

Student Version

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Science Olympiad Disease Detectives *Division B* *2016-17 Regional Event*

Scoring (for internal use only)

Page #	Possible Points	Points Earned	Page #	Possible Points	Points Earned
1	11		11	9	
2	5		12	3	
3	4		13	3	
4	0	0	14	7	
5	3		15	0	0
6	11		16	8	
7	14		17	3	
8	3		18	5	
9	4		19	3	
10	4		Total	100	

For more information, visit: <http://www.cdc.gov/careerpaths/diseasedetectives>



Acknowledgements

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Contact Information

Please send questions and comments to scienceambassador@cdc.gov.

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Student Instructions

Use the scenarios that follow to help answer the questions to the best of your ability

- Each question is worth one point, unless otherwise noted. You will not lose points for incorrect answers.
 - You can take the event packet apart to work on it. At the end of the allotted 50-minute period, please re-staple it in the correct page order and turn it in with your team number, school name, and student names.
 - Please remain seated throughout the entire 50-minute event. If you have a question, raise your hand and someone will assist you. You may not leave the event early. If you finish before the allotted time, please review your work.
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General Questions

During 2014–2015, CDC sent scientists and doctors trained in epidemiology to respond to health threats around the world approximately 750 times. These epidemiologists are often called *CDC disease detectives* because of the investigative methods they use to solve what initially may be considered public health mysteries. They use certain concepts and techniques covered in this event to respond to infectious and noninfectious diseases, global health, injury prevention, environmental health, and occupational health events.

- ___1. (10 points; 1 point each) Below you will find a list of public health events that CDC disease detectives responded to during the last year. Investigations are infectious or noninfectious. **Put an “I” next to events that are infectious and an “N” next to those that are noninfectious.**

_____	Dengue fever	_____	Pneumonia
_____	Methyl bromide exposure	_____	Obesity
_____	<i>Escherichia Coli</i>	_____	Lead poisoning
_____	Botulism	_____	Meningitis
_____	Youth suicide cluster	_____	Salmonella

- ___2. (3 points; 1 point each) Epidemiology is the study of the distribution and determinants of health-related states or events among specified populations, and the application of this study to the control of health problems. Below are key terms taken from the definition of epidemiology, followed by a list of activities that CDC disease detectives (epidemiologists) performed when responding to a public health event. **Match the term to the activity that best describes it.**
- A. Distribution
 - B. Determinants
 - C. Application

_____ During January 2014, four students at a university in Ohio received a diagnosis of meningitis. CDC disease detectives recommended a mass vaccination campaign for all students attending the university.

_____ On March 18, 2015, a family of four vacationing in the U.S. Virgin Islands developed neurological symptoms consistent with chemical exposure to Methyl bromide, a highly toxic pesticide that was inappropriately used to fumigate the condominium below the unit in which the family was residing. CDC disease detectives created a map showing both places that were fumigated by the company, as well as places where residents reported being sick with symptoms similar to the family who became ill.

_____ In April 2015, a group of persons who attended a potluck lunch in Ohio became ill from botulism. CDC disease detectives compared food histories among those who became ill and those who did not. Then, they compared results to determine which food was likely to have been contaminated.

Answer the remaining questions by selecting the correct multiple choice answer.

- ___3. (1 point) In 2015, an outbreak of approximately 4,000 cases of cholera occurred in Kenya. This waterborne disease caused numerous pandemics during the 1800s. An epidemic in the London SoHo district in 1854 was made famous by the person known as the father of epidemiology. He identified the outbreak source as the public water pump on Broad Street in London. The main cause of Kenya's outbreak can also be attributed to poor water drainage and sanitation. **Who is considered to be the father of epidemiology?**
- A. John Snow.
 - B. Jonas Salk.
 - C. Louis Pasteur.
 - D. Edward Jenner.
- ___4. (1 point) In 1976, Legionnaires' disease was found on a different Broad Street. This waterborne disease outbreak occurred in Philadelphia, Pennsylvania. In 2015, an outbreak of Legionnaires' disease occurred in Illinois at a Veterans Administration facility. The bacteria that causes this disease was found in the water supply. **What type of outbreak would this be considered?**
- A. Point source.
 - B. Continuous common source.
 - C. Intermittent common source.
 - D. Propagated.
- ___5. (1 point) On May 7, 2015, the local and state health department from Whatcom County, Washington, identified an outbreak of Shiga toxin-producing *Escherichia coli* O157 infections. **According to the steps in an outbreak investigation, what might they do next?** (Choose the best answer.)
- A. Construct a case definition and look for additional cases.
 - B. Develop a hypothesis, confirm laboratory cases, and prepare for fieldwork.
 - C. Report findings to public, shut down the local farms, and confirm laboratory cases.
 - D. Perform analytic epidemiology and confirm laboratory cases.
- ___6. (1 point) During 1980–2014, the number of adults in the United States, aged 18–79 years with newly diagnosed diabetes, approximately tripled from 493,000 persons in 1980 to more than 1.4 million persons in 2014. **What can the rate of the occurrence of new cases each year also be called?**
- A. Incidence rate.
 - B. Prevalence rate.
 - C. Case-fatality rate.
 - D. Rate ratio.
- ___7. (1 point) Mucormycosis is a serious, often fatal infection, caused by molds. In December 2014, a cluster of mucormycosis infection was identified. Health department personnel first characterized the cases by person, place, and time. **What type of epidemiology did they perform?**
- A. Descriptive.
 - B. Analytic.
 - C. Experimental.
 - D. Clinical.

- ___8. (2 points) In Tete Province, Mozambique, during January 28–February 14, 2015, a total of 245 men, women, and children became ill with an unknown infectious agent. Among the 245 patients, 107 were hospitalized, and 84 deaths were reported. **What was the case-fatality rate of this outbreak?**
- A. 34%.
 - B. 44%.
 - C. 56%.
 - D. 80%.
- ___9. (1 point) By the end of 2015, approximately 28,000 persons were believed to have been infected with the Ebola virus in West Africa. **Because the outbreak primarily was contained to one region of the world, what can it be considered?**
- A. Outbreak.
 - B. Epidemic.
 - C. Pandemic.
 - D. Cluster.
- ___10. (1 point) In July 2015, the Iowa Department of Public Health reported 13 mumps cases at a large public university. **What is this considered?**
- A. Outbreak.
 - B. Epidemic.
 - C. Pandemic.
 - D. Cluster.

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Scenario 1. Botulism¹

Botulism is a rare, paralytic illness caused by a nerve toxin produced by a certain type of bacteria. Often, botulism is foodborne. Because multiple persons can be poisoned by eating contaminated food and because botulism illness is severe, a single case is a public health emergency and is reportable in the United States.

In 2015, the largest botulism outbreak in the United States since 1977 occurred in Ohio. It began on April 21, 2015, when a hospital in Fairfield suspected a patient as having botulism. The hospital notified the local and state health department of the patient suspected of having botulism. Within two hours, four more patients with botulism-like signs and symptoms were reported. Later that afternoon, one patient died of respiratory failure shortly after arriving at the emergency department. All affected persons had eaten at the same widely-attended church potluck meal on April 19.

The health department requested help from CDC disease detectives to confirm the diagnosis, identify and treat additional patients, and determine the source.

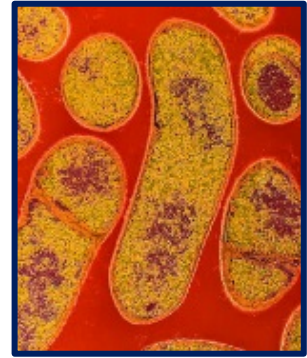


Figure 1. Clostridium botulinum bacteria.

___ 11. (1 point) In epidemiology, the interaction of three elements are assessed before developing control measures. This is often called the epidemiologic triad. **What is the name of the missing element in the adjacent diagram?**

- A. Microorganism.
- B. Pathogen.
- C. Environment.
- D. Disease.



___ 12. (1 point) In this scenario, the agent or pathogen is called *Clostridium botulinum*. In biology, this organism would be classified in the kingdom *Bacteria*. **Which kingdom does not include pathogens?**

- A. Protista.
- B. Fungi.
- C. Plants.
- D. Animals.

___ 13. (1 point) In a chain of infection, the agent starts in a reservoir and is transferred by a mode of transmission to infect a susceptible host. Foodborne botulism is an illness that usually results from the ingestion of a neurotoxin produced by the bacteria *C. botulinum*. **What is the mode of transmission for botulism?**

- A. Airborne.
- B. Droplet spread.
- C. Vector-borne.
- D. Vehicle-borne.
- E. Direct contact.

¹ This scenario is based on an outbreak of botulism in Ohio, 2015 presented in the following Morbidity and Mortality Weekly Report: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6429a6.htm>.

- ___14. (1 point) When CDC disease detectives were contacted, botulism was suspected in five patients at the hospital, signaling an outbreak. One of the epidemiologists' first tasks was to construct a case definition. **A case definition includes which of the following information?** (Choose the best answer.)
- A. Clinical criteria, such as signs and symptoms.
 - B. Clinical criteria limited by person, place, and time.
 - C. Attendance at the church potluck.
 - D. Descriptive epidemiology.
- ___15. (2 points) Of the 29 patients who met the case definition, 25 persons were confirmed cases and four were probable cases. **Which of the following would be part of the case definition for a confirmed case, but not for a probable case?**
- A. A laboratory test positive for botulism.
 - B. One sign of botulism.
 - C. One sign and one symptom of botulism.
 - D. Attended the church potluck.
- ___16. (2 points) In this outbreak, only one person died. **What was the case-fatality rate?**
- A. 3.4%.
 - B. 13.8%.
 - C. 28%.
 - D. 86.2%.
- ___17. (2 points) Twenty-seven of 29 patients were interviewed. CDC disease detectives also interviewed 44 persons who attended the church potluck and four persons who ate leftovers from the potluck and were not sick. **Why did they attempt to interview all attendees (n = 77) of the potluck?**
- A. To determine risk factors by comparing information from those who were sick with those who were not sick.
 - B. To identify which foods those who were sick ingested, compared with those who were not sick.
 - C. To identify additional cases.
 - D. All of the above.
- ___18. (2 points) During the interview, 75 of the 77 attendees of the church potluck were asked 55 questions about specific foods eaten, foods brought to the potluck, as well as demographic information. **Because all persons attending the potluck were asked to participate, what is this study considered?**
- A. Case-control study.
 - B. Cross-sectional study.
 - C. Cohort study.
 - D. Ecological study.
- ___19. (2 points) **What was the overall attack rate among those who ate potluck food?**
- A. 3.4%.
 - B. 36.0%.
 - C. 37.6%.
 - D. 38.6%.

