

Operation Outbreak

Eddie's Story



Activity details

Age or grade level

This activity is intended for middle and high school teachers to teach public health using the *The Junior Disease Detectives, Operation: Outbreak* graphic novel in their classrooms.

Learning objectives

At the end of this activity, students should be able to

- Identify steps in an influenza outbreak investigation.
- Define terms like “case”, “case definition”, “index case”, and “case classification”.
- Describe how a case definition is used to help investigate an outbreak.
- Differentiate between a “suspected,” “probable,” and “confirmed” case.
- Explain how a case definition can change over the course of an outbreak.

Problem-based skill

Decision-making

National standards

HS-EPHS1-3: Apply epidemiologic thinking and a public health approach to a model (e.g., an outbreak) to explain cause and effect associations that influence health and disease.

<https://www.cdc.gov/careerpaths/k12teacherroadmap/pdfs/ephs-competencies.pdf>

NGSS Science & Engineering Practice: Asking questions and defining problems; Crosscutting Concept: Patterns

<http://www.nextgenscience.org/get-to-know>

Activity time

45 minutes

Handouts

- Making the Case
- Case Reports
- Case Classifications

Materials

- The Junior Disease Detectives, Operation: Outbreak graphic novel (<https://www.cdc.gov/flu/graphicnovel>)

Introduction

During an outbreak investigation, disease detectives gather clues from clinical, epidemiologic, and laboratory data to identify the cause of the outbreak. One of the first steps of an investigation is to specify what it means to be a **case** or an instance of disease or injury that occurs in a person. This is done by using a **case definition**, or a set of uniformly applied criteria for determining whether an event (e.g., disease or injury) should be considered part of the outbreak. A case definition often includes medical features (i.e., clinical signs and symptoms), epidemiologic information, and laboratory test results. Epidemiologic information can include criteria on demographic characteristics such as sex and age (person), geographic location of where an ill person lives or visited recently (place), and onset of clinical signs and symptoms (time).

Although the term “case definition” is not used in the graphic novel, it is an integral part of any outbreak investigation. Disease detectives start with what they know. Eddie’s illness represents the **index case** — the first case to come to the attention of public health authorities. Based on the details of Eddie’s case, the disease detectives investigating this outbreak would have created an initial case definition. The initial case definition is often very general to ensure that investigators can capture as many potential cases as possible. Then, they would use the



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initial case definition to search for additional potential cases. For example, the disease detectives would contact local hospitals and doctors' offices and ask if there are patients that potentially meet the initial case definition.

In the story, as soon as they reach the public health department, Dr. Kim, a Centers for Disease Control and Prevention (CDC) Epidemic Intelligence Service (EIS) CDC EIS officer, mentions contacting local hospitals and doctors' offices to see if there have been any other unusual respiratory illnesses in the last few days. The initial case definition would be used to determine if illnesses reported by the hospitals or doctors' offices should be included as cases in the outbreak investigation.

Later in the story, Dr. Alex, another CDC EIS officer, meets with the Thomas County Fair director, Andy Duncan, and the state veterinarian, Dr. Tolani, who inspected animals at the fair. He asks Dr. Tolani if there was any illness among animals at the fair and he asks if Andy is aware of any illness reported among people who attended the fair. Dr. Tolani reports signs of illness among the horses, cows, and pigs. She shares the state animal health laboratory reports with Dr. Alex.

Mr. Duncan explains that a few people told him that they or someone in their family is sick with respiratory symptoms after the fair. To determine if these are additional cases, Dr. Alex requests the contact names and phone numbers to collect more information using a case report form.

A case report form is used to collect information on medical features — clinical signs and symptoms of illness, that include results of laboratory testing, and epidemiologic information — person, place, and time. People who become sick as well as people who care for sick animals have a responsibility to accurately report their symptoms and possible exposure history to their health care provider (e.g., a physician, physician's assistant, or nurse) or veterinarian. Disease detectives rely on people to report accurate and complete descriptions of signs and symptoms of illness and activities, such as attending animal exhibitions or exposure to environments shared with animals that may potentially lead to the

transmission of pathogens between humans and animals.

The disease detectives analyze these case report forms to identify patterns and to generate hypotheses about the potential cause of illness. Information from those reports can also be used to refine the case definition.

As more information becomes available, a more detailed case definition might be used to improve the chances or likelihood that the illness occurring among patients is caused by the same pathogen (i.e., a bacterium, virus, or other microorganism that can cause disease). A more detailed case definition can also be used to classify a patient's illness as a case of a certain infection. For example, CDC provides a case definition for novel influenza A virus infections to help disease detectives determine if patient illnesses can be classified as a case of novel influenza A virus infection or not.

