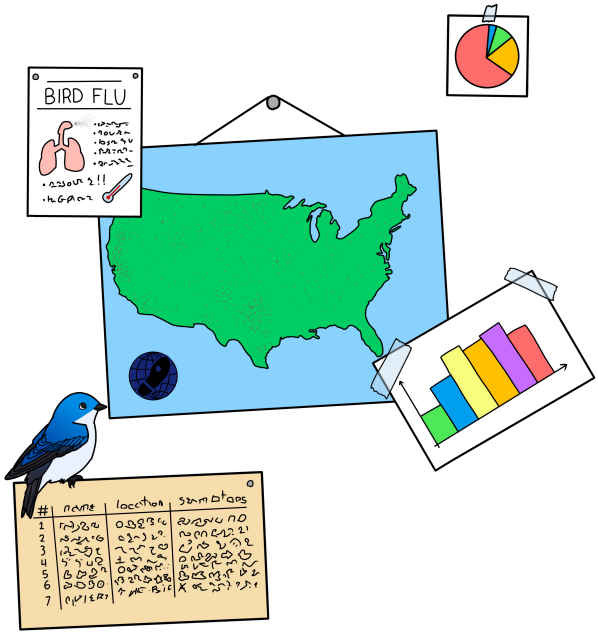
BirdSO Mini Invitational

Greycen Ren

11-18 December 2021



Directions:

Welcome to Disease Detectives! This test will have 253 points. It is 88 questions long and distributed into 4 sections, with point distributions as follows:

Section I: 39 points

Section II: 55 points

Section III: 68 points

Section IV: 91 points

This test is designed to test your problem-solving and creative thinking skills in applying epidemiological concepts in various scenarios. The four sections focus on four different health events that fall within the jurisdiction of epidemiology.

Round to 3 decimal places for all calculations. This includes percentages. For example, 11.111% would be considered as rounded to 3 decimal places.

Reference notes for this event should be PRINTED. However, each individual in a partner pair may have their own unique page of notes. Out-of-browser time will be monitored for this event.

Tiebreakers are listed in order as follows: 55, 46, 24, 54, 61, 19, 33

Page	Points	Score
3	21	
4	9	
5	9	
6	16	
7	13	
8	26	
9	8	
10	21	
11	8	
12	28	
13	14	
14	32	
15	17	
16	27	
17	4	
Total:	253	

Section I: Impaired Driving [39 points] Source: https://www.cdc.gov/mmwr/volumes/68/wr/mm6850a1.htm In 2018, there were an estimated 10,511 driving deaths that stemmed from impairedness from alcohol. Car crashes are one of the leading causes of death in the US and the greatest non-natural cause of death. The contribution of crashes stemming from marijuana and other related illicit substances to impaired driving deaths is relatively unknown. In a study in 2018, the prevalence of driving under the influence of marijuana and other illicit drugs was studied for people over the age of 16. These results were examined by age group, sex, and race/ethnicity. Why might this study have only included people over the age of 16?

1. (2 points) **Solution:** People under the age of 16 are generally unable to drive

The National Survey on Drug Use and Health (NSDUH) from the Substance Abuse and Mental Health Services Administration collects annual data on the use of illicit drugs, alcohol, and tobacco among the US civilian population using a computer-assisted personal interviewing system.

2. (5 points) What kind of study is this? What are 2 advantages to this type of study?

Solution: Cross-sectional. Advantages: Easy to conduct, cheap, quick, can calculate prevalence. Accept any other reasonable answers

3. (4 points) Define recall bias. How may it be applicable in this study?

Solution: Recall bias is a form of bias in which information may be falsely remembered from the past, leading to differences in reported values and actual values. In this survey, participants are asked to recall the number of times in which they have driven under the influence of illicit substances; these occasions may not be fully remembered.

4. (8 points) What other biases may be relevant to this study? Provide 2 examples, define them, and explain how they apply to this study.