20. (11 points) A total of 52 food items were available at the potluck dinner. CDC disease detectives calculated attack rates for all food items. By using the information provided in the table, calculate the attack rates for homemade potato salad, purchased potato salad, and macaroni and cheese. **Show your work in the space provided below the table. Write your final answers in the following table in the right-hand column.**

	Number of sick persons who ate this food	Number of sick persons who did not eat this food	Number of not sick persons who ate this food	Number of not sick persons who did not eat this food	Attack Rate (Sick)
Homemade potato salad	25	2	14	34	
Purchased potato salad	10	17	8	40	
Macaroni and cheese	11	16	18	30	

Show your work.

Attack rate formula (2 points)

Attack rates (9 points total)

(a) Homemade potato salad (3 points)

(b) Purchased potato salad (3 points):

(c) Macaroni and cheese (3 points):

21. (3 points) The disease detectives then identified which food had the highest association with illness by calculating the risk ratio for each food. **Choose the correct risk ratios for homemade potato salad, purchased potato salad, and macaroni and cheese.**

A.

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	11.5	1.86	1.09

B.

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	0.08	0.53	0.92

C.

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	3.17	2.22	1.09

- ___22. (2 points) Food samples were collected from plates in the church dumpster. Potato salad samples and macaroni and cheese samples were taken from 12 plates. Six tested positive for botulinum neurotoxin. Of those six, five of the plates contained potato salad and one contained macaroni and cheese. **Why did disease detectives collect and test samples from the dumpster?**
- A. To collect samples of the botulism neurotoxin for antitoxin development.
 - B. To confirm the epidemiologic findings with environmental studies.
 - C. To identify patterns in the food eaten by comparing plates found.
 - D. To determine the validity of the survey.
- ___23. (1 point) CDC's Strategic National Stockpile sent 50 doses of botulinum antitoxin to Ohio. Twenty-five patients received the antitoxin. **What is an antitoxin?**
- A. A vaccine.
 - B. An antibody.
 - C. A toxoid.

Scenario 2: Dengue²

On October 21, 2015, the Hawaii Department of Health (HDOH) was notified of a confirmed case of dengue fever. The patient had no history of travel outside Hawaii Island (also known as the Big Island), and other family members reported having similar signs and symptoms. These consisted of sudden onset of fever, severe headaches, eye, joint, and muscle pain, and rash.

On October 24, HDOH received a surveillance report of multiple persons with similar, dengue-like symptoms among a group of visitors from mainland U.S. who had traveled together on Hawaii Island. On October 27, HDOH was also notified of a person who was on Hawaii Island, without any connection to the group of visitors from mainland U.S., and had a positive dengue immunoglobulin M (IgM) test. An IgM is a type of antibody that usually appears for a limited time after infection. Detection of dengue IgM antibody test tells us that the person may have had a recent dengue virus infection.

___24. (1 point) **What is the definition of surveillance?**

- A. The ongoing, systematic collection analysis, interpretation, and dissemination of health data to help guide public health decision making and action.
- B. The aspect of epidemiology that focuses on person, place, and time.
- C. The study of the distribution and determinants of health conditions or events among populations and the application of that study to control health problems.
- D. The aspect of epidemiology concerned with why and how a health problem occurs.

___25. (1 point) **Which of the following determines what type of surveillance is used**

- A. The type of information that is collected.
- B. The source of information that is collected.
- C. How the information is analyzed.
- D. How the information is collected.

___26. (1 point) **What type of surveillance is used for dengue fever in this example?**

- A. Active surveillance.
- B. Passive surveillance.
- C. Syndromic surveillance.

On October 29, an investigation started. Epidemiologists interviewed each patient to identify where their exposure might have been, signs and symptoms, and the onset of disease. This information is given to a laboratorian to conduct laboratory testing. Because dengue fever is spread by mosquitoes, the information is also given to vector control specialists, who assess local mosquito populations and institute control measures if necessary.

___27. (1 point) **What is the mode of transmission for dengue fever?**

- A. Airborne.
- B. Droplet spread.
- C. Vector-borne.
- D. Vehicle-borne.

² This scenario is based on an outbreak of locally acquired cases of Dengue Fever in Hawaii, 2015 presented in the following Morbidity and Mortality Weekly Report:

<http://www.cdc.gov/mmwr/volumes/65/wr/mm6502a4.htm>.

- ___28. (1 point) **What term is used to describe an infectious disease that is transmissible from animals to humans?**
- Animal-borne.
 - Zoonotic.
 - Arbovirus.
 - Viral disease.
- ___29. (1 point) Laboratorians used a rapid diagnostic test (RDT) to confirm cases of dengue fever. During the first five days after onset of symptoms, a polymerase chain reaction (PCR) test can be used to confirm a diagnosis of dengue fever. After five or more days, an enzyme-linked immunosorbent assays (ELISA) test can be used to confirm a diagnosis of dengue fever.³ **What does a PCR test identify?**
- The presence of an antibody signaling immune system's immediate response to dengue virus.
 - The presence of an antibody signaling immune system's long-term protection against the dengue virus.
 - The presence of genetic material of the dengue virus.
 - Both answers A and B are correct.

Figure 2 shows, as of November 26, 2015, HDOH had identified 107 laboratory-confirmed cases of dengue fever, with symptom onset ranging from September 11–November 18, 2015.

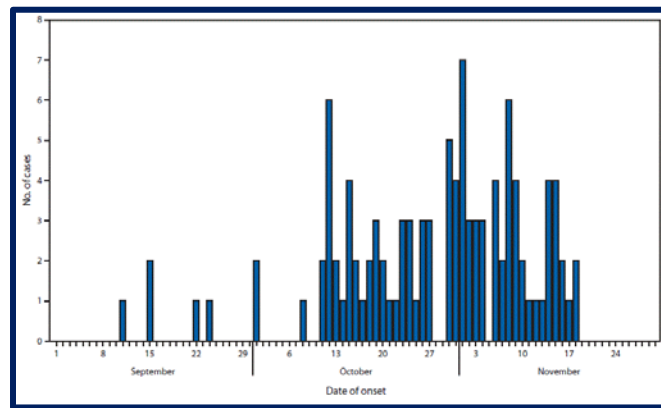


Figure 2. Number of laboratory-confirmed cases (N = 107) of dengue fever, by date of onset — Hawaii Island, September 11–November 18, 2015.
Source: <http://www.cdc.gov/mmwr/volumes/65/wr/mm6502a4.htm>.

- ___30. (1 point) The outbreak is visually described by Figure 2 (above). **What is the common name of this figure in epidemiology?**
- Outbreak curve.
 - Epidemic curve.
 - Bar graph.
 - Epidemiology graph.
- ___31. (1 point) **What type of outbreak is most likely represented in Figure 2?**
- Continuous common source outbreak.
 - Intermittent common source outbreak.
 - Propagated outbreak.

³ Learn more about laboratory guidance and diagnostic testing for dengue at: <http://www.cdc.gov/dengue/clinlab/lab>

As of January 20, 2016, a total of 977 RDT tests were ordered, but only 224 (23%) were laboratory-positive cases of dengue fever. HDOH was concerned about false negatives (i.e., persons who were infected, but had a negative laboratory test).

HDOH asked CDC disease detectives to determine RDT validity, against the standard test used to diagnose dengue. The standard test during the first five days after onset of symptoms is a polymerase chain reaction (PCR) test. The standard test after five or more days is an enzyme-linked immunosorbent assay (ELISA) test. For the activity, please note that we will use the term “standard test” to represent the appropriate test according to onset of symptoms.

HDOH sent samples from all 977 cases to CDC’s Dengue Branch for testing. Results were as follows.

		Standard Test		Total
		Positive	Negative	
RDT	Positive	203	21	224
	Negative	16	737	753
	Totals			977

32. (4 points) **Calculate RDT sensitivity.** For full credit, include the formula (1 point), the formula with the correct values entered (1 point), and the answer (2 points).

___ 33. (1 point) **Choose the best interpretation of your answer for sensitivity.**

- A. The percentage of those that tested **negative** with the standard test who also tested **negative** by using RDT, or the percentage of **noncases** RDT correctly identified.
- B. The percentage of those that tested **positive** by the standard test who also tested positive using RDT, or the percentage of **cases** RDT correctly identified.
- C. The percentage of those that tested **negative** by using RDT who also tested **negative** with the standard test, or the percentage of **cases** RDT correctly identified.
- D. The percentage of those that tested **positive** by using RDT who also tested **positive** with the standard test, or the percentage of **noncases** RDT correctly identified.

34. (4 points) **Calculate the specificity of RDT.** For full credit, include the formula (1 point), the formula with the correct values entered (1 point), and the answer (2 points).

- ___35. (1 point) **Choose the best interpretation of your answer for specificity?**
- A. The percentage of those that tested negative with the standard test who also tested negative by using RDT, or the percentage of noncases RDT correctly identified.
 - B. The percentage of those that tested positive by the standard test who also tested positive using RDT, or the percentage of cases RDT correctly identified.
 - C. The percentage of those that tested **negative** by using RDT who also tested **negative** with the standard test or the percentage of **cases** RDT correctly identified.
 - D. The percentage of those who tested **positive** by using RDT who also tested **positive** with the standard test or the percentage of **noncases** RDT correctly identified.
- ___36. (1 point) **Based on your calculations, would you recommend that HDOH continue using the same RDT to confirm cases of dengue?** Choose the best answer.
- A. Yes, the sensitivity is high; therefore, HDOH can be confident in the RDT positive results.
 - B. Yes, the sensitivity and specificity are high; therefore, HDOH can be confident in both positive and negative RDT results.
 - C. No, the specificity is higher than the sensitivity; therefore HDOH cannot be confident in the RDT positive results.
 - D. No, the sensitivity is higher than the specificity; therefore HDOH cannot be confident in the RDT negative results.
- ___37. (1 point) There were additional reports of probable cases. A probable dengue case occurs when someone reports signs and symptoms consistent with the case definition for dengue, but did not have confirmatory laboratory testing. **What action might you recommend to reduce the number of probable cases compared to the number of confirmed cases?** Choose the best answer.
- A. Adjust the case definition for dengue to be more specific to dengue symptoms.
 - B. Conduct an epidemiologic study among probable cases that tested negative to the RDT test to determine an alternative potential cause of illness that can be used to differentiate between dengue cases and non-dengue cases.
 - C. Answers A and B.
 - D. None of the above.

