CDC Science Ambassador Workshop
2015 Lesson Plan

Something Wicked This Way Comes: The 2014 Ebola Response

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CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Acknowledgements

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Contact Information

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Contents

Something Wicked This Way Comes

Summary

The 2014 Ebola epidemic in West Africa is the first in history. The first case was reported in Guinea in March 2014, and the disease then spread into the neighboring countries of Liberia and Sierra Leone. Over the span of a year, the Ebola epidemic caused more than 10 times as many cases of Ebola than the combined total of all those reported in previous Ebola outbreaks. As the outbreak became more widespread, travel-associated cases appeared in Nigeria, Mali, Senegal, and even countries outside Africa, including the United States. By the end of 2014, there were more than 20,000 cases and more than 7,000 deaths. Accurate numbers may be even higher, as many cases have gone undiagnosed and unreported.

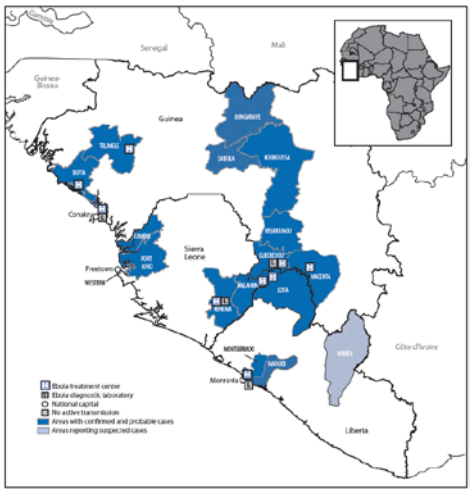

Figure 1: Location of cases of Ebola virus disease as of June 18, 2014 — West Africa, 2014. As of June 18, 2014, a total of 528 cases, including 337 deaths, had been reported in Guinea, Liberia, and Sierra Leone. Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm.

Not only has this epidemic been unprecedented, but so has the public health response. Within a week of the initial report of Ebola, CDC had a team of experts on the ground in Guinea. Over the past year, CDC has sent more than 1,500 people to Guinea, Liberia, and Sierra Leone, many of whom have gone more than once. Thousands more have worked on the response from the agency's headquarters in Atlanta, Georgia, other areas in the United States, and other countries around world. CDC has not done this work alone— in every aspect of the response, CDC has collaborated with partners, such as the ministries of health in West Africa, the World Health Organization, CDC Foundation, other parts of the U.S. government, U.S. Agency for International Development (USAID), Doctors Without Borders (Médecins Sans Frontières or MSF), and other non-profit organizations. Source: http://www.cdc.gov/about/ebola/introduction.html

In this lesson, students use information from the initial Ebola outbreak to justify each step of an outbreak investigation. Students then identify strategies to implement a public health response infrastructure that allows for effective management of national and international partnerships, allocation of personnel and resources, sharing of data, and the creation of a unified front against Ebola. The target grade level for this case study is an upper middle school to high school audience.

Learning Outcomes

After completing this lesson, students should be able to

- describe how epidemiologic thinking and a public health approach defined the order of steps of an outbreak investigation during the 2014 Ebola outbreak response.
- describe how to collect reliable data regarding Ebola virus transmission using contact tracing.
- calculate and discuss the significance of case-fatality rates
- identify strategies to implement an effective public health response with various national and international partnerships and systems influenced by scientific, social, cultural, and political factors.

Duration

This lesson can be conducted as one 90-minute lesson or divided into two 45-minute lessons.

Procedures

Day 1: The early response to the 2014 Ebola outbreak (45 minutes)

Preparation

Before Day 1,

- Arrange desks in U-shape or other configuration that facilitates group discussion.
- Make copies of Worksheet 1: Something Wicked This Way Comes (Appendix 1A).
- Review MMWR report: "Ebola Viral Disease Outbreak — West Africa, 2014" and the steps of an outbreak investigation. See Online Resources.

Materials

- Worksheet 1: Something Wicked This Way Comes (Appendix 1A)
  Description: Students work through the case study in groups using information from the initial outbreak to learn the steps of an outbreak investigation. Students also identify strategies to implement a public health response infrastructure, which allows for effective management of national and international partnerships, allocation of personnel and resources, sharing of data, and the creation of a unified front against Ebola.

Online Resources

- The Road to Zero: CDC's Response to the West African Ebola Epidemic, 2014-2015 (5:32 minutes)
  URL: http://www.cdc.gov/about/ebola/index.html
  Description: This video provides an overview of the response. It marks the key events during the Ebola response and describes the need for continued vigilance.
- Ebola Viral Disease Outbreak — West Africa, 2014
  URL: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w
  Description: This MMWR report provides background information used in this lesson plan, including cases and case fatalities rates during the early response.
- Steps of outbreak investigation
  URL: http://www.cdc.gov/ophss/csels/dsepd/ss1978/lesson6/Section2.html
  Description: The lesson provides an overview of each step of an outbreak investigation.

Activity

- Show students The Road to Zero: CDC's Response to the West African Ebola Epidemic, 2014-2015 (5:32 minutes). Discuss the following questions:
  - What were some of the core principles used in the beginning of the response?
    Answer: Contact tracing, case identification, educating people about disease, educating contacts to come to healthcare facilities.
  - Why was lab testing important in both West Africa and the United States?
    Answer: It was important in West Africa to rapidly detect cases, move negative patients out of the hospitals, and to reduce the chances of an infected person entering the United States.
  - Why was getting cooperation from West African communities difficult? Why was it so important?
    Answer: There was a lack of acceptance of Ebola among local populations and there was also a strong distrust of outsiders. Gaining the trust and acceptance of the local communities enabled responders to share information on infection control practices and combat rumors and stigma to stop the spread of Ebola.
- Provide each student with Worksheet 1: Something Wicked This Way Comes: The 2014 Ebola Response. Working around the class, ask each student to read a case study paragraph or question aloud for Part 1. For each question, allow students to work independently or with a group to answer the question, then share the answers with the group before moving to the next question.

Day 2: Coordinating a larger response to the 2014Ebola outbreak, 45 minutes

Preparation

Before Day 2,

- Review WHO's Emergency Guideline—Implementation and management of contact tracing for Ebola virus disease. See Online Resources.

Materials

- Worksheet 1: Something Wicked This Way Comes (Appendix 1A)
  Description: In groups, students work through the case study using information from the initial outbreak to learn the steps of an outbreak investigation. Students also identify strategies to implement a public health response infrastructure, which allows for effective management of national and international partnerships, allocation of personnel and resources, sharing of data, and the creation of a unified front against Ebola.

Online Resources

- WHO's Emergency Guideline—Implementation and management of contact tracing for Ebola virus disease
  URL: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1.
  Description: WHO's guidelines provide detailed information about the infrastructure for contact tracing.

Activity

1. Review Part 1 of Worksheet 1: Something Wicked This Way Comes (Appendix 1A).
2. Working around the class, ask each student to read a case study paragraph or question aloud for Part 2-4. For each question, allow students to work independently or with a group to answer the question, then share the answers with the group before moving to the next question.

Extension: Personal Protective Equipment, 45 minutes

Preparation

Prior to the Extension Activity,

- Review how to put on and remove personal protective equipment (PPE). See Online Resources.
- Collect PPE supplies to show students.

