a poor birth outcome) at the meeting. One young mother had agreed to attend but canceled at the last minute. You are disappointed and want to focus on engaging more community members before the next meeting.

8. **Group Brainstorm: Have one group member record answers on a flip chart.** Think about ways to include at-risk community members in this initiative. How can you identify them and increase the likelihood that they are willing and able to participate?

9. How important is the racial/ethnic make-up of the group? Should having a diverse group be a priority?

Update 5

Using the strategies you identified above, you successfully recruit a community organizer from a low-income housing community and several teens and young mothers to participate in the task force. To better accommodate these members, you will now have meetings in a small multi-purpose room in that community.

Your purpose for the next meeting is for EHBHB to identify goals and objectives for the 5-year program period. A goal is an overarching principle that guides decision making. Objectives are specific, measurable steps that can be taken to meet the goal. In general, goals are broad, abstract, and difficult to measure, while objectives are narrow, concrete, and measurable.

In the most recent community health assessment (3 years ago), a community survey revealed the following top priorities among residents: chronic disease, obesity, drug/alcohol abuse, and gangs/violence. Child abuse and teen pregnancy were mentioned less frequently, and infant mortality was not cited as a problem.

10. **Group activity.** Write 1-3 overall goals to accomplish over the 5-year program period. Some questions to consider as you write goals are:

    - What effect do we want to have on the "problem" in the community?
    - What does the community want to see happen?
    - What is the overall improvement we want to achieve?

11. **Group Activity.** Choose one of the goals above and write three outcome objectives to achieve it. Keep in mind that objectives should be SMART (specific, measurable, achievable, relevant, and time-bound). In other words, explain how much of what will be accomplished by when.

Update 6

The Evergreen Healthy Births, Healthy Babies group identified the following goal and objectives.

GOAL: Reduce the infant mortality rate in Evergreen County.

Objective 1. Reduce the percent of low birth weight infants among African-Americans in Evergreen County by 5% in Year 5.

Objective 2. Reduce the teen pregnancy rate in Evergreen County by 5% in Year 5.

Objective 3. Increase the percentage of pregnant women who receive prenatal care in Evergreen County by 10% in Year 5.

To address these objectives, participants were very interested in using evidence-based strategies and programs. The group asked the health department to help identify potential evidence-based strategies to present at the next meeting.

12. What is an evidence-based strategy? Where would you search to find evidence-based public health strategies and programs?

Update 7

Your team has identified three potential evidence-based strategies to present to the Evergreen Healthy Births, Healthy Babies group for selection (see summaries below).

1. **Nurse-Family Partnership (NFP)** (National, Best Practice) is an evidence-based, community health program that helps transform the lives of vulnerable mothers pregnant with their first child. Each mother served by NFP is partnered with a registered nurse early in her pregnancy and receives ongoing nurse home visits that continue through her child's second birthday.

   NFP has been extensively evaluated over the last three decades, including through randomized, controlled trials.

   For low-income women and their children, the program has been successful in: improving women's prenatal health-related behaviors (especially reducing cigarette smoking and improving diet); reducing pregnancy complications, such as hypertensive disorders and kidney infections; reducing harm to children, as reflected in fewer cases of child abuse and neglect and injuries to children revealed in their medical records; and improving women's own personal development, indicated by reductions in the rates of subsequent pregnancy, an increase in spacing between first and second born children, a reduction in welfare dependence, and reductions in behavioral problems due to substance abuse and in criminal behavior on the part of

mothers who were unmarried and from low-income households at registration during pregnancy." – AMCHP Best Practices

2. **Prenatal Plus Program** (Colorado, Promising Practice) is "a Medicaid-funded program that provides care coordination, nutrition and mental health counseling to Medicaid-eligible pregnant women in Colorado who are at a higher risk for delivering low birthweight infants. The goal is to reduce the number of low birthweight infants born to women in the program.

   The program uses the Client-Centered Counseling approach with all participants to address a variety of issues that have been shown to have a negative impact on birth outcomes. Providers are required to assist the client in developing a goal during one of the first three visits and then follow-up on this goal at subsequent visits. The key health areas targeted by this program are healthy weight, smoking/cessation and depression. In order to encourage providers to offer model care for all women in the program, the Medicaid reimbursement structure has been adapted to offer a greater monetary incentive for completing the required number of visits (10) for model care.

   In 2007, the low birthweight rate for infants born to Prenatal Plus participants who remained in the program through delivery was 10.7%; 22.5% less than the expected rate for this population without Prenatal Plus services (13.8%). This reduction in the low birthweight rate resulted in an estimated savings of 2.7 million dollars in health care costs for Medicaid during 2007." – AMCHP Best Practices

3. **Healthy Women, Healthy Futures (HWHF)** (Oklahoma, Promising Practice): "Offered at early childhood education centers (ECECs), this program aims to improve the physical, emotional, social, dental, and vision health of at-risk women living in poverty before they become pregnant again, thereby minimizing their risk of future premature birth or infant death.

   HWHF is based in Life Course Theory (LCT), and attempts to reduce participants" risk factors, which diminish health, and improve their protective factors by improving their equity to primary care and other health services, through health education and care coordination.

   Participants attend weekly one hour classes offered in Spanish and English on site at the ECECs, and develop health and reproductive life plans while consulting with HWHF staff during home visitation.

   Participants have provided written and verbal feedback about the program from inception. Comments are reviewed by all the HWHF staff and are considered for program revision. Classes and services have been modified to meet participants" needs or health interests.

   Evaluation data to this point have shown health improvements due to improved knowledge and resultant behavior change; lifestyle improvements, such as increased exercise and better nutrition; and healthy, full-term pregnancies among participants.

Additionally the program has an 85% retention rate in a population frequently characterized as non-compliant, apathetic, disinterested, mobile and difficult to retain in a program." – AMCHP Best Practices

13. Which program would you recommend Evergreen Healthy Births, Healthy Babies choose to replicate? Explain the rationale for your choice. Which of the objectives will the program address?

14. How would you modify the program you chose to best serve your local population?

Update 8

It is now Year 3 (2015) of the Evergreen Healthy Births, Healthy Babies initiative. Representatives from the state office funding your initiative are coming to the next meeting, where you would like to share updates on program impact. You have received Evergreen County birth data for 2013 (final data) and 2014 (provisional data) (Table 3).

Table 3. Final Birth Data (2013) and Provisional Birth Data (2014)

	Total	**White**	**African-American**
Year 1 (2013)			
Number of Live Births	2,111	977	883
Infant Deaths	21	11	9
Year 2 (2014)			
Number of Live Births	2,144	1008	887
Infant Deaths	20	12	8

15. Given the small numbers of infant deaths each year, the infant mortality rates for Year 1 and Year 2 are not stable. What is the best way to interpret this information? At this time, is it possible to draw meaningful conclusions regarding program impact on overall Evergreen County infant mortality rates?

Update 9

For the upcoming meeting, you decide to share updates on one aspect of the program: the impact on smoking cessation among program participants (pregnant mothers). Your team has been collecting outcome evaluation data from program participants using in-person interviews at the time a woman enters the program (first trimester of pregnancy) and the time she delivers her baby. Below are preliminary results for maternal smoking during Year 1 and Year 2 (Table 4).

Table 4. Maternal Smoking Year 1 and Year 2

	Year 1 N (%)	**Year 2 N (%)**
Total program participants	105 (100)	115 (100)
Smoked at program entry	35 (33)	41 (36)
Smoked at delivery	18 (17)	20 (17)

16. What conclusions can be made about preliminary program impact on smoking cessation during pregnancy? What limitations are important to share about this data?

Update 10

In an effort to plan ahead, EHBHB wants to secure sustainable funding to continue its initiatives after the 5-year state funding cycle has ended. The group holds a meeting to brainstorm ideas for program sustainability.

17. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What are some strategies to ensure that evidence-based initiatives to decrease infant mortality will continue? Consider funding, staff, politics, community engagement, etc.

References

Association of Maternal and Child Health Programs. State Infant Mortality Toolkit: a standardized approach for examining infant mortality. Available at: http://www.amchp.org/programsandtopics/data-assessment/InfantMortalityToolkit/Pages/default.aspx. Accessed April 6, 2016.

Association of Maternal and Child Health Programs. Innovation station: emerging, promising, and best practices on infant mortality and improving birth outcomes. Available at http://mchb.hrsa.gov/pdfs/amchpbestpractices.pdf. Accessed April 6, 2016.

North Carolina Institute of Medicine. Improving North Carolina's health: applying evidence for success. 2012. Available at http://www.nciom.org/publications/?improving-north-carolinas-health-applying-evidence-for-success. Accessed April 6, 2016.

North Carolina State Center for Health Statistics. County Health Data Book. 2015. NC Infant Mortality Rates by County (2009-2013) and Birth Indicator Tables by State and County. Available at http://www.schs.state.nc.us/schs/data/databook/2015/. Accessed April 6, 2016.

North Carolina State Center for Health Statistics. Pregnancy Risk Assessment and Monitoring System (PRAMS) Annual Survey Results. Available at http://www.schs.state.nc.us/data/prams/survey.htm. Accessed April 6, 2016.

Case Study 4: Addressing Birth Outcomes
Facilitator Guide

Situation

You are the Director of Nursing at the Evergreen County Health Department. Last week you learned that all local health departments in the state will receive state funding to address birth outcomes over a 5 year period. The goals are to reduce premature birth and infant mortality. To receive the initial funding, your health department must convene a group of community stakeholders, identify specific objectives to address, and choose an evidence-based intervention. You decide to begin by meeting with a small group of health department staff members, including the Coordinator of the WIC program and the Health Educator. Your goal for the meeting is to identify community partners or stakeholders that could participate in this initiative.

1. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** Which community members or groups should be involved in this new initiative?

Suggested answer: *One way to begin identifying stakeholders is to ask which groups or individuals are directly or indirectly affected by the problem or goal (i.e., to reduce premature birth and infant mortality). Next, consider people who may not traditionally have a voice in the community (e.g., teens, minority groups, economically disadvantaged groups/neighborhoods, etc.). Several categories should be considered, including service providers, members of the affected community, advocacy/faith and other non-profit organizations, and others. Below are some specific examples of possible stakeholders.*

- *Service providers: infant and women's health care providers, hospitals, health departments, federally-qualified health centers and other local clinics, social services, transportation services, health insurance companies, and school systems*
- *Affected community: Members from target populations, neighborhoods, etc. May include parents who experienced a premature birth or fetal/infant death, youth at high risk for teen pregnancy, and those who are currently expecting a baby or are new mothers*
- *Advocacy, faith, and other non-profit organizations: March of Dimes, teen/young women organizations (Girls on the Run, etc.), parish nurse networks, interfaith community leaders, United Way, Planned Parenthood, other advocacy organizations (El Centro, etc.)*
- *Other: academic partners, media, political representatives, local foundations, data analysts, chamber of commerce*

As you contact partners, remember to ask them about others who are invested in this issue who may want to be involved.
Finally, consider individuals or groups that were involved in any past efforts to improve birth outcomes. They have already shown interest in the issue and may have important lessons learned to share.

See more about identifying stakeholders at:

- *Community Toolbox. Increasing engagement and commitment of stakeholders. Available at http://webmedia.unmc.edu/Community/CityMatch/PPOR/archive/110222/StakeholderEngagementCollie-AkersFeb2011.pdf. Accessed June 9, 2015.*

2. Once you have identified possible stakeholders, what are some strategies you can use to invite and engage them?

Suggested Answer: *Often, a personal invitation is the most effective way to recruit partners. This can occur in many ways, including a face-to-face meeting, phone call, email, or letter. Some tips include:*

- *Focus on the person's interests (i.e., what may motivate them to participate);*
- *Provide a concise and persuasive description of the new initiative. If you do not have a clear sense of the program's purpose, it will be difficult to communicate with potential partners;*
- *Identify key knowledge, skills, attributes, or viewpoints the person will bring to the group;*
- *Make a specific request. What do you want the person to do? It is important for the person to understand what they are agreeing to do (e.g., leading a community initiative is a different level of commitment than providing input at a few meetings).*
- *Listen and respond to areas of concern (e.g., the person participated in a past initiative that never got off the ground after wasting valuable time in meetings)*
- *Always be courteous, professional, and appreciative of the person's time. Some people may not be able to participate at this time; ask if you can keep them in mind for future projects or a smaller role.*

You may also consider providing a brief fact sheet with key statistics about the problem you want to address. Try to make the numbers meaningful for your stakeholders. For example, "In the past 5 years, over 100 babies died before their first birthday in Evergreen County, enough children to fill over 3 kindergarten classes."

See more about recruiting stakeholders at:

- *Community Toolbox, Chapter 14 (Core Functions in Leadership). Available at http://ctb.ku.edu/en/table-of-contents/leadership/leadership-functions/build-sustain-commitment/main. Accessed June 9, 2015.*
- *Community Toolbox. Increasing engagement and commitment of stakeholders. Available at http://webmedia.unmc.edu/Community/CityMatch/PPOR/archive/110222/StakeholderEngagementCollie-AkersFeb2011.pdf. Accessed June 9, 2015.*

Update 1

You have spent the last several weeks contacting potential stakeholders and inviting them to participate in a kickoff meeting. As the Nursing Director, one of your agenda items at the kickoff meeting is to present the trends of infant mortality in Evergreen County. In preparation for the meeting, you compile some background information on the county from the most recent Census. Then you gather surveillance data on infant mortality for Evergreen County and the state as a whole (see both Table 1 and Figure 1 below). You and your health department colleagues review the data to present at the meeting.