HDOH epidemiologists and CDC Disease Detectives interviewed each of the 224 patients with RDT-confirmed illness. On the basis of these interviews, they created a map that was based on the number of confirmed cases with recent onset dates. Places with a high number of cases are considered high risk and places with no cases are considered low risk.

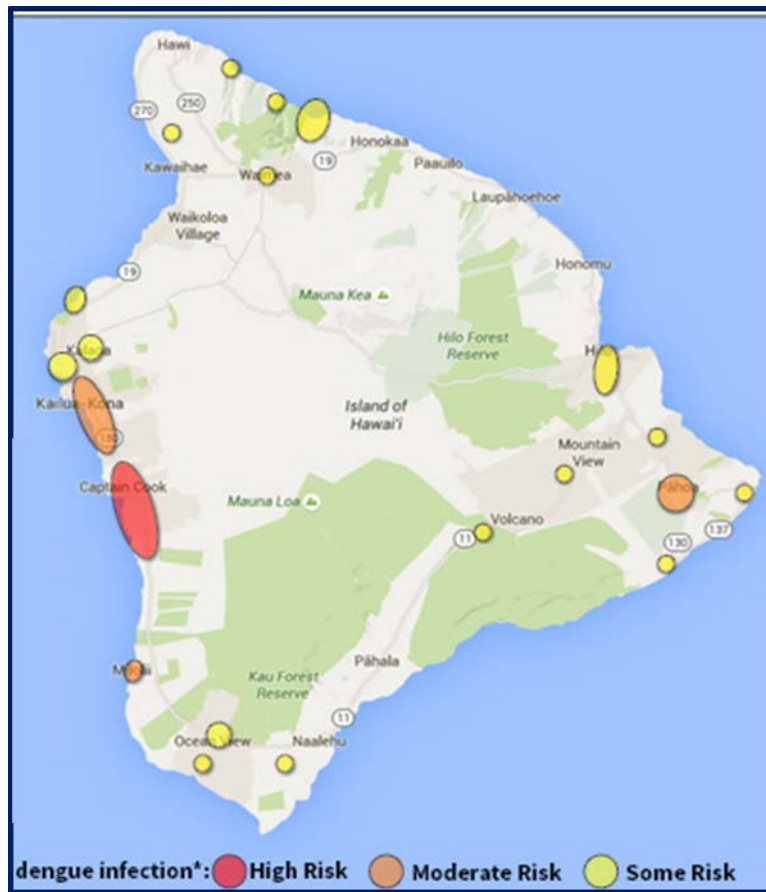


Figure 3. A map of Hawaii showing confirmed cases of dengue fever, September 11, 2015-January 20, 2016.
Source: <http://health.hawaii.gov/docd/dengue-outbreak-2015/>.

- ___38. (1 point) **What is the common name for this map in epidemiology?**
- A. Epidemic map.
 - B. Spot map.
 - C. Outbreak map.
 - D. Epidemiology map.
- ___39. (2 points) From the distribution of cases on the map, which of the following most likely influences the number of cases in a given area:
- A. Population density.
 - B. Latitude.
 - C. Average temperature.

___40. (3 points; 1 point each) Environmental specialists consider entomology (e.g., lifecycle) and ecology (e.g., habitat) when determining control measures, in this case for *Aedes* mosquitos carrying dengue. Mosquitos lay their eggs on the insides of containers with water, and eggs hatch into larvae after a rain or flooding. A larva changes into a pupa after approximately one week and into a mosquito two days later. Three methods are used to reduce the mosquito population, which in turn helps control dengue virus transmission.⁴

Match the following descriptions with the appropriate control method.

- A. Biological
- B. Chemical
- C. Environmental management

- _____ Destroys, alters, removes, or recycles nonessential containers that provide egg, larval, or pupal habitats.
- _____ Sprays larvicides and adulticides in the areas of risk.
- _____ Introduces copepods or fish to prey on or eat mosquitos during early larval stages.

___41. (2 points) Controlling or eliminating mosquitoes that can carry dengue viruses is difficult because of adaptations to the environment that make mosquitos highly resilient, as in their ability to rapidly bounce back to initial population after natural control measures (e.g., droughts) or human-environmental control measures. One such adaptation is the ability of the eggs to withstand desiccation (drying) and to survive without water for multiple months on the inner walls of containers.⁵ **If environmental specialists were to eliminate all larvae, pupae, and adult mosquitos at once from a site, what would likely happen during the next rainfall?**

- A. The mosquito population would be low or nonexistent, effectively controlling any dengue outbreaks.
- B. A different species of mosquito population will emerge, which could cause another type of mosquito-borne outbreak.
- C. The mosquito population would recover two weeks later as a result of egg hatching after rainfall or the addition of water to containers harboring eggs.

___42. (2 points) You are asked to help develop health education materials to provide to persons and families who reside in an at-risk area. Name two environmental management control measures that individuals living in an at-risk area can take on their own and that can be promoted in health education materials.⁴

⁴ Learn more about dengue control strategies at http://www.who.int/denguecontrol/control_strategies/en/.

⁵ Learn more about dengue entomology and ecology at <http://www.cdc.gov/dengue/entomologyEcology/>.

Scenario 3: Obesity⁶

In 2010, Guam Department of Public Health and Social Services (DPHSS) declared a state of regional health emergency because of an epidemic of obesity and noncommunicable disease. DPHSS developed a strategic plan to reverse the problem. In early 2015, Guam recognized that limited access to healthy food options might be contributing to the epidemic. To assess the nutritional environment, Guam requested CDC assistance.



Figure 4: World map with a red marker on Guam. Map courtesy of Google® maps.

The Youth Risk Behavior Surveillance System (YRBSS)⁷ and Behavior Risk Factor Surveillance System (BRFSS)⁸ monitor health-risk indicators (e.g., obesity) and behaviors (e.g., smoking, limited physical activity, and poor eating habits) that contribute to the leading causes of death and disability (e.g., noncommunicable disease) among youth and adults. Data from these surveillance systems were used to determine changes in obesity levels.

A high body mass index (BMI)⁹ can be an indicator of high body fat, or obesity.¹⁰ It is calculated by using a person’s weight and height. Among adults, a BMI of ≥ 30 is considered obese. Figure 5, below, is a trend graph from BRFSS that shows the percentage of adults by age group in Guam with a BMI of 30 and above.

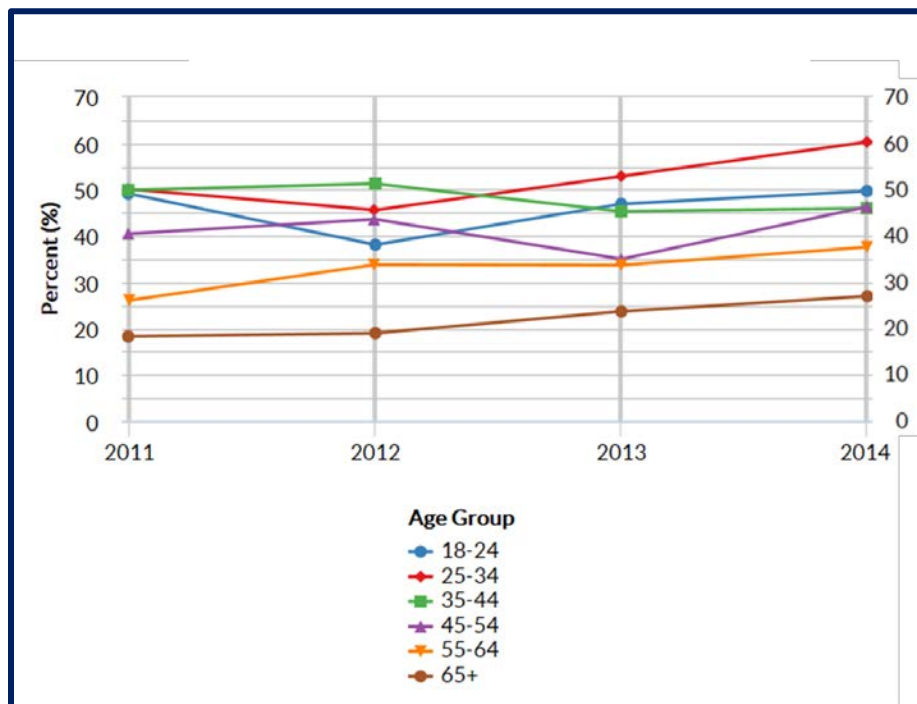


Figure 5: Percentage of adults who have obesity, by age group, Guam, 2011-2014. Data Source: Behavioral Risk Factor Surveillance System (BRFSS)

⁶ This scenario is based on a study of sodium in store and restaurant food environments — Guam, 2015 presented in the following Morbidity and Mortality Weekly Report: <http://www.cdc.gov/mmwr/volumes/65/wr/mm6520a2.htm>

⁷ Learn more about YRBSS at <http://www.cdc.gov/healthyyouth/data/yrbs/>.

⁸ Learn more about BRFSS at <http://www.cdc.gov/brfss/>.

⁹ Learn more about BMI at <http://www.cdc.gov/healthyweight/assessing/bmi/>.

¹⁰ Learn more about obesity at <https://www.cdc.gov/obesity/>.

