

Disease Detectives

Columbia High School - Captain's Tryouts 2016

Answers will be recorded in the test booklet. Select questions will be used as tiebreakers. You will have 50 minutes to complete the test. Please write neatly.

Participant 1:

Participant 2:

Team Number:

Score: /100

Part 1

A local hospital has experienced a number of diarrheal illnesses in the past two weeks. Due to this shared symptom, a foodborne disease has been suspected. Despite the best efforts of the staff, patients already weakened from their prior conditions have contracted this illness, prolonging their stay. There have been no mortalities associated with the illness as of yet, but several patients are in critical condition with decreased urination and marked tiredness. The state has sent you to investigate this outbreak.

1. What are some characteristics of an outbreak? List three. [3pt]

2. What is the primary mode of transmission for foodborne illnesses? [1pt]

While receiving treatment, a few of the older patients develop symptoms of another disease.

3. What kind of infection do they have? [1pt]

As you prepare for your investigation, you get some preliminary reports on the outbreak. 46 people have had diarrhea in the past two weeks. Among these few, 43 have had bloody diarrhea, and 21 have had a mild fever. Notably, 27 of the cases are among children under the age 12. The hospital has preemptively restricted diets to hot meals, and it has implemented more rigorous monitoring of food preparation.

Stool samples from 12 randomly selected potential cases were taken and results have come in. 11 of the 12 stool samples contain Shiga toxins. The remaining sample contains no notable characteristics, and the patient has reported forgetting to take her lactase supplements.

4.
 - a. Based on the laboratory results, what bacterium is the cause of this outbreak? [1pt]

 - b. How do these results explain decreased urination and marked tiredness exhibited by some patients? [2pt]

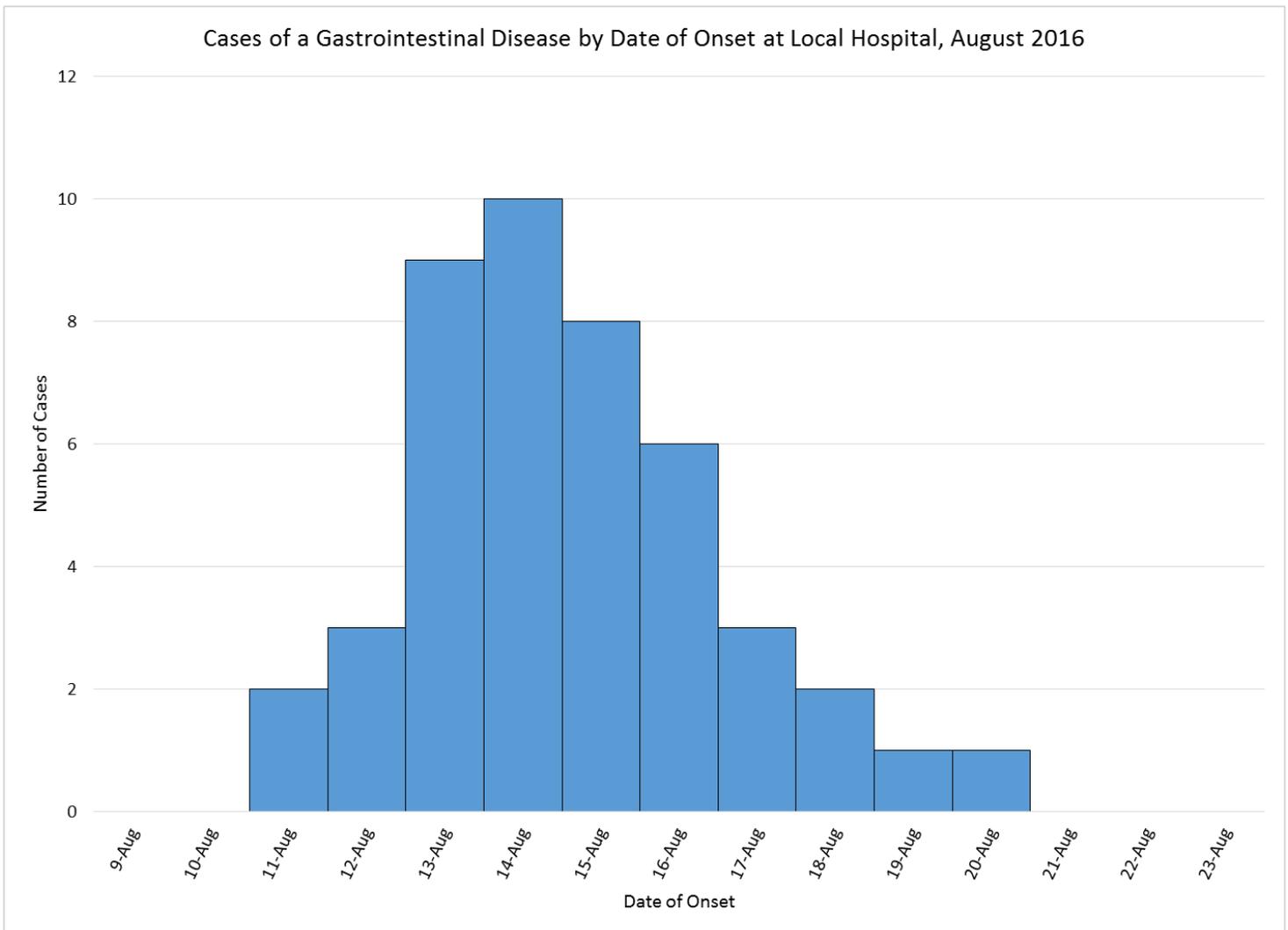
5. Create a case definition for this outbreak. [6pt]

