



## Disease Detectives

**2018 Golden Gate Science Olympiad Invitational Disease Detectives Test**

**Time limit: 50 minutes**

Names: \_\_\_\_\_

Team Number: \_\_\_\_\_

School: \_\_\_\_\_

Score:     / 183

Rank:

- Point values are written next to each question
- Round all answers to 3 significant figures
- Show ALL WORK! Work will be graded and follow through points will be given!
- There are 2 parts of the test: General questions (multiple choice, short answer, and matching) and a case study
- Tiebreakers (in order used to break ties): 23 (case study), 16, 28 (case study), 18

**Multiple Choice (1pt each)**

1. Which is an example of cross contamination?
  - a) George got bitten by a dog, and because the dog was rabid, George ended up in the hospital with rabies.
  - b) Chicken and lettuce were being transported in a truck got mixed during the process; sadly, the chicken was infected with Salmonella and the contact caused the lettuce to become infected as well.
  - c) Sam had the flu, and after hanging out with Sally, Sally got the flu too.
  - d) A family on a farm killed a cow to make pork for dinner. They fed the scraps of their dinner to the pigs; however, that cow had Mad Cow Disease, and eventually the pigs ended up with a similar form of BSE.
  
2. Which of the following is a defining characteristic of an outbreak?
  - a) Spread of cases geographically
  - b) Mortality rate
  - c) Number of cases relative to normal frequency
  - d) Type of agent
  
3. Of the disease-location pairings below, which is an example of a disease that is hyperendemic to that area?
  - a) Malaria, Congo
  - b) Avian flu, China
  - c) Measles, USA
  - d) Cholera, England

From 4 to 8, determine whether the example is a pandemic, an epidemic, an outbreak or none of the above.

4. The Spanish flu of 1918
  - a) Pandemic
  - b) Epidemic
  - c) Outbreak
  - d) None of the above

5. Opioid drug usage in the US

- a) Pandemic
- b) Epidemic
- c) Outbreak
- d) None of the above

6. A couple of kids at school are sick with the flu

- a) Pandemic
- b) Epidemic
- c) Outbreak
- d) None of the above

7. The cake at a wedding was infected and many people at the wedding got sick.

- a) Pandemic
- b) Epidemic
- c) Outbreak
- d) None of the above

8. Unpasteurized milk was used to make a brand of ice cream that was distributed all over the US, causing people from multiple states to get Salmonella.

- a) Pandemic
- b) Epidemic
- c) Outbreak
- d) None of the above

9. Which term refers to the period time between time of exposure and onset of symptoms in a chronic disease is called

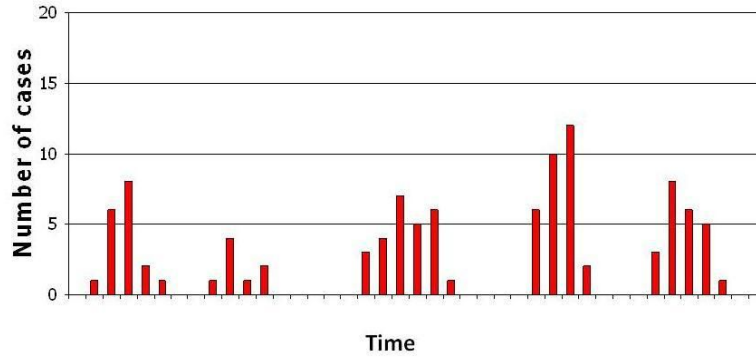
- a) Incubation period
- b) Latency period
- c) Prodromal stage
- d) Stage of susceptibility