- ___43. (2 points) Using Figure 5, which age group of adults in Guam had the greatest percent increase in obesity from 2011 to 2014?
- A. 18–24.
 - B. 35–44.
 - C. 55–64.
 - D. 65+.
- ___44. (2 points) In 2013, 76.5% of high school students and 48.7% of adults from Guam also reported not meeting aerobic physical activity guidelines. Research indicates that regular physical activity helps improve your overall health and fitness, and reduces your risk for many chronic diseases. In fact, the more physically active you are, the lower your risk for many chronic disease becomes. **What is this type of relationship called?**
- A. Dose-response relationship.
 - B. Inverse dose-response relationship.
 - C. Association.
 - D. Causation.
- ___45. (1 point) The YRBSS and the BRFSS use surveys to collect data. Behavioral data is self-reported. A common problem with self-reported data is bias. A common type of bias found in obesity and physical activity data is social desirability. **Which type of bias is also common in self-reported data?**
- A. Selection bias.
 - B. Information bias.
 - C. Response bias.
 - D. Recall bias.
 - E. Attrition bias.
- ___46. (2 points) In 2015, CDC was asked to conduct a study to establish baseline information about the nutritional environment in Guam. CDC Disease Detectives designed a study by using the Nutrition Environment Measures Survey (NEMS). CDC Disease Detectives visited a random sample of food retail venues (grocery and convenience stores), restaurants, and produce markets to determine availability, pricing, and promotion of healthier food options, including low-sodium options in the retail and restaurant food environments. **What type of study design was used?**
- A. Ecological.
 - B. Cohort.
 - C. Cross-sectional.
 - D. Experimental.
- ___47. (1 point) CDC disease detectives asked retail and restaurant managers exploratory questions about their perceptions of the barriers and facilitators to providing healthier food options, including low-sodium options, in their establishments. **What is this part of the study considered to be?**
- A. Qualitative.
 - B. Quantitative.

Scenario 4. *Salmonella* in Cucumbers¹¹

From summer 2015 to March 16, 2016, a total of 907 persons infected with the outbreak strains of *Salmonella* Poona were reported across the United States. Figure 6 is a map that was generated to show the number of cases for each state. Use this figure to help you answer questions 48–49.

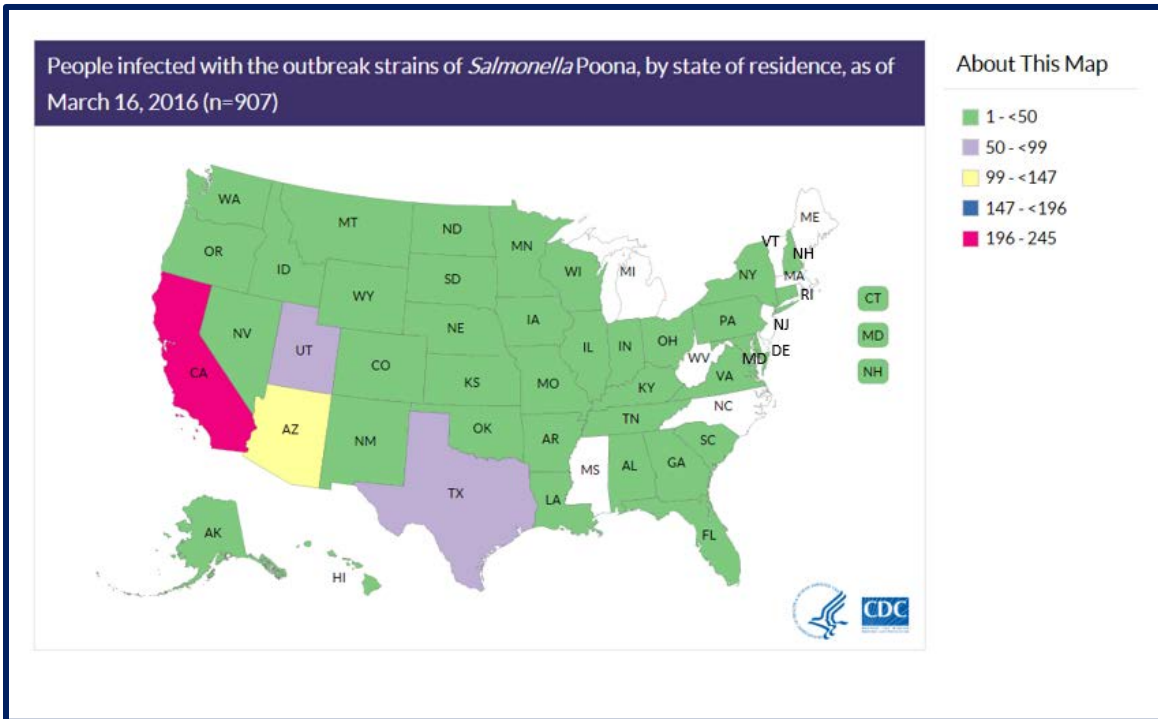


Figure 6. Persons infected with the outbreak strains of *Salmonella* Poona, by state of residence, as of March 16, 2016. Note that white (unshaded) states had 0 infected persons.

Source: CDC. Available at: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

___48. (2 points) **Which two states were the most affected?**

___49. (1 point) **How many states were unaffected?**

Several state health and agriculture departments collected and tested cucumbers from retail locations and isolated the outbreak strains of *Salmonella* Poona. Information indicated that these cucumbers were distributed by Andrew & Williamson Fresh Produce. Additionally, testing of cucumbers collected from the Andrew & Williamson Fresh Produce facility isolated the outbreak strains of *Salmonella* Poona.

On September 4, 2015, Andrew & Williamson Fresh Produce voluntarily recalled all cucumbers sold under the Limited Edition brand from August 1, 2015 through September 3, 2015 due to possible contamination with *Salmonella*. On September 11, 2015, Custom Produce Sales voluntarily recalled all cucumbers sold under the Fat Boy brand starting August 1, 2015 because Custom Produce Sales had purchased these cucumbers from Andrew & Williamson Fresh Produce.

¹¹ This scenario is based on a multistate outbreak of *Salmonella* Poona infections linked to imported cucumbers: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

Figure 7 is a graph that was generated to show the timeline of the outbreak. Use this figure to help you answer questions 50–51.

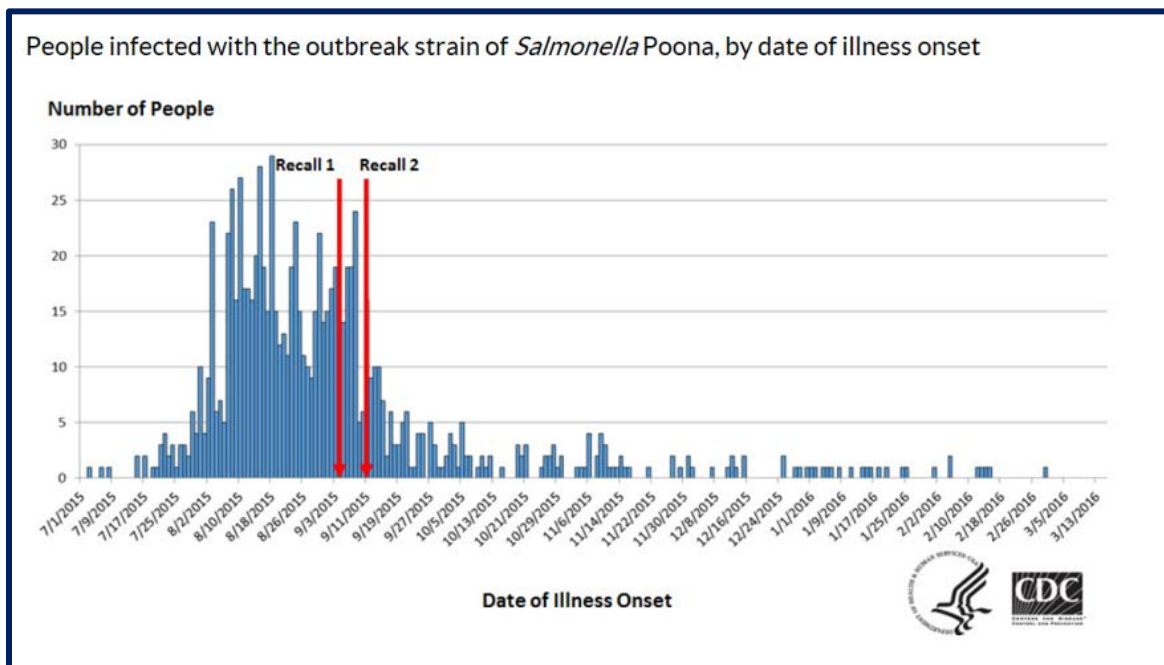


Figure 7. Persons infected with the outbreak strains of *Salmonella* Poona, by date of illness onset. **Source:** CDC. Available at: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

- ___50. (1 point) **When was the first illness onset?**
- Before July 1, 2015.
 - July 3, 2015.
 - August 2, 2015.
 - August 18, 2015.
- ___51. A. (2 points) **Describe what happened to the number of cases (persons infected) immediately after the first recall but before the second recall. Explain why this occurred.**
- B. (2 points) **Describe what happened to the number of cases immediately after the second recall, through mid-November. Explain why this occurred.**

- ___52. (2 points) Despite the two recalls, a higher number of cases than expected were reported through mid-November. (Assume that all cucumbers in the initial outbreak were discarded either because of the recall or had rotted.) **Explain why this might have happened.**
- ___53. (1 point) **Name at least one household control measure for those who may have purchased recalled cucumbers and have since discarded them accordingly.**

Answer Key

Score Rank

Team Number _____

School Name _____

Student Names _____

Science Olympiad Disease Detectives *Division B* *2016-17 Regional Event*

Scoring (for internal use only)

Page #	Possible Points	Points Earned	Page #	Possible Points	Points Earned
1	11		11	9	
2	5		12	3	
3	4		13	3	
4	0	0	14	7	
5	3		15	0	0
6	11		16	8	
7	14		17	3	
8	3		18	5	
9	4		19	3	
10	4		Total	100	

For more information, visit: <http://www.cdc.gov/careerpaths/diseasedetectives>



Acknowledgements

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Contact Information

Please send questions and comments to scienceambassador@cdc.gov.

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Student Instructions

Use the scenarios that follow to help answer the questions to the best of your ability

- Each question is worth one point, unless otherwise noted. You will not lose points for incorrect answers.
 - You can take the event packet apart to work on it. At the end of the allotted 50-minute period, please re-staple it in the correct page order and turn it in with your team number, school name, and student names.
 - Please remain seated throughout the entire 50-minute event. If you have a question, raise your hand and someone will assist you. You may not leave the event early. If you finish before the allotted time, please review your work.
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General Questions

During 2014–2015, CDC sent scientists and doctors trained in epidemiology to respond to health threats around the world approximately 750 times. These epidemiologists are often called *CDC disease detectives* because of the investigative methods they use to solve what initially may be considered public health mysteries. They use certain concepts and techniques covered in this event to respond to infectious and noninfectious diseases, global health, injury prevention, environmental health, and occupational health events.