More detailed case definitions typically include **case classifications** — suspected, probable, or confirmed depending on the amount of information available. Case classifications allow disease detectives to specify the likelihood that a given case involves the condition of interest. For example, cases may be classified as **suspected** — meets the clinical criteria only (i.e., the patient has the named signs and symptoms associated with the disease), **probable** — meets the clinical criteria and is epidemiologically linked to a confirmed case (i.e., the patient has the relevant signs and symptoms of illness and also has or has had contact with one or more people or animals who have or had the disease, and transmission is plausible via a known mode of transmission), or **confirmed** — there is confirmed laboratory evidence of the disease in question based on specimens collected and tested from the patient. Ideally, laboratory evidence is available to confirm the disease.

How a case is classified may change over time as more information is obtained. For example, if laboratory results become available, a suspect case could be reclassified as confirmed. Or, if new data are obtained that indicates no relation to the current disease outbreak or if another pathogen is detected, a suspect case may be removed from the investigation. Reclassification

of cases can occur as more epidemiologic information and laboratory results become available. In Eddie's example, he initially displayed clinical signs and symptoms of a respiratory infection. Because he meets the clinical criteria, he was classified as a suspected case. Then, more epidemiologic information was obtained about Eddie and his illness. A potential epidemiologic link was established between Eddie showing his pig at the fair and the state veterinarian, Dr. Tolani, testing a few of the pigs with a mild fever. This potential linkage would have caused Eddie's illness to be reclassified as a probable case. When Eddie's laboratory test results confirmed a variant influenza virus infection, Eddie's case was considered confirmed.

In this activity, students will collect information about Eddie to develop an initial case definition. Students will use the completed case report forms for Eddie and the other ill patients to identify patterns in clinical and epidemiologic information. Using these patterns, students will generate hypotheses about possible links between Eddie and the other ill patients. Then, students will use a detailed case definition for novel influenza A virus infection to determine Eddie and the other patients' classification status throughout the investigation.

Did you know?

At one time influenza was believed to have been caused by the bacteria *Haemophilus influenzae*. It was not until 1933 that the first human influenza virus was isolated. *H. influenzae* is now recognized as a cause of pneumonia (i.e., lung inflammation caused by bacterial or viral infection), bacteremia (i.e., the presence of bacteria in the blood), and meningitis (i.e., inflammation of the membranes around the brain and spinal chord) among children, older adults, and people with certain medical conditions, such as sickle cell disease, HIV infection, and cancers requiring treatment with chemotherapy, radiation, or bone marrow transplants.

Resources

Principles of Epidemiology in Public Health Practice: Lesson 1, Section 5: The Epidemiologic Approach (<https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section5.html>)

CDC Influenza A Case Report Form (<http://www.dph.illinois.gov/sites/default/files/forms/human-infectionwith-novel-influenza-avirus-case-report-form-050316.pdf>)

CDC Novel Influenza A Case Definition (2014) (<https://wwwn.cdc.gov/nndss/conditions/novel-influenza-a-virus-infections/case-definition/2014/>)

Activity instructions

Explain

When investigating an outbreak, disease detectives identify patterns in evidence or known information to make decisions about what to include in a case definition. Case definitions can change throughout the investigation as more information is learned and gathered. This step of refining and making the case definition more specific is important because including cases that are not part of the outbreak in the analysis can make it difficult to narrow down the cause or source of infection. On the other hand, if persons whose illness meets the case definition are not identified and included, valuable information about the outbreak could be missing. This would also make it more difficult to identify the cause or source of infection. Inaccurate identification of cases delays implementation of appropriate control measures that can halt the spread of the disease. This activity will help illustrate the importance of accuracy in making decisions about how to define a case.

Instruct

1. For homework, assign students to read *The Junior Disease Detectives, Operation: Outbreak* graphic novel.
2. In class, discuss the characters in *The Junior Disease Detectives, Operation: Outbreak* graphic novel. Ask students to identify (a) some of Eddie's clinical signs and symptoms of a respiratory illness and (b) some characteristics that Eddie has that are different than the other students (e.g., asthma).
3. Distribute the Making the Case handout; provide one per student.
 - a. Explain that disease detectives start with what they know. In the graphic

novel, Dr. Alison, a CDC EIS officer, talks to Eddie's family, physician, and friends at the hospital to collect information on signs and symptoms of illness and Eddie's activities. This information helps identify possible clues to Eddie's illness and helps the disease detectives create an initial case definition to identify other possible cases.