Materials

- PPE supplies (e.g., gloves, masks, disposable isolation gowns, head covers, foot covers, goggles, face shield)
- Red biohazard bags, or make a replica of one
  Description: Contaminated PPE are disposed of in red biohazard bags. If none are available for the activity, use a regular trash bag with a biohazardous waste symbol taped to it.
- Shaving cream or other easily cleaned thick gel/liquid.
  Description: Use to simulate 'blood or vomit' when using PPE.

Online Resources

- Poster "Sequence for Putting on and Removing Personal Protective Equipment"
  URL: http://www.cdc.gov/hai/pdfs/ppe/ppeposter8511.pdf
  Description: Step-by-step instructions for putting on and removing PPE.
- Infographic on glove disposal
  URL: http://www.cdc.gov/vhf/ebola/pdf/poster-how-to-remove-gloves.pdf
  Description: This poster provides pictorial steps of proper way to dispose of gloves. This can be used as a model for students to create their own poster after PPE training

Activity

1. Show video and demonstrate proper putting on and removal of PPE.
2. Set up isolation area, with PPE supplies at the entrance.
3. Allow students to try on PPE materials.
4. Use some type of non-staining item, such as shaving cream to represent blood or vomit. Apply a small amount onto students' gloved hands. Students will then demonstrate how to remove the PPE, without splattering or contaminating self with "blood or vomit". Removed PPE will be disposed of into biohazard bags.

5 After practice, students will create infographic similar to that distributed by CDC to document proficiency in PPE methods. See Online Resources.

Conclusions

The Ebola epidemic, larger and more widespread than any previous Ebola outbreak, has caused public health responders to face new and challenging obstacles — from hard-to-reach places and impassable roads to personal protective gear, transportation, and laboratory needs. Through the activities in this lesson plan, students are encouraged to think critically about the systems and resources needed to conduct an epidemiologic investigation while remaining sensitive to the cultural, societal, political, and scientific influences on public health practice. Students practice epidemiologic skills to provide evidence-based justification for a public health approach and consider the need to coordinate efforts with national and international partners to establish a unified front against Ebola.

Assessment

- Worksheet 1: Something Wicked This Way Comes (Appendix 1A)
  Learning Outcomes Assessed:
  - Describe how epidemiologic thinking and a public health approach defined the order of steps of an outbreak investigation during the 2014 Ebola outbreak response.
  - Describe how to collect reliable data regarding Ebola virus transmission using contact tracing.
  - Calculate and discuss the significance of case-fatality rates.
  - Identify strategies to implement an effective public health response with various national and international partnerships and systems influenced by scientific, social, cultural, and political factors.

  Description: In groups, students work through the case study using information from the initial outbreak to learn the steps of an outbreak investigation. Students also identify strategies to implement a public health response infrastructure system, which allows for effective management of national and international partnerships, allocation of personnel and resources, sharing of data, and the creation of a unified front against Ebola.

Educational Standards

In this lesson, the following CDC Epidemiology and Public Health Science (EPHS) Core Competencies for High School Students[1], Next Generation Science Standards* (NGSS) Science & Engineering Practices[2], and NGSS Cross-cutting Concepts[3] are addressed:

HS-EPHS 1-3: Apply epidemiologic thinking and a public health approach to a model (e.g., outbreak) to explain cause and effect relationships that influence health and disease.

NGSS Key Science & Engineering Practice[2]
Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
NGSS Key Crosscutting Concept[3]
Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

HS-EPHS2-1. Describe how to collect reliable data regarding priority health-related phenomena using public health surveillance systems.

NGSS Key Science & Engineering Practice[2]
Planning & Carrying out Investigations Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
NGSS Key Crosscutting Concept[3]
Systems and System Models Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.

HS-EPHS4-1. Describe a model illustrating how scientific, social, economic, environmental, cultural, and political systems influence intervention performance patterns.

NGSS Key Science & Engineering Practice[2]
Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.
NGSS Key Crosscutting Concept[3]
Cause and Effect Changes in systems may have various causes that may not have equal effects.

[1] Centers for Disease Control and Prevention (CDC). Science Ambassador Workshop—Epidemiology and Public Health Science: Core Competencies for high school students. Atlanta, GA: US Department of Health and Human Services, CDC; 2015. Not currently available for public use.

[2] NGSS Lead States. Next Generation Science Standards: For States, By States (Appendix F–Science and Engineering Practices). Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. 2013. Available at: http://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf

[3] NGSS Lead States. Next Generation Science Standards: For States, By States (Appendix G–Crosscutting Concepts). Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. 2013. Available at: http://www.nextgenscience.org/sites/ngss/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf.

Appendices: Supplementary Documents

Something Wicked This Way Comes

Name: _____ Date: _____

Directions: Read the case below. Answer the questions as you go along.

Case Overview

The 2014 Ebola epidemic in West Africa is the first in history. The first case was reported in Guinea in March 2014, and the disease then spread into the neighboring countries of Liberia and Sierra Leone. Over the span of a year, the Ebola epidemic caused more than 10 times as many cases of Ebola than the combined total of those reported in previous Ebola outbreaks. As the outbreak became more widespread, travel-associated cases appeared in Nigeria, Mali, Senegal, and even countries outside Africa, including the United States. By the end of 2014, there were more than 20,000 cases and more than 7,000 deaths. Accurate numbers may be even higher, as many cases have gone undiagnosed and unreported.

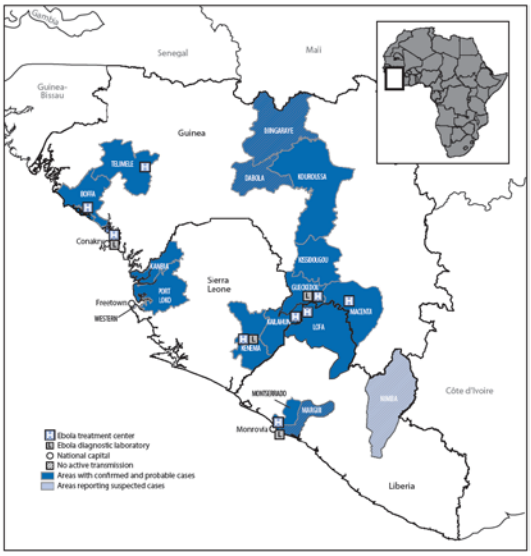

Figure 1: Location of cases of Ebola virus disease as of June 18, 2014 — West Africa, 2014. As of June 18, 2014, a total of 528 cases, including 337 deaths, had been reported in Guinea, Liberia, and Sierra Leone. Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm.

Not only has this epidemic been unprecedented, but so has the public health response. Within a week of the initial report of Ebola, CDC had a team of experts on the ground in Guinea. Over the past year, CDC has sent more than 1,500 people to Guinea, Liberia, and Sierra Leone, many of whom have gone more than once. Thousands more have worked on the response from the agency's headquarters in Atlanta, Georgia, other areas in the United States, and other countries around world. CDC has not done this work alone— in every aspect of the response, CDC has collaborated with partners, such as the ministries of health in West Africa, the World Health Organization, CDC Foundation, other parts of the U.S. government, U.S. Agency for International Development (USAID), Doctors Without Borders (Médecins Sans Frontières or MSF), and other non-profit organizations. Source: http://www.cdc.gov/about/ebola/introduction.html

After completing this case study, you should be able to

- list and identify the steps of an outbreak investigation.
- identify the four components of a case definition.
- describe and differentiate the case definition types: suspected, probable, and confirmed.
- identify the modes of transmission of Ebola.
- describe prevention and control measures for Ebola.
- calculate and discuss the significance of case-fatality rates.