- ___1. (10 points; 1 point each) Below you will find a list of public health events that CDC disease detectives responded to during the last year. Investigations are infectious or noninfectious. **Put an “I” next to events that are infectious and an “N” next to those that are noninfectious.**

___I___	Dengue fever	___I___	Pneumonia
___N___	Methyl bromide exposure	___N___	Obesity
___I___	<i>Escherichia Coli</i>	___N___	Lead poisoning
___I___	Botulism	___I___	Meningitis
___N___	Youth suicide cluster	___I___	Salmonella

- ___2. (3 points; 1 point each) Epidemiology is the study of the distribution and determinants of health-related states or events among specified populations, and the application of this study to the control of health problems. Below are key terms taken from the definition of epidemiology, followed by a list of activities that CDC disease detectives (epidemiologists) performed when responding to a public health event. **Match the term to the activity that best describes it.**
- D. Distribution.
E. Determinants.
F. Application.

___C___ During January 2014, four students at a university in Ohio received a diagnosis of meningitis. CDC disease detectives recommended a mass vaccination campaign for all students attending the university.

___A___ On March 18, 2015, a family of four vacationing in the U.S. Virgin Islands developed neurological symptoms consistent with chemical exposure to Methyl bromide, a highly toxic pesticide that was inappropriately used to fumigate the condominium below the unit in which the family was residing. CDC disease detectives created a map showing both places that were fumigated by the company, as well as places where residents reported being sick with symptoms similar to the family who became ill.

___B___ In April 2015, a group of persons who attended a potluck lunch in Ohio became ill from botulism. CDC disease detectives compared food histories among those who became ill and those who did not. Then, they compared results to determine which food was likely to have been contaminated.

Answer the remaining questions by selecting the correct multiple choice answer.

- ___3. (1 point) In 2015, an outbreak of approximately 4,000 cases of cholera occurred in Kenya. This waterborne disease caused numerous pandemics during the 1800s. An epidemic in the London SoHo district in 1854 was made famous by the person known as the father of epidemiology. He identified the outbreak source as the public water pump on Broad Street in London. The main cause of Kenya's outbreak can also be attributed to poor water drainage and sanitation. **Who is considered to be the father of epidemiology?**
- A. John Snow. (Answer)**
 - B. Jonas Salk.
 - C. Louis Pasteur.
 - D. Edward Jenner.
- ___4. (1 point) In 1976, Legionnaires' disease was found on a different Broad Street. This waterborne disease outbreak occurred in Philadelphia, Pennsylvania. In 2015, an outbreak of Legionnaires' disease occurred in Illinois at a Veterans Administration facility. The bacteria that causes this disease was found in the water supply. **What type of outbreak would this be considered?**
- A. Point source.
 - B. Continuous common source. (Answer)**
 - C. Intermittent common source.
 - D. Propagated.
- ___5. (1 point) On May 7, 2015, the local and state health department from Whatcom County, Washington, identified an outbreak of Shiga toxin-producing *Escherichia coli* O157 infections. **According to the steps in an outbreak investigation, what might they do next?** (Choose the best answer.)
- A. Construct a case definition and look for additional cases. (Answer)**
 - B. Develop a hypothesis, confirm laboratory cases, and prepare for fieldwork.
 - C. Report findings to public, shut down the local farms, and confirm laboratory cases.
 - D. Perform analytic epidemiology and confirm laboratory cases.
- ___6. (1 point) During 1980–2014, the number of adults in the United States, aged 18–79 years with newly diagnosed diabetes, approximately tripled from 493,000 persons in 1980 to more than 1.4 million persons in 2014. **What can the rate of the occurrence of new cases each year also be called?**
- A. Incidence rate. (Answer)**
 - B. Prevalence rate.
 - C. Case-fatality rate.
 - D. Rate ratio.
- ___7. (1 point) Mucormycosis is a serious, often fatal infection, caused by molds. In December 2014, a cluster of mucormycosis infection was identified. Health department personnel first characterized the cases by person, place, and time. **What type of epidemiology did they perform?**
- A. Descriptive. (Answer)**
 - B. Analytic.
 - C. Experimental.
 - D. Clinical.

- ___8. (2 points) In Tete Province, Mozambique, during January 28–February 14, 2015, a total of 245 men, women, and children became ill with an unknown infectious agent. Among the 245 patients, 107 were hospitalized, and 84 deaths were reported. **What was the case-fatality rate of this outbreak?**
- A. **34%. (Answer: $84 \div 245 = 34\%$)**
 - B. 44%.
 - C. 56%.
 - D. 80%.
- ___9. (1 point) By the end of 2015, approximately 28,000 persons were believed to have been infected with the Ebola virus in West Africa. **Because the outbreak primarily was contained to one region of the world, what can it be considered?**
- A. Outbreak.
 - B. **Epidemic. (Answer)**
 - C. Pandemic.
 - D. Cluster.
- ___10. (1 point) In July 2015, the Iowa Department of Public Health reported 13 mumps cases at a large public university. **What is this considered?**
- A. **Outbreak. (Answer)**
 - B. Epidemic.
 - C. Pandemic.
 - D. Cluster.

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Scenario 1. Botulism¹²

Botulism is a rare, paralytic illness caused by a nerve toxin produced by a certain type of bacteria. Often, botulism is foodborne. Because multiple persons can be poisoned by eating contaminated food and because botulism illness is severe, a single case is a public health emergency and is reportable in the United States.

In 2015, the largest botulism outbreak in the United States since 1977 occurred in Ohio. It began on April 21, 2015, when a hospital in Fairfield suspected a patient as having botulism. The hospital notified the local and state health department of the patient suspected of having botulism. Within two hours, four more patients with botulism-like signs and symptoms were reported. Later that afternoon, one patient died of respiratory failure shortly after arriving at the emergency department. All affected persons had eaten at the same widely-attended church potluck meal on April 19.

The health department requested help from CDC disease detectives to confirm the diagnosis, identify and treat additional patients, and determine the source.

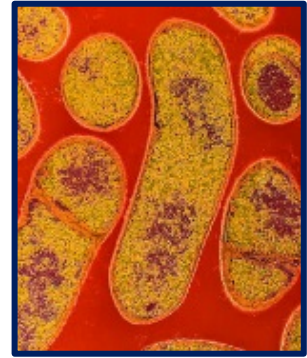


Figure 1. Clostridium botulinum bacteria.

___ 11. (1 point) In epidemiology, the interaction of three elements are assessed before developing control measures. This is often called the epidemiologic triad. **What is the name of the missing element in the adjacent diagram?**

- A. Microorganism.
- B. Pathogen.
- C. Environment. (Answer)**
- D. Disease.



___ 12. (1 point) In this scenario, the agent or pathogen is called *Clostridium botulinum*. In biology, this organism would be classified in the kingdom *Bacteria*. **Which kingdom does not include pathogens?**

- A. Protista.
- B. Fungi.
- C. Plants. (Answer)**
- D. Animals.

___ 13. (1 point) In a chain of infection, the agent starts in a reservoir and is transferred by a mode of transmission to infect a susceptible host. Foodborne botulism is an illness that usually results from the ingestion of a neurotoxin produced by the bacteria *C. botulinum*. **What is the mode of transmission for botulism?**

- A. Airborne.
- B. Droplet spread.
- C. Vector-borne.
- D. Vehicle-borne. (Answer)**
- E. Direct contact.

¹² This scenario is based on an outbreak of botulism in Ohio, 2015 presented in the following Morbidity and Mortality Weekly Report: <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6429a6.htm>.

- ___14. (1 point) When CDC disease detectives were contacted, botulism was suspected in five patients at the hospital, signaling an outbreak. One of the epidemiologists' first tasks was to construct a case definition. **A case definition includes which of the following information?** (Choose the best answer.)
- A. Clinical criteria, such as signs and symptoms.
 - B. Clinical criteria limited by person, place, and time. (Answer)**
 - C. Attendance at the church potluck.
 - D. Descriptive epidemiology.
- ___15. (2 points) Of the 29 patients who met the case definition, 25 persons were confirmed cases and four were probable cases. **Which of the following would be part of the case definition for a confirmed case, but not for a probable case?**
- A. A laboratory test positive for botulism. (Answer)**
 - B. One sign of botulism.
 - C. One sign and one symptom of botulism.
 - D. Attended the church potluck.
- ___16. (2 points) In this outbreak, only one person died. **What was the case-fatality rate?**
- A. 3.4%. (Answer: $1 \div 29 = 3.4\%$)**
 - B. 13.8%.
 - C. 28%.
 - D. 86.2%.
- ___17. (2 points) Twenty-seven of 29 patients were interviewed. CDC disease detectives also interviewed 44 persons who attended the church potluck and four persons who ate leftovers from the potluck and were not sick. **Why did they attempt to interview all attendees (n = 77) of the potluck?**
- A. To determine risk factors by comparing information from those who were sick with those who were not sick.
 - B. To identify which foods those who were sick ingested, compared with those who were not sick.
 - C. To identify additional cases.
 - D. All of the above. (Answer)**
- ___18. (2 points) During the interview, 75 of the 77 attendees of the church potluck were asked 55 questions about specific foods eaten, foods brought to the potluck, as well as demographic information. **Because all persons attending the potluck were asked to participate, what is this study considered?**
- A. Case-control study.
 - B. Cross-sectional study.
 - C. Cohort study. (Answer)**
 - D. Ecological study.
- ___19. (2 points) **What was the overall attack rate among those who ate potluck food?**
- A. 3.4%.
 - B. 36.0%.
 - C. 37.6%. (Answer: $29 \text{ sick persons} \div 77 \text{ attendees} = 37.6\%$)**
 - D. 38.6%.

20. (11 points) A total of 52 food items were available at the potluck dinner. CDC disease detectives calculated attack rates for all food items. By using the information provided in the table, calculate the attack rates for homemade potato salad, purchased potato salad, and macaroni and cheese. **Show your work in the space provided below the table. Write your final answers in the following table in the right-hand column.**

	Number of sick persons who ate this food	Number of sick persons who did not eat this food	Number of not sick persons who ate this food	Number of not sick persons who did not eat this food	Attack Rate (Sick)
Homemade potato salad	25	2	14	34	0.64 (Answer)
Purchased potato salad	10	17	8	40	0.56 (Answer)
Macaroni and cheese	11	16	18	30	0.38 (Answer)

Show your work.

Attack rate formula (2 points)

Answer: The number of sick persons who ate the food ÷ number of persons who ate the food.

