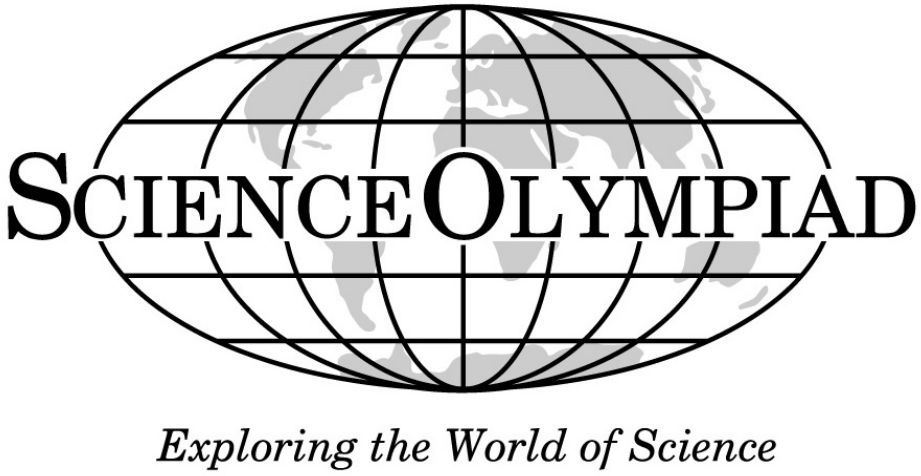
2018 University of Minnesota Science Olympiad Invitational

Disease Detectives



Event Notes

- 50 minutes are allowed. Stop precisely when the timer goes off.
- One 8.5x11" notesheet and 2 calculators dedicated to computation are permitted per team.
- Wrong answers are not penalized.
- **Work is required for all calculation questions. Show the formula used, the formula with numbers plugged in, and the final answer in a box (with units if appropriate).**
- Any rounding method is acceptable as long as graders can tell that the answer is accurate.
- You may take the test and/or answer packet apart to work on sections separately. Please make sure to get the exam in the correct order and stapled after time ends.
- Tiebreakers: highest score on the last section will be considered first, then highest score on the second last. If this fails, we will go backwards by question instead of by section.
- **This is a difficult test that only gets harder as the test goes on. Do your best, and do not be discouraged if you do not finish.**

Team Name: _____ Team Number: #___

Competitor Names: _____

Exam Questions: Remember to write your answers on the answer sheet provided.

Section I - Vocabulary

1. Fill each blank with an appropriate word/phrase from the table. Each word/phrase will be used once and only once. Each letter is worth 1 point.

Alternative hypothesis	Attributable proportion	CDC	Carrier	Cluster	Confounding
Cross-contamination	Determinants	Epidemic	Etiology	Fomite	Hyperendemic
Incidence	Incubation period	Index case	Morbidity	Mortality	Notifiable diseases
Null hypothesis	Outbreak	Pandemic	Prevalence	Quarantine	Risk
Surveillance	Vaccine	Vector	Vehicle	Virulence	Zoonosis

a. _____ is any departure from the state of good health OR the proportion of sickness or of a specific disease in a geographical locality.
b. A mosquito acts as a _____ for malaria.
c. A(n) _____ is a person or animal that has a disease but has no apparent symptoms, and can pass it to others. Typhoid Mary was one example.
d. An outbreak had a high case fatality rate. We could also say that the outbreak had a high rate of _____.
e. 100 cases of Salmonella were documented among people who ate lettuce from a certain store, 2 of which were caused by lettuce itself. The _____ for the lettuce is rather low.
f. A(n) _____ is an infectious disease that is transmissible from animals to humans (technically from any species to any species).
g. A(n) _____ is a physical object that serves to transmit an infectious agent from person to person.
h. A(n) _____ is a biological preparation that provides acquired active immunity to a particular disease.
i. We describe a disease that is present in a constant high rate as _____.
j. Examples of possible _____ include infections, change in workout routine, and change in diet or location.
k. We are investigating an outbreak and suspect that contaminated meat might be the cause. "The contaminated meat caused the outbreak" is our (not very formal!) _____.
l. "The _____ works 24/7 to protect America from health, safety, and security threats, both foreign and domestic. Whether diseases start at home or abroad, are chronic or acute, curable or preventable, human error or deliberate attack, they fight disease and support communities and citizens to do the same."
m. _____ is the process by which bacteria or other microorganisms are unintentionally transferred from one surface or substance to another with a harmful effect.

