

SEVEN LAKES HIGH SCHOOL

CAPTAINS EXCHANGE
DISEASE DETECTIVES 2018-2019

ANSWER KEY

Rules: always show work and keep answers in decimal form, unless otherwise told.

_____/201 points



Exploring the World of Science

Part 1: General Vocabulary and Knowledge

Hyperendemic disease: J	A. Time in between exposure to a pathogen and visible symptoms
Hypoendemic disease: N	B. General ability of a host to resist developing a particular disease
Latency period: F	C. Biological response to multiple substances where one substance worsens the effect of another substance
Incubation period: A	D. Increase in the occurrence of a disease in a large and geographically widespread population
Quarantine: R	E. Capacity to cause disease in a host
Isolation: G	F. Time in between exposure to a pathogen and infection
Immunity: B	G. Separation of ill persons to prevent transmission to the susceptible
Virulence: O	H. Sudden increase in occurrence of a disease above a normal level in a somewhat geographically widespread population
Pathogenicity: E	I. Illness acquired from a hospital setting
Infectivity: Q	J. Disease that is constantly present at a high incidence and/or prevalence rate
Nosocomial infection: I	K. Living organism that transmits disease
Synergistic effect: C	L. Periodic increases and decreases in the occurrence, interval, or frequency of disease
Vector: K	M. Non-living object that transmits infectious agent
Fomite: M	N. Disease that is constantly present at a low incidence or prevalence and affects a small proportion of individuals in a population
Epidemic: H	O. Severity of disease that agent brings to host
Outbreak: P	P. Sudden increase in occurrences of a disease in a particular place
Pandemic: D	Q. Measure of ability of pathogen to establish itself in a host
Seasonal trend: L	R. The separation of well people who have been exposed to a pathogen or are suspected of being exposed

1. Define surveillance, and name and define 3 types. (4 points)
 - Surveillance: systematic ongoing collection, analysis, interpretation, and dissemination of health data used to gain knowledge of patterns of disease and injuryPossible answers include:
 - Sentinel surveillance - uses prearranged sample of sources who have agreed to report all cases of one or more notifiable diseases
 - Syndromic surveillance – ongoing systematic collection, analysis, interpretation, and application of real-time indicators for a disease that allow for quick detection
 - Medical surveillance – monitoring of potentially exposed individuals to detect early symptoms of disease
 - Passive surveillance – gather disease data from all potential reporting health care workers without prompting
 - Active surveillance – health departments initiate collection of info from labs, physicians, health care providers, or people
2. What are the 10 steps of an outbreak investigation? (10 pts)
 1. Prepare for field work
 2. Establish the existence of an outbreak
 3. Verify the diagnosis
 4. Define and identify cases
 5. Describe and orient the data in terms of person, place, and time
 6. Develop hypotheses
 7. Evaluate hypotheses
 8. Refine hypotheses and carry out additional studies
 9. Implement control and prevention measures
 10. Communicate findings
3. Describe confirmed, probable, and possible cases and how they differentiate. (6 pts)
 - Confirmed case: Signs and symptoms plus laboratory confirmation
 - Probable case: Typical clinical features but without lab confirmation.
 - Possible case: Fewer or vague symptoms with no lab confirmation
4. Name the CDC's food production chain and describe one example for each link. (8 pts)

Examples may vary

 1. Production - growing plants or raising animals Ex: fields sprayed with contaminated water, fish in tropical reefs get toxin from sea creatures they eat, yolk of egg is contaminated if hen's reproductive organs are contaminated too
 2. Processing - changing plants or animals into what we buy as food (washing and sorting produce, milk being pasteurized or made into cheese, nuts are roasted, chopped, or ground. In animals, first step is slaughter, then cut into pieces or ground.) Ex: if contaminated water/ice is used, germs from animal hide gets into product, germs contaminate processing surfaces.
 3. Distribution - getting food from farm or processing plant to the consumer or a food service facility like a restaurant, cafeteria, or hospital kitchen. It can be transporting foods just once, such as trucking, or it might involve many stages. Meat processing plant to supplier's warehouse, then distribution facility to restaurant. Ex: refrigerated food left on loading dock in warm weather, produce loaded into unclean truck