Back at the hospital, you compile data on the date of onset among the ill patients and the diets of all patients that had resided within the past two weeks. Many of those afflicted are recovering, and the number of new cases is falling, but you still have to find the cause of this outbreak.

6. What type of study is being performed? [2pt]

7. List two advantages and two disadvantages of this kind of study. [4pt]

An epi curve of the outbreak is shown below.



You recall that this bacterium has an average incubation period of about 3-4 days, but it can last anywhere from 1 to 10 days.

8. Based on the epigraph, what is the most likely date of exposure? [2pt] (Tiebreaker #1)

9. What kind of outbreak is depicted by the epi curve? [1pt]

You pull up the meals consumed by the 134 patients on the date of the exposure. They are listed in the table shown here.

10. Calculate an appropriate measure of risk for each food item. Show your work below for at least one item. Round to two decimal places. [9pt]

Food Item	No. Ill	No. Not Ill	Risk
Beef Sandwich	26	32	
Pasta	5	19	
Tacos	14	38	
Salad	31	75	
Milk	18	31	
Apple Juice	27	58	
Cookies	30	82	

11.
 - a. What may have **contaminated** the food? List three sources. [3pt]

 - b. What actions could be taken to prevent future outbreaks? List two. [2pt]

12. If you resorted to surveying the patients themselves on what they had ate, what kind of error might be introduced? [1pt]

You contact supplier of the hospital's food to inform them of the potential contamination and order a recall. Although you have stopped the outbreak, there is concern that this strain was more pathogenic than typical of Shiga toxin-producing pathogens, especially among adults. While the state laboratory tries to serotype the bacterium, you've been asked to compare the mortality rate of this outbreak to one from 2015, a "typical" outbreak of a Shiga toxin-producing pathogen. The pertinent data is given below.

13. Fill out the blank columns and calculate the age-adjusted mortality rates. [12pt]

Age	Number of Case (2015)	Number of Deaths (2015)	Age-Specific Mortality Rate	Reference Population	Expected Number of Deaths
0-12	32	8		59	
13-25	48	5		53	
26-49	53	7		60	
50-75	75	10		77	
76+	62	17		66	
Total	270	47		315	

Age	Number of Case (Hospital)	Number of Deaths (Hospital)	Age-Specific Mortality Rate	Reference Population	Expected Number of Deaths
0-12	27	3		59	
13-25	5	1		53	
26-49	7	2		60	
50-75	2	0		77	
76+	4	2		66	
Total	45	8		315	

14. List two possible sources of error. [2pt]

15. What statistical technique could you use to determine whether there is significant difference in the age-adjusted rates? [1pt]

- Fischer's exact test
- T-test
- Chi-squared test
- Z-test
- McNemar test

Part 2

Botulism is a rare paralytic disease caused by the bacterium *Clostridium botulinum*. The bacteria release neurotoxins that cause flaccid paralysis. As such symptoms include muscle weakness, slurred speech, and blurred or double vision. If left untreated, paralysis of the respiratory muscles can lead to suffocation and death. Cases in adults are typically the result of improperly canned foods.

The Zika virus is a typically mild disease transmitted primarily by mosquitos. It can cause microcephaly and other birth defects in pregnant women, and it has been associated with Guillain-Barré syndrome. GBS is characterized by muscle weakness, and in severe cases it can affect the respiratory muscles, but it is usually not fatal. The number of reported cases has gone up as people travel abroad and the Zika virus begins to enter the continental United States.

You receive half a dozen reports and counting from hospitals of unusual muscle weakness consistent with botulism and GBS in the city of Denver. There have been no cases of death stemming from this condition, but you'll have to work quickly to determine the severity of the disease. You contact the state about this outbreak-in-progress and begin your investigation.

1. What's the difference between pathogenicity and virulence? [2pt]

2. A local newspaper ran the headline "ZIKA PANDEMIC IN DENVER." What's wrong with this? [1pt]

Botulism is generally difficult to diagnose due to the similarity of its symptoms with other diseases, including Guillain-Barré syndrome, stroke, and myasthenia gravis. While clusters of the latter two are rare, a high incident of GBS would be consistent with Zika virus infections. Usually, multiple tests are performed to rule out possibilities, and tests for Zika viruses are available, but they are time-consuming

You interview the now 24 patients along with 50 other people who had visited their doctor about their past exposures and day of onset (for the cases). You also have urine samples taken to test for Zika. Meanwhile, you analyze the results of your survey.