n. _____ is when there are more cases of a particular disease than expected in a given area or among a specialized group over a particular period of time.
o. _____ is the percentage of existing cases in the population.
p. The federal government's health agency gets some of its _____ information from via mandatory reports from healthcare providers.
q. _____ is when large numbers of people over a wide geographic area are affected.
r. _____ is an epidemic occurring over a very wide area (several countries or continents) and usually affects a large proportion of the population.
s. Healthcare providers are required to report cases of _____ to local governments, which in turn send the reports to national government agencies.
t. We learned that HIV originated in the Democratic Republic of the Congo through the scientific study called _____.
u. _____ is an object that may indirectly transit an infectious agent from a reservoir to a host.
v. _____ is the probability that an individual will be affected by, or die from, an illness or injury within a stated time or age span.
w. _____ separates well people from those who may have been exposed with a communicable disease. The purpose of this is to prevent possible transmission and to monitor for the disease.
x. _____ is an aggregation of cases over a particular period that is closely grouped in time and space, regardless of whether the number is more than the expected number.
y. _____ is the number of new cases in a fixed time period.
z. _____ is the severity of a disease.
aa. Unless proven otherwise, we assume the _____ is true.
bb. _____ is also known as the "mixing" of variables.
cc. _____ is the time between exposure and the onset of disease symptoms.
dd. _____ is the first known case of a disease in an outbreak.

Section II - General Epidemiology

2. Match each step in investigating an outbreak to the description that fits it. (1 point each)

a. Evaluate hypotheses epidemiologically	1. Creates a testable explanation for an outbreak
b. Implement control and prevention measures	2. Arranging travel would be a part of this
c. Find cases systematically and record information	3. Ensuring there were no errors made in identifying the disease causing the outbreak.
d. Reconsider, refine, and re-evaluate hypotheses	4. Involves creating a line listing.
e. Construct a working case definition	5. Determines how plausible our explanation for an outbreak is using analytic epidemiology
f. Prepare for field work	6. Often confirms or explains findings made earlier in the outbreak.
g. Develop hypotheses	7. This step will allow us to categorize people as suspected, probable, or confirmed cases
h. Perform descriptive epidemiology	8. Helps us determine whether or not control measures implemented worked
i. Verify the diagnosis	9. Performed if analytic data is unrevealing
j. Establish the existence of an outbreak	10. Directly breaks a disease's chain of transmission
k. Communicate findings	11. Requires knowledge of expected number of cases
l. Initiate or maintain surveillance	12. Oral briefing and written report are made
m. Compare and reconcile with laboratory and environmental studies	13. This step is concerned with the "time-place-person" triad

3. Answer the following questions about study design and data collection.
    a. Name one advantage and one disadvantage in performing a case-control study. (2 points)
    b. What type of surveillance occurs without an active search for cases? (1 point)
    c. Suppose we want to do a study on the rabies virus. Name a type of study which would definitely be unethical. Name 2 other drawbacks to this type of study. (3 points)
    d. Which type of study uses relative risk? (1 point)
4. Mark each of the following statements as true or false. If the statement is false, correct the statement or explain why it is false. (2 points each. If the answer is true then 2 points for answering true. If the answer is false then 1 point for answering false and 1 point for a proper explanation.)
    a. Odds ratio is a measure of risk used in case-control studies.
    b. In cohort study, both groups have a known exposure and are checked for future outcomes.

c. Radiation is an example of a chemical agent.
d. Hypotheses formed during an investigation should be revisited, but it is not formally part of the steps to investigating an outbreak.
e. Olivia eats a bag of cheese and gets sick. In this case, the cheese represents the agent of the epidemiologic triad.
f. Clinical epidemiology is population-oriented.
g. Increasing a study's sample size will reduce random error, but not systematic error.
h. A epi-curve depicting a propagated outbreak will likely have multiple peaks.
i. A team of epidemiologists will always prepare for field work after establishing the existence of an outbreak.
j. We classify a case of a disease as confirmed if and only if it meets the clinical case definition and is epidemiologically linked to a confirmed case.