10. The attack rate of a disease gives us information about what characteristic of the pathogen?
- a) Infectivity
  - b) Pathogenicity
  - c) Virulence
  - d) None of the above
11. What is an example of an iatrogenic infection?
- a) A brain surgery went wrong and resulted in a loss of speech function in the patient.
  - b) A health worker ends up getting infected by ebola due to their increased amounts of exposure the disease in their patients.
  - c) A patient with lung cancer ends up getting a skin infection due to their long stay in the hospital.
  - d) A doctor prescribes immunosuppressants for a patient with an autoimmune disease, but as a result the patient became more susceptible and caught pneumonia.
12. Approximately how many cases of foodborne illness occur in the US every year?
- a) 500, 000
  - b) 2 million
  - c) 17 million
  - d) 48 million
13. Which pathogen causes the most number of foodborne illness cases per year?
- a) Salmonella
  - b) E. coli
  - c) Norovirus
  - d) Trichinellosis
14. Which disease would be treated with antibiotics?
- a) Brucella
  - b) Botulism
  - c) Cryptosporidiosis
  - d) Rotavirus

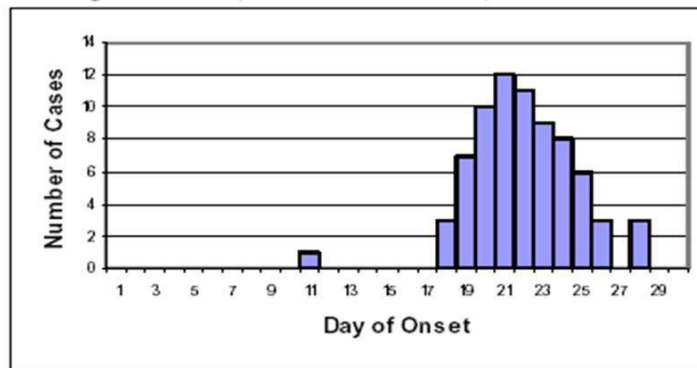
**Short Answer**

15) Determine whether the given scenarios or the given graphs represent a point, intermittent, continuous, or propagated source outbreak(s). (2 pts each)

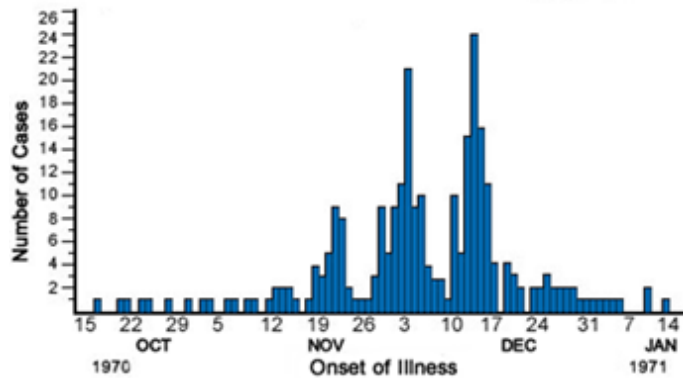
a.



b.



c.



- d. The measles outbreak in Southern California in 2014.
- e. The cholera outbreak studied by John Snow.
- f. Yearly influenza outbreaks in the United States.

16) In each scenario, identify one potential bias that could influence the results of the study.

Be specific as possible. (2 pts each)

- a. A cohort study enrolled 5,000 women to examine the effect of fat consumption on risk of coronary heart disease.
- b. A local public health agency interviewed patients at a local hospital to determine if there is a correlation between alcoholism and pneumonia.
- c. In a cohort study on the effects of smoking on risk of lung cancer, almost 40% of the participants stopped responding to surveys after 5 years.
- d. A cohort study was done on traumatic accidents among construction workers; the comparison group was taken randomly from the general population.
- e. A survey was taken among high school students on their smoking habits to be used for the new anti-smoking program at the school.