Solution: Social desirability bias: it may not be desirable to admit to driving under the influence of illicit substances, both from a social standpoint and possibly from a legal standpoint (depending on the legality of marijuana use across different states) Interviewer/Response bias: The computer-assisted interview in the survey may inadvertently influence the responses of the participants by the phrasing of questions, tonal delivery, or other means. Accept any other reasonable answers

47,570 unweighted responses were compiled in the NSDUH survey. The following table was compiled from the responses from the NSDUH survey:

	Marijuana		Illicit drugs other than marijuana	
Characteristic	Number who reported driving under the influence	% Prevalence (95% CI)	Number who reported driving under the influence	% Prevalence (95% CI)
Sex				
Male	7711	6.2 (5.9-6.6)	1578	1.3 (1.1-1.5)
Female	4249	3.2 (2.9-3.5)	722	0.5 (0.4-0.7)
Race/Ethnicity				
White	7913	4.9 (4.5-5.2)	1601	1.0 (0.9-1.1)
Black	1576	5.1 (4.5-5.7)	182	0.6 (0.3-0.9)
American Indian/Alaska Native	72	4.9 (2.7-7.1)	18	1.2 (0.2-2.2)
Hawaiian/Other Pacific Island	35	3.6 (0.9-6.3)	13	1.4 (0.0-3.3)
Asian	336	2.3 (1.2-3.4)	74	0.5 (0.2-0.9)
Multiracial	427	9.2 (6.3-12.1)	50	1.1 (0.5-1.6)
Hispanic	1602	3.8 (3.2-4.4)	362	0.9 (0.6-1.1)

5. (2 points) What does it mean that the survey was unweighted?

Solution: An unweighted survey is one where the sample of the survey is not adjusted by strata to accurately reflect the demographics of the population.

6. (1 point) Which demographic was most likely to drive under the influence of marijuana?

Solution: Multiracial

7. (1 point) What epidemiological term describes the differences between these groups?

Solution: Social determinants of health

8. (2 points) Calculate the prevalence ratio of driving under the influence of illicit drugs other than marijuana for a Black individual relative to any random individual in the US, given that the % prevalence for a weighted total US population is 0.9.

Solution: 0.667

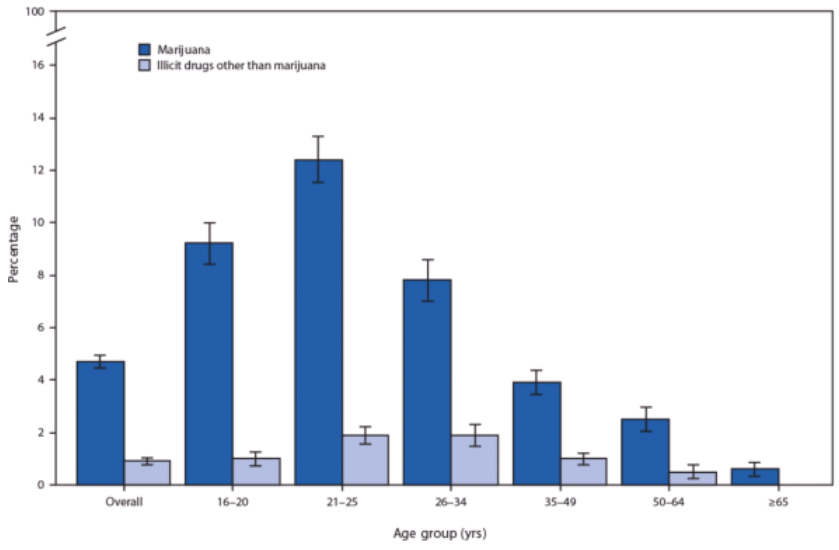
9. (2 points) Interpret the meaning of the prevalence ratio.

Solution: A Black individual is 0.67 times as likely to be driving under the influence of an illicit drug other than marijuana as compared to any random individual in the US.

10. (2 points) What is the prevalence of driving while under the influence of only marijuana for males?

Solution: This cannot be calculated since the prevalence of driving under both the influence of marijuana and some other illicit substance is not known; prevalence percentages may be overcounted by assuming disjointness.

Survey responses of those that reported driving a vehicle while under the influence of marijuana or other illicit substances were also stratified by age:



11. (1 point) What is this type of graph called?