Attack rates (9 points total)

(a) Homemade potato salad (3 points)

Answer: $25 \div (25 + 14) = 0.64$ or 64%.

(b) Purchased potato salad (3 points):

Answer: $10 \div (10 + 8) = 0.56$ or 56%.

(c) Macaroni and cheese (3 points):

Answer: $11 \div (11 + 18) = 0.38$ or 38%.

- ___21. (3 points) The disease detectives then identified which food had the highest association with illness by calculating the risk ratio for each food. **Choose the correct risk ratios for homemade potato salad, purchased potato salad, and macaroni and cheese.**

A. (Answer)

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	11.5	1.86	1.09

B.

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	0.08	0.53	0.92

C.

	Homemade potato salad	Purchased potato salad	Macaroni and cheese
Risk ratio	3.17	2.22	1.09

- ___22. (2 points) Food samples were collected from plates in the church dumpster. Potato salad samples and macaroni and cheese samples were taken from 12 plates. Six tested positive for botulinum neurotoxin. Of those six, five of the plates contained potato salad and one contained macaroni and cheese. **Why did disease detectives collect and test samples from the dumpster?**
- A. To collect samples of the botulism neurotoxin for antitoxin development.
 - B. To confirm the epidemiologic findings with environmental studies. (Answer)**
 - C. To identify patterns in the food eaten by comparing plates found.
 - D. To determine the validity of the survey.
- ___23. (1 point) CDC's Strategic National Stockpile sent 50 doses of botulinum antitoxin to Ohio. Twenty-five patients received the antitoxin. **What is an antitoxin?**
- A. A vaccine.
 - B. An antibody. (Answer)**
 - C. A toxoid.

Scenario 2: Dengue¹³

On October 21, 2015, the Hawaii Department of Health (HDOH) was notified of a confirmed case of dengue fever. The patient had no history of travel outside Hawaii Island (also known as the Big Island), and other family members reported having similar signs and symptoms. These consisted of sudden onset of fever, severe headaches, eye, joint, and muscle pain, and rash.

On October 24, HDOH received a surveillance report of multiple persons with similar, dengue-like symptoms among a group of visitors from mainland U.S. who had traveled together on Hawaii Island. On October 27, HDOH was also notified of a person who was on Hawaii Island, without any connection to the group of visitors from mainland U.S., and had a positive dengue immunoglobulin M (IgM) test. An IgM is a type of antibody that usually appears for a limited time after infection. Detection of dengue IgM antibody test tells us that the person may have had a recent dengue virus infection.

- ___24. (1 point) **What is the definition of surveillance?**
- A. The ongoing, systematic collection analysis, interpretation, and dissemination of health data to help guide public health decision making and action. (Answer)**
 - B. The aspect of epidemiology that focuses on person, place, and time.
 - C. The study of the distribution and determinants of health conditions or events among populations and the application of that study to control health problems.
 - D. The aspect of epidemiology concerned with why and how a health problem occurs.
- ___25. (1 point) **Which of the following determines what type of surveillance is used**
- A. The type of information that is collected.
 - B. The source of information that is collected.
 - C. How the information is analyzed.
 - D. How the information is collected. (Answer)**
- ___26. (1 point) **What type of surveillance is used for dengue fever in this example?**
- A. Active surveillance.
 - B. Passive surveillance. (Answer)**
 - C. Syndromic surveillance.

On October 29, an investigation started. Epidemiologists interviewed each patient to identify where their exposure might have been, signs and symptoms, and the onset of disease. This information is given to a laboratorian to conduct laboratory testing. Because dengue fever is spread by mosquitoes, the information is also given to vector control specialists, who assess local mosquito populations and institute control measures if necessary.

- ___27. (1 point) **What is the mode of transmission for dengue fever?**
- A. Airborne.
 - B. Droplet spread.
 - C. Vector-borne. (Answer)**
 - D. Vehicle-borne.

¹³ This scenario is based on an outbreak of locally acquired cases of Dengue Fever in Hawaii, 2015 presented in the following Morbidity and Mortality Weekly Report:

<http://www.cdc.gov/mmwr/volumes/65/wr/mm6502a4.htm>.

- ___28. (1 point) **What term is used to describe an infectious disease that is transmissible from animals to humans?**
- A. Animal-borne.
 - B. Zoonotic. (Answer)**
 - C. Arbovirus.
 - D. Viral disease.
- ___29. (1 point) Laboratorians used a rapid diagnostic test (RDT) to confirm cases of dengue fever. During the first five days after onset of symptoms, a polymerase chain reaction (PCR) test can be used to confirm a diagnosis of dengue fever. After five or more days, an enzyme-linked immunosorbent assays (ELISA) test can be used to confirm a diagnosis of dengue fever.¹⁴ **What does a PCR test identify?**
- A. The presence of an antibody signaling immune system's immediate response to dengue virus.
 - B. The presence of an antibody signaling immune system's long-term protection against the dengue virus.
 - C. The presence of genetic material of the dengue virus. (Answer)**
 - D. Both answers A and B are correct.

Figure 2 shows, as of November 26, 2015, HDOH had identified 107 laboratory-confirmed cases of dengue fever, with symptom onset ranging from September 11–November 18, 2015.

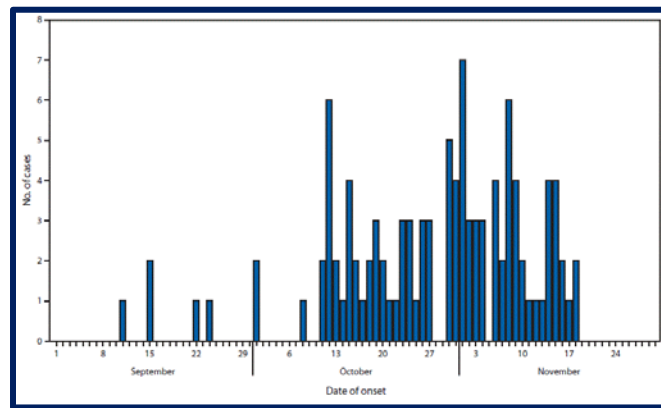


Figure 2. Number of laboratory-confirmed cases (N = 107) of dengue fever, by date of onset — Hawaii Island, September 11–November 18, 2015.
Source: <http://www.cdc.gov/mmwr/volumes/65/wr/mm6502a4.htm>.

- ___30. (1 point) The outbreak is visually described by Figure 2 (above). **What is the common name of this figure in epidemiology?**
- A. Outbreak curve.
 - B. Epidemic curve. (Answer)**
 - C. Bar graph.
 - D. Epidemiology graph.
- ___31. (1 point) **What type of outbreak is most likely represented in Figure 2?**
- A. Continuous common source outbreak.
 - B. Intermittent common source outbreak.
 - C. Propagated outbreak. (Answer)**

¹⁴ Learn more about laboratory guidance and diagnostic testing for dengue at: <http://www.cdc.gov/dengue/clinlab/laboratory>

As of January 20, 2016, a total of 977 RDT tests were ordered, but only 224 (23%) were laboratory-positive cases of dengue fever. HDOH was concerned about false negatives (i.e., persons who were infected, but had a negative laboratory test).

HDOH asked CDC disease detectives to determine RDT validity, against the standard test used to diagnose dengue. The standard test during the first five days after onset of symptoms is a polymerase chain reaction (PCR) test. The standard test after five or more days is an enzyme-linked immunosorbent assay (ELISA) test. For the activity, please note that we will use the term “standard test” to represent the appropriate test according to onset of symptoms.

HDOH sent samples from all 977 cases to CDC’s Dengue Branch for testing. Results were as follows.

RDT	Standard Test		Total
	Positive	Negative	
Positive	203	21	224
Negative	16	737	753
Totals			977

32. (4 points) **Calculate RDT sensitivity.** For full credit, include the formula (1 point), the formula with the correct values entered (1 point), and the answer (2 points).

Answer: Sensitivity

$$\begin{aligned}
 &= \text{Number of true positives} \div (\text{number of true positives} + \text{number of false negatives}) \\
 &= 203 \div (203 + 16) \\
 &= 92.7\%
 \end{aligned}$$

___ 33. (1 point) **Choose the best interpretation of your answer for sensitivity.**

- A. The percentage of those that tested **negative** with the standard test who also tested **negative** by using RDT, or the percentage of **noncases** RDT correctly identified.
- B. The percentage of those that tested positive by the standard test who also tested positive using RDT, or the percentage of cases RDT correctly identified. (Answer)**
- C. The percentage of those that tested **negative** by using RDT who also tested **negative** with the standard test, or the percentage of **cases** RDT correctly identified.
- D. The percentage of those that tested **positive** by using RDT who also tested **positive** with the standard test, or the percentage of **noncases** RDT correctly identified.

34. (4 points) **Calculate the specificity of RDT.** For full credit, include the formula (1 point), the formula with the correct values entered (1 point), and the answer (2 points).

Answer: Specificity

$$\begin{aligned}
 &= \text{Number of true negatives} \div (\text{number of true negatives} + \text{number of false positives}) \\
 &= 737 \div (737 + 21) \\
 &= 97.2\%
 \end{aligned}$$

- ___35. (1 point) **Choose the best interpretation of your answer for specificity?**
- A. The percentage of those that tested negative with the standard test who also tested negative by using RDT, or the percentage of noncases RDT correctly identified. (Answer)**
 - B. The percentage of those that tested positive by the standard test who also tested positive using RDT, or the percentage of cases RDT correctly identified.
 - C. The percentage of those that tested **negative** by using RDT who also tested **negative** with the standard test or the percentage of **cases** RDT correctly identified.
 - D. The percentage of those who tested **positive** by using RDT who also tested **positive** with the standard test or the percentage of **noncases** RDT correctly identified.
- ___36. (1 point) **Based on your calculations, would you recommend that HDOH continue using the same RDT to confirm cases of dengue?** Choose the best answer.
- A. Yes, the sensitivity is high; therefore, HDOH can be confident in the RDT positive results.
 - B. Yes, the sensitivity and specificity are high; therefore, HDOH can be confident in both positive and negative RDT results. (Answer)**
 - C. No, the specificity is higher than the sensitivity; therefore HDOH cannot be confident in the RDT positive results.
 - D. No, the sensitivity is higher than the specificity; therefore HDOH cannot be confident in the RDT negative results.
- ___37. (1 point) There were additional reports of probable cases. A probable dengue case occurs when someone reports signs and symptoms consistent with the case definition for dengue, but did not have confirmatory laboratory testing. **What action might you recommend to reduce the number of probable cases compared to the number of confirmed cases?** Choose the best answer.
- A. Adjust the case definition for dengue to be more specific to dengue symptoms.
 - B. Conduct an epidemiologic study among probable cases that tested negative to the RDT test to determine an alternative potential cause of illness that can be used to differentiate between dengue cases and non-dengue cases.
 - C. Answers A and B. (Answer)**
 - D. None of the above.