Emphasize the importance of people and animal caretakers reporting accurate and complete information (e.g., their—or their animal's—signs and symptoms and possible exposure history) to their primary care providers and veterinarians in the investigation.

- b. Discuss the components of a case definition: medical features — clinical signs and symptoms, and epidemiologic information — person, place, and time.

Emphasize the importance of creating an appropriate initial case definition to use in the investigation. Remind students that this is the initial case definition and may change after more information is known. Mention that once laboratory results become available, this will likely be added to the case definition.

- c. Instruct students to write an initial case definition based on Eddie's circumstances.

4. Distribute the Case Reports handout.

- a. Explain that Dr. Alex has received contact information regarding three ill patients who attended the fair. Ask students what information would be needed to determine if their illness was linked to Eddie's illness.
- b. Have students use the completed case report forms for Eddie and the other ill patients to identify patterns in clinical and epidemiologic information. Using these patterns, have students generate hypotheses about possible links between Eddie and the other ill patients.
- c. Ask students to update their case definition using this new information.

5. Distribute the case classification handout; provide one per student.
 - a. Discuss case classifications — suspected, probable, and confirmed. Discuss how case classification can be used to identify if an illness can be classified as a case of a certain infection, for example, a novel influenza A virus.
 - b. Using the graphic novel, have students consider Eddie's circumstances at various points of the story. Instruct students to complete the table by marking the appropriate case classification for novel influenza A at each of the three points of the story provided.
 - c. Discuss how case classifications also allow disease detectives to identify the likelihood that other patient's illnesses are associated with the outbreak. Based on the information provided in the case forms, classify Patient A, B, and C.

Discuss

1. Describe the components of a case definition.
2. Explain why creating a case definition early in the investigation is important.
3. Explain the advantages of using case classifications when investigating a disease outbreak.

Information

Authors

Activities were developed as a collaboration between the CDC Science Ambassador Fellowship program in CDC's Center for Surveillance, Epidemiology, and Laboratory Services; science, technology, engineering, and mathematics (STEM) teachers from across the country who participated in the 2017 CDC Science Ambassador Fellowship; CDC's National Center for Immunization and Respiratory Diseases; and CDC's National Center for Emerging and Zoonotic Infectious Diseases.

CDC's Center for Surveillance, Epidemiology, and Laboratory Services

The following experts in education from the U.S. Centers for Disease Control and Prevention provided leadership, content development, and editing for these activities: Kelly Cordeira, MPH, Student Programs and Partnerships Lead, Division of Scientific Education and Professional Development, Center for Surveillance, Epidemiology, and Laboratory Services.

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Making the Case

Name: _____

Date: _____

Directions

Dr. Alison, one of CDC’s disease detectives, interviews Eddie’s family, primary care providers, and friends while at the hospital. Eddie’s family and primary care providers describe Eddie’s clinical signs and symptoms, such as fever (measured temperature of 100°F or greater), cough, and muscle aches. They also provide information about Eddie’s other health condition, asthma. Preexisting health conditions, like asthma, can put a person at a higher risk for developing severe disease.

Eddie’s friends provide information on what activities Eddie was involved with at the Thomas County Fair. They provide important epidemiologic information on place (i.e., the geographic location of where Eddie recently visited, such as visiting the animal areas at the fair); and time (i.e., when Eddie may have been exposed and infected), such as before or during the Thomas County Fair and when Eddie started showing clinical signs and symptoms of infection.

After collecting some initial information, Dr. Alison and the other disease detectives work together to create a case definition. They will use the case definition to see if anyone else who is ill should be included in the investigation.

A **case definition** is a set of uniformly applied criteria for determining whether an event (e.g., disease or injury) should be considered as part of the outbreak. A case definition often includes medical features (e.g., clinical signs and symptoms), epidemiologic information, and laboratory test results. Epidemiologic information can include criteria on the demographic characteristics such as sex and age (i.e., person), geographic location of where an ill person lives or visited recently (i.e., place), and onset of clinical signs and symptoms (i.e., time).

Reread pages 37–40 of CDC’s *The Junior Disease Detectives, Operation: Outbreak* graphic novel. Then, use Eddie’s case to write an initial case definition for the outbreak investigation. Remember to include medical features—clinical signs and symptoms and epidemiologic information—person, place, time.

Initial Case Definition

Case Reports

Name: _____

Date: _____

Directions: On pages 40–41, Dr. Alex, a CDC EIS officer, asks Andy Duncan, the Thomas County Fair director, if he is aware of any illness reported among people who attended the fair. Mr. Duncan explains that a few people told him that they or someone in their family got sick with some kind of respiratory bug after the fair.