4. Preparation - getting food ready to eat. Ex: sick worker doesn't wash hands, cross-contamination in fridge and out

5. What are the 4 levels of disease prevention, and what do they mean? Provide one example for each level. (8 pts)

Examples may vary

- Primary prevention – actions undertaken to avoid occurrence of disease by increasing immunity to disease or eliminating the pathogen. Ex. vaccinations, maintaining a healthy diet and lifestyle, avoiding smoking
- Secondary prevention – methods to detect a disease while it is asymptomatic, so it can be quickly treated. Ex. Having yearly cancer screenings, treating small diseases (like hypertension or skin issues) which could lead to bigger disease (heart disease, skin cancer)
- Tertiary prevention – methods to reduce harm of and treat a symptomatic disease through rehabilitation and treatment. Ex. Radiation therapy, surgery
- Quaternary prevention – methods to avoid consequences of unnecessary or excessive intervention of the health system. Ex. Bringing a patient home from the hospital to live out their final days

6. Who is the father of epidemiology, and what is his main “claim to fame”? (2 pts)

John Snow – discovered that a well was the source of a London cholera epidemic

7. What are Hill's Criteria for Causation, and what does each mean? (Bonus point if you put Hill's first name) (18 pts)

Bradford Hill

- Strength of association - relationship is clear and risk estimate is high
- Consistency - observation of association must be repeatable in different populations at different times
- Specificity - a single cause produces a specific effect
- Alternative Explanations - consideration of multiple hypotheses before making conclusions about whether an association is causal or not
- Temporality - cause/exposure must precede the effect/outcome
- Dose-Response Relationship - an increasing amount of exposure increases the risk
- Biological Plausibility - the association agrees with currently accepted understanding of biological and pathological processes
- Experimental Evidence - the condition can be altered, either prevented or accelerated, by an appropriate experimental process
- Coherence - the association should be compatible with existing theory and knowledge, including knowledge of past cases and epidemiological studies

8. What are the stages of disease progression? Define each. (10 pts)

1. Incubation period – no signs or symptoms
2. Prodromal period – vague, general symptoms
3. Acme – most severe signs and symptoms
4. Decline – declining signs and symptoms
5. Convalescence – no signs or symptoms, healing

Part 2: Case -Studies (unless otherwise said, always show work and leave number in decimal form up to thousandths place)

Case #1: The Seven Lakes High School choir of 180 people was having a potluck on May 5, 2014. One choir brought sandwiches, which all included lettuce, tomatoes, mayonnaise, and either roast beef or chicken. One choir brought salad, composed mainly of lettuce. Another choir brought desserts, including ice cream and uncooked cookie dough. The last choir brought milk and fruit juice. 1 to 2 days later, many choir students began to complain of sickness. Their symptoms all included nausea, vomiting, abdominal cramps, watery diarrhea, malaise, a low fever, muscle pain, and headaches.

	Attended choir potluck	Did not attend choir potluck
Case	96	3
Control	56	25

- Calculate the appropriate measure of risk for this study. (4 pts)
Odds ratio: ad/bc
 $(96 * 25)/(3 * 56) = 14.286$
- Interpret the result of the previous question. (2 pts)
People who attended the potluck were 14.286 times more likely to get sick than those who didn't attend
- Why are the sandwiches a possible confounder? (2 pts)
They have many possible contaminants due to their ingredients, so any one of those ingredients could have caused the illness.

Sandwiches have been ruled out as a possible cause and therefore are not being studied.

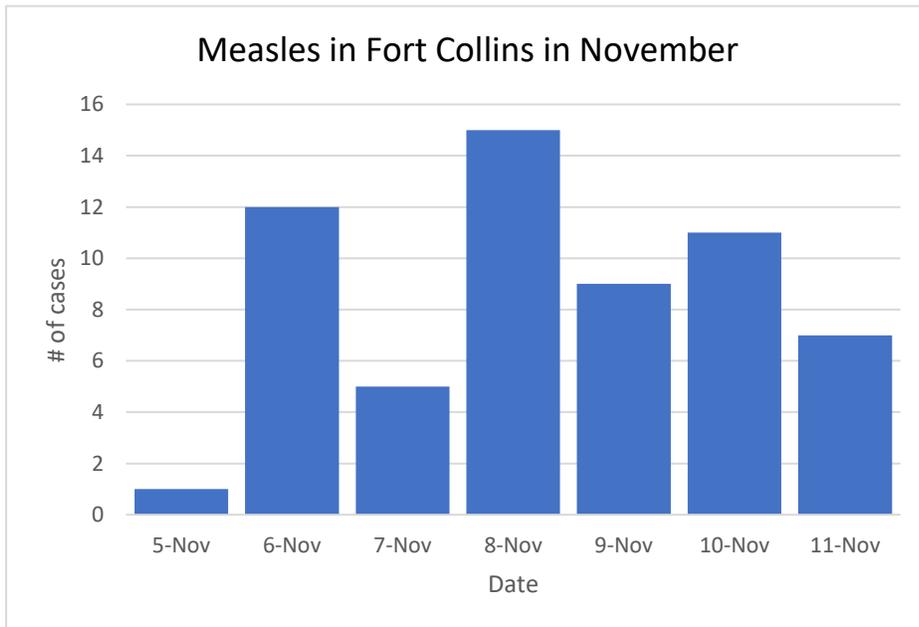
Food	Did Eat			Didn't Eat		
	Case	Control	Total	Case	Control	Total
Salad	49	32	81	17	60	71
Ice cream	32	37	96	40	16	56
Cookie dough	25	24	49	14	89	103
Milk	33	40	73	50	19	79
Fruit juice	15	20	35	49	68	117