Part 1: Preparing for field work

On March 21, 2014, WHO and the Ministry of Health of Guinea reported an outbreak of an illness characterized by fever, severe diarrhea, vomiting, and a high case-fatality rate (59%) among 49 people. Among the 20 tested, 15 people tested positive for the Ebola virus. By March 27, 2014, a total of 103 people with similar symptoms, including 66 deaths (case fatality rate: 64%), were reported. During that week, an illness with similar symptoms appeared in the neighboring countries of Liberia and Sierra Leone. Laboratory results confirmed *Zaïre ebolavirus* in additional cases.

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w.

What is a case fatality rate?
A **case fatality rate** is the proportion of people with a disease who die from it. The case fatality rate often identifies the severity of infection. The Ebola virus identified as the cause of the 2014 outbreak has previously shown case fatality rates as high as 90%. This would suggest that 90% of those who are infected with the Ebola virus would die from it.

Question 1. At this stage, why was it considered an outbreak rather than a cluster, epidemic, or pandemic?

International volunteer groups, including Doctors without Borders (MSF), were helping the Ministry of Health of Guinea to establish treatment and isolation centers near the epicenter of the outbreak. WHO requested CDC assistance with the investigation to identify sources and risk factors for Ebola infection in order to implement prevention and control measures. You are part of the initial CDC team. Before you leave, review the steps of an outbreak investigation.

What are the steps of an outbreak investigation?

Outbreak investigations involve strategic epidemiologic thinking and various scientific methods to systematically investigate cases of disease. An outbreak investigation includes the following steps:

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a working case definition
5. Find cases systematically and record information
6. Perform descriptive epidemiology
7. Develop hypotheses
8. Evaluate hypotheses using epidemiological data known
9. As necessary, reconsider, refine, and re-evaluate hypotheses
10. Compare and reconcile with laboratory and/or environmental studies
11. Implement control and prevention measures
12. Initiate or maintain surveillance
13. Communicate findings

In practice, epidemiologists may perform several steps at the same time, or the circumstances of the outbreak may dictate they follow a different order. (**Source**: Principles of Epidemiology, 3rd Edition.)

Question 2. Preparing for fieldwork is the first step to an outbreak investigation. What are some of the things you might need to do to prepare for this investigation?

Question 3. Which steps were completed before CDC was asked to assist? Why were these steps completed before the CDC was asked to assist?

Step 13 is to communicate findings. In an emergency response, communication is often the first line of defense. Fighting disease becomes less stressful when communities understand what they can do, when journalists report accurate information quickly, and when officials know how to communicate effectively. During a disease outbreak, communication strategies provide the essential bridge between science and the public — creating audience-tailored products, spreading accurate information through the best channels, fighting rumors and stigma, and ensuring the response respects a community's needs.

During a large-scale epidemic like Ebola, scientists aren't the only experts needed to help stem the spread of disease. CDC also sends teams of experts in communication, education, anthropology, and behavioral science to help communities get the information they need to protect themselves — through radio, posters and billboards, and face-to-face visits.

Source: http://www.cdc.gov/about/ebola/communicating-educating.html.

Question 4. During a large response, it is important that there is rapid and secure communication among the various types of responders. Why is this important?

Part 2: Construct a case definition (Step 4)

A case definition is a set of standard criteria used to determine whether or not a person has a particular disease, syndrome, or other health condition that may be part of an outbreak, cluster, or epidemic. The case definition typically includes clinical criteria but may also specify limitations on time period, geographic location, or personal characteristics. Clinical criteria are usually confirmed by laboratory tests, if available; if not, diagnosis is made by the presence of combinations of symptoms (subjective complaints, such as stomach ache), signs (objective physical findings, such as fever), and other findings common to the case condition. Limitations on time period, geographic location, or personal characteristics are usually determined by investigating disease transmission patterns to identify its origins and those most at risk. Thus, it is important to consider these factors in order to construct an accurate case definition.

Clinical Symptoms

Diagnosing Ebola in a person who has been infected for only a few days is difficult because the early symptoms, such as fever, are nonspecific to Ebola infection. Ebola is characterized by the sudden onset of fever and malaise (i.e., a general feeling of discomfort, illness, or uneasiness whose exact cause is difficult to identify), accompanied by other nonspecific signs and symptoms such as myalgia (i.e., muscle pain), headache, vomiting, and diarrhea. These signs and symptoms often are also seen in patients with more common diseases, such as malaria and typhoid fever.

The more severe symptoms of Ebola do not occur in all cases. Among Ebola patients from all Ebola outbreaks prior to 2014, 30%–50% experience unexplained hemorrhagic symptoms (bleeding or bruising). In severe and fatal forms, multiorgan dysfunction, including liver damage, kidney failure, and central nervous system disorders occur, leading to shock and death.

Source: http://www.cdc.gov/vhf/ebola/symptoms/index.html

Transmission

Because the natural reservoir host of Ebola viruses has not yet been identified, the way in which the virus first appears in a human at the start of an outbreak is unknown. However, scientists believe that the first patient in an outbreak becomes infected through contact with an infected animal, such as a fruit bat or primate (apes and monkeys); this is called a spillover event. Person-to-person transmission follows and can lead to large numbers of affected people. In some past outbreaks, primates were also affected by Ebola and multiple spillover events occurred when people touched or ate infected primates.

- When an infection occurs in humans, the virus can be spread to others through direct contact (through broken skin or mucous membranes in, for example, the eyes, nose, or mouth) with blood or body fluids (including but not limited to urine, saliva, sweat, feces, vomit, breastmilk, and semen) of a person who is sick with or has died from Ebola,
- objects (like needles and syringes) that have been contaminated with body fluids from a person who is sick with Ebola or the body of a person who has died from Ebola,
- infected fruit bats or primates (apes and monkeys), and
- possibly from contact with semen from a man who has recovered from Ebola (for example, by having oral, vaginal, or anal sex)

Ebola is not spread through the air, by water, or in general, by food. However, in Africa, Ebola may be spread from animals to humans as a result of handling bushmeat (wild animals hunted for food) and by contact with infected bats. There is no evidence that mosquitoes or other insects can transmit Ebola

virus. Only a few species of mammals (e.g. humans, bats, monkeys, and apes) have shown the ability to become infected with and spread Ebola virus.

Source: http://www.cdc.gov/vhf/ebola/transmission/index.html

Question 5. There is a common misconception that Ebola can be spread through the air by coughing or sneezing. There is no evidence to support this; however, droplets (e.g., splashes or sprays) of respiratory fluids or other body fluids from a person who is sick with Ebola could lead to infection. What is the difference between infections spreading through the air and infections spread by droplets?