Dr. Alex suspects that these may be additional cases in this outbreak. Dr. Alex requests the contact names and telephone numbers to follow up with the three additional patients. He uses a case report form to make sure he asks the right questions.

1. Read through the completed case report forms provided. Generate a possible hypothesis about if Eddie and the other patients' illness might be linked. Consider the medical features (i.e., clinical signs and symptoms) and epidemiologic information (i.e., person, place, and time) as clues.

Hypothesis Generation

2. Use your hypothesis to update your case definition.

Case Definition 2.0

Eddie

Interviewer: EIS officer, Dr. Alison

Interview date: 9/19

Demographics

Sex: Male **Age:** 17 years **City, State:** Slayerville (Thomas County)

Clinical signs and symptoms

Fever ≥100°F?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/17
Cough?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/14
Sore throat?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/15
Muscle Aches?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/17

Epidemiologic risk factors

Attended fair?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Date? 9/14
Date(s) attended	<input checked="" type="checkbox"/> On the day of illness onset <input type="checkbox"/> 1 day before illness onset	<input type="checkbox"/> 2 days before illness onset <input type="checkbox"/> 3 days before illness onset	<input type="checkbox"/> 4 days before illness onset <input type="checkbox"/> 5 days before illness onset	<input type="checkbox"/> 6 days before illness onset <input type="checkbox"/> 7 days before illness onset
Sick before the fair?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unknown	
Direct contact with (touch, pet, or kiss) livestock animal?	<input type="checkbox"/> Horses <input type="checkbox"/> Cows	<input type="checkbox"/> Goats <input type="checkbox"/> Poultry	<input type="checkbox"/> Sheep <input checked="" type="checkbox"/> Pigs or hogs	<input type="checkbox"/> Other <input type="checkbox"/> No Contact
Where did direct contact occur?	<input checked="" type="checkbox"/> Home <input type="checkbox"/> Work	<input checked="" type="checkbox"/> Fair <input type="checkbox"/> Petting Zoo	<input type="checkbox"/> Live Animal Market	<input type="checkbox"/> Other
Indirect contact with (walk through or come within 6 feet of) livestock animals?	<input type="checkbox"/> Beef or Dairy Barn <input type="checkbox"/> Horse Barn <input checked="" type="checkbox"/> Poultry Barn	<input type="checkbox"/> Sheep or Goat Barn <input checked="" type="checkbox"/> Swine Barn <input type="checkbox"/> Horse Arena	<input checked="" type="checkbox"/> Practice Ring A <input type="checkbox"/> Practice Ring B	<input type="checkbox"/> Arena A <input type="checkbox"/> Arena B <input checked="" type="checkbox"/> Other: Home Barn <input type="checkbox"/> No Contact
Where did indirect contact occur?	<input checked="" type="checkbox"/> Home <input type="checkbox"/> Work	<input type="checkbox"/> Work <input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Live Market <input type="checkbox"/> Petting Zoo	<input type="checkbox"/> Other

Influenza testing

Result	<input type="checkbox"/> Influenza A <input type="checkbox"/> Influenza B	<input type="checkbox"/> Influenza A/B (not distinguished)	<input type="checkbox"/> Negative <input type="checkbox"/> Other	<input checked="" type="checkbox"/> Not yet known
If influenza A, what is the subtype?	<input type="checkbox"/> Human seasonal influenza A (H1N1) <input type="checkbox"/> Influenza A (H1N1) variant <input type="checkbox"/> Avian influenza A (H5N1)	<input type="checkbox"/> Human seasonal influenza A (H3N2) <input type="checkbox"/> Influenza A (H1N2) variant	<input type="checkbox"/> Avian influenza A (H7N2) <input type="checkbox"/> Influenza A (H3N2) variant	<input type="checkbox"/> Avian influenza A (H7N9) <input type="checkbox"/> Other ____ <input checked="" type="checkbox"/> Not yet known

Patient A

Interviewer: EIS officer, Dr. Alex

Interview date: 9/19

Demographics

Sex: Female

Age: 16 years

City, State: Archerville (Thomas County)

Clinical signs and symptoms

Fever $\geq 100^\circ\text{F}$?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/16
Sore throat?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/15
Cough?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/15
Muscle Aches?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/16