- Calculate the attack rate for each of these foods and express them in percentages to the tenth place. (10 pts)
Food-specific attack rate: # of ppl sick that ate a food/total that ate that food
Salad: $49/81 = 60.5\%$
Ice cream: $32/96 = 33.3\%$
Cookie dough: $25/49 = 51.0\%$
Milk: $33/73 = 45.2\%$
Fruit juice: $15/30 = 42.9\%$
- Given the above results, which food had the greatest risk of transmitting the illness? (2 pts)
Salad
- With all the information given so far, which disease is this most likely to be? (4 pts)
 - Salmonella
 - Botulism

- c. E. coli
 - d. **Norovirus**
 - e. B. cereus
 - f. Vibrio
7. Why might there be 3 unexposed people who still got sick? (hint: look at the disease chosen above) (3 pts)
Norovirus can be transmitted from person to person through bodily fluids.
8. What is the most common test to detect a foodborne illness? (3 pts)
Stool test
9. What is the chain of infection, with examples for this case? (12 pts)
Norovirus (agent) → Contaminated water/other vector (Reservoir) → Water used to irrigate lettuce (Portal of exit) → Vector-borne through lettuce (Mode of transmission) → Salad that is eaten (Portal of entry) → Susceptible host (person that eats salad)
10. What is vertical transmission? Would the transmission of this illness be considered vertical transmission? (4 pts)
Transmission of disease from individual to offspring or through breast milk. No.

Case #2: There has been an outbreak of measles among children in Fort Collins, Colorado. The first case was reported on November 5, and today is November 11. As of today, 60 children have come down with the virus, and there have been 7 deaths. Common symptoms include fever, dry cough, runny nose, sore throat, inflamed eyes, white spots on the inner cheek, and a blotchy skin rash. The incubation period is estimated to be around 10-14 days. People are contagious through droplet transmission for about 8 days after symptoms begin.

11. Given the information and the chart, draw an epicurve. (6 pts. 3 if no titles)



Date	# of cases
11/5	1
11/6	12
11/7	5
11/8	15
11/9	9
11/10	11
11/11	7

12. What is an index case? What date did the index case show up in, in this scenario? (2 pts)
It's the first reported case. It showed up on 11/5.
13. Given the graph and the information above, what type of epi-curve is this outbreak? Explain. (2 pts – 2 for just mc, 1 pt for continuous source)
- Common continuous source
 - Point source
 - Common intermittent source
 - Propagated source
- Since it is transmitted from person to person, and the graph doesn't have one clear peak, it is propagated. Continuous source is wrong because the graph fits but since measles is contagious it must be propagated.
14. Calculate the case-fatality rate and express it in a percentage to the tenths place. (2 pts)
Case fatality rate: # of deaths due to disease/# of cases of that disease
 $7/60 = 11.7\%$
15. What is droplet transmission? (2 pts)
Disease transmission through mucous or saliva droplets that are expelled after a sneeze or cough
16. What are 4 ways to prevent contracting measles? (4 pts)
Possible answers include
- Vaccinating children
 - Always washing hands before touching your face or eating
 - Making sure others cover their mouth when sneezing or coughing
 - Wearing a mask before coming into contact with sick people
 - Disinfect commonly used surfaces often
 - There may be more
17. Write a case definition for this outbreak. (4 pts)
Children in Fort Collins, Colorado from November 5 who have measles, with symptoms of fever, dry cough, runny nose, sore throat, inflamed eyes, white spots in the inner cheek, and a rash. Can differ, but must include Fort Collins, November, children, and measles.
18. What is the difference between quarantine and isolation? Which would you put the infected children into? (4 pts – 2 for each component)
Quarantine is the separation of well persons to monitor for illness, while isolation is the separation of ill persons to prevent transmission to susceptible populations. Infected children would be put into isolation.
19. What is the epidemiological triad? (3 pts)
Agent-host-environment
20. Why would this not always be considered a nosocomial infection? (2 pts)
Nosocomial infections are infections acquired from a hospital. There is no evidence that all these cases were acquired from a hospital.