Case Definition

Cases of disease can be determined using one of three progressively more reliable case definitions:

- suspected
- probable
- confirmed

Question 6. Develop a case definition for each category: suspected, probable, and confirmed. Hint: You may first want to decide what type of information each category might include before applying it to Ebola.

Question 7. Although WHO included hemorrhagic symptoms and multi-organ dysfunction in the case definition, why might you exclude these symptoms in your case investigation?

Question 8: When documenting cases, reports from an outbreak typically include suspected, probable, and confirmed cases. Why do they report all cases instead of only the confirmed cases?

Part 3: Find cases systematically and record information

CDC and partners use contact tracing (Figure 2) to identify potential new Ebola cases quickly and to isolate patients as soon as they show symptoms, preventing spread to others. One missed contact can keep Ebola spreading, but careful tracing of contacts and isolating new cases can stop the outbreak.

Contact tracing is finding everyone who has come in direct contact with a sick Ebola patient. Contacts are watched for signs of illness for 21 days from the last day they came in contact with the Ebola patient. If the contact develops a fever or other Ebola symptoms, they are immediately isolated, tested, provided care, and the cycle starts again—all of the new patient's contacts are found and watched for 21 days. Contact tracing emphasizes finding new cases quickly so they can be isolated, stopping further spread of Ebola.

Figure 2: Contact tracing for Ebola. Source: CDC. Available at: http://www.cdc.gov/vhf/ebola/pdf/contact-tracing.pdf

Contact tracing can break the chain of Ebola transmission if it is implemented immediately, comprehensively, and effectively. Preparation is essential and requires establishing infrastructure for managing personnel, communication, and resources. A model commonly used in public health is the Incident Management Framework. This includes organized teams of people who are designated to lead the response. An Incident Manager is designated and must have the authority to make immediate decisions, immediately allocate resources and funds, and coordinate the public health partners involved. Elements of the Incident Management Framework can include a network of personnel with specific roles and responsibilities, facilities and treatment centers, laboratories, transportation protocols, and a data management system.

When a potential case of Ebola is first identified, a team of investigators travels to meet the person in question to record symptoms, exposure, and risk factors. If the person meets the definition of a case, then the Incident Management Framework is activated.

Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Question 9. Why is the Incident Management Framework important in a response that involves a variety of public health partners and personal with diverse backgrounds?

The team of investigators who travels to meet the person in question also meets with the case management team—the team providing clinical care, conducting research, overseeing infection prevention and control, or performing burials. The team of investigators interview the person in question to systematically identify all potential contacts since the onset of symptoms. They ask detailed questions to establish all of the patient's activities since the onset of illness and to identify everyone involved in those activities. The team talks to the family and other contacts, such as people who cared for or were geographically close to the person in question, including healthcare workers, family and neighbors, and funeral attendees (if applicable).To ensure a complete and accurate list of contacts, the team conducts several interviews and visits places that the person went to after they started to have symptoms to get the names of contacts that the person does not know or remember (i.e., others at a restaurant, hotel, conference, market, place of worship, clinic, or workplace). The team verifies and double checks the exposure information for consistency and completeness during a second interview in later visits to ensure that all contacts and potential chains of transmission have been identified. Another team then follows up daily with all contacts and suspected cases for 21 days.

Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Question 10. Why is developing a relationship of trust between public health officials and the community essential to effective finding cases through contact tracing?

The team provides the specific information for each infected person to the database manager who enters it into the electronic database. Database managers from other teams investigating Ebola cases from the same outbreak enter their information into the same shared database.

Question 11. Explain why an electronic database is necessary to effectively manage cases and contacts?

Part 4: Treatment, control, and prevention measures

Treatment

No FDA-approved vaccine or medicine (e.g., antiviral drug) is available for Ebola. Experimental vaccines and treatments for Ebola are under development, but they have not yet been fully tested for safety or effectiveness.

Symptoms of Ebola and complications are treated as they appear. For example, Ebola can lead to dehydration from diarrhea, which could be treated by rehydrating and providing electrolyte (body salts) drips. The following basic interventions, when used early, can significantly improve the chances of survival:

- Providing intravenous fluids (IV) and balancing electrolytes.
- Maintaining oxygen status and blood pressure.
- Treating other infections if they occur.

Recovery from Ebola depends on good supportive care and the patient's immune response. People who recover from Ebola infection develop antibodies that last for at least 10 years, possibly longer. It is not known if people who recover are immune for life or if they can become infected with a different species of Ebola. Some people who have recovered from Ebola have developed long-term complications, such as joint and vision problems. Even after recovery, Ebola might be found in some body fluids (e.g., semen, breast milk, ocular fluid, cerebrospinal fluid). Based on the results from limited studies conducted to date, it appears that the amount of virus found in body fluids decreases over time.

Source: http://www.cdc.gov/vhf/ebola/treatment/index.html

Question 12. What is involved in supportive care and why was it given? Remember, while treating the patient, all aspects of patient well-being need to be addressed. How does supportive care differ from interventional or therapeutic care?

Question 13. In addition to Ebola, what other possible health complications may need to be addressed during patient care?

Control and Prevention
Implementing exposure control and prevention measures (Step 11) is an important part of any outbreak investigation and is usually started at the beginning of the investigation and modified as needed as the investigation moves forward.

Keys to controlling Ebola outbreaks include 1) active case identification and isolation of patients from the community to prevent continued virus spread; 2) identifying contacts of ill or deceased patients and tracking contacts daily for the entire incubation period of 21 days; 3) investigation of previous and current cases to document all historic and ongoing chains of virus transmission; 4) identifying deaths in the community and using safe burial practices; and 5) daily reporting of cases. Educating healthcare workers regarding safe infection prevention and control practices, including appropriate use of PPE, is essential to protect themselves and their patients because healthcare–associated transmission has played a part in spreading disease during previous outbreaks.

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w

Question 14. Why is it important to implement infection prevention and control measures early in the investigation? What are the benefits and risks of doing this?

Question 15. What are some of the challenges you might face in implementing each of the above control measures in a resource-poor developing country? How might you address them?

Part 4: Conclusions

No new cases were reported in Liberia for several weeks after April 9, 2014, and Guinea had reported only nine new cases for the week of April 27; the outbreak appeared to be slowing. However, during the week of May 25, Liberia reported a new case, Guinea reported 38 cases, and Sierra Leone, a neighboring country, reported its first laboratory confirmed case. By mid-June 2014, total case counts were established for the combined three countries of Guinea, Liberia, and Sierra Leone (Table 1).

Table 1: Total Ebola case counts for Guinea, Liberia, and Sierra Leone as of mid-June 2014.

Country	Cases	Deaths
Guinea	398	264
Liberia	33	24
Sierra Leone	97	49
Total	528	337

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w

Question 16. Based on the data provided in the above table, what were the case fatality rates for each country in mid-June 2014? What was the overall case fatality rate in these three countries?

Control of the Ebola outbreak was significantly impacted by its wide geographic spread, poor public health infrastructures, and community mistrust and resistance of outsiders. By the end of 2014, there were 20,171 cases reported in the three most affected countries and 7,889 deaths.

Source: http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/previous-case-counts.html.

Question 17. What was the case fatality rate in the three most affected countries by the end of 2014?