Epidemiologic risk factors

Attended fair?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Date? 09/15
Date(s) attended	<input checked="" type="checkbox"/> On the day of illness onset	<input type="checkbox"/> 2 days before illness onset	<input type="checkbox"/> 4 days before illness onset	<input type="checkbox"/> 6 days before illness onset
	<input type="checkbox"/> 1 day before illness onset	<input type="checkbox"/> 3 days before illness onset	<input type="checkbox"/> 5 days before illness onset	<input type="checkbox"/> 7 days before illness onset
Sick before the fair?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unknown	
Direct contact with (touch, pet, or kiss) livestock animal?	<input type="checkbox"/> Horses	<input type="checkbox"/> Goats	<input type="checkbox"/> Sheep	<input type="checkbox"/> Other
	<input checked="" type="checkbox"/> Cows	<input type="checkbox"/> Poultry	<input checked="" type="checkbox"/> Pigs or hogs	<input type="checkbox"/> No Contact
Where did direct contact occur?	<input checked="" type="checkbox"/> Home	<input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Live Animal Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input type="checkbox"/> Petting Zoo		
Indirect contact with (walk through or come within 6 feet of) livestock animals?	<input checked="" type="checkbox"/> Beef or Dairy Barn	<input type="checkbox"/> Sheep or Goat Barn	<input checked="" type="checkbox"/> Practice Ring A	<input checked="" type="checkbox"/> Arena A
	<input type="checkbox"/> Horse Barn	<input checked="" type="checkbox"/> Swine Barn	<input type="checkbox"/> Practice Ring B	<input type="checkbox"/> Arena B
	<input type="checkbox"/> Poultry Barn	<input type="checkbox"/> Horse Arena		<input checked="" type="checkbox"/> Other: Home Barn
				<input type="checkbox"/> No Contact
Where did indirect contact occur?	<input checked="" type="checkbox"/> Home	<input type="checkbox"/> Work	<input type="checkbox"/> Live Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Petting Zoo	

Influenza testing

Result	<input type="checkbox"/> Influenza A	<input type="checkbox"/> Influenza A/B (not distinguished)	<input type="checkbox"/> Negative	<input checked="" type="checkbox"/> Not yet known
	<input type="checkbox"/> Influenza B		<input type="checkbox"/> Other	
If influenza A, what is the subtype?	<input type="checkbox"/> Human seasonal influenza A (H1N1)	<input type="checkbox"/> Human seasonal influenza A (H3N2)	<input type="checkbox"/> Avian influenza A (H7N2)	<input type="checkbox"/> Avian influenza A (H7N9)
	<input type="checkbox"/> Influenza A (H1N1) variant	<input type="checkbox"/> Influenza A (H1N2) variant	<input type="checkbox"/> Influenza A (H3N2) variant	<input type="checkbox"/> Other
	<input type="checkbox"/> Avian influenza A (H5N1)			<input checked="" type="checkbox"/> Not yet known

Patient B

Interviewer: EIS officer, Dr. Alex

Interview date: 9/19

Demographics

Sex: Male

Age: 14 years

City, State: Germ town (Thomas County)

Clinical signs and symptoms

Fever $\geq 100^{\circ}\text{F}$?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/17
Sore throat?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/17
Cough?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/17
Muscle Aches?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> Unknown	Onset? N/A

Epidemiologic risk factors

Attended fair?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Date(s)? 9/14, 9/15
Date(s) attended	<input type="checkbox"/> On the day of illness onset	<input checked="" type="checkbox"/> 2 days before illness onset	<input type="checkbox"/> 4 days before illness onset	<input type="checkbox"/> 6 days before illness onset
	<input type="checkbox"/> 1 day before illness onset	<input checked="" type="checkbox"/> 3 days before illness onset	<input type="checkbox"/> 5 days before illness onset	<input type="checkbox"/> 7 days before illness onset
Sick before the fair?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unknown	
Direct contact with (touch, pet, kiss) livestock animal?	<input type="checkbox"/> Horses	<input type="checkbox"/> Goats	<input type="checkbox"/> Sheep	<input type="checkbox"/> Other
	<input type="checkbox"/> Cows	<input type="checkbox"/> Poultry	<input type="checkbox"/> Pigs or hogs	<input checked="" type="checkbox"/> No Contact
Where did direct contact occur?	<input type="checkbox"/> Home	<input type="checkbox"/> Fair	<input type="checkbox"/> Live Animal Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input type="checkbox"/> Petting Zoo		
Indirect contact with (walk through or come within 6 feet of) livestock animals?	<input type="checkbox"/> Beef/ Dairy Barn	<input checked="" type="checkbox"/> Sheep or Goat Barn	<input type="checkbox"/> Practice Ring A	<input checked="" type="checkbox"/> Arena A
	<input type="checkbox"/> Horse Barn	<input checked="" type="checkbox"/> Swine Barn	<input type="checkbox"/> Practice Ring B	<input checked="" type="checkbox"/> Arena B
	<input type="checkbox"/> Poultry Barn	<input type="checkbox"/> Horse Arena		<input type="checkbox"/> Other: Home Barn
				<input type="checkbox"/> No Contact
Where did indirect contact occur?	<input type="checkbox"/> Home	<input type="checkbox"/> Work	<input type="checkbox"/> Live Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Petting Zoo	