Part 3: General epidemiology

- What does the Germ Theory of Disease state? (2 pts)
Diseases are caused by microorganisms in the body.
- What are Koch's four postulates? (4 pts)
 - The pathogen must be present in all cases
 - The pathogen can be isolated from the diseased host and grown in pure culture

- The pathogen from the pure culture must cause the disease when put into a healthy, susceptible lab animal
 - The pathogen must be re-isolated from the new host and show to be the same as the originally isolated one
3. What is the Hawthorne Effect? Describe a scenario in which this type of bias can be seen. (4 pts)
In a study, it is when the subjects act differently because they know they are being studied. Scenarios will vary, but they must include there being a study in which participants are not behaving as their usual selves due to awareness of the study.
4. What is PulseNet? (2 pts)
A national network of public health and food regulatory agency laboratories coordinated by the Centers for Disease Control and Prevention (CDC). The network consists of: state health departments, local health departments, and federal agencies (CDC, USDA/FSIS Food Safety and Inspection Service, US Department of Agriculture, FDA)
5. Name 3 types of studies, and at least 2 advantages and 2 disadvantages for each. (12 pts)
Possible answers include
- Randomized trial:
 - o Adv: most scientifically sound, best measure of exposure, no population bias
 - o Disadv: time-consuming, most expensive, unethical for harmful exposures, no follow up treatment
 - Ecological
 - o Adv: inexpensive, not time-consuming, examines community, group, and national level data trends
 - o Disadv: subject to ecological fallacy, difficult to detect complicated exposure-outcome relationships
 - Cohort:
 - o Adv: most accurate observational study, good measure of exposure, comparatively easy, can study multiple diseases/outcomes at once, best info about causation and risk, good for rare exposures, establishes time sequence
 - o Disadv: time-consuming, expensive, loss to follow up bias is possible, inefficient for diseases with long latency periods, need large sample size to detect occurrence of rare disease
 - Case-control:
 - o Adv: can study rare diseases, relatively cheap, relatively fast, multiple risk factors can be studied
 - o Disadv: possible time-order confusion, possible recall bias, difficulty finding controls
 - Cross-sectional:
 - o Adv: fastest, cheapest, quick picture of prevalence of exposure and of outcome
 - o Disadv: possible time-order confusion, least confidence in findings, difficult to make cause-effect relationship, can't study rare diseases or rare causes
6. What is herd immunity? (2 pts)
Resistance of a population to spread of an infectious organism due to the immunity of a high proportion of the population
7. What are the 4 types of errors? Define each. (8 pts)
1. Type I (Alpha) Error: When the null hypothesis is true and you reject it, you make a type I error. Aka, false positive. For example, a researcher rejects the null hypothesis and concludes that two medications are different when, in fact, they are not. If the medications have the same effectiveness, the researcher may not consider this error too severe because

- the patients still benefit from the same level of effectiveness regardless of which medicine they take.
2. Type II (Beta) Error: When the null hypothesis is false and you fail to reject it. Aka, false negative. For example, the researcher concludes that the medications are the same when, in fact, they are different. This error is potentially life-threatening if the less-effective medication is sold to the public instead of the more effective one.
 3. Type 3 – correctly rejecting the null hypothesis for the wrong reason
 4. Type 4 – specific type of type 3 error. Correctly rejecting null hypothesis, but making mistake interpreting the results
8. What is a double blind experiment? (2 pts)
An experiment in which neither the participants nor the researchers know which group is receiving a treatment and which is receiving a placebo.
 9. Is it possible for relative risk to be less than 1? If so, what does it mean? (2 pts)
It is possible. It means that the people who were part of that group were less likely to get the disease, indicating a possible protective effect.
 10. What does the acronym “DALYS” mean? (1 pt)
Disability-adjusted life years