- Population: 168,148 (60% White, 34% African American, 2% Asian, 6% Hispanic/Latino)
- Median Income: $40,718 ($5,000 lower than the state average)
- 25% of population lives in poverty, compared to 18% in the state overall
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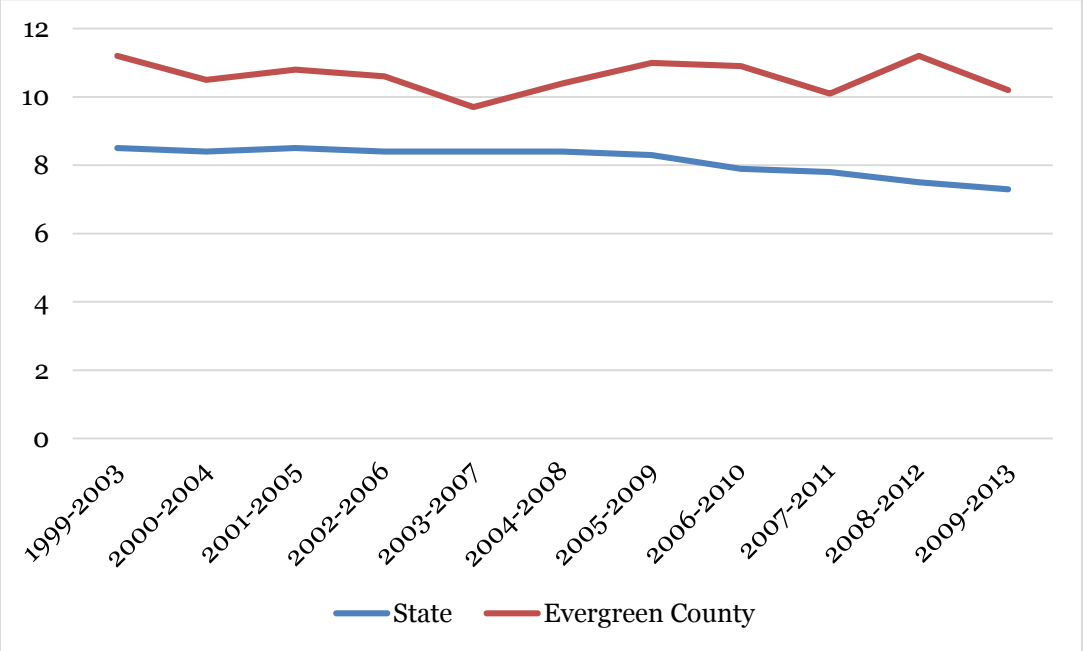

3. Complete the following questions to summarize the data.

   a) What is the baseline infant mortality rate in Evergreen County? How does it compare to the state rate?

   b) What are the county and state trends (are rates increasing, decreasing, or remaining steady)?

   c) Are there racial disparities in Evergreen County?

Suggested answer:

a) For the most recent 5-year period (2009-2013), the rate for Evergreen County was 10.2 infant deaths per 1,000 live births. This is higher than the state rate of 7.3 per 1,000 during the same period.

b) The county rate is fluctuating but overall has changed little in the past 14 years. The state rate is decreasing slightly over time.

c) The infant mortality rate for African-Americans in Evergreen County is 17.1 per 1,000 live births, nearly 3 times the rate among Whites (5.9 deaths per 1,000 live births). The numbers for other groups are not sufficiently large to make meaningful comparisons.

4. Discuss the data. What strikes you as most important to address? Why?

Suggested answer: *The infant mortality rate in Evergreen County is consistently higher than the state rate, which is possibly related to a relatively high percentage of the population living in poverty (25%) compared to the state (18% in poverty). The racial disparity in infant mortality is even more pronounced in Evergreen than in the state overall. One of the overarching goals of Healthy People 2020 has been to reduce disparities and to achieve health equity. For this reason, addressing the racial disparity in infant mortality may be one of the most important aspects to address.*

5. The data presented above is largely focused on the problem (infant mortality). How do you determine what assets already exist in the community, region, or state to address this issue? Once you identify the assets, how can you leverage those existing efforts for your current initiative?

Suggested answer: *Identifying community strengths and assets is an important step in addressing any public health problem. Being familiar with the community in which you are working is especially helpful for this task, so if you are not familiar with the community, be sure to include members on your team who are well-connected in the area. Consider the following potential assets:*

- *Community health centers or other health care providers working with low-income or vulnerable populations;*
- *Non-profit organizations serving or advocating for under-resourced individuals or neighborhoods;*
- *Elected city or county officials who have expressed an interest in maternal and child health, or who have a positive voting record on maternal and child health issues;*
- *Faith-based organizations or coalitions; and*
- *Foundations and other funding organizations with a focus on health.*

Meeting with representatives of these organizations can help you to identify common goals and ways in which your initiative can build upon ongoing community efforts. Face-to-face meetings are ideal for this purpose, but open communication through any channel is helpful.

Look at the state level as well for existing resources on which to build. Revisit the focus areas in the Title V Maternal and Child Health Services Block Grant. Determine whether your state has an infant mortality strategic plan; can your goals and objectives align with the ones in that plan?

Update 2

Infant mortality can be related to risk factors before and during pregnancy, during labor and delivery, and after birth. Some examples of risk factors during each period include:

- Preconception: Poor maternal nutrition (including low folic acid intake), overweight/obesity, use of tobacco and other substances, low socioeconomic status, sexually transmitted infections, short inter-pregnancy interval, poor mental health, lack of access to family planning and health care providers
- Pregnancy: Insufficient or excess gestational weight gain, use of tobacco or other substances, lack of social support, inadequate prenatal care, hypertension, diabetes
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	Total	**White**	**African-American**	**Total**	**White**	**African-American**
Number of Live Births	2,111	977	883	118,983	66,181	28,865
% Low Birth Weight (<2,500 g)	7.2	5.7	10.1	8.8	7.3	13.4
% Very Low Birth Weight (< 1,500 g)	2.7	1.8	4.1	1.7	1.2	3.2
% Preterm (<37 weeks gestation)	14.4	11.4	18.3	11.4	9.8	15.6
% Maternal Age < 18 years	2.7	0.5	4.8	2.1	1.3	3.4
% Maternal Education < High School	17.1	5.9	22.8	17.0	8.6	16.6
% Multiple Births	5.0	5.1	5.3	3.5	3.6	4.1
% No or Unknown Prenatal Care	5.7	2.7	8.1	3.8	3.2	4.7
% Smoked	11.6	11.7	14.2	10.3	13.0	9.8
% Not Breastfed at Discharge	26.0	15.7	41.3	22.0	18.2	36.6

6. Given all of the information available on possible determinants of infant death in Evergreen County, how do you decide which risk factors to address?

Suggested Answer: *There are a number of ways to prioritize which factors to address, always keeping in mind the resources available in the county. One data-*

driven strategy is called Perinatal Periods of Risk, or PPOR. According to CityMatCH, PPOR "provides an analytic framework and steps for investigating and addressing the specific local causes of high fetal and infant mortality rates and disparities." (http://www.citymatch.org/projects/perinatal-periods-risk-ppor). This process uses vital records data to identify the factors contributing to the largest share of infant mortality compared with a state or national benchmark. If the personnel and time are available to use PPOR, this is a great option.

Other ways to prioritize risk factors include:

- *Ranking factors on their importance and changeability and choosing those that are most important and most changeable;*
- *Determining which factors affect the most people;*
- *Addressing factors with the most striking disparities;*
- *Choosing factors which have the highest return on investment;*
- *Identifying the most urgent problem;*
- *Choosing factors of particular interest to stakeholders (use a standardized method of prioritization to ensure all voices are equally represented);*
- *Targeting actors where potential interventions can build upon existing programs or infrastructure.*

Update 3

Your health department has recently starting using mapping software to identify areas of particular need. Below are two maps of Evergreen County; the map on the left shows the percent of babies who are low birthweight (≤2500 grams) by zip code (Fig. 2), while the map on the right shows the percent of families living in poverty by Census tract (Fig. 3).

Figure 2. Percent of Babies with Low Birthweight

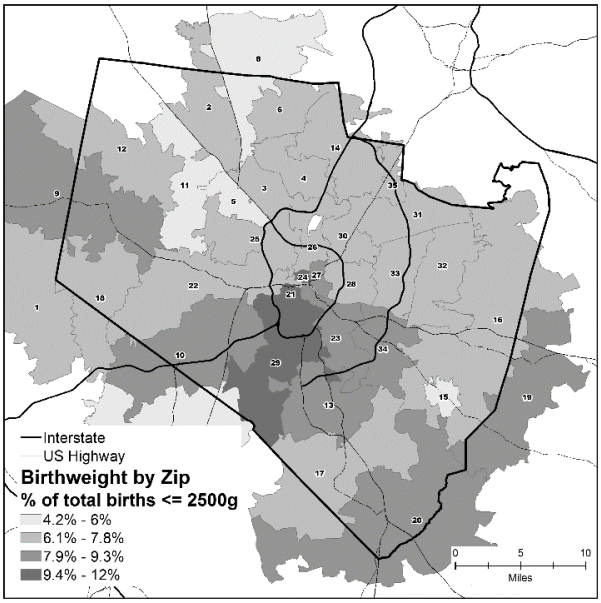
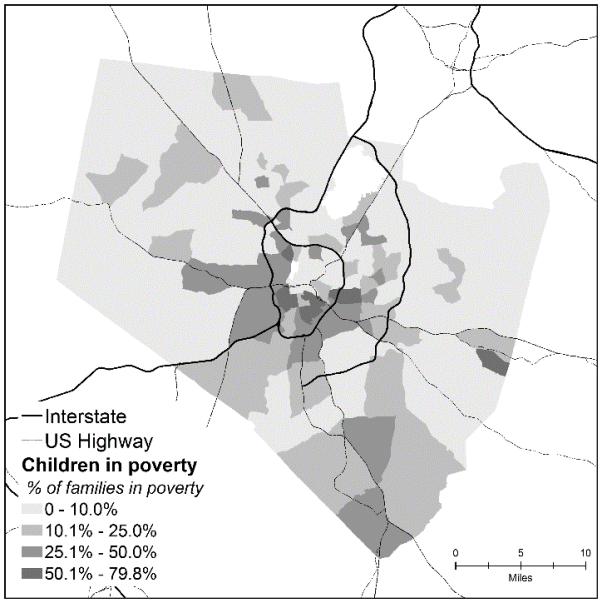


Figure 3. Percent of Families Living in Poverty



Map credit: Matt Simon, NCIPH

7. How does this information help to inform the new initiative?

Suggested answer: *Maps such as the ones above are useful for focusing an intervention to a specific geographic area, which is particularly relevant in an era of limited resources. Using these maps, your group can choose to focus on the neighborhoods with the highest percentage of low birthweight babies (many of which are the areas of highest poverty). Your group might also choose to map other factors, such as teen pregnancy or preterm birth, to focus the intervention.*

Update 4

The kickoff meeting happened yesterday. The group chose a name for itself – Evergreen Healthy Births, Healthy Babies (EHBHB). In addition to health department staff, the following stakeholders attended:

- Local health care providers (a neonatologist from the hospital, an OB/GYN with an interest in prenatal care, a pediatrician from private practice, and a nurse practitioner from a community health clinic)
- Non-profits
  - -Local United Way manager
  - -Executive director of Inspire, a group advocating for educational opportunities, healthcare access, and employment for girls and women in poverty
  - -Pastor of a local church in an area with high rates of teen pregnancy
- Other
  - -Professor of Maternal and Child Health from a nearby university

Unfortunately, there were no members of the affected community (women at high risk for having a poor birth outcome) at the meeting. One young mother had agreed to attend but canceled at the last minute. You are disappointed and want to focus on engaging more community members before the next meeting.

8. **Group Brainstorm: Have one group member record answers on a flip chart.** Think about ways to include at-risk community members in this initiative. How can you identify them and increase the likelihood that they are willing and able to participate?

Suggested answer: *Begin by asking community members who are already involved, especially those with existing ties to the community (e.g., the pastor and the director of Rise Up), to identify individuals who might be interested. When talking to those individuals about participating, identify the barriers to participation and adjust your meetings if possible. This may mean holding meetings at a site in the affected community, providing childcare, transportation, or food, or even giving other options to get involved that do not require attending meetings.*

9. How important is the racial/ethnic make-up of the group? Should having a diverse group be a priority?

Suggested answer: *Ideally, the group should represent the community you are focusing on. Because of the persistent racial/ethnic disparities in birth outcomes, it is especially important that the EHBHB group have representation from people of color, and since the focus is maternal and infant health, the group should have a significant proportion of females. If the current group is not racially diverse or includes few women, you should reconsider who else should be invited to participate.*

Update 5

Using the strategies you identified above, you successfully recruit a community organizer from a low-income housing community and several teens and young mothers to participate in the task force. To better accommodate these members, you will now have meetings in a small multi-purpose room in that community.

Your purpose for the next meeting is for EHBHB to identify goals and objectives for the 5-year program period. A goal is an overarching principle that guides decision making. Objectives are specific, measurable steps that can be taken to meet the goal. In general, goals are broad, abstract, and difficult to measure, while objectives are narrow, concrete, and measurable.

In the most recent community health assessment (3 years ago), a community survey revealed the following top priorities among residents: chronic disease, obesity, drug/alcohol abuse, and gangs/violence. Child abuse and teen pregnancy were mentioned less frequently, and infant mortality was not cited as a problem.

10. **Group activity.** Write 1-3 overall goals to accomplish over the 5-year program period. Some questions to consider as you write goals are:

    - What effect do we want to have on the "problem" in the community?
    - What does the community want to see happen?
    - What is the overall improvement we want to achieve?

Suggested answer: *There are a variety of goals to address infant mortality and birth outcomes. Examples are:*

- *Reduce the infant mortality rate in Evergreen County;*
- *Reduce the rate of teen pregnancy in Evergreen County; and*
- *Improve preconception health of women in Evergreen County.*

Regardless of the goals your group chooses, be sure they are broad, overarching principles.

11. **Group Activity**. Choose one of the goals above and write three outcome objectives to achieve it. Keep in mind that objectives should be SMART (specific, measurable, achievable, relevant, and time-bound). In other words, explain how much of what will be accomplished by when.

Suggested answer: *There are many objectives that could address the broad goals of reducing infant mortality and improving birth outcomes. Some examples are:*

- *Reduce the percent of low birthweight infants among African-Americans in Evergreen County by 5% in Year 5.*
- *Reduce the percentage of women who smoke during pregnancy in Evergreen County by 5% in Year 5.*
- *Increase the percentage of pregnant women who receive prenatal care in Evergreen County by 10% in Year 5.*

Healthy People 2020 includes a number of objectives related to maternal and child health that could be used as models for this type of program (https://www.healthypeople.gov/2020/topics-objectives/topic/maternal-infant-and-child-health/objectives). As noted above, objectives should be SMART so it is easy to determine whether the objective has been met.

Update 6

The Evergreen Healthy Births, Healthy Babies group identified the following goal and objectives.

GOAL: Reduce the infant mortality rate in Evergreen County.

Objective 1. Reduce the percent of low birth weight infants among African-Americans in Evergreen County by 5% in Year 5.

Objective 2. Reduce the teen pregnancy rate in Evergreen County by 5% in Year 5.

Objective 3. Increase the percentage of pregnant women who receive prenatal care in Evergreen County by 10% in Year 5.

To address these objectives, participants were very interested in using evidence-based strategies and programs. The group asked the health department to help identify potential evidence-based strategies to present at the next meeting.

12. What is an evidence-based strategy? Where would you search to find evidence-based public health strategies and programs?