Influenza testing

Result	<input checked="" type="checkbox"/> Influenza A	<input type="checkbox"/> Influenza A/B (not distinguished)	<input type="checkbox"/> Negative	<input type="checkbox"/> Not yet known
	<input type="checkbox"/> Influenza B		<input type="checkbox"/> Other	
If influenza A, what is the subtype?	<input type="checkbox"/> Human seasonal influenza A (H1N1)	<input type="checkbox"/> Human seasonal influenza A (H3N2)	<input type="checkbox"/> Avian influenza A (H7N2)	<input type="checkbox"/> Avian influenza A (H7N9)
	<input type="checkbox"/> Influenza A (H1N1) variant	<input type="checkbox"/> Influenza A (H1N2) variant	<input type="checkbox"/> Influenza A (H3N2) variant	<input type="checkbox"/> Other
	<input type="checkbox"/> Avian influenza A (H5N1)			<input checked="" type="checkbox"/> Not yet known

Patient C

Interviewer: EIS officer, Dr. Alex

Interview date: 9/19

Demographics

Sex: Male

Age: 41 years

City, State: Slayerville (Thomas County)

Clinical signs and symptoms

Fever $\geq 100^{\circ}\text{F}$?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/14
Sore throat?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/14
Cough?	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? N/A
Muscle aches?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Onset? 9/15

Epidemiologic Risk Factors

Attended fair?	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unknown	Date(s)? 9/14, 9/15, 9/16
Date(s) attended	<input checked="" type="checkbox"/> On the day of illness onset	<input type="checkbox"/> 2 days before illness onset	<input type="checkbox"/> 4 days before illness onset	<input type="checkbox"/> 6 days before illness onset
	<input type="checkbox"/> 1 day before illness onset	<input type="checkbox"/> 3 days before illness onset	<input type="checkbox"/> 5 days before illness onset	<input type="checkbox"/> 7 days before illness onset
Sick before the fair?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input checked="" type="checkbox"/> Unknown	
Direct contact with (touch, pet, kiss) livestock animal?	<input type="checkbox"/> Horses	<input type="checkbox"/> Goats	<input type="checkbox"/> Sheep	<input type="checkbox"/> Other
	<input checked="" type="checkbox"/> Cows	<input checked="" type="checkbox"/> Poultry	<input checked="" type="checkbox"/> Pigs or hogs	<input type="checkbox"/> No Contact
Where did direct contact occur?	<input checked="" type="checkbox"/> Home	<input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Live Animal Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input type="checkbox"/> Petting Zoo		
Indirect contact with (walk through or come within 6 feet of) livestock animals?	<input checked="" type="checkbox"/> Beef or Dairy Barn	<input type="checkbox"/> Sheep or Goat Barn	<input checked="" type="checkbox"/> Practice Ring A	<input checked="" type="checkbox"/> Arena A
	<input type="checkbox"/> Horse Barn	<input checked="" type="checkbox"/> Swine Barn	<input type="checkbox"/> Practice Ring B	<input checked="" type="checkbox"/> Arena B
	<input checked="" type="checkbox"/> Poultry Barn	<input type="checkbox"/> Horse Arena		<input checked="" type="checkbox"/> Other: Home Barn
				<input type="checkbox"/> No Contact
Where did indirect contact occur?	<input type="checkbox"/> Home	<input type="checkbox"/> Work	<input type="checkbox"/> Live Market	<input type="checkbox"/> Other
	<input type="checkbox"/> Work	<input checked="" type="checkbox"/> Fair	<input type="checkbox"/> Petting Zoo	

Influenza Testing

Result	<input type="checkbox"/> Influenza A	<input type="checkbox"/> Influenza A/B (not distinguished)	<input checked="" type="checkbox"/> Negative	<input type="checkbox"/> Not yet known
	<input type="checkbox"/> Influenza B		<input type="checkbox"/> Other	
If influenza A, what is the subtype?	<input type="checkbox"/> Human seasonal influenza A (H1N1)	<input type="checkbox"/> Human seasonal influenza A (H3N2)	<input type="checkbox"/> Avian influenza A (H7N2)	<input type="checkbox"/> Avian influenza A (H7N9)
	<input type="checkbox"/> Influenza A (H1N1) variant	<input type="checkbox"/> Influenza A (H1N2) variant	<input type="checkbox"/> Influenza A (H3N2) variant	<input type="checkbox"/> Other
	<input type="checkbox"/> Avian influenza A (H5N1)			<input type="checkbox"/> Not yet known

Case Classifications

Name: _____

Date: _____

A more detailed case definition typically includes **case classifications** — suspected, probable, or confirmed. CDC provides a case definition for novel influenza A virus infections¹ to help disease detectives determine if patient illnesses can be classified as a case of novel influenza A virus infection or not.

