

Operation Outbreak

The Outbreak Team



Activity details

Age or grade level

This activity is intended for middle and high school teachers to teach public health using *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 during an influenza outbreak investigation.
- Identify roles and responsibilities of public health, animal health, environmental health, and other relevant professionals in an influenza outbreak investigation and the skills each needs to fulfill their roles.
- Describe why using a One Health approach connecting human, animal, and environmental health is best when investigating or preventing zoonotic diseases.

Problem-based skill

Collaborative performance

National standards

HS-EPHS1-2: Discuss how epidemiologic thinking and a public health approach is used to transform a narrative into an evidence-based explanation.

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

NGSS Science & Engineering Practice: Obtaining, evaluating, and communicating information; Crosscutting Concept: Cause and effect

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

Activity time

45 minutes

Handouts

- Role Play Cards

Materials

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

Introduction

The outbreak investigation portion of the story begins after the Thomas County Fair. At the fair, Eddie Schwartz, a 4-H student, shows his pig named Hamlet and notices that Hamlet appears sluggish.

Later, Eddie becomes very sick with flu-like symptoms, including a fever of 101°F, a cough, and muscle aches. His mother takes him to visit his primary care provider, Dr. Walker. Dr. Walker collects clinical information about Eddie's illness and a respiratory specimen (she swabs the inside of his nose), which she sends to a local clinical laboratory for testing. Laboratory testing is used by primary care providers (e.g., physicians, physician's assistants, and nurse practitioners) to identify the cause of a patient's illness. Patient specimens for laboratory testing are also used by public health authorities as part of routine efforts to track diseases that make people sick.

In the story, neither the clinical laboratory nor the state public health laboratory are able to identify the source of Eddie's illness. (Note: In a real-life situation, state public health laboratories have the capability to determine from a patient specimen if the patient has been infected with an influenza A or B virus and if that virus is a human seasonal flu virus or a novel influenza A virus, i.e., a new flu virus in humans that may have come from an animal.)



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and Laboratory Services

Therefore, the state public health laboratory follows federal and international health regulation reporting protocols and reports Eddie's case to the Centers for Disease Control and Prevention (CDC) for additional testing. CDC is the nation's health protection agency. CDC uses science to provide health information and recommendations that protect our nation against dangerous health threats. When these health threats arise, CDC responds. For more information on CDC's role and mission, see <https://www.cdc.gov/about/organization/mission.htm>.

The state epidemiologist, Dr. Jim Jefferies, and his staff are particularly concerned with Eddie's illness because testing at the state public health laboratory was unable to identify the pathogen (i.e., a bacterium, virus, or other microorganism that can cause disease) responsible. This suggests the cause of Eddie's illness could be something new or not common among people.

As the story continues, Dr. Jefferies contacts a CDC epidemiologist, Dr. Lee, and explains the situation. Because the state public health laboratory was unable to identify the cause, Dr. Jefferies and Dr. Lee decide to work together on an investigation. Dr. Jefferies submits a formal request to CDC for help investigating this situation.

Dr. Lee is joined by his CDC team of [Epidemic Intelligence Service \(EIS\)](https://www.cdc.gov/eis/index.html) (<https://www.cdc.gov/eis/index.html>) officers, including Drs. Alison, Kim, and Alex, to help with the investigation. EIS officers are CDC epidemiologists, or disease detectives, who complete a two-year training and serve on the front lines of public health. CDC epidemiologists work with their local (i.e., county and city) and state public health and animal health colleagues to assist with the investigation, including on-site data collection, analysis, and interpretation. After the cause of Eddie's illness is determined, they will also work together to implement prevention and control measures.

One way the team collects data and information is through contact tracing. Contact tracing is the identification and follow-up of people or animals that may have been infected with a pathogen. This information is important for helping to identify the source of a disease outbreak. It can

also be used to find new cases quickly so that the infected people or animals can be treated and isolated, if necessary, to stop spread of a disease. CDC epidemiologists, or their state and local colleagues, perform contact tracing to identify human cases and their contacts. Animal health experts perform contact tracing in animals. In the story, people they contact include the following: Eddie and his friends in 4-H, Eddie's parents and Dr. Walker (Eddie's primary care provider), Andy Duncan (the state fair organizer), other fair attendees, local hospitals and doctors' offices, and Dr. Tolani (the state veterinarian) who inspected animals at the fair.