Question 18. Compare the case fatality rates from the beginning of the outbreak to the end of 2014. What might have caused such a significant decrease?

As of January 3, 2016, 28,637 cases (suspected, probable, and confirmed) of Ebola and 11,315 total Ebola related deaths had been reported.

Source: http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html.

The 2014 Ebola outbreak response has been the largest international outbreak response in CDC's history. Thousands of highly trained public health professionals have helped stop the epidemic in Guinea, Liberia, and Sierra Leone. CDC continues to work alongside many national and international partners in West Africa towards the goal of zero new cases in West Africa and to strengthen vigilance throughout the region.

When that day comes, West Africa will have many systems and resources that it did not have before—emergency operations centers, laboratories, stronger surveillance systems, vaccine trials, and CDC country offices. But just as people and their expert knowledge and skills have made a difference in curbing the epidemic, people hold the key to securing national and global health in the future. There is a need for continued vigilance and the same kind of ongoing intensity and commitment to protect not only the residents of countries where outbreaks occur, but also their neighbors around the world.

Source: http://www.cdc.gov/about/ebola/moving-forward.html

The response continues into 2016. For up-to-date information, visit http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html.

Something Wicked This Way Comes

Name: _____ Date: _____

Directions: Read the case below. Answer the questions as you go along.

Case Overview

The 2014 Ebola epidemic in West Africa is the first in history. The first case was reported in Guinea in March 2014, and the disease then spread into the neighboring countries of Liberia and Sierra Leone. Over the span of a year, the Ebola epidemic caused more than 10 times as many cases of Ebola than the combined total of those reported in previous Ebola outbreaks. As the outbreak became more widespread, travel-associated cases appeared in Nigeria, Mali, Senegal, and even countries outside Africa, including the United States. By the end of 2014, there were more than 20,000 cases and more than 7,000 deaths. Accurate numbers may be even higher, as many cases have gone undiagnosed and unreported.

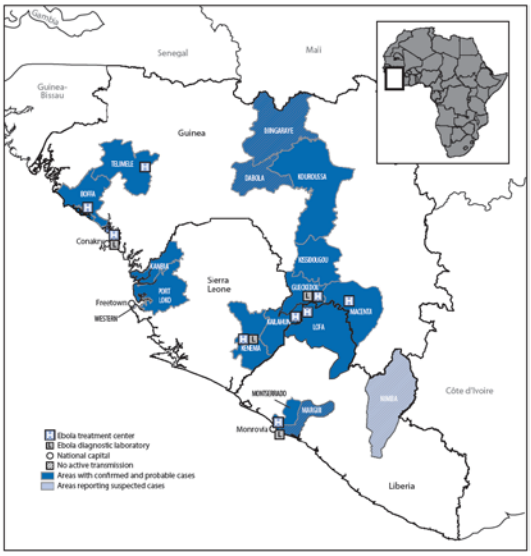

Figure 1: Location of cases of Ebola virus disease as of June 18, 2014 — West Africa, 2014. As of June 18, 2014, a total of 528 cases, including 337 deaths, had been reported in Guinea, Liberia, and Sierra Leone. Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm.

Not only has this epidemic been unprecedented, but so has the public health response. Within a week of the initial report of Ebola, CDC had a team of experts on the ground in Guinea. Over the past year, CDC has sent more than 1,500 people to Guinea, Liberia, and Sierra Leone, many of whom have gone more than once. Thousands more have worked on the response from the agency's headquarters in Atlanta, Georgia, other areas in the United States, and other countries around world. CDC hasn't done this work alone— in every aspect of the response, CDC has collaborated with partners, such as the ministries of health in West Africa, the World Health Organization, CDC Foundation, other parts of the U.S. government, U.S. Agency for International Development (USAID), Doctors Without Borders (Médecins Sans Frontières or MSF), and other non-profit organizations. Source: http://www.cdc.gov/about/ebola/introduction.html

After completing this case study, you should be able to

- list and identify the steps of an outbreak investigation.
- identify the four components of a case definition.
- describe and differentiate the case definition types: suspected, probable, and confirmed.
- identify the modes of transmission of Ebola.
- describe prevention and control measures for Ebola.
- calculate and discuss the significance of case-fatality rates.

Part 1: Preparing for field work

On March 21, 2014, WHO and the Ministry of Health of Guinea reported an outbreak of an illness characterized by fever, severe diarrhea, vomiting, and a high case-fatality rate (59%) among 49 people. Among the 20 tested, 15 people tested positive for the Ebola virus. By March 27, 2014, a total of 103 people with similar symptoms, including 66 deaths (case fatality rate: 64%), were reported. During that week, an illness with similar symptoms appeared in the neighboring countries of Liberia and Sierra Leone. Laboratory results confirmed *Zaïre ebolavirus* in additional cases.

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w.

What is a case fatality rate?
A **case fatality rate** is the proportion of people with a disease who die from it. The case fatality rate often identifies the severity of infection. The Ebola virus identified as the cause of the 2014 outbreak has previously shown case fatality rates as high as 90%. This would suggest that 90% of those who are infected with the Ebola virus would die from it.

Question 1. At this stage, why was it considered an outbreak rather than a cluster, epidemic, or pandemic?

Answer: During these early stages, it was considered an outbreak because there was a fairly localized increase in the number of cases over what was expected within the geographic area of the condition, during a specific timeframe. The term "outbreak" may have been used at this point to evoke less public panic. Note: As the disease spread, it has been referred to as the largest Ebola outbreak ever, the first Ebola epidemic, a pandemic because it spread to multiple countries, and clusters of cases as the widespread nature of the outbreak died down.

Teacher note: It may be helpful to define each of the terms with the students. Consider writing the definitions on the board or cling sheets. Ask students, working in small groups, to decide which classification makes the most sense. Ask a student volunteer from each group to present their answer and reasoning.

- Cluster: Aggregation of cases of a disease, injury, or other health condition (particularly cancer and birth defects) within a defined geographical area, during a specified time period, without regard to whether the number of cases is more than normally expected (often the norm is not known).
- Outbreak: Occurrence of more cases of disease, injury, or other health condition than expected within a defined geographic area or among a specific group of people, during a specific time period. Usually, the cases are presumed to have a common cause or to be related to one another in some way. Sometimes used to distinguish the condition from an "epidemic" (i.e., more localized), or as a term less likely to evoke public panic.
- Epidemic: Occurrence of more cases of disease, injury, or other health condition than expected within a defined geographic area or among a specific group of persons, during a particular period. Usually, the cases are presumed to have a common cause or to be related to one another in some way.
- Pandemic: Epidemic that occurs over a wide geographic area (multiple countries or continents) and usually affecting a substantial proportion of the population.

International volunteer groups, including Doctors without Borders (MSF), were helping the Ministry of Health of Guinea to establish treatment and isolation centers near the epicenter of the outbreak. WHO requested CDC assistance with the investigation to identify sources and risk factors for Ebola infection in order to implement prevention and control measures. You are part of the initial CDC team. Before you leave, review the steps of an outbreak investigation.

What are the steps of an outbreak investigation?