***Suggested answer**: Evidence-based strategies are "programs, clinical interventions, and policies that have been evaluated and shown to have positive outcomes. Using evidence-based strategies (EBSs) in public health yields many benefits including increasing the likelihood that programs, clinical interventions, and policies implemented at the state or local level will be successful, and increasing public source efficiency." (North Carolina Institute of Medicine, 2012).*

Some resources of evidence-based strategies are:

- *The Guide to Community Preventive Services (Community Guide)*
- *U.S. Preventive Services Taskforce Recommendations for Primary Care Practice*
- *Substance Abuse and Mental Health National Registry of Evidence-based Programs and Practices*
- *Using What Works for Health (County Health Rankings)*
- *Promising Practices Network (RAND Corporation)*
- *Cochrane Library*

Another source of EBSs specific to maternal and child health is the Association of Maternal and Child Health Programs (AMCHP) Best Practices Innovation Station (http://www.amchp.org/programsandtopics/BestPractices/InnovationStation/Pages/default.aspx).

Update 7

Your team has identified three potential evidence-based strategies to present to the Evergreen Healthy Births, Healthy Babies group for selection (see summaries below).

1. **Nurse-Family Partnership (NFP)** (National, Best Practice) is an evidence-based, community health program that helps transform the lives of vulnerable mothers pregnant with their first child. Each mother served by NFP is partnered with a registered nurse early in her pregnancy and receives ongoing nurse home visits that continue through her child's second birthday.

   NFP has been extensively evaluated over the last three decades, including through randomized, controlled trials.

   For low-income women and their children, the program has been successful in: improving women's prenatal health-related behaviors (especially reducing cigarette smoking and improving diet); reducing pregnancy complications, such as hypertensive disorders and kidney infections; reducing harm to children, as reflected in fewer cases of child abuse and neglect and injuries to children revealed in their medical records; and improving women's own personal development, indicated by reductions in the rates of subsequent pregnancy, an increase in spacing between first and second born children, a reduction in welfare dependence, and reductions in behavioral problems due to substance abuse and in criminal behavior on the part of mothers who were unmarried and from low-income households at registration

during pregnancy." – AMCHP Best Practices

2. **Prenatal Plus Program** (Colorado, Promising Practice) is "a Medicaid-funded program that provides care coordination, nutrition and mental health counseling to Medicaid-eligible pregnant women in Colorado who are at a higher risk for delivering low birthweight infants. The goal is to reduce the number of low birthweight infants born to women in the program.

   The program uses the Client-Centered Counseling approach with all participants to address a variety of issues that have been shown to have a negative impact on birth outcomes. Providers are required to assist the client in developing a goal during one of the first three visits and then follow-up on this goal at subsequent visits. The key health areas targeted by this program are healthy weight, smoking/cessation and depression. In order to encourage providers to offer model care for all women in the program, the Medicaid reimbursement structure has been adapted to offer a greater monetary incentive for completing the required number of visits (10) for model care.

   In 2007, the low birthweight rate for infants born to Prenatal Plus participants who remained in the program through delivery was 10.7%; 22.5% less than the expected rate for this population without Prenatal Plus services (13.8%). This reduction in the low birthweight rate resulted in an estimated savings of 2.7 million dollars in health care costs for Medicaid during 2007." – AMCHP Best Practices

3. **Healthy Women, Healthy Futures (HWHF)** (Oklahoma, Promising Practice): "Offered at early childhood education centers (ECECs), this program aims to improve the physical, emotional, social, dental, and vision health of at-risk women living in poverty before they become pregnant again, thereby minimizing their risk of future premature birth or infant death.

   HWHF is based in Life Course Theory (LCT), and attempts to reduce participants‟ risk factors, which diminish health, and improve their protective factors by improving their equity to primary care and other health services, through health education and care coordination.

   Participants attend weekly one hour classes offered in Spanish and English on site at the ECECs, and develop health and reproductive life plans while consulting with HWHF staff during home visitation.

   Participants have provided written and verbal feedback about the program from inception. Comments are reviewed by all the HWHF staff and are considered for program revision. Classes and services have been modified to meet participants‟ needs or health interests.

   Evaluation data to this point have shown health improvements due to improved knowledge and resultant behavior change; lifestyle improvements, such as increased exercise and better nutrition; and healthy, full-term pregnancies among participants. Additionally the program has an 85% retention rate in a population frequently

characterized as non-compliant, apathetic, disinterested, mobile and difficult to retain in a program." – AMCHP Best Practices

13. Which program would you recommend Evergreen Healthy Births, Healthy Babies choose to replicate? Explain the rationale for your choice. Which of the objectives will the program address?

Suggested answer: *Any of the three programs would be appropriate to address the overall goal of improving birth outcomes, although each has a slightly different focus. Also, the first program, Nurse Family Partnership, is a "best practice", meaning that it is scientifically supported and has undergone a rigorous process of peer review demonstrating its effectiveness for the target population. It is the most well-established intervention and has been used and evaluated extensively around the U.S. Both of the other two initiatives are solid options. As "promising practices", these interventions have strong data showing positive outcomes, but more research/replication is needed to determine whether those outcomes are generalizable in a variety of settings. By choosing one of those strategies, the work in Evergreen County could be used to contribute to the research base. All three programs emphasize reaching low-income women at highest risk of poor birth outcomes.*

14. How would you modify the program you chose to best serve your local population?

Suggested answer: *Although evidence-based strategies can be modified to a local population, changes should be made with care. Below is general guidance about what aspects can be changed and which core elements should remain intact to preserve the essence of the intervention.*

"Safe" changes: minor adaptations to increase reach, receptivity and participation

- ☺ *Update and/or customize statistics and guidelines*
- ☺ *Customize program materials to fit the priority population. E.g., change names, pictures, wording, etc.*
- ☺ *Change ways to recruit and/or engage priority population*

"Yellow light" adaptations: can probably be changed <u>with caution</u>

- 😐 *Content/ methods*
  - *Alter the length of program activities*
  - *Change the order of sessions or sequence of activities*
  - *Add activities to address other risk factors or behaviors*
  - *Apply EBA to a different population*
- 😐 *Delivery mechanisms*
  - *Change delivery format/ process*
  - *Modify who delivers the program*
  - *Change setting of delivery*
  - *Substitute activities and/or materials*

Things that should <u>not</u> be adapted:

- ☹ *Methods*
  - *Change theoretical underpinning; mechanisms of change*
- ☹ *Content*
  - *Change health topic/behavior addressed*
  - *Add activities that contradict or detract from the original EBA's goals*
  - *Delete whole sections or major activities*
  - *Reduce duration and dose*

Update 8

It is now Year 3 (2015) of the Evergreen Healthy Births, Healthy Babies initiative. Representatives from the state office funding your initiative are coming to the next meeting, where you would like to share updates on program impact. You have received Evergreen County birth data for 2013 (final data) and 2014 (provisional data) (Table 3).

Table 3. Final Birth Data (2013) and Provisional Birth Data (2014)

	Total	**White**	**African-American**
Year 1 (2013)			
Number of Live Births	2,111	977	883
Infant Deaths	21	11	9
Year 2 (2014)			
Number of Live Births	2,144	1008	887
Infant Deaths	20	12	8

15. Given the small numbers of infant deaths each year, the infant mortality rates for Year 1 and Year 2 are not stable. What is the best way to interpret this information? At this time, is it possible to draw meaningful conclusions regarding program impact on overall Evergreen County infant mortality rates?

Suggested answer: *Working with small numbers of events can be challenging for epidemiologists, program planners, and other public health professionals. Although the annual infant mortality rates cannot be calculated because the small numbers don't provide stable rates, it is still possible to use this information. Earlier in the case study, you were provided with data showing 111 infant deaths (30 White and 76 African American) in Evergreen County over a 5-year period, which is an average of 22 per year (6 White and 15 African American). The numbers from Year 1 and Year 2 are consistent with those averages. In addition, you could calculate an updated 5-year infant mortality rate combining Years 1 and 2 of the program with the previous 3 years. However, you would not necessarily expect to observe an impact in the first year or two of the intervention, so it will be critical to continue monitoring the infant mortality rate throughout the program. Finally, the program is ideally using some other objectives, including process objectives (i.e., was the program implemented as planned?) and intermediate outcome objectives (e.g., reduction in smoking among pregnant women) to evaluate the program.*

Update 9

For the upcoming meeting, you decide to share updates on one aspect of the program: the impact on smoking cessation among program participants (pregnant mothers). Your team has been collecting outcome evaluation data from program participants using in-person interviews at the time a woman enters the program (first trimester of pregnancy) and the time she delivers her baby. Below are preliminary results for maternal smoking during Year 1 and Year 2 (Table 4).

Table 4. Maternal Smoking Year 1 and Year 2

	Year 1 N (%)	**Year 2 N (%)**
Total program participants	105 (100)	115 (100)
Smoked at program entry	35 (33)	41 (36)
Smoked at delivery	18 (17)	20 (17)

16. What conclusions can be made about preliminary program impact on smoking cessation during pregnancy? What limitations are important to share about this data?

Suggested answer: *In both Year 1 and Year 2, smoking decreased among program participants. In Year 1, 33% of women smoked at the time they entered the program, and only 17% smoked at the time they delivered their baby (a decrease of 49%). In Year 2, 36% of women smoked at the time they entered the program, and only 17% smoked at the time they delivered their baby (a decrease of 51%). This indicates some success of the smoking cessation component of the program. One important limitation is the way data was collected (in-person interviews), which may lead to reporting bias (women who were still smoking at delivery reporting incorrectly that they did not smoke). Given this limitation, you may consider another method of data collection for a post-partum follow-up survey.*

Update 10

In an effort to plan ahead, EHBHB wants to secure sustainable funding to continue its initiatives after the 5-year state funding cycle has ended. The group holds a meeting to brainstorm ideas for program sustainability.

17. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** What are some strategies to ensure that evidence-based initiatives to decrease infant mortality will continue? Consider funding, staff, politics, community engagement, etc.

Suggested answer: *Probably the most important step is to build a robust evaluation component into the program. If you can demonstrate that the program is having a positive impact on birth outcomes, it will be easier to advocate for additional funding. Some potential funders include private foundations, academic centers, and large non-profits like United Way. Creating a culture of evidence-based practice is another important step for sustainability. Training task force members, health department staff, and other stakeholders on the importance of using evidence based strategies can help them to better advocate for continuing this or similar interventions.*

References

Association of Maternal and Child Health Programs. State Infant Mortality Toolkit: a standardized approach for examining infant mortality. Available at: http://www.amchp.org/programsandtopics/data-assessment/InfantMortalityToolkit/Pages/default.aspx. Accessed April 6, 2016.

Association of Maternal and Child Health Programs. Innovation station: emerging, promising, and best practices on infant mortality and improving birth outcomes. Available at http://mchb.hrsa.gov/pdfs/amchpbestpractices.pdf. Accessed April 6, 2016.

North Carolina Institute of Medicine. Improving North Carolina's health: applying evidence for success. 2012. Available at http://www.nciom.org/publications/?improving-north-carolinas-health-applying-evidence-for-success. Accessed April 6, 2016.

North Carolina State Center for Health Statistics. County Health Data Book. 2015. NC Infant Mortality Rates by County (2009-2013) and Birth Indicator Tables by State and County. Available at http://www.schs.state.nc.us/schs/data/databook/2015/. Accessed April 6, 2016.

North Carolina State Center for Health Statistics. Pregnancy Risk Assessment and Monitoring System (PRAMS) Annual Survey Results. Available at http://www.schs.state.nc.us/data/prams/survey.htm. Accessed April 6, 2016.

Case Study 4: Addressing Birth Outcomes
Post-Test

1. Which of the following are examples of community stakeholders who may be affected by a public health problem or goal?
    a. Service providers
    b. Affected community members
    c. Advocacy and faith organizations
    d. Media
    e. All of the above
    f. A, B, and C only

2. True or False: When engaging stakeholders you should focus your efforts on presenting your own interests and needs of the project.

3. Which of the following is a method in which to prioritize risk factors?
    a. Rank factors on their importance and changeability and choose those that are most important and most changeable
    b. Choose factors which have the highest return on investment
    c. Choose factors of particular interest to stakeholders
    d. Identify the most urgent problem
    e. All are methods in which to prioritize risk factors
    f. A, B , and D only

4. True or False: Evidence-based strategies can be modified to a local population.

Case Study 4: Addressing Birth Outcomes
Answer Key

1. Which of the following are examples of community stakeholders who may be affected by a public health problem or goal?
    a. Service providers
    b. Affected community members
    c. Advocacy and faith organizations
    d. Media
    e. All of the above
    f. A, B, and C only

    Answer: e. All of the above

    Feedback: Many groups or individuals are directly or indirectly affected by the problem or goal and should be considered when identifying stakeholders. Several categories should be considered, including service providers, members of the affected community, advocacy/faith and other non-profit organizations, and others, including the media, academic partners and local foundations.

2. True or False: When engaging stakeholders you should focus your efforts on presenting your own interests and needs of the project.

    Answer: False

    Feedback: When engaging stakeholders you should focus on the person's interests in order to understand what may motivate them to participate.

3. Which of the following is a method in which to prioritize risk factors?
    a. Rank factors on their importance and changeability and choose those that are most important and most changeable
    b. Choose factors which have the highest return on investment
    c. Choose factors of particular interest to stakeholders
    d. Identify the most urgent problem
    e. All are methods in which to prioritize risk factors
    f. A, B , and D only

    Answer: e. All are methods in which to prioritize risk factors.

    Feedback: There are many ways to prioritize risk factors. Additionally, you can determine which factors affect the most people; address factors with the most striking disparities; and target actors where potential interventions can build upon existing programs or infrastructure.

4. True or False: Evidence-based strategies can be modified to a local population.

    Answer: True.

Feedback: Evidence-based strategies can be modified to a local population, but changes should be made with care. There is general guidance available about what aspects can be changed and which core elements should remain intact to preserve the essence of the intervention.

Case Study 4: Addressing Birth Outcomes
Session Evaluation

Congratulations on completing Case Study 4 of the *P is for Practice* training.

To ensure the best learning experience possible for training participants, we would like your feedback. This feedback is carefully reviewed by staff to make continual improvements to training materials.

In addition, you must complete the evaluation in order to receive a certificate of completion or continuing education credit (if applicable) for this case study.

The evaluation for this training is available online at:
http://tiny.cc/pps4p

To begin the evaluation, you will need to log in to the NC institute for Public Health Training Website. If you have previously taken online trainings through the Training Website (including other trainings in the *E is for Epidemiology* or *I is for Investigation* curriculum), you may use your existing username and password to log in to this evaluation. If this is your first time visiting the Training Website, you must complete a short registration to create your username and password; instructions will be provided.

Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

Case Study 5: Outbreak in a School Setting
Session Overview

Instructions
For this exercise, you will be asked to work in groups to participate in an outbreak investigation in a school setting. Information regarding the scenario will be provided in parts, each of which will be followed by related discussion questions. Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to answer each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital, and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
90 minutes

Learning Objectives
- Describe the school nurse's role in responding to and managing an infectious disease outbreak
- List the steps of outbreak investigation in a school setting
- Discuss ways that schools can work with local public health authorities for effective outbreak response
- Create a case definition
- Write main points for a letter to parents about a school outbreak

Case Study 5: Outbreak in a School Setting
Pre-Test

1. True or False: A school nurse is not required to report an outbreak to the local health department.

2. What data can be used to determine whether an outbreak is occurring in a school setting?
    a. Comparison of current rates of disease observed among the population with baseline rates in the same group
    b. Comparisons of the current absenteeism rate with baseline rates
    c. Interviews with students and/or their parents on their condition and possible exposures
    d. All of the above
    e. A and C only

3. True or False: Once case definitions for probable and confirmed cases are developed, they cannot be changed.

4. Which of the following information would **NOT** be included in a message to parents about a school outbreak?
    a. A summary of the outbreak to date
    b. A list of control measures
    c. Signs and symptoms of the disease
    d. Instructions on proper hygiene practices
    e. Information about treatment
    f. Indicators of severe illness requiring hospitalization
    g. Contact information for the school nurse
    h. All of the above information should be provided

Case Study 5: Outbreak in a School Setting
Student Guide

Update 1: January 10th

You are a school nurse at Oak Ridge Elementary School. It is January 10th, and students returned from winter break last week. Today, 14 children came to your office complaining of symptoms including vomiting, nausea, and diarrhea. Two students also had a low-grade fever. The number of students with these gastrointestinal symptoms seems higher than usual (which would indicate and outbreak), although not alarmingly so. Unfortunately, you rotate schools throughout the week and are not at this school on a daily basis to determine whether these reports of illness are definitely an outbreak.

1. What control measures (if any) would you take at this point?

2. As a school nurse, are you required to report certain diseases or outbreaks to your local public health department? Should you report anything at this time? Who is the point of contact at your local health department?

Update 2: January 12th

Over the next few days, more students become ill with gastrointestinal symptoms, and absenteeism at your school increases markedly above the usual rates of 5-6% for this time of year to a rate of 15% among students. Staff absenteeism also increases above usual rates.

Given the high absenteeism and common symptoms, you suspect an outbreak may be happening. You decide to gather more information and notify the local health department.

3. What information should you gather to determine whether an outbreak is occurring?

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** When you call the local health department to report the potential outbreak, what information should you be prepared to provide?

Update 3: January 13th

One ill student has been hospitalized for dehydration due to vomiting and diarrhea. This afternoon, you receive a call from a nurse at the health department that the student has tested positive for norovirus. Although not a reportable disease by law, norovirus is highly contagious and contributes to over 50,000 hospitalizations and between 570-800 deaths each year in the U.S. It causes outbreaks in a variety of settings, including health care facilities, restaurants, cruise ships, schools, prisons, and other institutional settings. Because of its transmissibility and potential for large outbreaks, the nurse, Jeremy, recommends that you work together with him to conduct a full outbreak investigation at the school, with the health department as the lead.

5. What are the steps of an outbreak investigation? Are there additional considerations when the investigation is conducted in a school setting?

6. As a school nurse, would you be responsible for working with the local public authority to investigate and respond to this outbreak? If not, who would serve as the main liaison from the school to the health department? What are some of the responsibilities of the school liaison to the health department?

Update 4: January 13th

Below is a line listing of the possible cases to date (Table 1). Some information is incomplete since you have not been able to interview everyone yet.

Table 1. Possible Cases as of January 13

First Name	Last Name	Sex	Age	Symptoms	Date of Onset	Laboratory Testing	Notes
Juan	Ramirez	M	8	D,V,N	1/10	none	
Madison	Hooper	F	10	D,V	1/9	None	
Noah	Price	M	9	D,V,F,M	1/9	Positive – norovirus	
Trey	Milton	M	11	D,N,F	1/11	None	
Hannah	Nicholson	F	10	D,V,N	1/10	None	
Isabel	Johnson	F	6	D,V			No interview
Katherine	Atwood	F	7	D,?			No interview
Miguel	Santos	M	8	V			No interview
Harper	Burke	F	10	D,V			No interview
Bella	Lucas	F	11	D,V,?			No interview
Raymond	Ross	M	9	D,V,F,N	1/9	None	
Jacob	Hall	M	9	D,V,?			No interview
Julie	Brentwood	F	39	D,V,N,M	1/11	None	
Monica	Hardesty	F	25	D,V,N,F,M	1/10	None	
Katie	Volksman	F	32	D,V			No interview

* D = diarrhea; V = vomiting; F = fever; N = nausea; C = abdominal cramps; M = muscle aches

7. Based on the information provided, write case definitions for probable and confirmed cases. (Hint: Case definitions determine who is counted as a "case" in an outbreak. They should always include criteria for person, place, time, and clinical features).

Update 5: January 13th

Jeremy, the health department nurse, recommends the following control measures: more thorough handwashing and bleach cleaning of shared environmental surfaces, especially high-traffic areas such as hand rails and door handles. You make a note to meet with the custodial staff to discuss cleaning and disinfecting procedures.

Jeremy also notifies you that environmental health specialists plan to visit tomorrow to collect specimens. You know that norovirus can persist on surfaces and continue to infect people for days or weeks.

In addition, he suggests conducting an epidemiologic study as a method to identify the cause of the outbreak. Jeremy asks you whether it is practical to conduct a cohort study, or whether it is more realistic to conduct a case-control study. He is willing to write a draft questionnaire and then send it to you for review.

8. What types of environmental samples should be collected? Which laboratory tests will be conducted to determine if norovirus is present in the samples?

9. What is the difference between a cohort study and a case-control study? Which study design would be best in this situation?

Update 6: January 14th

Information and rumors about the norovirus outbreak spread throughout the school and the local community. Worried parents are calling the school asking whether schools will close. Staff members are asking how they can protect themselves and their students from becoming ill. Students with chronic illness and/or immune suppression require special consideration in order to meet their health and educational needs. You will need to assess the plan for this population in more detail with guidance from the local health director. So far those students have not shown symptoms of norovirus infection.

Since it is Friday, it would be ideal to send a letter home with students this afternoon.

10. **Group Activity: Have one member of the group write ideas on a white board or flip chart.** What do you communicate to parents at this point? As a group, draft 3-4 key points to include in a letter to parents (do not spend time on fine details, think about the major points you would cover).

Update 7: January 14th

Today you received a phone call from the parent of one ill student who is concerned about the privacy of her daughter's personally identifiable health information. The call prompts you to review what you know about data confidentiality, particularly the intersection of the Health Insurance Portability and Accountability Act (HIPAA) and the Family Educational Rights and Privacy Act (FERPA) during a school-associated disease outbreak.

11. Are student health records covered by HIPAA and/or FERPA? Are you (as a school nurse) permitted to release personally identifiable information (PII) or protected health information (PHI) to the health department without written parental consent?

Update 8: January 17th

After consulting with the principal, you decided to conduct a cohort study using a web-based questionnaire for parents and staff. For families without at-home Internet access, a paper questionnaire was sent home with students before the weekend. The questionnaire included a 3-day food history. Of the 314 students and 66 staff members in the school, 207 (66%) students and 59 (89%) staff members participated in the study.

Initial descriptive analysis of the interview data is useful. Among the 266 respondents, 85 (32%) met the probable case definition for norovirus. There were no differences in illness based on age or gender. None of the cafeteria staff members was ill, and no food item was significantly associated with illness. However, there were two factors that were significantly associated with illness in bivariate and multivariate analysis: being in a classroom along the kindergarten hallway (attack rate = 71%; relative risk [RR] = 1.9; 95% confidence interval [CI] = 1.3--2.8) and having contact with an ill individual (AR = 38%; RR = 1.8; CI = 1.2--2.7).

12. Based on these results, what control measures do you recommend? Does the lack of association with a specific food rule out the possibility that this was a foodborne outbreak?

Update 9: January 19th

The outbreak has subsided, and school attendance is back to normal levels. You have found that the outbreak gave you an opportunity to promote the importance of proper hand hygiene, and students and staff have been receptive. You also conducted an interactive lesson with the food service staff about food safety.

References

Association of State and Territorial Health Officials. Comparison of FERPA and HIPAA privacy rule for accessing student health data. http://www.astho.org/programs/preparedness/public-health-emergency-law/public-health-and-schools-toolkit/comparison-of-ferpa-and-hipaa-privacy-rule/. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Norovirus website. http://www.cdc.gov/norovirus/index.html. Updated December 30, 2014. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Norovirus outbreak in an elementary school – District of Columbia, February 2007. *Morb Mortal Wkly Rep*. 2008;56(51):1340-1343.

Centers for Disease Control and Prevention. Updated norovirus outbreak management and disease prevention guidelines. *MMWR Rec Rep*. 2011;60(RR03):1-15.

Minnesota Department of Health. Checklist for schools when outbreaks of gastroenteritis are suspected. http://www.health.state.mn.us/divs/idepc/dtopics/foodborne/outbreak/facility/checklist.html. Accessed April 6, 2016.

North Carolina Division of Public Health. Steps of an outbreak investigation. July 2012. http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/conference/2012/2012_OB_investigation_steps.pdf. Accessed April 6, 2016.

Schwab NC, Gelfman MHB. *Legal issues in school health services a resource for school administrators, school attorneys, school nurses*. New York: Authors Choice Press, p. 193; 2005.

U.S. Department of Education. Family Educational Rights and Privacy Act (FERPA) and the disclosure of student information related to emergencies and disasters. June 2010. https://www2.ed.gov/policy/gen/guid/fpco/pdf/ferpa-disaster-guidance.pdf. Accessed April 6, 2016.

Case Study 5: Outbreak in a School Setting
Facilitator Guide

Update 1: January 10th

You are a school nurse at Oak Ridge Elementary School. It is January 10th, and students returned from winter break last week. Today, 14 children came to your office complaining of symptoms including vomiting, nausea, and diarrhea. Two students also had a low-grade fever. The number of students with these gastrointestinal symptoms seems higher than usual (which would indicate and outbreak), although not alarmingly so. Unfortunately, you rotate schools throughout the week and are not at this school on a daily basis to determine whether these reports of illness are definitely an outbreak.

1. What control measures (if any) would you take at this point?

Suggested answer: *The symptoms are consistent with gastrointestinal illness, although it's unclear whether this is an outbreak. Even if not, it is a good opportunity to provide health education messages to students and staff.*

- *Consider making a school-wide announcement about the importance of proper hand hygiene (e.g., the CDC's Handwashing: Clean Hands Save Lives campaign), which can prevent the spread of many diseases. Be sure that there are adequate supplies (soap/hot water or alcohol-based hand sanitizers) in school restrooms and classrooms.*
- *If possible, make a special visit to cafeteria staff, since gastrointestinal symptoms may indicate a foodborne illness. Reinforce food safety messages, including the importance of proper cooking and holding temperatures, preventing cross contamination, cleaning and disinfecting all kitchen equipment, wearing gloves, and using proper hand hygiene.*
- *Consider sending a message home to parents about following good hand hygiene practices. Children can benefit from practicing proper handwashing at home as well as in school.*
- *Consult the school illness policy and remind parents to keep sick children home from school. Parent reminders may be sent via email listserv, emergency notification systems, or other forms of communication.*

2. As a school nurse, are you required to report certain diseases or outbreaks to your local public health department? Should you report anything at this time? Who is the point of contact at your local health department?

Suggested answer: *Yes. At this time, you are documenting reports of acute gastrointestinal illness, which could be the result of reportable diseases like salmonella or shigella. As a health care provider, you are required to report certain diseases to the health department. Each state has a list of reportable diseases and the timeframes*

in which those diseases must be reported. Also, whether required by law or not, it is prudent to report suspected infectious disease outbreaks to the local health department to determine the best control measures. All outbreaks of acute gastroenteritis should be reported to state or local health departments, according to local regulations. In addition, each school system should have a communicable disease policy that should be referred to and followed.

At this point, you do not have enough information to merit an outbreak report to the health department. However, you should monitor the situation closely. If at any point you suspect that an outbreak is occurring, you should call the local health department (after consultation with school administration) and request guidance. Most health departments have a communicable disease department. Nurses in that department or infectious disease epidemiologists would be the best points of contact at either the local or state health departments.

Update 2: January 12th

Over the next few days, more students become ill with gastrointestinal symptoms, and absenteeism at your school increases markedly above the usual rates of 5-6% for this time of year to a rate of 15% among students. Staff absenteeism also increases above usual rates.

Given the high absenteeism and common symptoms, you suspect an outbreak may be happening. You decide to gather more information and notify the local health department.

3. What information should you gather to determine whether an outbreak is occurring?

Suggested answer: *Ideally, you would compare the rates of disease you observe among students and staff with baseline rates in the same groups (routine disease surveillance). However, if you are not conducting routine surveillance, you can use the absenteeism rate as a proxy. If it is not attributable to another cause, the high absenteeism rate is a strong indicator of a possible outbreak. Next, you should interview the ill students (or their parents if students are too young to respond) and ill staff members. Gather information about their condition (e.g., symptoms, date/time of symptom onset, any diagnostic tests conducted and treatment received) and their possible exposures (e.g., places they've eaten, contact with other ill persons). Recording this information in a spreadsheet will allow you to more easily identify common characteristics and exposures among ill persons.*

4. **Group Brainstorm: Have one member of the group write ideas on the flip chart.** When you call the local health department to report the potential outbreak, what information should you be prepared to provide?

Suggested answer: *The goal is to gather information that will help to confirm and characterize the outbreak. The health department will want to know the total number of ill persons, demographic information about the cases (e.g., age, gender, etc.), and information you gathered from ill students and staff about their symptoms, diagnostic tests, and treatment. It may be useful to provide lists of students, marked as ill or not ill, organized by grade level and classroom. To ensure student privacy use student ID numbers rather than names.*

Besides information about the cases, the health department may want the following information:

- *Names of food service staff and any illness reported among those staff;*
- *Any control measures that have already been implemented in the school;*
- *Total student and staff enrollment;*
- *All events and extracurricular activities at the school in the two weeks prior to disease onset;*
- *Lunch menus for the two weeks prior to disease onset (include breakfast menus if served); and,*
- *Roster of students attending before and after school care at the school.*

(Source: MN Department of Health)

Although the information should be as complete as possible, you should make contact with the health department when you suspect the outbreak, even if you haven't gathered all of the information yet. When investigating a possible outbreak, information is constantly evolving, so establishing open communication between the school and the health department is the most important step.

Update 3: January 13th

One ill student has been hospitalized for dehydration due to vomiting and diarrhea. This afternoon, you receive a call from a nurse at the health department that the student has tested positive for norovirus. Although not a reportable disease by law, norovirus is highly contagious and contributes to over 50,000 hospitalizations and between 570-800 deaths each year in the U.S. It causes outbreaks in a variety of settings, including health care facilities, restaurants, cruise ships, schools, prisons, and other institutional settings. Because of its transmissibility and potential for large outbreaks, the nurse, Jeremy, recommends that you work together with him to conduct a full outbreak investigation at the school, with the health department as the lead.