Later in the story, Eddie's friends and CDC's EIS officers suspect that there might be a link between the source of Eddie's illness and his pig, Hamlet, which he showed at the Thomas County Fair. CDC conducts laboratory testing on the specimen obtained from Eddie, while USDA conducts laboratory testing on the specimen obtained from Hamlet. CDC and USDA laboratory scientists share their respective test results with each other, which indicate that Eddie and Hamlet were infected with an influenza virus with very similar genomes. (Note: the term *genome* refers to the complete set of genes present in an organism; in this case, a virus.) This leads the public health and animal health authorities to conclude that the influenza virus that infected Hamlet is the same virus that infected Eddie. This virus is a novel influenza virus because it is a nonhuman flu virus detected in a person. Specifically, this would be called a variant virus, because that is the terminology used when an influenza virus that usually spreads among pigs is found in a person. (For more information, see the Educational Overview description of zoonotic diseases, variant influenza, novel influenza, and pandemics.)

Public health, animal health, environmental health and other relevant authorities (e.g. wildlife authorities) work together using a One Health approach to investigate novel influenza virus infections among people. A One Health approach requires human, animal, and environmental health professionals to work together at the local, state, federal, and global levels to improve the health of people, animals, and their shared environment. One important

goal of the outbreak investigation is to determine if the viruses in question are changing in ways that would allow them to spread more easily among people and potentially cause a pandemic.

Depending on the size and scale of an outbreak investigation, the number of health professionals involved will vary and their roles can expand and change. Overall, the collaboration of professionals with expertise in the areas of epidemiology, laboratory testing, public health, animal health, environmental health, communications, policy, statistics, and clinical care is what makes the investigation possible.

As part of the investigation, CDC experts, including informaticians, data managers, biostatisticians, and laboratory scientists work behind the scenes. The data managers set up databases to store information that EIS officers and other epidemiologists collect in a manner that will allow for efficient data analyses with the support of biostatisticians. Public health laboratory scientists work to characterize the virus that infected Eddie, while staff at USDA's laboratories analyze specimens collected by the state veterinarian from some of the animals present at the Thomas County Fair. The virus specimen testing results from both CDC and USDA's laboratories are compared to determine if there are similarities between the viruses collected from people and animals.

Throughout the investigation, health communications specialists create communication products to educate the public, media, and other audiences about what is known and not known about the outbreak, and what actions people should take to protect themselves and their families. During an outbreak response, health communications specialists develop messages and products in accordance with well-established risk communications principles. Health communications specialists help coordinate communications efforts and messages between local, state and federal partners, and then communicate necessary information to external audiences.

Did you know?

Influenza viruses that are different from the influenza viruses that spread in people circulate

among pigs and other animals, like birds and dogs. Wild birds are the natural hosts of all influenza A viruses. Experts believe all four flu pandemics that occurred in the last 100 years were caused by viruses that originated from birds or pigs, and later gained the ability to spread among people.

Resources

Careers at CDC

(<https://jobs.cdc.gov/career-fields>)

Careers in public health

(<http://www.careersinpublichealth.net/careers/>)

CDC influenza (flu)

(<https://www.cdc.gov/flu/index.htm>)

CDC swine/variant influenza virus

(<https://www.cdc.gov/flu/swineflu/index.htm>)

CDC One Health website

(<https://www.cdc.gov/onehealth>)

USDA One Health website

(<https://www.usda.gov/topics/animals/one-health>)

USDA influenza in swine

(<https://www.usda.gov/topics/animals/one-health/influenza-swine>)

CDC stay healthy at animal exhibits

(<https://www.cdc.gov/features/animalexhibits/>)

CDC Says "Take 3" Actions to Fight the Flu

(<https://www.cdc.gov/flu/protect/preventing.htm>)

Activity instructions

Explain

During an outbreak investigation, professionals from different disciplines related to public health, animal health, environmental health and other relevant authorities work together. By leveraging their diverse skill sets, these experts can carry out a more efficient investigation than if they were working independently.