17) Briefly explain the difference between endotoxins and exotoxins, specifically in relation to bacteria. Which one causes the more severe disease? (3 pts)

18) Is it always safe to eat contaminated food if you heat it up enough? Why or why not? (3 pts)

## Matching

In the following section, match the disease with the type of agent and mode of transmission. If it's a foodborne illness, write in the specific name of the agent and a specific food it is transmitted by next to your matching answers. (1 pt for matching, 1 pt each for agent and food)

- |                   |   |                      |
|-------------------|---|----------------------|
| a) Bacteria       | · | Foodborne            |
| b) Virus          | · | Waterborne           |
| c) Protozoa       | · | Airborne/droplet     |
| d) Fungi          | · | Bloodborne           |
| e) Parasitic Worm | · | Vectorborne          |
| f) Prion          | · | Sexually transmitted |
|                   | · | Fomite               |

- 19) Anthrax
- 20) Paralytic Shellfish Poisoning
- 21) Chagas disease
- 22) Lassa fever
- 23) Amoebic dysentery
- 24) Rocky Mountain Spotted Fever
- 25) Histoplasmosis
- 26) Hemorrhagic colitis
- 27) Malaria
- 28) Hepatitis C
- 29) Cyclosporiasis
- 30) Syphilis
- 31) Salmonellosis
- 32) Tetanus
- 33) Cholera
- 34) Paragonimiasis
- 35) Trichinosis
- 36) Cryptosporidiosis

37) Botulism

38) Hepatitis A

### Case Study

In 2002, attention was called to several cases of listeriosis across multiple states, with an incidence much higher than the national average. Cases lasted from March 25 to October 26.

1. Not all incidents can be investigated due to limited resources. Give 3 reasons why this specific one should be investigated. (3 pts)

One part of determining if this is an outbreak is to verify the diagnosis of listeriosis. To do this, the CDC and FDA combined efforts to check lab screenings through PulseNet.

2. What is PulseNet? (3 pts)
3. How would you test for listeriosis? In other words, what culture would you need from the patient? (1 pt)
4. The table below shows data from a specific listeriosis screening test. Use the information to calculate the sensitivity, specificity, positive predictive value, and negative predictive value of this screening. (2 pts for each value)

	Test Positive	Test Negative
Disease	19	3
No Disease	6	16

5. Listeriosis can have serious consequences. Give 2 specific groups of people who can be seriously affected by this disease. (2 pts)
6. Given how fatal this disease can be, which would you rather have high sensitivity or high specificity? High positive predictive value or high negative predictive value? Explain. (5 pts)



Now that we have established the fact that we are dealing with an outbreak, the next step of the investigation is to define what we will consider as cases in this outbreak.

7. What are the 3 different tiers of case definitions? (3 pts)
8. Given answer to question 6, write an appropriate case definition. (5 pts)

According to our case definition, there was determined to be 22 cases. The table below shows the time of onsets and the number of cases for each.

3/27	4/15	4/17	4/24	6/11	6/16	6/24	7/3	7/10	7/23	8/7	8/20	8/29	8/30	9/2	9/21	9/30
1	1	1	1	2	1	1	1	1	2	1	2	1	1	1	2	2

9. Draw an epidemic curve for this data. (10 pts)
10. What is this kind of epidemiology called? (1 pt)
11. What is the incubation period of Listeriosis? (1 pt)
12. Use the incubation period to determine the earliest date of exposure in this outbreak. (2 pts)

After descriptive analysis, we need analytical studies to help us determine the cause of the outbreak. Given that the disease is listeriosis, soft cheeses were a big consideration. Investigators asked the cases and people from the general population whether or not they ate certain types of soft cheese during the time frame. The table below shows the collected data.