5. What are the steps of an outbreak investigation? Are there additional considerations when the investigation is conducted in a school setting?

Suggested answer: *The steps of an outbreak investigation are:*

1. *Identify investigation team and resources*
2. *Establish the existence of an outbreak*
3. *Verify the diagnosis*
4. *Construct a working case definition*
5. *Case finding: Find cases systematically and develop line list*
6. *Perform descriptive epidemiology and develop hypotheses*
7. *Evaluate hypotheses and perform additional studies (as necessary)*
8. *Implement control measures*
9. *Communicate findings*
10. *Maintain surveillance*

Note that although these steps are presented in sequential order, they may occur simultaneously or in another order. For example, communication of findings will often happen throughout the investigation, as you find cases and perform descriptive epidemiology.

*The major considerations for working in a school setting include abiding by school district policies for communicable disease which include confidentiality protections for students, school and community notification, and reporting to local and state health departments. Additional considerations include effective ways to communicate with parents (keeping in mind different cultures and languages that are part of this school community) to gather information about symptoms seen at home, referral and follow up to medical providers, and how to assist those who do not have a healthcare provider and/or insurance coverage (*Schwab and Gelfman, 2005).

6. As a school nurse, would you be responsible for working with the local public authority to investigate and respond to this outbreak? If not, who would serve as the main liaison from the school to the health department? What are some of the responsibilities of the school liaison to the health department?

Suggested answer: *In most cases, school administrators will determine the contact person for the investigation. The school nurse may serve as a single point of contact between the health department and the school. In some situations, however, the school nurse may serve multiple schools and may not have the time and resources to be the primary point of contact. In that case, the school may designate a Vice Principal or another member of the administration to be the liaison to the health department.*

Responsibilities for the school nurse and/or other school staff members include:

- *Invite Jeremy and other health department personnel to conduct interviews with students and staff;*
- *Continue to gather, record, and organize information relevant to the outbreak;*

- *Work with other school administrators to implement recommended control measures; and*
- *Work with other school administrators and the health department to communicate with parents, staff, and media.*

Update 4: January 13th

Below is a line listing of the possible cases to date (Table 1). Some information is incomplete since you have not been able to interview everyone yet.

Table 1. Possible Cases as of January 13

First Name	Last Name	Sex	Age	Symptoms	Date of Onset	Laboratory Testing	Notes
Juan	Ramirez	M	8	D,V,N	1/10	none	
Madison	Hooper	F	10	D,V	1/9	None	
Noah	Price	M	9	D,V,F,M	1/9	Positive – norovirus	
Trey	Milton	M	11	D,N,F	1/11	None	
Hannah	Nicholson	F	10	D,V,N	1/10	None	
Isabel	Johnson	F	6	D,V			No interview
Katherine	Atwood	F	7	D,?			No interview
Miguel	Santos	M	8	V			No interview
Harper	Burke	F	10	D,V			No interview
Bella	Lucas	F	11	D,V,?			No interview
Raymond	Ross	M	9	D,V,F,N	1/9	None	
Jacob	Hall	M	9	D,V,?			No interview
Julie	Brentwood	F	39	D,V,N,M	1/11	None	
Monica	Hardesty	F	25	D,V,N,F,M	1/10	None	
Katie	Volksman	F	32	D,V			No interview

* D = diarrhea; V = vomiting; F = fever; N = nausea; C = abdominal cramps; M = muscle aches

7. Based on the information provided, write case definitions for probable and confirmed cases. (Hint: Case definitions determine who is counted as a "case" in an outbreak. They should always include criteria for person, place, time, and clinical features).

***Suggested answer**: Creating a case definition is one of the key steps in an outbreak investigation, since it allows you to determine exactly which persons are connected to the outbreak. In this scenario, the school nurse would be working with the local and state health department to create the case definition. Sometimes, the case definition may be changed during the investigation as you gather additional information.*

Elements that may be included:

> *Person: Age or grade level, sex, co-morbidities (e.g., asthma, allergies, BMI), student/teacher/staff, etc.*
> *Place: School, classroom/floor/hall*
> *Time: Date/hour of symptom onset*
> *Clinical information: symptoms, signs (e.g., fever), laboratory tests*

Possible definitions are below:

- *Probable case: Oak Ridge Elementary School students or staff members with onset of vomiting and/or diarrhea on or after January 9th.*
- *Confirmed case: Meets probable case definition and has positive laboratory test for norovirus.*

Keep in mind that although some people had other symptoms, such as nausea and fever, the symptoms common to almost all suspected cases are vomiting and diarrhea, so those are included in the case definitions.

Update 5: January 13th

Jeremy, the health department nurse, recommends the following control measures: more thorough handwashing and bleach cleaning of shared environmental surfaces, especially high-traffic areas such as hand rails and door handles. You make a note to meet with the custodial staff to discuss cleaning and disinfecting procedures.

Jeremy also notifies you that environmental health specialists plan to visit tomorrow to collect specimens. You know that norovirus can persist on surfaces and continue to infect people for days or weeks.

In addition, he suggests conducting an epidemiologic study as a method to identify the cause of the outbreak. Jeremy asks you whether it is practical to conduct a cohort study, or whether it is more realistic to conduct a case-control study. He is willing to write a draft questionnaire and then send it to you for review.

8. What types of environmental samples should be collected? Which laboratory tests will be conducted to determine if norovirus is present in the samples?

Suggested answer: *Environmental samples can be collected from food, water, and surfaces. Ideally, interviews with ill students and staff would help investigators to narrow down the possible sources of exposure. Food specimens should be frozen, and water samples should be stored refrigerated or chilled on ice. Swabs can be taken from a variety of surfaces in the school. All samples will likely be tested using real-time reverse transcription-polymerase chain reaction (RT-qPCR) assays, the preferred laboratory method to detect norovirus.*

9. What is the difference between a cohort study and a case-control study? Which study design would be best in this situation?

Suggested answer: *A cohort study includes all individuals in the cohort (here, the school), so it may be more time-consuming to conduct. A case control study includes all ill individuals, plus an equal or greater number of healthy controls. While the cohort study is a more robust study design, the case-control study may be more practical to implement. The choice here probably depends largely on the resources available from the health department and the school for conducting interviews over the next few days. If enough interviewers are available, the cohort study would be the best option. Another option for the cohort study, depending on the school population, is to use a questionnaire (web-based, email, and/or paper) for parents to complete on behalf of the students.*

Update 6: January 14th

Information and rumors about the norovirus outbreak spread throughout the school and the local community. Worried parents are calling the school asking whether schools will close. Staff members are asking how they can protect themselves and their students from becoming ill. Students with chronic illness and/or immune suppression require special consideration in order to meet their health and educational needs. You will need to assess the plan for this population in more detail with guidance from the local health director. So far those students have not shown symptoms of norovirus infection.

Since it is Friday, it would be ideal to send a letter home with students this afternoon.

10. **Group Activity: Have one member of the group write ideas on a white board or flip chart.** What do you communicate to parents at this point? As a group, draft 3-4 key points to include in a letter to parents (do not spend time on fine details, think about the major points you would cover).

Suggested answer: *Your message to parents might include the following:*

- *A summary of the outbreak to date (e.g., numbers of probable cases among students and staff, laboratory confirmation);*
- *A list of control measures that have been implemented and those that are planned;*
- *Basic information about the signs and symptoms of norovirus;*
- *Instructions on proper hygiene practices and keeping ill children at home (including 48 hours after symptoms have ended), minimizing contact between ill and well family members;*
- *Information about norovirus treatment (i.e., there is no medicine to treat the virus, antibiotics should NOT be used, drinking plenty of liquids is the most important way to prevent dehydration);*
- *Indicators of severe dehydration that would require hospitalization; and*
- *Contact information for the school nurse (or other main point of contact at the school).*

Update 7: January 14th

Today you received a phone call from the parent of one ill student who is concerned about the privacy of her daughter's personally identifiable health information. The call prompts you to review what you know about data confidentiality, particularly the intersection of the Health Insurance Portability and Accountability Act (HIPAA) and the Family Educational Rights and Privacy Act (FERPA) during a school-associated disease outbreak.

11. Are student health records covered by HIPAA and/or FERPA? Are you (as a school nurse) permitted to release personally identifiable information (PII) or protected health information (PHI) to the health department without written parental consent?

Suggested answer: *Student health records are covered by FERPA if the health care provider (in this case the school nurse) is employed by the school, under contract, or under the "direct control" of the school. If the health care provider is not acting on behalf of the school, the records are <u>not</u> covered by FERPA, even if services are provided at the school site (i.e. in a school based health center). If student health records are not covered by FERPA, they may still be considered protected health information under HIPAA if they are transmitted electronically.*

Under both FERPA and HIPAA, student health information may be shared when there is ***written permission*** *from the parent. Without written permission, personal information may only be shared as follows:*

"FERPA permits school officials to disclose, without consent, education records, or personally identifiable information from education records, to appropriate parties in connection with an emergency, if knowledge of that information is necessary to

protect the health or safety of the student or other individuals. Under this health or safety emergency provision, an educational agency or institution is responsible for making a determination whether to make a disclosure of personally identifiable information on a case-by-case basis, taking into account the totality of the circumstances pertaining to a threat to the health or safety of the student or others. If the school district or school determines that there is an articulable and significant threat to the health or safety of the student or other individuals and that a party needs personally identifiable information from education records to protect the health or safety of the student or other individuals, it may disclose that information to such appropriate party without consent." In general, public health authorities are considered to be "appropriate parties" under this exception. Note that this exception only applies to a specific threat, not to general emergency preparedness activities. (Source: U.S. Department of Education)

Update 8: January 17th

After consulting with the principal, you decided to conduct a cohort study using a web-based questionnaire for parents and staff. For families without at-home Internet access, a paper questionnaire was sent home with students before the weekend. The questionnaire included a 3-day food history. Of the 314 students and 66 staff members in the school, 207 (66%) students and 59 (89%) staff members participated in the study.

Initial descriptive analysis of the interview data is useful. Among the 266 respondents, 85 (32%) met the probable case definition for norovirus. There were no differences in illness based on age or gender. None of the cafeteria staff members was ill, and no food item was significantly associated with illness. However, there were two factors that were significantly associated with illness in bivariate and multivariate analysis: being in a classroom along the kindergarten hallway (attack rate = 71%; relative risk [RR] = 1.9; 95% confidence interval [CI] = 1.3--2.8) and having contact with an ill individual (AR = 38%; RR = 1.8; CI = 1.2--2.7).

12. Based on these results, what control measures do you recommend? Does the lack of association with a specific food rule out the possibility that this was a foodborne outbreak?

Suggested answer: *The association with the kindergarten hallway makes environmental cleaning of that area a top priority. Use a 5.25% bleach solution (5.25 tablespoons of household bleach per gallon of water). You might also recommend more frequent handwashing (using soap and water) for the kindergarten classes until the outbreak has ended. Be sure that staff members are aware that hand sanitizer is not effective against norovirus.*

Although foodborne transmission cannot be ruled out, it seems unlikely in this situation. It would be worth asking whether the kindergarten classes participated in any events with shared food in the few days prior to the outbreak. In addition, this can be used as a prime opportunity to provide health education to the food service staff members about ways to prevent norovirus transmission.

Update 9: January 19th

The outbreak has subsided, and school attendance is back to normal levels. You have found that the outbreak gave you an opportunity to promote the importance of proper hand hygiene, and students and staff have been receptive. You also conducted an interactive lesson with the food service staff about food safety.

References

Association of State and Territorial Health Officials. Comparison of FERPA and HIPAA privacy rule for accessing student health data. http://www.astho.org/programs/preparedness/public-health-emergency-law/public-health-and-schools-toolkit/comparison-of-ferpa-and-hipaa-privacy-rule/. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Norovirus website. http://www.cdc.gov/norovirus/index.html. Updated December 30, 2014. Accessed April 6, 2016.

Centers for Disease Control and Prevention. Norovirus outbreak in an elementary school – District of Columbia, February 2007. *Morb Mortal Wkly Rep*. 2008;56(51):1340-1343.

Centers for Disease Control and Prevention. Updated norovirus outbreak management and disease prevention guidelines. *MMWR Rec Rep*. 2011;60(RR03):1-15.

Minnesota Department of Health. Checklist for schools when outbreaks of gastroenteritis are suspected. http://www.health.state.mn.us/divs/idepc/dtopics/foodborne/outbreak/facility/checklist.html. Accessed April 6, 2016.

North Carolina Division of Public Health. Steps of an outbreak investigation. July 2012. http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/conference/2012/2012_OB_investigation_steps.pdf. Accessed April 6, 2016.

Schwab NC, Gelfman MHB. *Legal issues in school health services a resource for school administrators, school attorneys, school nurses*. New York: Authors Choice Press, p. 193; 2005.

U.S. Department of Education. Family Educational Rights and Privacy Act (FERPA) and the disclosure of student information related to emergencies and disasters. June 2010. https://www2.ed.gov/policy/gen/guid/fpco/pdf/ferpa-disaster-guidance.pdf. Accessed April 6, 2016.

Case Study 5: Outbreak in a School Setting
Post-Test

1. True or False: A school nurse is not required to report an outbreak to the local health department.

2. What data can be used to determine whether an outbreak is occurring in a school setting?
    a. Comparison of current rates of disease observed among the population with baseline rates in the same group
    b. Comparisons of the current absenteeism rate with baseline rates
    c. Interviews with students and/or their parents on their condition and possible exposures
    d. All of the above
    e. A and C only

3. True or False: Once case definitions for probable and confirmed cases are developed, they cannot be changed.

4. Which of the following information would **NOT** be included in a message to parents about a school outbreak?
    a. A summary of the outbreak to date
    b. A list of control measures
    c. Signs and symptoms of the disease
    d. Instructions on proper hygiene practices
    e. Information about treatment
    f. Indicators of severe illness requiring hospitalization
    g. Contact information for the school nurse
    h. All of the above information should be provided

Case Study 5: Outbreak in a School Setting
Answer Key

1. True or False: A school nurse is not required to report an outbreak to the local health department.

   Answer: False

   Feedback: A school nurse, as a health care provider, is required by law to report certain diseases to the local health department. Each state has a list of reportable diseases and the timeframes in which those diseases must be reported.

2. What data can be used to determine whether an outbreak is occurring in a school setting?
   a. Comparison of current rates of disease observed among the population with baseline rates in the same group
   b. Comparisons of the current absenteeism rate with baseline rates
   c. Interviews with students and/or their parents on their condition and possible exposures
   d. All of the above
   e. A and C only

   Answer: d. All of the above

   Feedback: To determine whether an outbreak is occurring in a school setting you can compare the rates of disease observed among students and staff with baseline rates in the same groups. If routine surveillance is not available, the absenteeism rate can be used as a proxy. Interviews with ill students, or their parents if students are too young to respond, and ill staff members will provide additional data about their condition and their possible exposures.