Establishing data collection, management and reporting protocols as well as communication procedures allows different health professionals at the local, state, and federal levels from multiple disciplines and sectors to work together to identify the cause of Eddie's illness and

establish measures to ensure additional people do not get sick.

In this activity, students will learn about the roles of different characters from the graphic novel. Then, together, they will decide the action sequence of the outbreak investigation using the graphic novel as a guide.

Instruct

1. For homework, assign students to read *The Junior Disease Detectives, Operation: Outbreak* graphic novel.
2. Print enough sets of the role play cards so that each student in the class has at least one role. There are 14 roles in a set. Mark each set with a letter: A, B, C, etc.
3. Hand out the role play cards, and then have students find other students with the same role play card. Have each team consider the following:
 - What general responsibilities does this person have in their job?
 - What professional skills might this person need to do their job?
 - What role might this person have during an influenza outbreak investigation?
 - Who might this person communicate with during an influenza outbreak investigation?
4. Group students based on their role play card set marked with a letter A, B, C, etc. Within each group, have each student present 3 or 4 key facts about their role to the group.
5. Have each group work together to determine the steps of the influenza outbreak investigation by ordering their set of role play cards according to when each role would become involved in the outbreak investigation.
6. When each group comes to a consensus on the order of the steps of the influenza outbreak investigation, have each group tape their role play cards on a wall, accordingly.

7. Instruct each group to add arrows that show communication pathways among the roles.
8. Assign students to write up a 1- or 2-page story about how the outbreak was investigated based on the steps of the influenza outbreak investigation and the communication pathways.

Discuss

1. Why would one case of respiratory illness caused by an unidentified virus in a person who recently attended an agricultural fair be cause for concern?
2. Why is it beneficial to have professionals with different roles, skills, and disciplines involved in an influenza outbreak investigation?

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

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Eddie

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Primary Care Provider

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Clinical Laboratory Scientist

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

State Laboratory Scientist

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

State Epidemiologist

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

State Public Health Veterinarian

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Thomas County Fair Director

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

State Veterinarian

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

CDC Epidemiologists

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

CDC Biostatisticians

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

CDC Laboratory Scientists

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

USDA Laboratory Scientists

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Health Educators

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Communications Specialists

General responsibilities

Role in an outbreak investigation

Professional skills

Communicate with during an outbreak investigation

Answer Key

Note: Sample answers are provided below, but are not meant to be comprehensive or exhaustive. Additional information on these and other public health careers can be found using the Careers in Public Health websites. See Resources.

	General responsibilities	Professional skills ¹	Main role in an influenza outbreak investigation	Communicate with during an influenza outbreak investigation
Eddie	A 4-H exhibitor who should follow safe animal handling and flu prevention practices	Knowledge about owning, caring for, and keeping records of livestock. Following guidelines or requirements for showing livestock	Report symptoms and information that could help identify the cause of illness	Primary care provider, epidemiologists, or others who interview him as part of the investigation
Primary care provider	A trained medical professional (e.g., physician, physician's assistant, or nurse practitioner) who provides direct treatment for the patient	Medical knowledge and awareness of public health, ability to communicate clearly, ability to think critically and problem solve, and attention for detail	Collect clinical information and specimens for laboratory testing; treat the patient, as needed	Eddie, local clinical laboratory, and local or state public health department
Clinical laboratory scientists	A laboratory scientist who tests and analyzes samples from patients sent by physicians at hospitals or clinics, and who should follow recommended protocols for specimens to send for additional testing	Laboratory procedure skills, such as skills in identifying appropriate lab test to run, specimen preparation and testing, maintaining lab equipment, ensuring lab safety, following lab protocols, accurately reporting of results, interpreting results, knowing when to send specimens for further testing if needed, and attention for detail	Test specimens; report results back to physician, and, depending on the result, to the local or state public health department or public health laboratory	Primary care provider, local or state health department epidemiologist, and state public health laboratory
State public health laboratory scientists	A laboratory scientist who tests and analyzes samples from patients at hospitals or clinics that have been sent from clinical laboratories for testing, and who should follow recommended protocols for specimens to send to	Laboratory procedure skills, research and data analysis, developing and implementing new testing methods, ability to communicate clearly, attention to detail	Test specimens, confirm test results; send specimens to CDC, if requested by the state public health department and CDC	Local clinical laboratory, state public health department epidemiologist and staff, and CDC laboratory scientist