Outbreak investigations involve strategic epidemiologic thinking and various scientific methods to systematically investigate cases of disease. An outbreak investigation includes the following steps:

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a working case definition
5. Find cases systematically and record information
6. Perform descriptive epidemiology
7. Develop hypotheses
8. Evaluate hypotheses using epidemiological data known
9. As necessary, reconsider, refine, and re-evaluate hypotheses
10. Compare and reconcile with laboratory and/or environmental studies
11. Implement control and prevention measures
12. Initiate or maintain surveillance
13. Communicate findings

In practice, epidemiologists may perform several steps at the same time, or the circumstances of the outbreak may dictate they follow a different order. (**Source:** Principles of Epidemiology, 3rd Edition.)

Question 2. Preparing for fieldwork is the first step to an outbreak investigation. What are some of the things you might need to do to prepare for this investigation?

Answer: Answers may vary, but might include:

- Make arrangements for travel and lodging (e.g., passports, visas, immunizations)
- Identify and verify contacts (e.g., who will you be working with, how to contact them, initial meetings) and command chains
- Determine equipment and materials that will/might be needed (i.e., prioritize, what is available on site, including the quality, quantity, accessibility; and what will need to be transported, including when and how.)
- Determine initial goals and objectives (e.g., what will you be trying to accomplish)

Question 3. Which steps were completed before CDC was asked to assist? Why were these steps completed before the CDC was asked to assist?
Answer: The initial WHO/MoH Guinea team team established the existence of an outbreak (step 2), verified the diagnosis (step 3), verified the outbreak was caused by or resulted from a causative agent (i.e., Ebola virus), and verified that outbreak control necessitated a larger response. When deciding how to respond to a disease outbreak, public health agencies must take into consideration many factors.

Some outbreak factors that may require a more complex response include:

- Unknown causative agents, including potential dual infections
- Severe signs and symptoms or disease manifestations, such as those requiring hospitalization or leading to death
- Factors that may be useful to answer epidemiologic, laboratory, or infection control questions
- Vaccine-preventable diseases
- Institutional settings or with a likely (controllable) environmental source
- Bioterrorism agents
- Vulnerable populations
- Excessive public anxiety
- Large size or rapid progression

Teacher note: Remind students that CDC will only investigate if they are invited by the appropriate authorities. Discuss which factors may have necessitated a larger response in the case of Ebola.

Step 13 is to communicate findings. In an emergency response, communication is often the first line of defense. Fighting disease becomes less stressful when communities understand what they can do, when journalists report accurate information quickly, and when officials know how to communicate effectively. During a disease outbreak, communication strategies provide the essential bridge between science and the public — creating audience-tailored products, spreading accurate information through the best channels, fighting rumors and stigma, and ensuring the response respects a community's needs.

During a large-scale epidemic like Ebola, scientists aren't the only experts needed to help stem the spread of disease. CDC also sends teams of experts in communication, education, anthropology, and behavioral science to help communities get the information they need to protect themselves — through radio, posters and billboards, and face-to-face visits.

Source: http://www.cdc.gov/about/ebola/communicating-educating.html.

Question 4. During a large response, it is important that there is rapid and secure communication among the various types of responders. Why is this important?
Answer: Rapid and secure communication among the Ministry (or Ministries if multiple countries involved) of Health, international volunteer agencies, WHO, CDC, and other public health partners is crucial to ensure a prompt and coordinated response. Sharing information and strategies to coordinate with local health officials, healthcare professionals, and the public are essential to ensuring that the response is unified. It is also important in reporting accurate and consistent information to the public quickly.

Part 2: Construct a case definition (Step 4)

A case definition is a set of standard criteria used to determine whether or not a person has a particular disease, syndrome, or other health condition that may be part of an outbreak, cluster, or epidemic. The case definition typically includes clinical criteria but may also specify limitations on time period, geographic location, or personal characteristics. Clinical criteria are usually confirmed by laboratory tests, if available; if not, diagnosis is made by the presence of combinations of symptoms (subjective complaints, such as stomach ache), signs (objective physical findings, such as fever), and other findings common to the case condition. Limitations on time period, geographic location, or personal characteristics are usually determined by investigating disease transmission patterns to identify its origins and those most at risk. Thus, it is important to consider these factors in order to construct an accurate case definition.

Clinical Symptoms

Diagnosing Ebola in a person who has been infected for only a few days is difficult because the early symptoms, such as fever, are nonspecific to Ebola infection. Ebola is characterized by the sudden onset of fever and malaise (i.e., a general feeling of discomfort, illness, or uneasiness whose exact cause is difficult to identify), accompanied by other nonspecific signs and symptoms such as myalgia (i.e., muscle pain), headache, vomiting, and diarrhea. These signs and symptoms often are also seen in patients with more common diseases, such as malaria and typhoid fever.

The more severe symptoms of Ebola do not occur in all cases. Among Ebola patients from all Ebola outbreaks prior to 2014, 30%–50% experience unexplained hemorrhagic symptoms (bleeding or bruising). In severe and fatal forms, multiorgan dysfunction, including liver damage, kidney failure, and central nervous system disorders occur, leading to shock and death.

Source: http://www.cdc.gov/vhf/ebola/symptoms/index.html

Transmission

Because the natural reservoir host of Ebola viruses has not yet been identified, the way in which the virus first appears in a human at the start of an outbreak is unknown. However, scientists believe that the first patient in an outbreak becomes infected through contact with an infected animal, such as a fruit bat or primate (apes and monkeys); this is called a spillover event. Person-to-person transmission follows and can lead to large numbers of affected people. In some past outbreaks, primates were also affected by Ebola and multiple spillover events occurred when people touched or ate infected primates.

- When an infection occurs in humans, the virus can be spread to others through direct contact (through broken skin or mucous membranes in, for example, the eyes, nose, or mouth) with blood or body fluids (including but not limited to urine, saliva, sweat, feces, vomit, breastmilk, and semen) of a person who is sick with or has died from Ebola,
- objects (like needles and syringes) that have been contaminated with body fluids from a person who is sick with Ebola or the body of a person who has died from Ebola,
- infected fruit bats or primates (apes and monkeys), and
- possibly from contact with semen from a man who has recovered from Ebola (for example, by having oral, vaginal, or anal sex)

Ebola is not spread through the air, by water, or in general, by food. However, in Africa, Ebola may be spread from animals to humans as a result of handling bushmeat (wild animals hunted for food) and by contact with infected bats. There is no evidence that mosquitoes or other insects can transmit Ebola

virus. Only a few species of mammals (e.g. humans, bats, monkeys, and apes) have shown the ability to become infected with and spread Ebola virus.

Source: http://www.cdc.gov/vhf/ebola/transmission/index.html

Question 5. There is a common misconception that Ebola can be spread through the air by coughing or sneezing. There is no evidence to support this; however, droplets (e.g., splashes or sprays) of respiratory fluids or other body fluids from a person who is sick with Ebola could lead to infection. What is the difference between infections spreading through the air and infections spread by droplets?
Answer: Airborne spread happens when germs float through the air after a person talks, coughs, or sneezes. Those germs can be inhaled even after the original person is no longer nearby. Therefore, direct contact with the infectious person is not needed for someone else to get sick. Germs like chicken pox and tuberculosis are spread through the air.