3. True or False: Once case definitions for probable and confirmed cases are developed, they cannot be changed.

   Answer: False

   Feedback: A case definition may be changed during the investigation as additional information is gathered.

4. Which of the following information should **NOT** be included in a message to parents about a school outbreak?
    a. A summary of the outbreak to date
    b. A list of control measures
    c. Signs and symptoms of the disease
    d. Instructions on proper hygiene practices
    e. Information about treatment
    f. Indicators of severe illness requiring hospitalization
    g. Contact information for the school nurse
    h. All of the above information should be provided

    Answer: h. All of the above information should be provided.

    Feedback: A message to parents might include a summary of the outbreak to date (e.g., numbers of probable cases among students and staff, laboratory confirmation); a list of control measures that have been implemented and those that are planned; basic information about the signs and symptoms of the disease; instructions on proper hygiene practices and keeping ill children at home; information about treatment; indicators of severe illness requiring hospitalization; and contact information for the school nurse or other main point of contact at the school.

Case Study 5: Outbreak in a School Setting
Session Evaluation

Congratulations on completing Case Study 5 of the *P is for Practice* training.

To ensure the best learning experience possible for training participants, we would like your feedback. This feedback is carefully reviewed by staff to make continual improvements to training materials.

In addition, you must complete the evaluation in order to receive a certificate of completion or continuing education credit (if applicable) for this case study.

The evaluation for this training is available online at:
http://tiny.cc/pps5p

To begin the evaluation, you will need to log in to the NC institute for Public Health Training Website. If you have previously taken online trainings through the Training Website (including other trainings in the *E is for Epidemiology* or *I is for Investigation* curriculum), you may use your existing username and password to log in to this evaluation. If this is your first time visiting the Training Website, you must complete a short registration to create your username and password; instructions will be provided.

Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit Session Overview

Instructions
For the purposes of this exercise, you will be asked to work in groups to participate in a healthcare associated infection investigation. Information regarding the scenario will be provided to you in parts, each of which will be followed by related discussion questions. Choose one group member to read each segment of information aloud to the rest of the group. After receiving the information, work as a team to formulate answers to each discussion question.

Intended Audience
All public health, medical, veterinary, pharmacy, emergency management, hospital and other professionals interested in public health preparedness and field epidemiology.

Time Required (estimated)
90 minutes

Learning Objectives
- Describe infection control practices in a healthcare setting
- Calculate disease prevalence, case-fatality rate, and odds ratio
- Create a histogram of cases over time
- Choose an appropriate epidemiological study design, given information about an outbreak
- Interpret epidemiologic study results

Case Study 6: Outbreak in a Neonatal Intensive Care Unit
Pre-Test

1. Which of the following describe contact precautions to prevent the spread of infection in a hospital setting?
    a. Limiting patient movement
    b. Providing gown and gloves for patient
    c. Using dedicated equipment
    d. Cleaning and disinfecting patient room daily
    e. All of the above are contact precautions
    f. A, B, and D only

2. Prevalence is:
    a. $\frac{\text{number of deaths in infected persons}}{\text{total number of infected persons}}$
    b. $\frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$
    c. $\frac{\text{number or cases (new and existing)}}{\text{total number of infected persons}}$
    d. none of the above

3. True or False: In a case control-study, the controls should represent the population that gave rise to the case patients.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit
Student Guide

Situation

Healthcare associated infections (HAIs), previously referred to as nosocomial infections, are acquired by patients during their treatment in a healthcare setting. HAIs are of serious concern in the healthcare field. Hospitals are an ideal setting for opportunistic pathogens because they house both highly infectious and highly susceptible patients. Simple infection control practices such as hand washing and thorough cleaning and disinfecting of items have greatly reduced the incidence of HAIs, yet such infections still occur. In the U.S. alone, it is estimated that HAIs are responsible for 1.7 million infections annually, 75,000 of which are fatal.

Most hospitals employ an infection control practitioner (ICP) who monitors cases of disease throughout the hospital and ensures that proper hygiene and infection control procedures are followed throughout the hospital. Additionally, many hospitals employ a hospital epidemiologist to assist the ICP in surveillance and epidemiologic investigations, when necessary. The following case study examines what can happen when there is a lapse in surveillance and cases go unreported, and is loosely based on an actual outbreak that occurred in a children's hospital in the United States.

Update 1: Day 1

You are the hospital epidemiologist in the regional children's hospital in your state. You receive a call from the infection control practitioner, who was notified of a patient with early signs of a systemic infection by an attending physician in the neonatal intensive care unit (NICU). Despite a variety of differential diagnoses, the physician began antibiotic treatment, knowing that neonates such as this patient are at high risk of developing neonatal sepsis. The physician ordered blood and serum samples, and requested a cerebrospinal fluid (CSF) sample be collected as soon as possible.

The infection control practitioner asks for your help in investigating the circumstances of this case.

1. What pertinent information would be helpful for you and the physician to know regarding this patient?

2. What infectious agents would be of greatest concern to the physician?

Update 2: Day 2

You find out from the ICP that the patient is 2 week-old infant born prematurely at 33 weeks with underdeveloped lungs and has been intubated in the NICU since birth. The infant began showing signs of cyanosis and the nurse caring for the infant noticed the child had a rapid heartbeat and a fever of 101.5°F.

After initial antibiotic treatment, the patient's fever dropped to 100.8°F but the heart rate remained elevated. A rapid laboratory test revealed gram-negative rods in the patient's blood and CSF, although specific lab results that will identify the pathogen are still pending. The finding of gram-negative rods in the blood is particularly worrisome and indicative of bacterial sepsis, but the infant appears to be responding well to the antibiotic treatment.

In thinking about the source of the infection, the physician reviews the chart of the mother to see if she could have been the source. Although the baby was born premature, the mother showed no signs of infection upon admission to the hospital.

3. Could the mother be the source of infection, why or why not?

4. What might be other sources of infection in this patient?

5. Would you consider this a hospital acquired infection? Discuss what factors would lead you to determine if an infection is hospital acquired.

Update 4: Day 2

You receive a call from the ICP, and the results of the laboratory diagnostic tests came back positive for *Pseudomonas aeruginosa (su-doe-mo-nas air-rudge-i-nosa)*. You and the ICP are immediately concerned about the potential spread throughout the NICU and the rest of the hospital. Below is what you know about this pathogen:

P. aeruginosa is one of the most common hospital acquired pathogens and can cause severe infections in hospitalized patients. It occurs naturally in the environment, and can be found in soil, water, plants and animals. *P. aeruginosa* is an opportunistic pathogen, meaning that it predominately infects persons with compromised immune systems. Infection with the bacteria can be localized or systemic if it enters the bloodstream. A 2011 study in the New England Journal of Medicine showed that *P. aeruginosa* caused 7% of all healthcare-associated infections, including 13% of healthcare associated pneumonia cases. Notably, there are now multidrug resistant strains of *P. aeruginosa* that cause approximately 400 deaths per year in the U.S. Within the healthcare setting, outbreaks of *P. aeruginosa* have been linked to contaminated respiratory, endoscopic, urodynamic and pressure monitoring equipment, contaminated sinks, products (e.g., eye drops), tap and bottled water, and even healthcare workers. *P. aeruginosa* infection is treatable, although acute infections in immunocompromised patients have resulted in a 30% - 60% mortality rate.

6. What steps should the infection control practitioner take to ensure the infection does not spread to other patients?

7. Considering the information given, does it warrant a full investigation into the source of the infection?

Update 5: Day 3

In looking over hospital surveillance data given to you by the ICP, you find an alarming trend that the new ICP did not notice. This case of is part of a growing number of *P. aeruginosa* infections in the NICU reported over the past year, and there have been several cases of *P. aeruginosa* this month.

8. Aside from an outbreak of disease, what might be other explanations of a rise in reportable diseases? Are these explanations likely for the observed causes of *P. aeruginosa*?

Update 6: Day 3

Although there have been several cases other of *P. aeruginosa* infection throughout the hospital, the cases outside the NICU are comparable to baseline numbers and are not out of the ordinary. Knowing this, you begin to wonder if the NICU cases are linked to a common source. You decide to do some preliminary research on NICU patients in your hospital and discover the following:

Since January of last year, 519 infants were admitted to the NICU, with 439 staying for a period longer than 48 hours, thus putting them at a higher risk of contracting the infection. Forty-six patients were culture positive for *P. aeruginosa*, including the most recent patient, which sparked your interest in these infections. Despite the success in treating the most recent patient, 16 infected patients in the NICU died from their infection.

9. What is the prevalence of *P. aeruginosa* infections in patients who visited the NICU more than 2 days? Prevalence is a proportion that measures disease in a given population that is considered to be at risk. Prevalence is found by dividing the number of infected persons by the total number of people in the population at risk:

$$\text{Prevalence} = \frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$$

10. Calculate the case-fatality rate of infected patients from the NICU since January of the previous year. Case-fatality rate is the proportion of deaths in infected persons among the total number of infected persons (Note: Despite its name, a case fatality rate is not a true rate, but simply a proportion).

$$\text{Case-fatality rate} = \frac{\text{number of deaths in infected persons}}{\text{total number of infected persons}}$$

Update 7: Day 3

Looking back at past cases since the previous January, you are able to quantify the magnitude of *P. aeruginosa* infection over a 15-month period. All 46 cases were admitted to the small baby room and mechanically ventilated. In all the cases, infections were either systemic (in bloodstream) or localized in and around the endotracheal tube (ETT). All cases were laboratory confirmed. No *P. aeruginosa* was isolated from skin or wound cultures. Table 1 below summarizes the results of your chart review:

Table 1. Cases of *P. aeruginosa, January 2014-March 2015*

Month of Diagnosis	Site of infection	Month of Diagnosis	Site of infection
January 2014	ETT	August 2014	ETT
February 2014	ETT	August 2014	ETT
March 2014	Blood	August 2014	Blood
March 2014	ETT	September 2014	ETT
April 2014	Blood	September 2014	ETT
April 2014	ETT	November 2014	Blood
April 2014	ETT	November 2014	ETT
April 2014	ETT	December 2014	Blood
May 2014	Blood	December 2014	Blood
May 2014	ETT	December 2014	ETT
May 2014	ETT	December 2014	Blood
May 2014	ETT	January 2015	ETT
May 2014	Blood	January 2015	ETT
May 2014	ETT	January 2015	ETT
May 2014	ETT	January 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	March 2015	ETT
June 2014	ETT	March 2015	Blood
June 2014	Blood	March 2015	Blood
July 2014	Blood	March 2015	Blood
July 2014	ETT	March 2015	Blood

11. Construct a histogram plotting the number of cases, by type of infection, for each month of diagnosis beginning with January 2014 and ending in March 2015. (Hint: Plot Blood and ETT on the same graph, differentiated by shading).

12. Look at the histogram you created. Is this histogram an epidemic curve? Why or why not?

13. What are the next steps in determining the source of the outbreak?

14. Considering that all cases are on mechanical ventilators and a large number of patients had bacterial colonization on endotracheal tubes, what control measures, if any do you implement?

Update 8

Based on the findings of your research of recent infections in the NICU, you are interested in the possible link between endotracheal tubes and the *P. aeruginosa* infections, but do not want to narrow your focus before obtaining more evidence to confirm your suspicions. You begin by requesting environmental samples from surfaces in the NICU: ventilator equipment, faucets, sink drains, hand lotion, and cleaning agents. Worried about infections spread via healthcare workers, you obtain cultures from ear canals and hands of any healthcare worker working in the NICU, as ear canals and hands are common colonization sites. You also questioned the workers about recent history of skin or ear infections, and workers' fingernail length was assessed by the ICP and recorded.

The results of the environmental assessment reveal that *P. aeruginosa* was isolated from 2 sink drains—no other samples tested positive. From the healthcare worker specimen collection, you find that 2 NICU nurses had *P. aeruginosa* isolated from their hands, but not from their ear canals. You also note that on inspection of their hands, one nurse had long natural fingernails (nurse A) and the second nurse had short natural fingernails (nurse B).

You decide to conduct an epidemiologic investigation to look at factors that might have contributed to *P. aeruginosa* infection.

15. Given this information what type of epidemiologic study design would you use?

16. You decide to conduct a case-control investigation. Discuss what criteria should be used to classify cases and controls.

Update 9

In this study, cases were defined as intubated patients with laboratory confirmed *P. aeruginosa* infection that stayed in the NICU longer than 48 hours during the period between January 1, 2014 and March 31, 2015. Controls were intubated patients admitted to the NICU for more than 48 hours between January 1, 2014 and March 31, 2015.

135 controls were randomly selected from NICU chart reviews of patient visits during the study period and compared against the 46 cases. Of all the experimental variables, you find that contact with an infected nurse was slightly greater than 1, but exposure to the infected nurse with long fingernails was much greater.

17. The odds ratio for contact with an infected nurse was 1.21, with a 95% confidence interval of 0.35 - 4.65. Do these results imply that contact with an infected nurse was a risk factor for developing *P. aeruginosa* infection? Why or why not?

Table 2. Number of Cases and Controls in Contact with an Infected Nurse

Contact with Infected Nurse with long fingernails	Cases	Controls
Yes	41	75
No	5	60

18. From table 2 above, calculate the odds of acquiring infection if you had contact with the infected, long-nailed nurse within this study. The odds of acquiring infection from an infected nurse is found by dividing the number of cases who had contact with the nurse by the number of controls having contact with the nurse.

19. Using the same table, calculate the odds of acquiring infection if you did not have contact with the long-nailed infected nurse. The odds of being a case if you did not have contact with the long-nailed infected nurse is found by dividing the number of cases who did not have contact with the nurse by the number of controls who did not have contact with the nurse.

20. Calculate the disease odds ratio using the data provided. A disease odds ratio is found by obtaining the ratio of the probability of being a case among the exposed and the probability of being a case among the non-exposed. These two probabilities have been found in questions 18 and 19, and were 0.54 and 0.083.

Disease odds ratio = $\frac{\text{odds of infection \& having contact with long-nailed infected nurses}}{\text{odds of infection \& not having contact w/ long-nailed infected nurse}}$

Conclusion

Based on the results of your investigation, it was recommended that nurses in the NICU keep short to medium length nails (<1/4 inch from nailbed). As an added precaution, the nurses carrying *P. aeruginosa* were assigned to tasks that did not involve contact with NICU patients, but returned to NICU patient care after it was determined they were no longer carrying the bacteria. With the implementation of these recommendations, the number of *P. aeruginosa* cases declined.