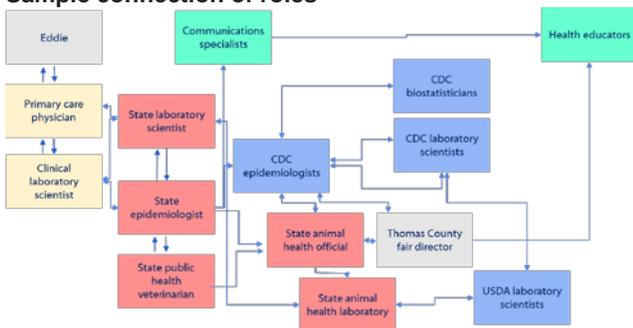
¹ Professional skills are derived from positions or similar positions on the Careers in Public Health website provided in the resource section: <http://www.careersinpublichealth.net/careers>.

	General responsibilities	Professional skills ¹	Main role in an influenza outbreak investigation	Communicate with during an influenza outbreak investigation
	CDC for additional testing			
State epidemiologist	An epidemiologist who works for the state health department with a specific focus on the population of an entire state	Knowledge of descriptive and analytic epidemiology, ability to analyze data and interpret findings, ability to think critically and problem solve, strong math skills, ability to communicate clearly, willingness to work in different environments and ability to work collaboratively with other specialists, including federal, state, and local public health partners	Collect and analyze information about who is sick, when they became sick, and exposures they may have had before becoming sick to determine where, when, and how each person may have become infected; coordinate with the local health department, others in the state health department including the laboratory, CDC, animal health partners (depending on the situation), and physicians (sometimes this is left for local health departments and sometimes it's handled by the state)	Local health department epidemiologist; state laboratory scientist; CDC epidemiologist, CDC laboratory scientist, health educators or communication specialists
State public health veterinarian	A veterinarian who works for the state health department, focusing efforts on protecting human populations from infections caused by zoonotic diseases and other One Health issues	Knowledge of clinical veterinary medicine and general public health knowledge, willingness to work in different environments and ability to work collaboratively with other animal and public health specialists at the federal, state, and local level	Coordinate public health activities using a One Health approach, collect human epidemiologic information; coordinate with animal health and environmental health authorities and activities	State animal health official; state public health epidemiologist, CDC representatives, including epidemiologists, laboratory staff, and communications specialists and other relevant partners
Thomas County fair director	A person who coordinates fair activities and communicates with all stakeholders	Knowledge and oversight of local, state, and federal requirements and recommendations from public health officials at the fair; and ability to communicate clearly	Support communication between the state health department and state fair attendees	Animal health official or veterinarian, state epidemiologist, state public health veterinarian, and fair attendees
State veterinarian	A veterinarian who works for the state agriculture department, focusing efforts on protecting livestock and other animal populations from animal diseases (including zoonoses)	Knowledge of clinical animal medicine, ability to think critically and problem solve, ability to communicate clearly, willingness to work in various environments and ability to work	Coordinate animal health activities using a One Health approach within their jurisdiction, authorize testing of swine samples, direct sample collection of animals, make decisions regarding	State public health veterinarian, state epidemiologist, USDA laboratorians, state agricultural authorities, fair director or organizers, and producers and