Solution: bar graph or bar chart

12. (1 point) Which age group is most likely to drive while under the influence of marijuana?

Solution: 21-25

13. (3 points) If active surveillance were to be implemented where all drivers pulled over for unsafe driving behavior were tested for tetrahydrocannabinol (THC), the active compound in marijuana, how would the measured prevalence of impaired driving compare to the actual prevalence? Will it be an overestimate or an underestimate or neither? Why?

Solution: The measured prevalence would likely be an overestimate as the presence of THC does not necessarily mean impairedness from THC.

14. (2 points) Provide one example of a primary prevention measure that could be implemented to decrease the prevalence of driving under the influence of illicit substances?

Solution: Increase educational programs warning about the risk of driving under the influence. Accept any other reasonable answers.

15. (3 points) Is secondary prevention a feasible task for the risk factors involved in impaired driving? Explain.

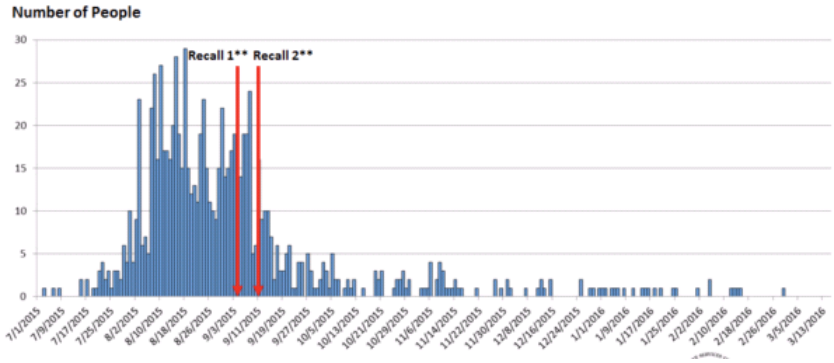
Solution: No. It is difficult to decrease the amount of impaired driving after the impaired driving has already begun. It is an infeasible task to create surveillance systems across the road systems to watch out for potentially impaired drivers at all times. Accept any other reasonable answers.

Section II: Salmonella [55 points]

Sources: https://www.cdc.gov/salmonella/poona-09-15/index.html, https://www.fda.gov/food/outbreaks-foodborne-illness/fda-investigated-multistate-outbreak-salmonella-poona-linked-cucumbers

CDC PulseNet identified 907 people infected with a strain of Salmonella Poona across 40 states in 2015. Cases were reported to the CDC by various local public health departments. Investigated was coordinated between the CDC, multiple states, and the FDA. PulseNet is a CDC national laboratory system that performs genetic testing on potential outbreak strains. For people with available information, the onset of illness occurred from July 3, 2015, to February 29, 2016.

Salmonella is a bacterial infection that presents with gastrointestinal symptoms between 12-72 hours after exposure to the bacteria. Signs and symptoms are primarily diarrhea, fever, and abdominal cramps and tend to last for 4-7 days. Most infected individuals recover without treatment.



16. (1 point) What is this graph called?

Solution: Epicurve

17. (1 point) What type of outbreak is this initially?

Solution: Continuous Common Source

18. (4 points) After the CDC recommended a recall of a potential source of illness, cases continued rising. Provide 2 explanations as to why this occurred.

Solution: Increased newsworthiness led to increased reporting of potential cases (overreporting). Cases continued to consume recalled products in times immediately after the recall. Cases after implemented recall were exposed prior to recall and were in the incubation period. Accept any other reasonable answers.

19. (2 points) The later part of the outbreak appears to show a different pattern in comparison to the start. What has changed in the transmission of Salmonella throughout the outbreak?

Solution: The original common source is no longer the primary reservoir for Salmonella bacteria. Transmission has largely moved to human-human transmission, as noted from the more propagated pattern in the epicurve.

The first technique used by PulseNet and other laboratories to isolate potential outbreak strains is pulsed-field gel electrophoresis (PFGE), where an alternating electric field is applied to gel electrophoresis to differentiate and separate DNA molecules of large sizes. However, PFGE is sometimes not specific enough to detail mutants in potential outbreak strains.