HDOH epidemiologists and CDC Disease Detectives interviewed each of the 224 patients with RDT-confirmed illness. On the basis of these interviews, they created a map that was based on the number of confirmed cases with recent onset dates. Places with a high number of cases are considered high risk and places with no cases are considered low risk.

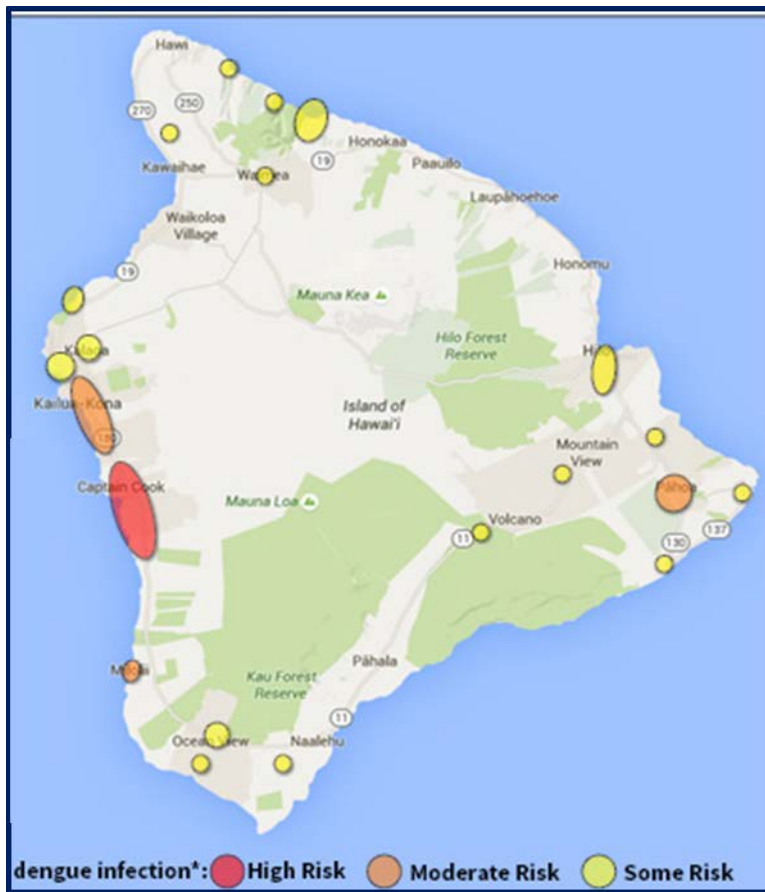


Figure 3. A map of Hawaii showing confirmed cases of dengue fever, September 11, 2015-January 20, 2016.
Source: <http://health.hawaii.gov/docd/dengue-outbreak-2015/>.

- ___38. (1 point) **What is the common name for this map in epidemiology?**
- A. Epidemic map.
 - B. Spot map. (Answer)**
 - C. Outbreak map.
 - D. Epidemiology map.
- ___39. (2 points) From the distribution of cases on the map, which of the following most likely influences the number of cases in a given area:
- A. Population density. (Answer)**
 - B. Latitude.
 - C. Average temperature.

___40. (3 points; 1 point each) Environmental specialists consider entomology (e.g., lifecycle) and ecology (e.g., habitat) when determining control measures, in this case for *Aedes* mosquitos carrying dengue. Mosquitos lay their eggs on the insides of containers with water, and eggs hatch into larvae after a rain or flooding. A larva changes into a pupa after approximately one week and into a mosquito two days later. Three methods are used to reduce the mosquito population, which in turn helps control dengue virus transmission.¹⁵

Match the following descriptions with the appropriate control method.

- A. Biological
- B. Chemical
- C. Environmental management

___**C**_____ Destroys, alters, removes, or recycles nonessential containers that provide egg, larval, or pupal habitats.

___**B**_____ Sprays larvicides and adulticides in the areas of risk.

___**A**_____ Introduces copepods or fish to prey on or eat mosquitos during early larval stages.

___41. (2 points) Controlling or eliminating mosquitoes that can carry dengue viruses is difficult because of adaptations to the environment that make mosquitos highly resilient, as in their ability to rapidly bounce back to initial population after natural control measures (e.g., droughts) or human-environmental control measures. One such adaptation is the ability of the eggs to withstand desiccation (drying) and to survive without water for multiple months on the inner walls of containers.¹⁶ **If environmental specialists were to eliminate all larvae, pupae, and adult mosquitos at once from a site, what would likely happen during the next rainfall?**

A. The mosquito population would be low or nonexistent, effectively controlling any dengue outbreaks.

B. A different species of mosquito population will emerge, which could cause another type of mosquito-borne outbreak.

C. The mosquito population would recover two weeks later as a result of egg hatching after rainfall or the addition of water to containers harboring eggs. (Answer)

___42. (2 points) You are asked to help develop health education materials to provide to persons and families who reside in an at-risk area. Name two environmental management control measures that individuals living in an at-risk area can take on their own and that can be promoted in health education materials.⁴

Answer: Score one point for one of the following and two points for any two:

- **Clothing** that minimizes skin exposure during daylight hours when *Aedes* mosquitoes are most active affords limited protection from the bites of the dengue vectors.
- **Repellents** can be applied to exposed skin or to clothing.
- **Mosquito nets** can provide protection for those who sleep during the day (e.g., infants).
- **Household fixtures** (e.g., window, door screens, or air conditioning) can also reduce biting.

¹⁵ Learn more about dengue control strategies at http://www.who.int/denguecontrol/control_strategies/en/.

¹⁶ Learn more about dengue entomology and ecology at <http://www.cdc.gov/dengue/entomologyEcology/>.

Scenario 3: Obesity¹⁷

In 2010, Guam Department of Public Health and Social Services (DPHSS) declared a state of regional health emergency because of an epidemic of obesity and noncommunicable disease. DPHSS developed a strategic plan to reverse the problem. In early 2015, Guam recognized that limited access to healthy food options might be contributing to the epidemic. To assess the nutritional environment, Guam requested CDC assistance.



Figure 4: World map with a red marker on Guam. Map courtesy of Google® maps.

The Youth Risk Behavior Surveillance System (YRBSS)¹⁸ and Behavior Risk Factor Surveillance System (BRFSS)¹⁹ monitor health-risk indicators (e.g., obesity) and behaviors (e.g., smoking, limited physical activity, and poor eating habits) that contribute to the leading causes of death and disability (e.g., noncommunicable disease) among youth and adults. Data from these surveillance systems were used to determine changes in obesity levels.

A high body mass index (BMI)²⁰ can be an indicator of high body fat, or obesity.²¹ It is calculated by using a person's weight and height. Among adults, a BMI of ≥ 30 is considered obese. Figure 5, below, is a trend graph from BRFSS that shows the percentage of adults by age group in Guam with a BMI of 30 and above.

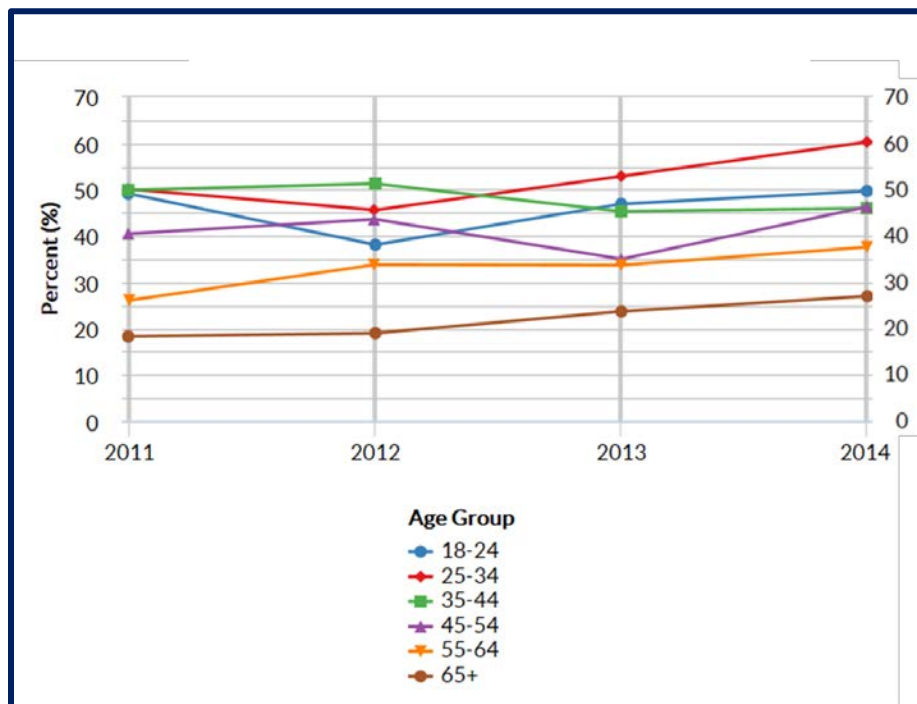


Figure 5: Percentage of adults who have obesity, by age group, Guam, 2011-2014. Data Source: Behavioral Risk Factor Surveillance System (BRFSS)

¹⁷ This scenario is based on a study of sodium in store and restaurant food environments — Guam, 2015 presented in the following Morbidity and Mortality Weekly Report: <http://www.cdc.gov/mmwr/volumes/65/wr/mm6520a2.htm>

¹⁸ Learn more about YRBSS at <http://www.cdc.gov/healthyyouth/data/yrbs/>.

¹⁹ Learn more about BRFSS at <http://www.cdc.gov/brfss/>.

²⁰ Learn more about BMI at <http://www.cdc.gov/healthyweight/assessing/bmi/>.

²¹ Learn more about obesity at <https://www.cdc.gov/obesity/>.