Suspected

A case meeting the clinical criteria (fever with measured temperature of 100°F or greater, with cough or sore throat), pending laboratory confirmation. Any case of human infection with an influenza A virus that is different from currently circulating human influenza H1 and H3 viruses is classified as a suspected case until the confirmation process is complete.

Probable

A case meeting the clinical criteria (fever with measured temperature of 100°F or greater, with cough or sore throat) and epidemiologically linked to a confirmed case (i.e., the patient has had contact with one or more persons who either have or had the disease, and transmission of the agent by the usual modes of transmission is plausible), but for which no confirmatory laboratory testing for influenza virus infection has been performed or test results are inconclusive for a novel influenza A virus infection.

Confirmed

A case of human infection with a novel influenza A virus confirmed by CDC's influenza laboratory or by public health laboratories following CDC-approved protocols. (Note: Although flu has a confirmed case definition that does not require symptoms, the confirmed case definition for other diseases may include clinical illness. For example, the confirmed case definition for other diseases might be "laboratory confirmation of infection in a patient with compatible symptoms".

¹CDC. Novel Influenza A Virus Infections, 2014 Case Definition. Available at: <https://www.cdc.gov/nndss/conditions/novel-influenza-a-virus-infections/case-definition/2014/>

1. At each point in time, identify to what extent Eddie meets the case definition for a novel influenza A virus infection. Justify your answer.

Date	Classification	Justification
Friday, Sept. 14– Monday, Sept. 17 (p. 16–26)	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed	
Early Wednesday, Sept. 19 (p. 29–41)	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed	
Later Wednesday Sept. 19 (p. 42–48)	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed	

2. Case classifications allow disease detectives to identify the likelihood that other patient's illnesses are associated with the outbreak. Assume that Eddie's case has been confirmed as a novel influenza A virus infection. Based on the information provided in the case report forms, classify Patients A, B, and C.

	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed
	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed
	<input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed

Answer Key

Initial Case Definition

A flu-like illness (e.g., a fever with measured temperature $\geq 100^{\circ}\text{F}$, with cough or sore throat) occurring in a person who had recent (within 7 days of illness onset) direct or indirect exposure to livestock, including attendance at an agricultural fair within 500 miles of Thomas County.

Clinical signs and symptoms

Fever with measured temperature $\geq 100^{\circ}\text{F}$, with cough or sore throat (Note: muscle aches are not part of CDC's influenza-like (flu-like) illness or novel influenza case definitions.)

Epidemiologic Information

Person — a person with a flu-like illness who recently (within 7 days of illness onset) had direct or indirect exposure to livestock.

Place — attendance at an agricultural fair within 500 miles of Thomas County (Note: It is common for exhibitors to visit multiple fairs with the same animals.)

Time — direct or indirect exposure to livestock occurring within 7 days of illness onset. (Note: The time from exposure to illness signs and symptoms is called the incubation period. Because the incubation period for influenza is 1–4 days, the case definition will need to capture first symptoms within or shortly after the incubation time period. Illness onset is defined as the onset of first symptoms; other symptoms may appear after onset.)

Hypothesis Generation

Answers will vary. Hypotheses should be justified with patterns in the information provided in the case report forms.

Possible patterns may include:

- Eddie, Patient A, and Patient B are of similar age (14–17 years old). Patient C is older (41 years old). Patient A is the only female. All live in Thomas County.
- All had a fever with a measured temperature $\geq 100^{\circ}\text{F}$, with cough or sore throat. Patient B may not have had muscle aches. Patient C did not have a cough.
- All attended the fair during September 14–September 16 and had signs or symptoms on the day of or within 1–3 days of attendance.
- All reported indirect contact with livestock animals in the swine barn. Eddie, Patient A, and Patient C had direct contact with pigs or hogs.

Case Definition 2.0

“A flu-like illness (e.g., a fever with measured temperature $\geq 100^{\circ}\text{F}$, with cough or sore throat occurring in a person who had recent (within 7 days of illness onset) direct or indirect exposure to a pig at an agricultural fair within 500 miles of the Thomas County Fair, including attendance of the Thomas County Fair.”