20. (1 point) What lab technology should be utilized if PFGE does not give meaningful results?

Solution: Whole Genome Sequencing (WGS)

Further genetic testing was done and genetic sequence isolates from cases were shown to be related closely genetically. These isolates included cases in the peak of the outbreak as well as later in October, November, and January.

21. (2 points) What does the genetic similarity of the outbreak say about the source of the outbreak?

Solution: The source of the outbreak was probably a common source. That even after the peak, other cases had genetic similarity implies they are secondary cases to earlier exposed cases from the original common source.

Of the cases, 519 were interviewed, of which, 391 reported eating cucumbers. In comparison, according to the CDC FoodNet Atlas of Exposures Population Survey from 2006-2007, 47% of healthy people reported eating cucumbers in the week before they were interviewed.

22. (1 point) What type of study is this?

Solution: Case-control

23. (4 points) Calculate the strength of association between eating cucumbers and contracting Salmonella. Explain

what your result means.

Solution: Odds ratio = 3.444 Those that are ill are 3.444 times as likely to have eaten cucumbers as compared to those that are not.

24. (3 points) What is the major flaw in the design of this study?

Solution: Controls are not case-matched but are taken from a survey completed previously. Social determinants may play a role in the outbreak and cannot be controlled between the cases and the controls. It is unclear how much of the correlation is due strictly to an association between eating cucumbers and contracting salmonellosis.

The characterization of the outbreak was further clarified by the presence of illness clusters. Across various clusters across various states, cucumbers were found to be a common item eaten by ill people. Investigators concluded that cucumbers distributed by Andrew and Williamson Fresh Produce were the probable cause of the outbreak.

25. (2 points) What is an illness cluster?

Solution: An aggregation of cases over a particular period, closely grouped in time and space, regardless of whether the number of cases is more than expected.

26. (5 points) Write a case definition for this outbreak.

Solution: A case is defined as someone who, in the 40 affected US States, from July 3, 2015, to February 29, 2016, exhibited signs of diarrhea, fever, and abdominal cramps with possible consumption of cucumbers distributed by Andrew and Williamson Fresh Produce. Genetic testing for the outbreak strain defines a confirmed case.

27. (1 point) What is the next step for investigators to take?

Solution: Implement control and prevention methods; maintain surveillance; communicate findings

A major concern with bacterial infections is the growing rate of antibiotic-resistant bacteria. Primarily, antibiotic resistance is an acquired trait in healthcare settings and can be transmitted in healthcare environments. Antibiotic-resistant bacteria present a large risk in terms of morbidity and potential mortality in the difficulty of treating widespread infection of antibiotic-resistant strains.

28. (1 point) What is the term for a disease that is transmitted in a healthcare environment?

Solution: Nosocomial

29. (1 point) How are antibiotic-resistant genes transmitted between bacteria?

Solution: R-plasmids or transformation 1/2 credit for "horizontal gene transfer" or "conjugation" or "plasmids" or other related but vaguer terms

The CDC's National Antimicrobial Resistance Monitoring System (NARMS) laboratory tested 30 isolates of the outbreak strains for antibiotic resistance. Of those, only 2 were drug-resistant. One was resistant to tetracycline while the other was resistant to nalidixic acid and nonsusceptible to ciprofloxacin.

30. (2 points) What does nonsusceptible mean?

Solution: The antibiotic doesn't completely kill or stop the growth of the bacteria.

31. (2 points) What is a possible source of the different antibiotic resistance in the outbreak strains?

Solution: Horizontal gene transfer from different bacteria species are transformed into Salmonella bacteria in individual cases

Of the 907 cases, 204 were hospitalized and 6 deaths were recorded. For 2 of the three deaths, Salmonella infection was not considered to be a contributing factor.

32. (2 points) What is the case-fatality rate per 100 people?

Solution: 0.662

33. (3 points) Can the prevalence of Salmonella be determined in this study? Why or why not?

Solution: No. Case-control studies are unable to calculate prevalence because measurements are not taken from a sample intended to represent a population

34. (2 points) Provide 2 groups of people that are most susceptible to severe illness

Solution: Elderly, children, immunocompromised

35. (10 points) List 5 potential guidelines that should be followed to limit the spread of Salmonella.