- ___43. (2 points) Using Figure 5, which age group of adults in Guam had the greatest percent increase in obesity from 2011 to 2014?
- A. 18–24.
 - B. 35–44.
 - C. 55–64. (Answer)**
 - D. 65+.
- ___44. (2 points) In 2013, 76.5% of high school students and 48.7% of adults from Guam also reported not meeting aerobic physical activity guidelines. Research indicates that regular physical activity helps improve your overall health and fitness, and reduces your risk for many chronic diseases. In fact, the more physically active you are, the lower your risk for many chronic disease becomes. **What is this type of relationship called?**
- A. Dose-response relationship.
 - B. Inverse dose-response relationship. (Answer)**
 - C. Association.
 - D. Causation.
- ___45. (1 point) The YRBSS and the BRFSS use surveys to collect data. Behavioral data is self-reported. A common problem with self-reported data is bias. A common type of bias found in obesity and physical activity data is social desirability. **Which type of bias is also common in self-reported data?**
- A. Selection bias.
 - B. Information bias.
 - C. Response bias.
 - D. Recall bias. (Answer)**
 - E. Attrition bias.
- ___46. (2 points) In 2015, CDC was asked to conduct a study to establish baseline information about the nutritional environment in Guam. CDC Disease Detectives designed a study by using the Nutrition Environment Measures Survey (NEMS). CDC Disease Detectives visited a random sample of food retail venues (grocery and convenience stores), restaurants, and produce markets to determine availability, pricing, and promotion of healthier food options, including low-sodium options in the retail and restaurant food environments. **What type of study design was used?**
- A. Ecological.
 - B. Cohort.
 - C. Cross-sectional. (Answer)**
 - D. Experimental.
- ___47. (1 point) CDC disease detectives asked retail and restaurant managers exploratory questions about their perceptions of the barriers and facilitators to providing healthier food options, including low-sodium options, in their establishments. **What is this part of the study considered to be?**
- A. Qualitative. (Answer)**
 - B. Quantitative.

Scenario 4. *Salmonella* in Cucumbers²²

From summer 2015 to March 16, 2016, a total of 907 persons infected with the outbreak strains of *Salmonella* Poona were reported across the United States. Figure 6 is a map that was generated to show the number of cases for each state. Use this figure to help you answer questions 48–49.

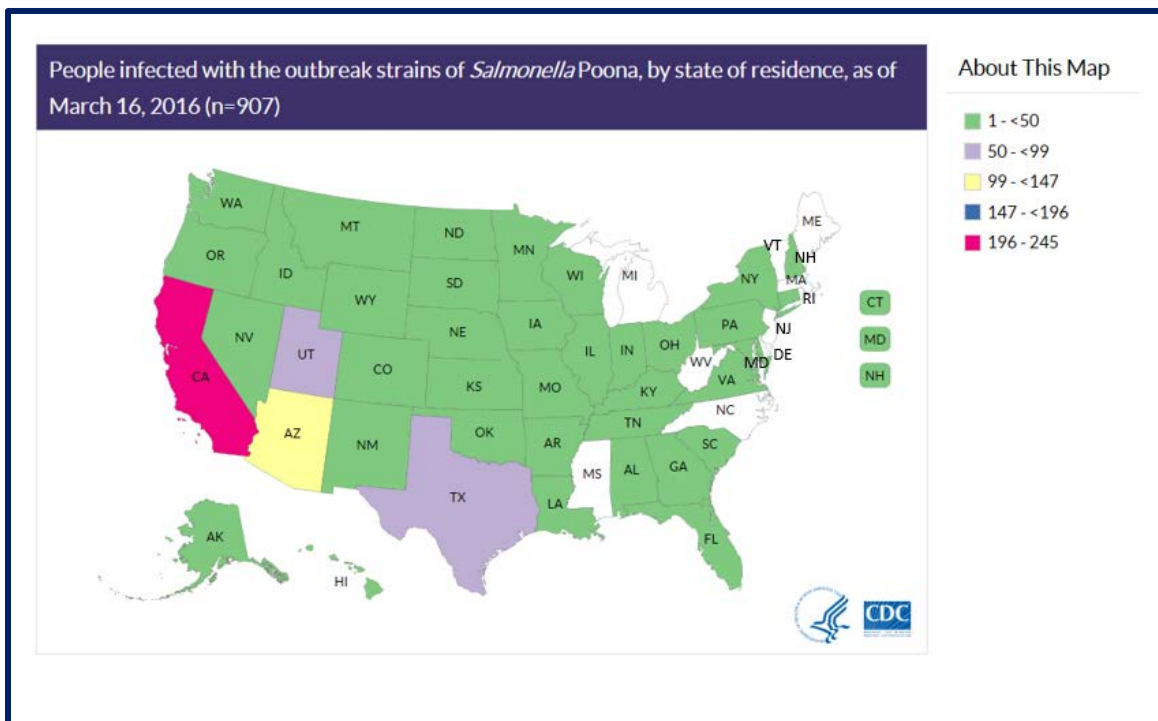


Figure 6. Persons infected with the outbreak strains of *Salmonella* Poona, by state of residence, as of March 16, 2016. Note that white (unshaded) states had 0 infected persons.

Source: CDC. Available at: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

___48. (2 points) **Which two states were the most affected?**

Answer: California and Arizona.

___49. (1 point) **How many states were unaffected?**

Answer: 10 states (Delaware, Maine, Massachusetts, Michigan, Mississippi, New Jersey, North Carolina, Rhode Island, Vermont, and West Virginia)

Several state health and agriculture departments collected and tested cucumbers from retail locations and isolated the outbreak strains of *Salmonella* Poona. Information indicated that these cucumbers were distributed by Andrew & Williamson Fresh Produce. Additionally, testing of cucumbers collected from the Andrew & Williamson Fresh Produce facility isolated the outbreak strains of *Salmonella* Poona.

On September 4, 2015, Andrew & Williamson Fresh Produce voluntarily recalled all cucumbers sold under the Limited Edition brand from August 1, 2015 through September 3, 2015 due to possible contamination with *Salmonella*. On September 11, 2015, Custom Produce Sales voluntarily recalled all cucumbers sold under the Fat Boy brand starting August 1, 2015 because Custom Produce Sales had purchased these cucumbers from Andrew & Williamson Fresh Produce.

²² This scenario is based on a multistate outbreak of *Salmonella* Poona infections linked to imported cucumbers: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

Figure 7 is a graph that was generated to show the timeline of the outbreak. Use this figure to help you answer questions 50–51.

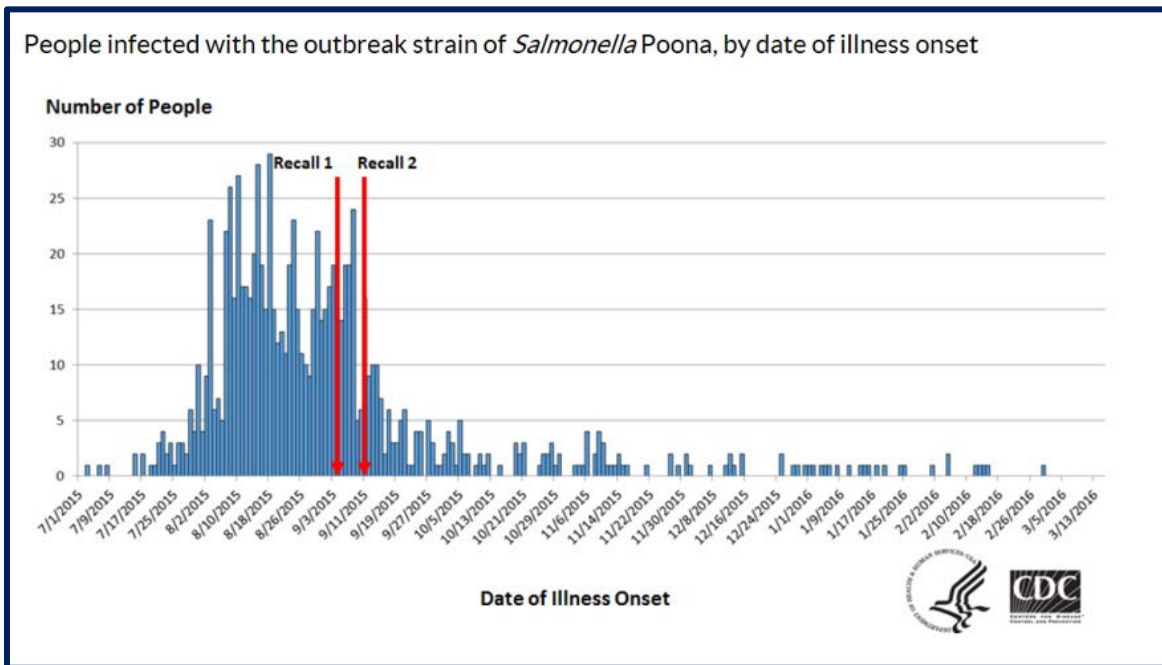


Figure 7. Persons infected with the outbreak strains of *Salmonella* Poona, by date of illness onset. **Source:** CDC. Available at: <http://www.cdc.gov/salmonella/poona-09-15/index.html>.

___50. (1 point) **When was the first illness onset?**

- A. Before July 1, 2015
- B. July 3, 2015 (Answer)**
- C. August 2, 2015
- D. August 18, 2015

___51. A. (2 points) **Describe what happened to the number of cases (persons infected) immediately after the first recall but before the second recall. Explain why this occurred.**

Answer: The number of cases increased for a limited number of days and then decreased. This might have occurred because those who had consumed the cucumbers before the recall became sick (incubation period of *Salmonella*). It also might have occurred because cucumbers have a 2 week shelf life so, there may have been affected cucumbers sold before the recall or those remaining on the shelf under the Fat Boy label.

B. (2 points) **Describe what happened to the number of cases immediately after the second recall, through mid-November. Explain why this occurred.**

Answer: The number of cases steadily declined. This was likely attributable to the recall. However, the maintained higher than usual number of cases indicates cross-contamination might be a factor.

- ___52. (2 points) Despite the two recalls, a higher number of cases than expected were reported through mid-November. (Assume that all cucumbers in the initial outbreak were discarded either because of the recall or had rotted.) **Explain why this might have happened.**
Answer: The contamination source might still remain at the farm where the cucumbers were grown. Cross contamination with other food items during distribution might have occurred.
- ___53. (1 point) **Name at least one household control measure for those who may have purchased recalled cucumbers and have since discarded them accordingly.**
Answer: Wash and sanitize drawers or shelves in refrigerators where cucumbers were stored and wash reusable grocery bags.