Droplet spread happens when fluids in large droplets from a sick person splash the eyes, nose, or mouth of another person or enter the body through a cut in the skin. Droplets may also cause short-term environmental contamination, like a soiled bathroom surface or handrails, from which another person can pick up the infectious material. Some germs, such as plague, can be spread through large droplets. Ebola may be spread through large droplets, but only when a person is very sick.

Source: http://www.cdc.gov/vhf/ebola/pdf/infections-spread-by-air-or-droplets.pdf

Case Definition
Cases of disease can be determined using one of three progressively more reliable case definitions:

- suspected
- probable
- confirmed

Question 6. Develop a case definition for each category: suspected, probable, and confirmed. Hint: You may first want to decide what type of information each category might include before applying it to Ebola.

Answer:

- Suspected:
  - Any person, alive or dead, suffering or having suffered from a sudden onset of high fever and having had contact with a suspected, probable or confirmed Ebola case, or a dead or sick animal, OR
  - Any person with sudden onset of high fever and at least three of the following symptoms: headache, vomiting, diarrhea, anorexia/loss of appetite, lethargy, stomach pain, aching muscles or joints, difficulty swallowing, breathing difficulties, or hiccups; OR
  - Any person with unexplained bleeding/hemorrhaging; OR
  - Any person with sudden, unexplained death

(Answer continued on next page)

- Probable:
  - Any suspected case evaluated by a clinician, OR
  - Any person who died from 'suspected' EVD and had an epidemiological link to a confirmed case but was not tested and did not have laboratory confirmation of the disease
- Confirmed:
  - Any suspected or probable cases with a positive laboratory result

Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Question 7. Although WHO included hemorrhagic symptoms and multiorgan dysfunction in the case definition, why might you exclude these symptoms in your case investigation?

Answer: The more severe symptoms of Ebola do not occur in all cases. Including hemorrhagic symptoms and multiorgan dysfunction among the definitive signs and symptoms in the case definition would capture only more severe cases (approximately 30%–50% of cases) and would exclude cases with milder symptoms.

Question 8: When documenting cases, reports from an outbreak typically include suspected, probable, and confirmed cases. Why do they report all cases instead of only the confirmed cases?

Answer: There are major challenges in countries with limited infrastructure for laboratory confirmation, including collecting and transporting specimens and access to the appropriate laboratory equipment, staffing, and facilities to test the specimens. Contact tracing is not always complete. Reporting only confirmed cases would be an underestimate of the true number of cases.

Part 3: Find cases systematically and record information

CDC and partners use contact tracing (Figure 2) to identify potential new Ebola cases quickly and to isolate patients as soon as they show symptoms, preventing spread to others. One missed contact can keep Ebola spreading, but careful tracing of contacts and isolating new cases can stop the outbreak.

Contact tracing is finding everyone who has come in direct contact with a sick Ebola patient. Contacts are watched for signs of illness for 21 days from the last day they came in contact with the Ebola patient. If the contact develops a fever or other Ebola symptoms, they are immediately isolated, tested, provided care, and the cycle starts again—all of the new patient's contacts are found and watched for 21 days. Contact tracing emphasizes finding new cases quickly so they can be isolated, stopping further spread of Ebola.

Figure 2: Contact tracing for Ebola. Source: CDC. Available at: http://www.cdc.gov/vhf/ebola/pdf/contact-tracing.pdf

Contact tracing can break the chain of Ebola transmission if it is implemented immediately, comprehensively, and effectively. Preparation is essential and requires establishing infrastructure for managing personnel, communication, and resources. A model commonly used in public health is the Incident Management Framework. This includes organized teams of people who are designated to lead the response. An Incident Manager is designated and must have the authority to make immediate decisions, immediately allocate resources and funds, and coordinate the public health partners involved. Elements of the Incident Management Framework can include a network of personnel with specific roles and responsibilities, facilities and treatment centers, laboratories, transportation protocols, and a data management system.

When a potential case of Ebola is first identified, a team of investigators travels to meet the person in question to record symptoms, exposure, and risk factors. If the person meets the definition of a case, then the Incident Management Framework is activated.

Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Question 9. Why is the Incident Management Framework important in a response that involves a variety of public health partners and personal with diverse backgrounds?
Answer: A large response requires a clear infrastructure for a variety of public health partners and personnel with diverse backgrounds because it provides a unified and structured approach to the response. To ensure that the response is coordinated as a whole, it's important that the team develop a chain of command and a clear understanding of how the different personnel, skills, and resources fit into the larger picture in aligning strategies for the greater good.

The team of investigators who travels to meet the person in question also meets with the case management team—the team providing clinical care, conducting research, overseeing infection prevention and control, or performing burials. The team of investigators interview the person in question to systematically identify all potential contacts since the onset of symptoms. They ask detailed questions to establish all of the patient's activities since the onset of illness and to identify everyone involved in those activities. The team talks to the family and other contacts, such as people who cared for or were geographically close to the person in question, including healthcare workers, family and neighbors, and funeral attendees (if applicable).To ensure a complete and accurate list of contacts, the team conducts several interviews and visits places that the person went to after they started to have symptoms to get the names of contacts that the person does not know or remember (i.e., others at a restaurant, hotel, conference, market, place of worship, clinic or workplace). The team verifies and double checks the exposure information for consistency and completeness during a second interview in later visits to ensure that all contacts and potential chains of transmission have been identified. Another team then follows up daily with all contacts and suspected cases for 21 days.

Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Question 10. Why is developing a relationship of trust between public health officials and the community essential to effective finding cases through contact tracing?
Answer: Contact tracing relies on active participation and cooperation from residents in the affected communities to be effective. To develop a relationship of trust between public health officials and the community, every effort should be made to engage communities. Involving key local community members, stakeholders, and volunteers very early in response planning and preparation is important to cultivate community ownership and trust in the health system. Communities should have the confidence to cooperate with teams that are conducting case investigation and contact tracing and support the referral of symptomatic people to designated isolation and treatment facilities. If the community does not trust public health officials conducting contact tracing, they may not be forthcoming in reporting all contacts or may hide their symptoms.

The team provides the specific information for each infected person to the database manager who enters it into the electronic database. Database managers from other teams investigating Ebola cases from the same outbreak enter their information into the same shared database.

Question 11. Explain why an electronic database is necessary to effectively manage cases and contacts?
Answer: In addition to being able to constantly register information about cases and contacts in real time, an electronic database will allow staff to produce daily reports, export data for analysis, geographically map contacts, and visually represent the chains of transmission. This allows epidemiologists to perform ongoing descriptive epidemiology (Step 6). Using an electronic database facilitates the rapid reporting of data and trends, and thus, can quickly inform decisions about the contact tracing process and identify needs for prevention and control strategies (Step 11). It also initiates a public health surveillance system (Step 12). Source: http://apps.who.int/iris/bitstream/10665/185258/1/WHO_EVD_Guidance_Contact_15.1_eng.pdf?ua=1

Part 4: Treatment, control, and prevention measures

Treatment

No FDA-approved vaccine or medicine (e.g., antiviral drug) is available for Ebola. Experimental vaccines and treatments for Ebola are under development, but they have not yet been fully tested for safety or effectiveness.