Clinical signs and symptoms

Fever with measured temperature $\geq 100^{\circ}\text{F}$, with cough or sore throat

Epidemiologic Information

Person — a person with a flu-like illness who recently (within 7 days of illness onset) had direct or indirect exposure to a pig/hog.

Place — attended an agricultural fair within 500 miles of the Thomas County Fair, including attendance of the Thomas County Fair.

Time — direct or indirect exposure to a pig or hog occurred within 7 days of illness onset during the agricultural fair season.

Date	Classification	Justification
<p>Friday, Sept. 14– Monday, Sept. 17 (p. 16–26)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Not a case <input checked="" type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed 	<p>Eddie meets the clinical criteria (displays flu-like clinical symptoms, including a fever of $\geq 100^{\circ}\text{F}$, with a cough or sore throat), with pending laboratory results. Note: Dr. Walker collected clinical information and a respiratory specimen (a nasal swab) from Eddie, which she sent to a local clinical laboratory for testing. This suggests that Eddie’s case would be classified as suspected.</p>
<p>Early Wednesday, Sept. 19 (p. 29–41)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input checked="" type="checkbox"/> Probable <input type="checkbox"/> Confirmed 	<p>Dr. Alison interviews Eddie’s family, primary care providers, and friends while at the hospital. Eddie’s friends provide information on what activities Eddie was involved with while at the Thomas County Fair. Eddie’s friends told Dr. Alison that Eddie showed his pig, Hamlet, and that Eddie mentioned that Hamlet “was not 100 percent” suggesting that he showed signs that he was not feeling well. Dr. Tolani, the state veterinarian who inspected animals at the fair also shared information that a few of the pigs she examined had mild fever. This possible epidemiologic link suggests that Eddie’s case could be reclassified as probable.</p>
<p>Later Wednesday, Sept. 19 (p. 42–48)</p>	<ul style="list-style-type: none"> <input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input checked="" type="checkbox"/> Confirmed 	<p>Results from the pigs at the Thomas County Fair come back positive for an influenza A virus that is circulating in swine. Preliminary test results from Eddie come back positive for influenza A, and the subtyping suggests that he was infected with a similar virus as the pigs at the Thomas County Fair. This indicates that Eddie may have been infected by his pig. These events would suggest that Eddie’s case is confirmed.</p>

Patient	Classification	Justification
A	<ul style="list-style-type: none"> <input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input checked="" type="checkbox"/> Probable <input type="checkbox"/> Confirmed 	<p>Patient A meets the clinical criteria (displays flu-like clinical symptoms, including a fever of $\geq 100^{\circ}\text{F}$, with cough or a sore throat) for a suspected case. In addition, epidemiologic links suggests that Patient A's case could be classified as probable. For instance, Patient A attended the fair within 7 days of illness onset and one day after Eddie. Patient A also had direct contact with pigs or hogs and indirect contact with pigs or hogs at the fair, including areas that Eddie had contact with pigs or hogs (practice ring A or swine barn). However, since the laboratory results are pending, it could not be confirmed.</p>
B	<ul style="list-style-type: none"> <input type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input checked="" type="checkbox"/> Probable <input type="checkbox"/> Confirmed 	<p>Patient B meets the clinical criteria (displays flu-like clinical symptoms, including a fever of $\geq 100^{\circ}\text{F}$, with a cough or sore throat) for a suspected case. In addition, epidemiologic links suggest that Patient B's case could be classified as probable. For instance, Patient B attended the fair within 7 days of illness onset and on the same day as Eddie. Patient B also had indirect contact with pigs or hogs at the fair in areas that Eddie had contact with pigs or hogs (swine barn). Although laboratory test results confirm that patient B was infected with influenza A virus, the test did not confirm the subtype and could not be confirmed.</p>
C	<ul style="list-style-type: none"> <input checked="" type="checkbox"/> Not a case <input type="checkbox"/> Suspected <input type="checkbox"/> Probable <input type="checkbox"/> Confirmed 	<p>Patient C meets the clinical criteria (displays flu-like clinical symptoms, including a fever of $\geq 100^{\circ}\text{F}$, with a cough or sore throat) for a suspected case. In addition, epidemiologic links suggests that Patient C's case could be classified as probable. For instance, Patient C attended the fair within 7 days of illness onset and on the same day as Eddie. Patient C also had direct contact with pigs or hogs and indirect contact with pigs or hogs at the fair, including areas where Eddie had contact with pigs or hogs (practice ring A or swine barn). However, Patient C is not considered a case because the laboratory test result was negative for influenza.</p>