Solution: Do not eat potentially contaminated products (throw out); follow recall instructions to remove potentially contaminated products; wash and sanitize storage facilities where potentially contaminated products were stored; wash and sanitize equipment used to process potentially contaminated products; wash hands thoroughly for all persons that have handled potentially contaminated products; clean surfaces where potentially contaminated products have been handled; proper cooking of potentially contaminated products to a high enough temperature; separation of uncooked products from cooked products; proper storage at low enough temperature to limit the growth of bacteria.

Accept any other reasonable answers

36. (1 point) Salmonella is part of the Nationally Notifiable Diseases Surveillance System (NNDSS). What type of surveillance does this system utilize?

Solution: passive

37. (4 points) What are 2 advantages and disadvantages of this system?

Solution: Advantages: Cheap, easy to maintain, self-sufficient, less time consuming Disadvantages: subjective to reporters, high underreporting

Accept all other reasonable answers

Section III: Cervical Cancer [68 points]

Source: https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6801a4-H.pdf

In India, cervical cancer is the second leading cause of cancer deaths among women. Annually, there are an estimated 96,922 new cases and 60.078 deaths. The Fourth National Family Health Survey (NFHS-4) was a nationally representative survey completed in India at the district level in 2015-2016 that sampled 699,686 women aged 15-49 in urban and rural regions across India about cervical examinations. These results are shown in the following table:

Chracteristic	Number	% weighted screening prevalence (95% CI)	p-value (χ2)
Age group (yrs)			
30-34	97,048	29.0 (28.4-29.6)	<0.0001
35-39	90,433	29.5 (29.0-30.0)	
40-44	76,627	30.4 (29.9-31.0)	
45-49	72,669	30.7 (30.1-31.3)	
Education			
No education	143,607	24.7 (24.2-25.5)	<0.0001
Grades 1-8	96,582	29.9 (29.4-30.4)	
Grades 9-11	51,753	36.9 (36.1-37.8)	
Grades 12+	44,835	37.1 (36.1-38.1)	
Partners' education			
No education	13,470	26.3 (25.1–27.5)	<0.0001
Grades 1–8	18,214	31.4 (30.3–32.6)	
Grades 9–11	13,735	35.9 (34.4–37.3)	
Grades ≥12	12,524	36.9 (35.2–38.5)	
Marital status			
Never married	7,165	6.2 (5.0–7.3)	<0.0001
Currently married	305,662	30.5 (30.1–30.9)	
Widowed	18,838	25.9 (24.9–27.0)	
Divorced/Separated/ Deserted	5,112	24.9 (23.0–26.9)	
No. of children			
0	17,562	27.6 (26.4–28.8)	<0.0001
1	31,029	33.0 (32.0–34.0)	
2	98,185	34.0 (33.4–34.6)	
≥3	190,001	26.8 (26.5–27.2)	
Household wealth index			
Poorest	63,723	17.1 (16.6–17.5)	<0.0001
Poor	69,441	23.1 (22.5–23.6)	
Middle	68,525	30.2 (29.5–30.8)	
Rich	67,191	34.7 (33.9–35.4)	
Richest	67,897	40.4 (39.5–41.3)	
Working status			
Currently working	17,732	31.9 (30.7–33.1)	0.6
Not currently working	41,489	32.1 (31.3–33.0)	
Place of residence			
Urban	102,300	34.0 (33.2–34.8)	<0.0001
Rural	234,477	27.5 (27.1–27.9)	
Geographic regions			
North	56,018	37.0 (36.2–37.9)	<0.0001
Central	91,087	22.7 (22.1–23.3)	
East	59,048	15.7 (15.2–16.2)	
Northeast	49,292	10.0 (9.5–10.5)	
Western	27,537	45.2 (43.8–46.6)	
South	45,070	38.1 (37.2–39.0)	
Union Territories	8,725	41.2 (35.3–47.0)	

38. (1 point) What type of study is this?