Symptoms of Ebola and complications are treated as they appear. For example, Ebola can lead to dehydration from diarrhea, which could be treated by rehydrating and providing electrolyte (body salts) drips. The following basic interventions, when used early, can significantly improve the chances of survival:

- Providing intravenous fluids (IV) and balancing electrolytes.
- Maintaining oxygen status and blood pressure.
- Treating other infections if they occur.

Recovery from Ebola depends on good supportive care and the patient's immune response. People who recover from Ebola infection develop antibodies that last for at least 10 years, possibly longer. It is not known if people who recover are immune for life or if they can become infected with a different species of Ebola. Some people who have recovered from Ebola have developed long-term complications, such as joint and vision problems. Even after recovery, Ebola might be found in some body fluids (e.g., semen, breast milk, ocular fluid, cerebrospinal fluid). Based on the results from limited studies conducted to date, it appears that the amount of virus found in body fluids decreases over time.

Source: http://www.cdc.gov/vhf/ebola/treatment/index.html

Question 12. What is involved in supportive care and why was it given? Remember, while treating the patient, all aspects of patient well-being need to be addressed. How does supportive care differ from interventional or therapeutic care?
Answer: Supportive care aims to prevent and treat a patient's symptoms. This may include providing emotional and psycho-social support to fight the stigma that is associated with an infectious disease. Interventional or therapeutic care tries to stop the infection and treat the disease. Care during the Ebola outbreak was often limited to supportive options because there were no approved treatments. As a result of this outbreak, there are new therapeutic agents being developed including monoclonal antibodies to treat infections and vaccines to help prevent them.

Question 13. In addition to Ebola, what other possible health complications may need to be addressed during patient care?
Answer: Patients may have other infections common to the region such as malaria, diarrheal illness, HIV infections, and tuberculosis. Pregnancy also complicated care.

Control and Prevention
Implementing exposure control and prevention measures (Step 11) is an important part of any outbreak investigation and is usually started at the beginning of the investigation and modified as needed as the investigation moves forward.

Keys to controlling Ebola outbreaks include 1) active case identification and isolation of patients from the community to prevent continued virus spread; 2) identifying contacts of ill or deceased patients and tracking contacts daily for the entire incubation period of 21 days; 3) investigation of previous and current cases to document all historic and ongoing chains of virus transmission; 4) identifying deaths in the community and using safe burial practices; and 5) daily reporting of cases. Educating healthcare workers regarding safe infection prevention and control practices, including appropriate use of PPE, is essential to protect themselves and their patients because healthcare–associated transmission has played a part in spreading disease during previous outbreaks.

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w

Question 14. Why is it important to implement infection prevention and control measures early in the investigation? What are the benefits and risks of doing this?
Answer: Preventing disease and death is the most important function of an outbreak investigation and implementing infection prevention and control measures can do that. Early interventions, even nonspecific ones such as promoting hygiene, will often slow the outbreak until more information is known about the cause and more specific instructions can be given. Interventions that are perceived as misguided, unnecessary, or alarmist may weaken public confidence, waste resources, and detract from more effective activities.

Question 15. What are some of the challenges you might face in implementing each of the above control measures in a resource-poor developing country? How might you address them?
Answer:
1. Identifying and isolating all active cases in the community to prevent continued virus spread: Suspected cases may not want to be identified due to fears of discrimination and isolation; monitoring is resource intensive
2. Identifying contacts of ill or deceased people and tracking the contacts daily for the entire incubation period of 21 days: In addition to the above, contacts may be difficult to identify and locate.
3. Investigation of previous and current cases to document all historic and ongoing chains of virus transmission: In addition to all the above, those with information – especially on historic chains of transmission, may be dead, unable, or unwilling to provide accurate information.
4. Identifying deaths in the community and using safe burial practices: Deaths may be incorrectly attributed to other causes, or people may be unwilling to report them or to practice safe burial because of traditional cultural or religious practices, as well as because of possible stigma that might result in negative social or economic consequences.
5. Daily reporting of cases: In addition to the above, there may be a lack of mechanisms and an infrastructure for obtaining and recording data on cases.

You might address these by developing materials, programs, policies and resources to promote and educate the public about the above is the best was to address the above.

Part 4: Conclusions

No new cases were reported in Liberia for several weeks after April 9, 2014, and Guinea had reported only nine new cases for the week of April 27; the outbreak appeared to be slowing. However, during the week of May 25, Liberia reported a new case, Guinea reported 38 cases, and Sierra Leone, a neighboring country, reported its first laboratory confirmed case. By mid-June 2014, total case counts were established for the combined three countries of Guinea, Liberia, and Sierra Leone (Table 1).

Table 1: Total Ebola case counts for Guinea, Liberia, and Sierra Leone as of mid-June 2014.

Country	Cases	Deaths
Guinea	398	264
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Total	528	337

Source: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6325a4.htm?s_cid=mm6325a4_w

Question 16. Based on the data provided in the above table, what were the case fatality rates for each country in mid-June 2014? What was the overall case fatality rate in these three countries?
Answer: The case fatality rates were as follows: Guinea = 66%, Liberia = 73%, Sierra Leone = 51%, and Total = 64%.

Control of the Ebola outbreak was significantly impacted by its wide geographic spread, poor public health infrastructures, and community mistrust and resistance of outsiders. By the end of 2014, there were 20,171 cases reported in the three most affected countries and 7,889 deaths.

Source: http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/previous-case-counts.html.

Question 17. What was the case fatality rate in the three most affected countries by the end of 2014?
Answer: The case fatality rate was 39% by the end of 2014.

Question 18. Compare the case fatality rates from the beginning of the outbreak to the end of 2014. What might have caused such a significant decrease?
Answer: Previously, the case fatality rate for *Zaire ebolavirus* was as high as 90%, but in this outbreak it was 64% in the beginning and decreased to 39% by the end of 2014. There are many reasons for the case fatality rate to decrease, but one reason may have been the development of a public health infrastructure, highly trained public health professionals, and the coordinated response among national and international partners. Improving the systems, such as identifying cases early through contact tracing allowing for early supportive care and follow-up, distributing prevention information using clear, culturally-sensitive messages, and allocating resources to areas most in need to support prevention and control. Other reasons for the decrease may include a less severe version of the virus.

As of January 3, 2016, 28,637 cases (suspected, probable, and confirmed) of Ebola and 11,315 total Ebola related deaths had been reported.

Source: http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html.

The 2014 Ebola outbreak response has been the largest international outbreak response in CDC's history. Thousands of highly trained public health professionals have helped stop the epidemic in Guinea, Liberia, and Sierra Leone. CDC continues to work alongside many national and international partners in West Africa towards the goal of zero new cases in West Africa and to strengthen vigilance throughout the region.

When that day comes, West Africa will have many systems and resources that it did not have before—emergency operations centers, laboratories, stronger surveillance systems, vaccine trials, and CDC country offices. But just as people and their expert knowledge and skills have made a difference in curbing the epidemic, people hold the key to securing national and global health in the future. There is a need for continued vigilance and the same kind of ongoing intensity and commitment to protect not only the residents of countries where outbreaks occur, but also their neighbors around the world.

Source: http://www.cdc.gov/about/ebola/moving-forward.html

The response continues into 2016. For up-to-date information, visit http://www.cdc.gov/vhf/ebola/outbreaks/2014-west-africa/index.html.