Section III - Case Study

The date is April 24, 2030. You are now the head of the local public health department. You are pacing around in your office one day after just solving a recent Salmonella outbreak when you hear an urgent phone call from the University of John Snow, where Science Olympiad Nationals is taking place: “Many people have suddenly fallen ill since the 23th! This is extremely unexpected, and we had to summon extra nurses and doctors to our hospital.”

“What symptoms do they have? What are the patients’ diagnoses?” You ask. The caller says that they will teleport the patients’ information over to you immediately, then hang up.

Your first reaction is that it’s another case of Salmonella: a very common food borne illness. After all, the last few outbreaks you solved all were cases of Salmonella, and you are wonder why someone hadn’t already come up with a vaccine for it. However, before you can hypothesize further, you get another call: “I’m sorry for that abrupt call. I’m the activity director of the tournament. 15 people are sick with severe dehydration, so I was extremely concerned and called you.”

1. Determine whether or not this situation can be considered an outbreak by referencing what the caller said. (2 points)

2. Can we reasonably assume that Salmonella is the agent responsible for the situation? Justify your answer. (2 points)

3. Write a suitable case definition. (4 points)

You do some background research on the situation, and found that approximately 2850 people are at the university.

4. Calculate the prevalence and incidence of this outbreak, if possible; if not, explain why (6 points)

5. Which of the steps to investigating an outbreak did you just perform by researching the situation? (1 point)

With the information the hospital gives you, you decide to make a chart.

Information about confirmation: Diagnosis may be made by rapid detection of norovirus antigen in stool specimens. Strains may be further characterized by enzyme immunoassay or reverse transcriptase polymerase chain reaction, but such testing is not commonly done.

ID#	Initials	Age	Gender	Date of Onset	Diagnosis	Confirmation
1	RS	11	Male	4/23/2030	Probable norovirus	Not done
2	OC	15	Female	4/23/2030	Probable norovirus	Not done
3	EF	14	Male	4/23/2030	Norovirus	Stool sample
4	AN	12	Male	4/23/2030	Probable norovirus	Not done
5	SZ	15	Female	4/23/2030	Norovirus	Enzyme immunoassay
6	YM	62	Male	4/24/2030	Probable norovirus	Not done
7	HH	38	Female	4/24/2030	Probable norovirus	Not done
8	EF	18	Female	4/24/2030	Probable norovirus	Not done
9	BG	26	Male	4/24/2030	Norovirus	Reverse transcriptase polymerase chain reaction
10	BL	14	Female	4/24/2030	Probable norovirus	Not done
11	HB	13	Male	4/24/2030	Probable norovirus	Not done
12	ZH	16	Male	4/24/2030	Probable norovirus	Not done
13	TY	48	Male	4/24/2030	Probable norovirus	Not done
14	NP	17	Female	4/24/2030	Norovirus	Stool sample
15	JL	16	Female	4/24/2030	Probable norovirus	Not done