Solution: Ecological

39. (3 points) Does it make sense for there to be a significant difference in rates of cervical cancer screening when stratifying responses by age group? Why?

Solution: Yes. Those that are older have had more time to be able to have had a cervical cancer screening.

40. (2 points) The increase in mortality from illnesses such as cancer and cardiovascular disease represents an epidemiological transition. What is the epidemiological transition theory?

Solution: Epidemiological transition theory is a theoretical consideration of the changing nature of public health events due to changing population patterns and access to medical care.

41. (2 points) Who first proposed this theory and when?

Solution: Abdel Omran, 1971

42. (2 points) Based on the theory, what phase does cervical cancer fall into?

Solution: Age of Degenerative and Man-Made Diseases

43. (3 points) Given the nature of the study, are these results likely to underestimate, overestimate, or accurately estimate the actual rate of cervical cancer screening? Why?

Solution:

Overestimate. Study participants may confuse cervical cancer screening with other examinations such as pelvic exams. Not all exams reported as cervical cancer screenings may be actual cervical cancer screens.

44. (3 points) Increased household wealth index and education level appear to be associated with increased cervical cancer screening prevalence. Why might this be the case?

Solution: Increased education level tends to yield greater employment opportunities, and thus, a greater household wealth index. More money provides more opportunities in health care, leading to a greater rate of screening of cervical cancer.

45. (3 points) Are there significant differences in cervical cancer screening rates due to occupational status? Include specific evidence.

Solution: No. The p-value is 0.6, which suggests that the difference in rates between occupational statuses occur by chance 60% of the time.

46. (6 points) What is the odds ratio associated with each higher education level?

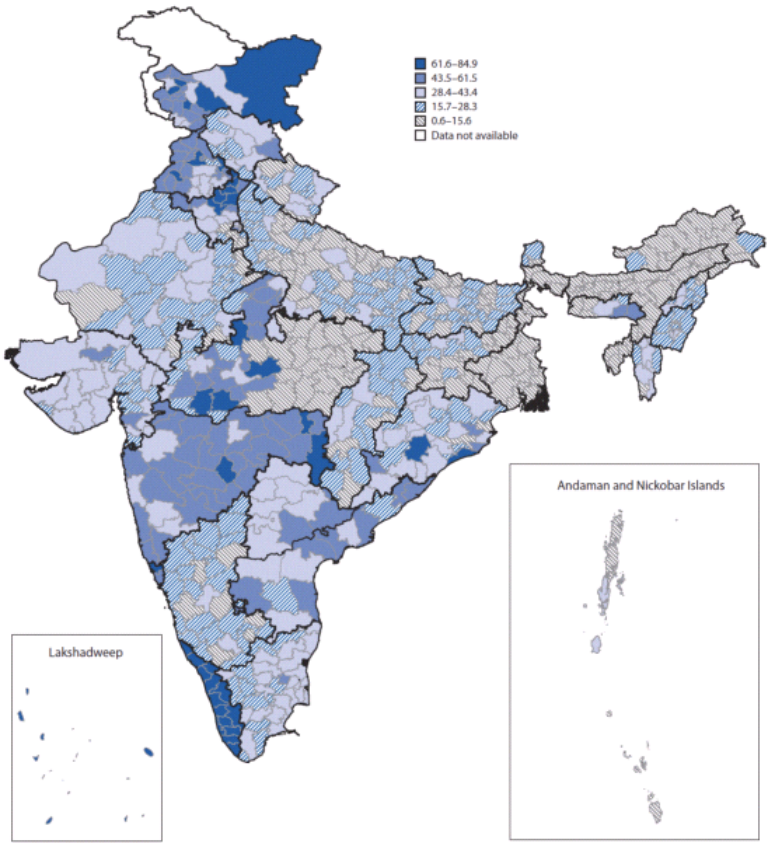
Note: you are tasked to calculate the odds ratio for each of the 3 education levels higher than "no education" separately. You should have 3 distinct values.

Solution: Grade 1-8 Odds ratio = 1.300; Grade 9-11 Odds ratio = 1.598; Grade 12+ Odds ratio = 1.474;

47. (4 points) Why might women aged ¿49 not be included in the study? Would this exclusion have a significant impact on the results of the study?