3. What cases may have been missed in your survey? List two groups. [2pt]

A portion of a line listing showing the afflicted patients is shown below.

Name	Visited Areas with Zika	Ate Factory Canned Food	Ate Home-Canned Food	Time of Onset	Age	Sex
John Moss	yes	no	no	1:15pm, 5/23	64	M
Raymond Garner	no	no	no	8:00am, 5/22	43	M
Brandy White	no	yes	yes	8:00am, 5/24	60	M
George Garrett	no	no	yes	1:00am, 5/24	73	M
Miranda Obrien	no	no	yes	3:30pm, 5/25	7	M
Percy Byrd	no	no	no	4:30pm, 5/24	70	M
Lora Wagner	no	yes	yes	7:45am, 5/25	47	F
Sandra Caldwell	yes	no	yes	10:00pm, 5/26	28	F
Courtney Hodges	no	no	yes	12:30pm, 5/24	74	F
Kelly Welch	no	yes	yes	9:00am, 5/25	34	F
Gail Abbott	yes	no	no	2:00pm, 5/23	68	M
Teri Gutierrez	no	no	yes	2:30pm, 5/25	44	F
Jackson Howard	no	no	yes	5:30pm, 5/25	27	M
Lucy Ryan	no	no	yes	7:30am, 5/26	30	F
Charles Adams	no	no	yes	7:30pm, 5/23	63	M
Viola Beck	yes	yes	no	7:30am, 5/23	23	F
Rickey Fuller	no	no	yes	9:00pm, 5/27	17	M
Santiago Mathis	no	yes	yes	5:00pm, 5/23	61	M
Elsa Joseph	no	no	yes	8:00pm, 5/24	59	F
Henrietta Mills	no	yes	yes	11:00am, 5/23	74	F
Lindsey Hamilton	no	yes	yes	11:30am, 5/25	69	F
Marianne Vargas	yes	no	yes	10:00am, 5/25	49	F
Joyce Bailey	no	no	yes	6:30am, 5/24	47	F
Robert Austin	no	no	yes	4:31pm, 5/24	35	M

4. Create an epigraph for the outbreak. [6pt]

5. Calculate an appropriate measure or risk for each potential exposure. Show your work below for at least one item. Round to two decimal places. [6pt] (Tiebreaker #3)

	Muscle Weakness	No Symptoms	Risk
Visited Areas with Local Zika Transmission	5	9	
Ate Commercially Canned Food	7	15	
Ate Home-Canned Food	19	8	
None of the Above	2	24	

6. Tables such as the one given are also known as ____? [1pt]
7. Name two possible bias that exist in this survey. [2pt]

As it turns out, an outbreak of botulism had occurred. Fortunately, due to the nature of botulism reservoirs, some phone calls to a few households ended the already dwindling outbreak.

8. What could be done to prevent future outbreaks? [1pt]

As your investigation draws to a close, one of your colleagues mentions a new screening test for detecting botulinum toxins in a patient. Intrigued, you decide to try it on the 74 people you surveyed earlier. The sensitivity of the test was 95.7%, while the specificity was 76.0%.

9. What are some of the criteria for an effective screening test? List two. [1pt]

10. Individuals who ate home-canned foods and have muscle weakness are considered infected for this survey. All others are considered not infected. If this classification misses some cases of botulism, what kind of error would this be? [1pt]

11.
 - a. What are some advantages of this screening test? List two. [2pt]

 - b. What are some disadvantages? List two. [2pt]

Part 3

1. Typhoid Mary was a cook who carried *Salmonella Typhi* in her digestive system. She didn't become ill, but those who ate her food developed typhoid fever.

How did she transmit Typhoid fever to others without showing any symptoms? [1pt]

2. Dengue, yellow fever, and Zika are a few of the viruses carried by the mosquitos of the genus *Aedes*. Commonly associated with the tropics, the diseases often lead to fever, and some can cause joint pain, muscle pain, or rash.

Viruses that are transmitted through mosquitoes are known as what type of virus? [1pt]

3. List three types of indirect transmission. [3pt]

4. What types of hepatitis are most commonly associated with contaminated food or water? [1pt]

5. What is the leading cause of death in the US? [1pt] (Tiebreaker #2)

6. List the four basic steps for preventing foodborne illnesses. [1pt]

7. List five different risk factors that may affect trends in population health. [2pt]

Write the correct word for each definition.

8. constant presence of a disease or condition in an area or population
9. a person who is contagious for a disease but does not show any symptoms
10. non-living thing that transmits an agent
11. the typical habitat of a disease-causing organism
12. brings together an infectious agent and a susceptible host
13. a map that marks where each case lived or worked
14. a route by which a pathogen can leave a host
15. resistance of a population to an infectious agent due to immunity in a large percentage of the population
16. living thing that transmits an agent
17. proportion of a specific group that becomes infected

You have reached the end of the test. Put the test back in order and ensure your team number is on every sheet before handing in your test.