	General responsibilities	Professional skills ¹	Main role in an influenza outbreak investigation	Communicate with during an influenza outbreak investigation
	and animal welfare issues	collaboratively with other specialists, including federal, state, and local animal and public health partners and other relevant partners	animal health and coordinate with public health activities	exhibitors and other relevant partners
CDC epidemiologists	A person who investigates the causes of disease, how they are spread and how they can be prevented	Knowledge of descriptive and analytic epidemiology, ability to analyze data and interpret findings, ability to think critically and problem solve, strong math skills, ability to communicate clearly, willingness to work in different environments, and ability to work collaboratively with other specialists, including federal, state, and local public health partners and other One Health partners	Support the state epidemiologist in collecting and analyzing information about who is sick, when they became sick, and exposures they may have had before becoming sick to determine where, when, and how each person may have become infected; translate this information into recommendations for prevention and control measures	State epidemiologists; state and local public health officials, CDC data manager or biostatistician, CDC laboratory scientists, USDA as appropriate, health educators or communication specialists, animal health personnel, fair organizer, and state public health veterinarian
CDC data managers or biostatisticians	A data manager is proficient at creating databases to store collected information in a manner that it can be efficiently analyzed and shared as needed; a biostatistician is a professional who utilizes statistical techniques and tools to drive forward research in the health field and by applying statistics to their scientific research, a statistician in this field will help develop reports that can be used to improve health	Knowledge of biostatistics, knowledge of descriptive and analytic epidemiology, ability to analyze data and interpret findings, and strong math skills	Organize and aggregate data from disparate sources, analyze data to identify patterns in who was infected and how the virus was transmitted	CDC epidemiologists, and state public health officials
CDC laboratory scientists	Laboratory scientists at CDC who test and analyze samples from human cases and potential cases, and who provide laboratory science assistance to states that have requested CDC aid	Laboratory procedure skills, research and data analysis, developing and implementing new testing methods, ability to communicate clearly, and attention to detail	Verify test results and performing genomic sequence analyses on the specimens provided by the state laboratory	CDC epidemiologist and state laboratory scientists

	General responsibilities	Professional skills ¹	Main role in an influenza outbreak investigation	Communicate with during an influenza outbreak investigation
USDA laboratory scientists	Laboratory scientists at the USDA who test and analyze samples from animal or food, usually related to agriculture, and researches findings	Laboratory procedure skills, research and data analysis, developing and implementing new testing methods, ability to communicate clearly, and attention to detail	Test animal specimens to identify and characterize the virus causing the infection	CDC laboratory scientists, state laboratory scientists, state epidemiologist, and veterinarian
Health educators	Professionals who develop, oversee, manage, and provide health education programs to a group of people	Knowledge of education theory and strategies, ability to communicate clearly, willingness to work in various environments and ability to work collaboratively with other specialists, including federal, state, and local public health partners	Develop educational materials and resources used to communicate with the public about prevention measures	Communication specialists, and state epidemiologist
Communications specialists	Professionals who develop communication strategies, messages and products, and communicates public health risks, concerns, trends, and recommendations to the public, as well as media, policy makers and other health professionals; a communications director will oversee the communications of a public health group within a public health department or agency	Knowledge of risk communication principles and practice, public speaking, leadership, ability to communicate clearly, ability to condense and summarize complex scientific information into easy to follow information and recommendations, willingness to work in different environments and ability to work collaboratively with other specialists, including federal, state, and local public health partners	Develop messages and materials to communicate with the public, media, government officials, and partners about the outbreak and the investigation	General public, media, public and animal health stakeholders and partners, businesses, schools, politicians, state epidemiologist; health educator; laboratory scientists, statisticians, and veterinarians

Sample connection of roles



Note: This is an example of the connection of the roles, but it is not meant to capture all possible lines of communication. As you can see in the novel, there are many professionals involved in an outbreak situation. Early planning for how to communicate among and between local teams (e.g., physicians and clinical laboratories), state-level teams, and knowing how to request federal assistance (CDC and USDA) are key elements to initiating an outbreak investigation. Clear protocols for responsibilities including data collection, analysis and communication of results are essential for the investigation to progress efficiently.