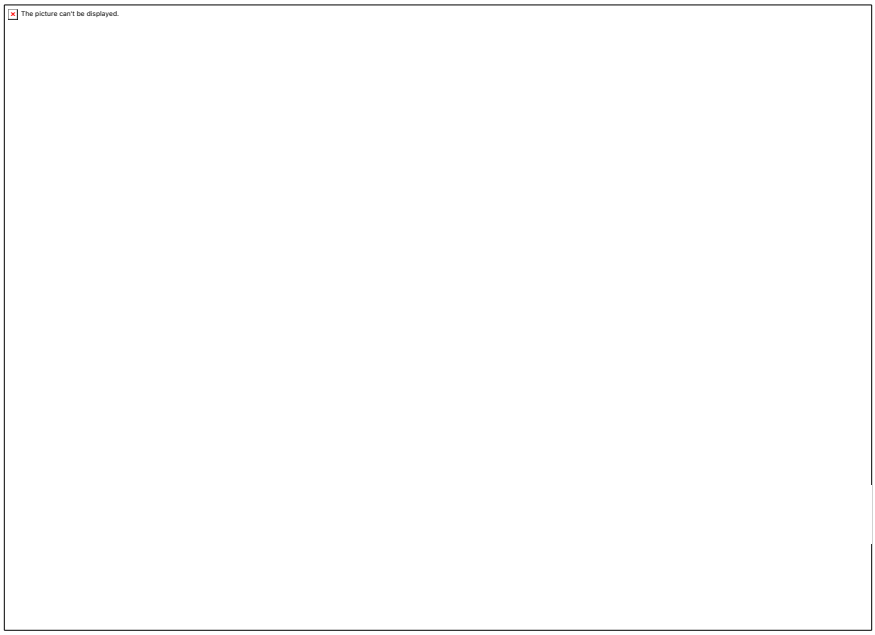
6. What is the chart above called formally? (1 point)

7. In this chart, there are probable diagnoses and confirmed diagnoses. There is one more category used to classify cases. What is it? (1 point)

8. Is this analytic or descriptive epidemiology? Justify your answer. What is a limitation of this type of epidemiology? (3 points)

9. Identify and explain the pattern in the ages of the cases. (2 points)

It has been 3 days since your investigation started. General measures have been made to control the outbreak, but you have not yet determined the exact cause. You also decide that you should organize all the information you have gathered to assess how the outbreak is progressing, and being an experienced epidemiologist, you are now a professional at making epi-curves. So, you made one:



10. It appears that an error resulted in the deletion of a critical element of an epi-curve. What is it? (1 point)

11. What type of epidemic is exhibited in this epi-curve? Is this typical of food-borne illness outbreaks? (2 points)

12. How well have the control measures taken improved the situation and how can you tell? (2 points)

In order to identify the specific cause of the outbreak, you need to perform an epidemiologic study. You suspect that two particular items at one of the cafeterias, the shellfish and the produce, may have caused the outbreak. Futuristic technology (remember, it's 2030) allows you to access a list of who ate each food. You then contact each person who ate at least one of the two foods to check if they meet the case definition or not. The results are shown below:

	Ate neither	Ate shellfish	Ate produce	Ate both
Diseased	5	27	1	28
Not diseased	2510	49	177	53

13. Which type of study is being carried out here? (1 point)
14. Make two 2 by 2 tables (one for shellfish, one for produce) representing the study results. (4 points)
15. Calculate the appropriate risk measure (either odds ratio or relative risk) for each suspected food. (5 points)
16. Analyze what your results from question 15 mean in context. (2 points)
17. Suppose only one item was responsible for the outbreak. How might the item not responsible still have a measure of risk above 1? (2 points)

You perform further research and find that the shellfish was sourced from contaminated waters. The cafeteria stops serving it, and no new cases occur.

18. When the cafeteria stops serving the shellfish, they are performing which step to Investigating an outbreak? (1 point)
19. A person who already ate the shellfish before their removal is concerned. They ask you if they are likely to get sick. Find the exact probability of them getting sick. What is this percent also called? (5 points)

Finally, you have solved this strange case of foodborne illness. It is time for you to recline and bask in glory - after you answer this last question.

20. You have to write a report summarizing the outbreak despite the fact that it is already over. Even though it is likely tiring, why do you have to do this? Identify 3 reasons. (3 points)

Congratulations on finishing! Good luck at your next events!

Credits: Test written by Arthur Nghiem, Eric Feng, and Sandy Zhang
Information about diagnosis of norovirus cases