Restrictions preventing fingernail length had been in place in certain hospital departments (most notably operating rooms). The investigation on which this study was based led to a more widespread acceptance of fingernail length guidelines.

References

Anderson-Berry AL, Bellig LL, Ohning BL. Neonatal sepsis. eMedicine. 2014. Available at: http://www.emedicine.com/PED/topic2630.htm. Accessed April 6, 2016.

Aschengrau A, Seage GR. *Essentials of Epidemiology in Public Health*. Sudbury: Jones and Bartlett Publishers, Inc; 2003.

Bodey GP, Bolivar R, Fainstein V, Jadeja L. Infections caused by Pseudomonas aeruginosa. Rev Infect Dis 1983; 5: 279-313.

Centers for Disease Control and Prevention. Healthcare-associated infections (HAIs). 2015. Available at http://www.cdc.gov/HAI/surveillance/index.html. April 6, 2016.

Centers for Disease Control and Prevention. Pseudomonas aeruginosa in healthcare settings. 2014. Available at http://www.cdc.gov/HAI/organisms/Pseudomonas.html. April 6, 2016.

Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care-associated infections. *N Engl J Med 2014; 370:1198-1208*.

Moolenaar RL, Crutcher JM, San Joaquin VH, et al. A prolonged outbreak of *Pseudomonas aeruginosa* in a neonatal intensive care unit: did staff fingernails play a role in disease transmission? Infect Control Hosp Epidemiol 2000; 21:80-85.

Naze F, Jouen E, Randriamahazo RT, Simac C, Laurent P, Bleriot A, et al. Pseudomonas aeruginosa outbreak linked to mineral water bottles in a neonatal intensive care unit: fast typing by use of high-resolution melting analysis of a variable-number tandem-repeat locus. *J Clin Microbiology 2010;48(9):3146-3152*.

Occupational Safety and Health Standards (OSHA). 1910.1030. Bloodborne pathogens: Toxic and Hazardous Substances. Occupational Safety and Health Administrator. US Department of Labor.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit
Facilitator Guide

Situation

Healthcare associated infections (HAIs), previously referred to as nosocomial infections, are acquired by patients during their treatment in a healthcare setting. HAIs are of serious concern in the healthcare field. Hospitals are an ideal setting for opportunistic pathogens because they house both highly infectious and highly susceptible patients. Simple infection control practices such as hand washing and thorough cleaning and disinfecting of items have greatly reduced the incidence of HAIs, yet such infections still occur. In the U.S. alone, it is estimated that HAIs are responsible for 1.7 million infections annually, 75,000 of which are fatal.

Most hospitals employ an infection control practitioner (ICP) who monitors cases of disease throughout the hospital and ensures that proper hygiene and infection control procedures are followed throughout the hospital. Additionally, many hospitals employ a hospital epidemiologist to assist the ICP in surveillance and epidemiologic investigations, when necessary. The following case study examines what can happen when there is a lapse in surveillance and cases go unreported, and is loosely based on an actual outbreak that occurred in a children's hospital in the United States.

Update 1: Day 1

You are the hospital epidemiologist in the regional children's hospital in your state. You receive a call from the infection control practitioner, who was notified of a patient with early signs of a systemic infection by an attending physician in the neonatal intensive care unit (NICU). Despite a variety of differential diagnoses, the physician began antibiotic treatment, knowing that neonates such as this patient are at high risk of developing neonatal sepsis. The physician ordered blood and serum samples, and requested a cerebrospinal fluid (CSF) sample be collected as soon as possible.

The infection control practitioner asks for your help in investigating the circumstances of this case.

1. What pertinent information would be helpful for you and the physician to know regarding this patient?

Suggested answer: *Because this particular patient has been in the NICU since birth, a relatively complete medical history would be available. In addition to the patient's*

medical history, you would want to know the infant's level of activity or lethargy, feeding patterns, immunization history (if any), and any contact with ill individuals.

You might also want to know if any other patients in the NICU are showing signs of infection. Additionally, the nurse or physician should inspect vascular or urinary catheters or any other indwelling lines for signs of infection.

The physician might also inquire about the health status of the mother, as some neonatal infection, especially in premature infants, can be acquired from the mother during birth.

2. What infectious agents would be of greatest concern to the physician?

Suggested answer: *At this point, it is reasonable to assume that this patient has an infection, but the source of the infection, as well as the agent, is not currently known. While there are numerous bacteria that can cause an infection, the main cause for concern in this situation is the progression of infection to pneumonia and/or bacteremia (sepsis) in the patient. One might consider the bacteria most commonly associated with sepsis: coagulase-negative staphylococci, Staphylococcus aureus, E. coli, Klebsiella, Pseudomonas, Enterobacter, Candida, GBS, Serratia, Acinetobacter, and anaerobes.*

Update 2: Day 2

You find out from the ICP that the patient is 2 week-old infant born prematurely at 33 weeks with underdeveloped lungs and has been intubated in the NICU since birth. The infant began showing signs of cyanosis and the nurse caring for the infant noticed the child had a rapid heartbeat and a fever of 101.5°F.

After initial antibiotic treatment, the patient's fever dropped to 100.8°F but the heart rate remained elevated. A rapid laboratory test revealed gram-negative rods in the patient's blood and CSF, although specific lab results that will identify the pathogen are still pending. The finding of gram-negative rods in the blood is particularly worrisome and indicative of bacterial sepsis, but the infant appears to be responding well to the antibiotic treatment.

In thinking about the source of the infection, the physician reviews the chart of the mother to see if she could have been the source. Although the baby was born premature, the mother showed no signs of infection upon admission to the hospital.

3. Could the mother be the source of infection, why or why not?

Suggested answer: *Sepsis in neonates is categorized as early-onset or late-onset. Early-onset sepsis is generally attributed to the transfer of pathogens from the mother to the infant through the placenta or from the mother's genitourinary tract during birth.*

Because the onset is 14 days after birth, there is very little chance the infection could have been acquired from the mother. For the child to contract a disease during birth would mean the disease was in a pre-clinical phase (or at least not detected) for 13 days, which is highly unlikely. Infections occurring after 6 days are thought to be acquired from the outside environment, and when they advance to bacteremia are known as late-onset sepsis.

Additionally, onset of disease is more rapid in premature neonates. With newborns, 89% of early-onset infections present within 48 hours, with the remaining extending up to 6 days.

4. What might be other sources of infection in this patient?

Suggested answer: *The infection must have been acquired in the hospital. With respect to the exact source of infection, one can only speculate. Bacteria have been known to colonize infant's skin, gastrointestinal tract, respiratory tract, umbilicus, and conjunctivae from the following vectors: ventilators, indwelling lines such as vascular or urinary catheters, and contact with infected caregivers.*

5. Would you consider this a hospital acquired infection? Discuss what factors would lead you to determine if an infection is hospital acquired.

Suggested answer: *Yes, this is a hospital acquired infection. This is a simple answer because the child has not left the hospital, and has had no contact with anyone other than healthcare workers and occasional contact with the mother.*

To be considered a healthcare associated infection, the infection must not be present or incubating upon admission. Any infection that develops thereafter would be considered a healthcare associated infection.

Update 4: Day 2

You receive a call from the ICP, and the results of the laboratory diagnostic tests came back positive for *Pseudomonas aeruginosa (su-doe-mo-nas air-rudge-i-nosa)*. You and the ICP are immediately concerned about the potential spread throughout the NICU and the rest of the hospital. Below is what you know about this pathogen:

P. aeruginosa is one of the most common hospital acquired pathogens and can cause severe infections in hospitalized patients. It occurs naturally in the environment, and can be found in soil, water, plants and animals. *P. aeruginosa* is an opportunistic pathogen, meaning that it predominately infects persons with compromised immune systems. Infection with the bacteria can be localized or systemic if it enters the bloodstream. A 2011 study in the New England Journal of Medicine showed that *P. aeruginosa* caused 7% of all healthcare-associated infections, including 13% of healthcare associated pneumonia cases. Notably, there are now multidrug resistant strains of *P. aeruginosa* that cause approximately 400 deaths per year in the U.S. Within the healthcare setting, outbreaks of *P. aeruginosa* have been linked to contaminated respiratory, endoscopic, urodynamic and pressure monitoring equipment, contaminated sinks, products (e.g., eye drops), tap and bottled water, and even healthcare workers. *P. aeruginosa* infection is treatable, although acute infections in immunocompromised patients have resulted in a 30% - 60% mortality rate.

6. What steps should the infection control practitioner take to ensure the infection does not spread to other patients?

Suggested answer: *The most important step to take is to reinforce proper infection control practices. Proper hand hygiene is one of the most important prevention measures of infection, and this is a good opportunity to reinforce those principles. Along with hand hygiene, "universal precautions" should be followed at all times. With an easily transmissible bacterial infection, you might also want to consider taking contact precautions as well. It would be prudent to educate staff and remind them of what these precautions entail.*

Universal Precautions include:

- *Wash hands before and after each procedure*
- *Wear gloves*
- *Wear full-body gowns when necessary*
- *Wear face masks and eye protection when necessary*
- *Dispose of contaminated sharp objects in a safe container*
- *Dispose of contaminated personal protective equipment in an appropriately marked container*

Contact Precautions include:

- *Limit patient movement*
- *Isolate or cohort patients*

- *Gown + gloves for patient / room contact*
  - *Remove immediately after contact*
- *Do not touch eyes, nose, mouth with hands*
- *Avoid contaminating environmental surfaces*
- *Wash hands immediately after patient contact*
- *Use dedicated equipment if possible*
  - *If not, clean and disinfect between uses*
- *Clean, then disinfect patient room daily*
  - *Bed rails*
  - *Bedside tables*
  - *Lavatory surfaces*
  - *Blood pressure cuff, equipment surfaces*

7. Considering the information given, does it warrant a full investigation into the source of the infection?

Suggested answer: *Of course it would be ideal to know the source of the bacterial infection—knowing the infection was hospital acquired is particularly troubling—however this is a dilemma faced by some smaller hospitals in that they cannot fully investigate single occurrences of disease.*

It is worth obtaining more information and checking previous hospital records and surveillance data to see if there is any reason to believe there is a more serious problem occurring.

Update 5: Day 3

In looking over hospital surveillance data given to you by the ICP, you find an alarming trend that the new ICP did not notice. This case of is part of a growing number of *P. aeruginosa* infections in the NICU reported over the past year, and there have been several cases of *P. aeruginosa* this month.

8. Aside from an outbreak of disease, what might be other explanations of a rise in reportable diseases? Are these explanations likely for the observed causes of *P. aeruginosa*?

Suggested answer: *A change in reporting practices (e.g. a change in a case definition) can result in unexpected trends in disease surveillance. A classic example of a rise in disease not associated with an outbreak occurred when the HIV case definition was revised in 1993, resulting in a large increase in the number of reported cases. Such changes require caution when comparing surveillance data and may not accurately reflect change over time.*

Update 6: Day 3

Although there have been several cases other of *P. aeruginosa* infection throughout the hospital, the cases outside the NICU are comparable to baseline numbers and are not out of the ordinary. Knowing this, you begin to wonder if the NICU cases are linked to a common source. You decide to do some preliminary research on NICU patients in your hospital and discover the following:

Since January of last year, 519 infants were admitted to the NICU, with 439 staying for a period longer than 48 hours, thus putting them at a higher risk of contracting the infection. Forty-six patients were culture positive for *P. aeruginosa*, including the most recent patient, which sparked your interest in these infections. Despite the success in treating the most recent patient, 16 infected patients in the NICU died from their infection.

9. What is the prevalence of *P. aeruginosa* infections in patients who visited the NICU more than 2 days? Prevalence is a proportion that measures disease in a given population that is considered to be at risk. Prevalence is found by dividing the number of infected persons by the total number of people in the population at risk:

$$\text{Prevalence} = \frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$$

Suggested answer: *Prevalence can be reported as a percent, but is also reported in terms of cases "per 1,000" persons or any other numerically equivalent expression. Although there were 519 infants admitted to the NICU, this study defined the at risk group as NICU patients staying for a period longer than 48 hours. In this example, there were 46 case-patients found among 439 "at risk" patients in the NICU.*

$$\textit{Prevalence} = \frac{\textit{46 case-patients with P. aeruginosa infection}}{\textit{439 NICU patients staying >48 hours}}$$

Prevalence = 10.5%, or 105 cases of infection per 1,000 persons.

10. Calculate the case-fatality rate of infected patients from the NICU since January of the previous year. Case-fatality rate is the proportion of deaths in infected persons among the total number of infected persons (Note: Despite its name, a case fatality rate is not a true rate, but simply a proportion).

$$\text{Case-fatality rate} = \frac{\text{number of deaths in infected persons}}{\text{total number of infected persons}}$$

Suggested answer: *In this example, there were 16 deaths among infected individuals, and a total of 46 infected persons. Therefore,*

Case-fatality rate = 16 deaths in infected persons / 46 infected persons

Case-fatality rate = 34.8%

Update 7: Day 3

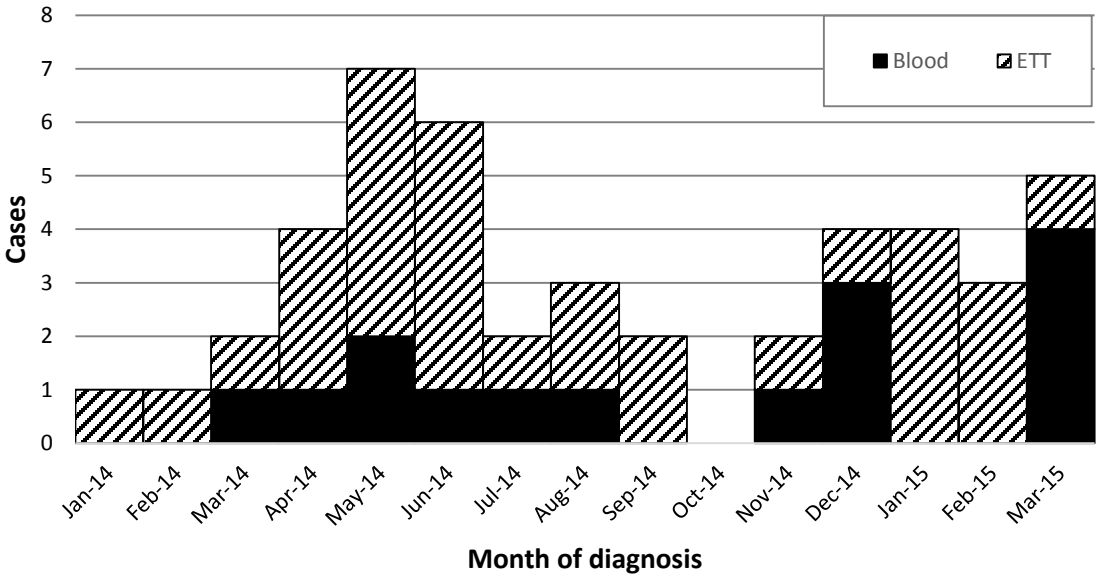
Looking back at past cases since the previous January, you are able to quantify the magnitude of *P. aeruginosa* infection over a 15-month period. All 46 cases were admitted to the small baby room and mechanically ventilated. In all the cases, infections were either systemic (in bloodstream) or localized in and around the endotracheal tube (ETT). All cases were laboratory confirmed. No *P. aeruginosa* was isolated from skin or wound cultures. Table 1 below summarizes the results of your chart review:

Table 1. Cases of *P. aeruginosa, January 2014-March 2015*

Month of Diagnosis	Site of infection	Month of Diagnosis	Site of infection
January 2014	ETT	August 2014	ETT
February 2014	ETT	August 2014	ETT
March 2014	Blood	August 2014	Blood
March 2014	ETT	September 2014	ETT
April 2014	Blood	September 2014	ETT
April 2014	ETT	November 2014	Blood
April 2014	ETT	November 2014	ETT
April 2014	ETT	December 2014	Blood
May 2014	Blood	December 2014	Blood
May 2014	ETT	December 2014	ETT
May 2014	ETT	December 2014	Blood
May 2014	ETT	January 2015	ETT
May 2014	Blood	January 2015	ETT
May 2014	ETT	January 2015	ETT
May 2014	ETT	January 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	February 2015	ETT
June 2014	ETT	March 2015	ETT
June 2014	ETT	March 2015	Blood
June 2014	Blood	March 2015	Blood
July 2014	Blood	March 2015	Blood
July 2014	ETT	March 2015	Blood

11. Construct a histogram plotting the number of cases, by type of infection, for each month of diagnosis beginning with January 2014 and ending in March 2015. (Hint: Plot Blood and ETT on the same graph, differentiated by shading).