Type of Cheese	Disease		No Disease	
	Ate cheese	Didn't eat cheese	Ate cheese	Didn't eat cheese
Feta	11	11	21	19
Stilton	12	10	6	34
Brie	15	7	10	30
Mimolette	8	14	16	24
Ricotta	18	4	15	25

13. What measurement of risk do we use for this study? (1 pt)

14. Calculate the appropriate measurement of risk for this study for each cheese. (10 pt)
15. Interpret the risk measurement for ricotta cheese. (3 pts)
16. Which cheese(s) most likely caused this outbreak? (3 pts)
17. A disadvantage of this kind of study is that it's difficult to choose a control group, so investigators will often use family members and neighbors. Explain why this control group isn't necessarily the best representation of the entire population at risk. What effect would this have on the resulting risk analysis? (2 pts)
18. Explain why the other commonly used measurement of risk cannot be measured with this kind of study. (2 pts)
19. Getting accurate data was difficult in this case because people had a hard time remembering the exact kind of cheese they ate. This is an example of what kind of error? (1 pt)
20. Eventually, the investigators discovered the source of listeria was ricotta. Give an explanation for why there were other cheeses with high risk. (1 pt)

The steps of outbreak investigation don't always have to be followed in strict order. Now that we have strong evidence on what the source of the problem is, we can immediately begin to work on controlling it.

21. What is the most important thing to do at this point in the investigation in order to control the outbreak? (1 pt)

Although we have strong evidence that ricotta is the source of the outbreak, continued testing is needed to determine the statistical significance of the results of the analytical study.

22. Using the information given in the previous table, make a 2x2 contingency table for ricotta cheese only. (6 pts)
23. Perform a Chi square test to determine if the increased risk of listeriosis from eating ricotta is statistically significant at a 95% confidence level. Format test as a hypothesis test. (14 pts)

df	p value											
	0.25	0.2	0.15	0.1	0.05	0.025	0.02	0.01	0.005	0.0025	0.001	0.0005
	25%	20%	15%	10%	5%	2.5%	2%	1%	0.05%	0.025%	0.01%	0.005%
1	1.32	1.64	2.07	2.71	3.84	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.6	11.98	13.82	15.2
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.59	6.74	7.78	9.49	11.14	11.67	13.23	14.86	16.42	18.47	20
5	6.63	7.29	8.12	9.24	11.07	12.83	13.33	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.53	14.45	15.03	16.81	18.55	20.25	22.46	24.1
7	9.04	5.8	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02
8	10.22	11.03	12.03	13.36	15.51	17.53	18.17	20.09	21.95	23.77	26.12	27.87
9	11.39	12.24	13.29	14.68	16.92	19.02	19.63	21.67	23.59	25.46	27.83	29.67
10	12.55	13.44	14.53	15.99	18.31	20.48	21.16	23.21	25.19	27.11	29.59	31.42

Our study analysis made ricotta a focal point for investigators, and testing done on the cheese confirmed that one brand of ricotta, Fattorie Chiarappa, which is made in Italy but shipped to the US and distributed by Forever Cheese, Inc. in New York, had cultures of *Listeria monocytogenes*. The cheese was tested positive before it reached the distribution center.

24. Now confirmed cause, what stage in the food production chain did the soft cheese get infected? (1 pt)
25. Is this food poisoning or food intoxication? What's the difference? (3 pts)

The multistate listeriosis outbreak was finally declared to be over on December 26, but there is still more work to be done.

26. What is the minimum amount of time you need to wait until you can declare an outbreak over, and why? (2 pts)
27. What are the 4 most important steps to prevent foodborne illnesses? (4 pts)
28. Give 5 preventative measures you would ask your government to add/improve on in light of the findings of this outbreak. (5 pts)

**Multiple Choice**

- 1)\_\_\_\_\_ 2)\_\_\_\_\_ 3)\_\_\_\_\_ 4)\_\_\_\_\_ 5)\_\_\_\_\_ 6)\_\_\_\_\_ 7)\_\_\_\_\_ 8)\_\_\_\_\_
- 9)\_\_\_\_\_ 10)\_\_\_\_\_ 11)\_\_\_\_\_ 12)\_\_\_\_\_ 13)\_\_\_\_\_ 14)\_\_\_\_\_

**Short Answer**

- 15) a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- f. \_\_\_\_\_
- 16) a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- 17)

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## Matching

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## Case Study

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