Suggested answer: *Graphs may vary, but should look similar to the histogram pictured below. Ensure that Month of Diagnosis is on the x-axis, and that Number of Cases is on the y-axis. As with any graph, it should include a title, properly labeled axes, legend (if needed), and a descriptive title.*



Number of cases of *Pseudomonas aeruginosa* infection in neonatal intensive care patients, by method and month of diagnosis, January 1, 2014 – March 31 2015.

12. Look at the histogram you created. Is this histogram an epidemic curve? Why or why not?

Suggested answer: *This histogram is not a true epidemic curve. Although it plots the number of cases over time, the time interval of 1 month is much too long to be a true epidemic curve. The common practice when constructing epidemic curves is to begin with a time interval equal to ¼ an incubation period, which for P. aeruginosa infection, would be within hours or possibly days, NOT months. Using the time interval of ¼ the incubation period highlights the transmission pattern of the cases, in addition to recording the total number of cases.*

While helpful in characterizing the prevalence of infection, this should not be considered epidemic curve.

13. What are the next steps in determining the source of the outbreak?

Suggested answer: *The next step in the outbreak investigation would be to conduct a thorough environmental health assessment and begin thinking about conducting an epidemiologic study.*

14. Considering that all cases are on mechanical ventilators and a large number of patients had bacterial colonization on endotracheal tubes, what control measures, if any do you implement?

Suggested answer: *Knowing that most infants in the NICU are intubated, it would be a mistake to conclude that endotracheal tubes are the cause of the outbreak. However, your suspicion is high that this could be a source of infection, so you would want to reinforce aseptic technique when inserting endotracheal tubes. You could also take this opportunity to reinforce universal and contact precautions when dealing with infected individuals.*

Update 8

Based on the findings of your research of recent infections in the NICU, you are interested in the possible link between endotracheal tubes and *Pseudomonas* infections, but do not want to narrow your focus before obtaining more evidence to confirm your suspicions. You begin by requesting environmental samples from surfaces in the NICU: ventilator equipment, faucets, sink drains, hand lotion, and cleaning agents. Worried about infections spread via healthcare workers, you obtain cultures from ear canals and hands of any healthcare worker working in the NICU, as ear canals and hands are common colonization sites. You also questioned the workers about recent history of skin or ear infections, and workers' fingernail length was assessed by the ICP and recorded.

The results of the environmental assessment reveal that *P. aeruginosa* was isolated from 2 sink drains—no other samples tested positive. From the healthcare worker specimen collection, you find that 2 NICU nurses had *P. aeruginosa* isolated from their hands, but not from their ear canals. You also note that on inspection of their hands, one nurse had long natural fingernails (nurse A) and the second nurse had short natural fingernails (nurse B).

You decide to conduct an epidemiologic investigation to look at factors that might have contributed to *P. aeruginosa* infection.

15. Given this information what type of epidemiologic study design would you use?

Suggested answer: *Although this is a well-defined population, a case-control study is the best choice of study design to use. A cohort study examines a particular exposure and accesses their health outcome after a period of time. It would be difficult to clearly define exposed and unexposed persons in the study because there are many potential factors that could contribute to the spread of this infection and multiple exposures most likely occurred.*

A case-control study is better suited to assess a variety of risk factors and to assess multiple exposures. This will allow you to examine the relationship between infected patients and endotracheal tubes, contact with infected nurses, contact with infected nurses with long vs. short fingernails, and any other potential sources of infection.

16. You decide to conduct a case-control investigation. Discuss what criteria should be used to classify cases and controls.

Suggested answer: *Controls should represent the NICU population that gave rise to the cases. This reduces the possibility of confounding variables that might influence the results of the study. Although not specifically discussed, this information, specifically the criteria used to classify cases, would be referred to as the case definition, which is often a work in progress during the course of an investigation that can be narrowed down as more information is discovered. For example, laboratory confirmation may not be initially required if the suspect agent is not known. This will change as laboratory results are returned, which might warrant updating your case definition. To increase the statistical power of the study, up to 3 times as many controls as cases can be used —although this can be quite difficult. There are also statistical formulas you can use to determine ratio of cases to controls to increase power.*

Cases: Must have laboratory confirmed P. aeruginosa infection. From other available information you know that the 46 infected patients were all on mechanical ventilators in the NICU, which can be incorporated into the definition of a case. We were also told that these 46 patients stayed in the NICU longer than 48 hours, an important aspect to consider when thinking about hospital acquired infections. It is also important to include a time period in a case definition, which in this situation is between January 1, 2014 and March 31, 2015.

Controls: Controls should represent the at risk population as best as possible. In this example, that would mean selecting controls with the following characteristics similar to cases:

- *Patient visit in the NICU >48 hours, admitted to small baby room*
- *Visit in NICU from January 1, 2014 – March 31, 2015*

In the study from which this example was derived, investigators also matched cases and controls by birth-weight to account the variation among patients (which includes premature infants).

Update 9

In this study, cases were defined as intubated patients with laboratory confirmed *P. aeruginosa* infection that stayed in the NICU longer than 48 hours during the period between January 1, 2014 and March 31, 2015. Controls were intubated patients admitted to the NICU for more than 48 hours between January 1, 2014 and March 31, 2015.

135 controls were randomly selected from NICU chart reviews of patient visits during the study period and compared against the 46 cases. Of all the experimental variables, you find that contact with an infected nurse was slightly greater than 1, but exposure to the infected nurse with long fingernails was much greater.

17. The odds ratio for contact with an infected nurse was 1.21, with a 95% confidence interval of 0.35 - 4.65. Do these results imply that contact with an infected nurse was a risk factor for developing *P. aeruginosa* infection? Why or why not?

Suggested answer: *When analyzing odds ratios, there are two factors that must be considered. The odds ratio, in this case 1.21, should be greater than 1. This means that the odds of having P. aeruginosa infection among people with contact to one or both of the infected nurses was 1.2 times the odds of having P. aeruginosa infection among people who did not have contact with the infected nurses.*

The other information that must considered in an odds ratio is the 95% confidence interval. The confidence interval gives you an idea about the precision of the odds ratio, where a wide-ranging ratio is less precise than a narrower confidence interval. More importantly, however, the confidence interval gives you a determination of the significance of the odds ratio. If the confidence interval includes 1, then the odds ratio is not statistically significant.

In this case, the odds ratio is greater than 1.0 (slightly), but it is not statistically significant because the confidence interval includes 1.

Table 2. Number of Cases and Controls in Contact with an Infected Nurse

Contact with Infected Nurse with long fingernails	Cases	Controls
Yes	41	75
No	5	60

18. From table 2 above, calculate the odds of acquiring infection if you had contact with the infected, long-nailed nurse within this study. The odds of acquiring infection from an infected nurse is found by dividing the number of cases who had contact with the nurse by the number of controls having contact with the nurse.

Suggested answer: *Odds of acquiring infection and had contact with long-nailed infected nurses = 41/75 = 0.547*

19. Using the same table, calculate the odds of acquiring infection if you did not have contact with the long-nailed infected nurse. The odds of being a case if you did not have contact with the long-nailed infected nurse is found by dividing the number of cases who did not have contact with the nurse by the number of controls who did not have contact with the nurse.

Suggested answer: *Odds of acquiring infection and not having contact with long-nailed nurse = 5/60 = 0.083*

20. Calculate the disease odds ratio using the data provided. A disease odds ratio is found by obtaining the ratio of the probability of being a case among the exposed and the probability of being a case among the non-exposed. These two probabilities have been found in questions 18 and 19, and were 0.547 and 0.083.

$$\text{Disease odds ratio} = \frac{\text{odds of infection \& having contact with long-nailed infected nurses}}{\text{odds of infection \& not having contact w/ long-nailed infected nurse}}$$

Suggested answer: Disease odds ratio = 0.54/0.083 = 6.59

(Answers may vary due to rounding)

Conclusion

Based on the results of your investigation, it was recommended that nurses in the NICU keep short to medium length nails (<1/4 inch from nailbed). As an added precaution, the nurses carrying *Pseudomonas* were assigned to tasks that did not involve contact with NICU patients, but returned to NICU patient care after it was determined they were no longer carrying the bacteria. With the implementation of these recommendations, the number of *P. aeruginosa* cases declined.

Restrictions preventing fingernail length had been in place in certain hospital departments (most notably operating rooms). The investigation on which this study was based led to a more widespread acceptance of fingernail length guidelines.

References

Anderson-Berry AL, Bellig LL, Ohning BL. Neonatal sepsis. eMedicine. 2014. Available at: http://www.emedicine.com/PED/topic2630.htm. Accessed April 6, 2016.

Aschengrau A, Seage GR. *Essentials of Epidemiology in Public Health*. Sudbury: Jones and Bartlett Publishers, Inc; 2003.

Bodey GP, Bolivar R, Fainstein V, Jadeja L. Infections caused by Pseudomonas aeruginosa. Rev Infect Dis 1983; 5: 279-313.

Centers for Disease Control and Prevention. Healthcare-associated infections (HAIs). 2015. Available at http://www.cdc.gov/HAI/surveillance/index.html. April 6, 2016.

Centers for Disease Control and Prevention. Pseudomonas aeruginosa in healthcare settings. 2014. Available at http://www.cdc.gov/HAI/organisms/Pseudomonas.html. April 6, 2016.

Magill SS, Edwards JR, Bamberg W, Beldavs ZG, Dumyati G, Kainer MA, et al. Multistate point-prevalence survey of health care-associated infections. *N Engl J Med 2014; 370:1198-1208*.

Moolenaar RL, Crutcher JM, San Joaquin VH, et al. A prolonged outbreak of *Pseudomonas aeruginosa* in a neonatal intensive care unit: did staff fingernails play a role in disease transmission? Infect Control Hosp Epidemiol 2000; 21:80-85.

Naze F, Jouen E, Randriamahazo RT, Simac C, Laurent P, Bleriot A, et al. Pseudomonas aeruginosa outbreak linked to mineral water bottles in a neonatal intensive care unit: fast typing by use of high-resolution melting analysis of a variable-number tandem-repeat locus. *J Clin Microbiology 2010;48(9):3146-3152*.

Occupational Safety and Health Standards (OSHA). 1910.1030. Bloodborne pathogens: Toxic and Hazardous Substances. Occupational Safety and Health Administrator. US Department of Labor.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit
Post-Test

1. Which of the following describe contact precautions to prevent the spread of infection in a hospital setting?
    a. Limiting patient movement
    b. Providing gown and gloves for patient
    c. Using dedicated equipment
    d. Cleaning and disinfecting patient room daily
    e. All of the above are contact precautions
    f. A, B, and D only

2. Prevalence is:
    a. $\frac{\text{number of deaths in infected persons}}{\text{total number of infected persons}}$
    b. $\frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$
    c. $\frac{\text{number or cases (new and existing)}}{\text{total number of infected persons}}$
    d. none of the above

3. True or False: In a case control-study, the controls should represent the population that gave rise to the case patients.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit
Answer Key

1. Which of the following describe contact precautions to prevent the spread of infection in a hospital setting?
    a. Limiting patient movement
    b. Providing gown and gloves for patient
    c. Using dedicated equipment
    d. Cleaning and disinfecting patient room daily
    e. All of the above are contact precautions
    f. A, B, and D only

    Answer: E. All of the above are contact precautions.

    Feedback: Proper hand hygiene and universal precautions (i.e., Washing hands before and after each procedure, wearing gloves, full-body gowns, face masks and eye protection when necessary, disposing of contaminated sharp objects and contaminated personal protective equipment in an appropriately container) are important infection control practices in a hospital setting. With an easily transmissible bacterial infection, contact precautions can strengthen prevention. Other contact precautions include isolating patients, avoiding contact of eyes, nose, mouth with hands, avoiding contamination of environmental surfaces, and washing hands immediately after patient contact.

2. Prevalence is:
    a. $\frac{\text{number of deaths in infected persons}}{\text{total number of infected persons}}$
    b. $\frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$
    c. $\frac{\text{number or cases (new and existing)}}{\text{total number of infected persons}}$
    d. none of the above

    Answer: b. $\frac{\text{number or cases (new and existing)}}{\text{population at risk of infection}}$

    Feedback: Prevalence is a proportion that measures disease in a given population that is considered to be at risk. Prevalence is found by dividing the number of infected persons by the total number of people in the population at risk.

3. True or False: In a case control-study, the controls should represent the population that gave rise to the case patients.

    Answer: True

Feedback: Controls should represent the at risk population as best as possible. This would mean selecting controls with the same characteristics to the case patients.

Case Study 6: Outbreak in a Neonatal Intensive Care Unit Session Evaluation

Congratulations on completing Case Study 6 of the *P is for Practice* training.

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Please Note: Be sure that you have completed all training components (pre-test, training activity, and post-test) before accessing the evaluation. You will be required to certify that you have completed all training components as part of the evaluation. Contact hours for this training are based on the completion of all training components.

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