Solution: Cervical cancer is largely caused by HPV which is a primarily sexually transmitted infection; women aged ¿49 tend to be less sexually active. Still, women ¿49 are recommended to be screened for cervical cancer on a regular basis. However, this may not significantly impact the results of the study, as socioeconomic conditions likely stabilize by age ¿49, and thus, access to screening and healthcare would likely not deviate significantly from the 45-49 age group.

Cervical cancer screening prevalence rates were also organized by region and compiled into the following figure:



48. (1 point) What is this type of map called?

Solution: Choropleth

49. (2 points) What is one disadvantage of this type of map in comparison to a spot map?

Solution: A choropleth doesn't show individuals nor their locations within a region Accept any other reasonable answers

50. (1 point) Who was the first epidemiologist to use a spot map?

Solution: John Snow

51. (4 points) Despite the disadvantages, what are two possible reasons why this type of map is preferred in this study?

Solution: An ecological study looks at correlations in populations; understanding individuals is unimportant The large number of participants makes it difficult to visualize differences in regions with higher rates due to the clustering of spots Rates are more easily differentiable in coloring gradients of a choropleth Accept any other reasonable answers

Suppose that a hypothetical laboratory called BirdSO Inc. has developed a new screening test for Human Papillomavirus (HPV), the primary cause of HPV, called the HPV-NoMore. 117 cervical cancer patients with a positive screening of HPV are tested using the new HPV-NoMore test. Of these 117 patients, 95 tested positive. Further, among 142 controls, 12 tested positive.

52. (4 points) What is the sensitivity of this test? Interpret your result.

Solution: 81.197%. The probability of testing positive given that an individual has HPV is 81.197%

53. (4 points) What is the positive predictive value of this test? Interpret your result.

Solution: 88.785%. The probability of having the disease given a positive test is 88.785%

54. (4 points) Given the nature of cervical cancer and HPV, is a more sensitive or a more specific test ideal? Explain.

Solution: Sensitive. Cervical cancer is important to detect early and accurately. False negatives are most dangerous as they lead to patients that have cervical cancer but don't seek treatment due to perceived healthiness.

BirdSO Inc. has also developed a new branch of vaccine development, specifically for HPV. The new vaccine was administered in a double-blinded clinical trial where 266 volunteers were randomly assigned into two experimental groups. One group was administered the new BirdSO HPV Vaccine (BSOHPVV) while the other received the existing HPV vaccine, which has an efficacy rate of 98%. Among those who received the existing HPV vaccine, 4 contracted HPV. Of those who were administered BSOHPVV, 10 contracted HPV.

55. (2 points) What is the efficacy of BSOHPVV?

Solution: 94.756%

56. (2 points) Why might BSOHPVV be preferred over the existing HPV vaccine?

Solution: Although it has a slightly lower efficacy, it may be much more easily produced or distributed, allowing for better access to immunization.

57. (2 points) What is the difference between efficacy and effectiveness?

Solution: Efficacy is within a controlled, clinical trial whereas effectiveness is within the context of real life.

58. (2 points) Suppose that BirdSO Inc. wishes to study the effectiveness of BSOHPVV. What conditions may be necessary in order for such a study to occur?

Solution: A good surveillance system to analyze trends in morbidity between vaccinated and unvaccinated groups

59. (5 points) What are five components of a good surveillance system?

Solution: High sensitivity, High PPV, short reporting delay time, required reporting of all cases, lab confirmation of cases Accept any other reasonable answers

60. (3 points) Differentiate between serial interval and incubation period. Which is typically longer?

Solution: Serial interval is the duration between the onset of a secondary case from a primary case while incubation period is the duration between onset of symptoms and exposure. Serial interval is longer

61. (2 points) For cervical cancer and HPV, is vaccination considered a clinical approach or a public health approach? Explain.

Solution: Because HPV is primary transmitted human to human, vaccination is considered both a clinical approach AND a public health approach

62. (1 point) What is the period between onset of cervical cancer and exposure to HPV referred to as?

Solution: Latent period

Section IV: Clostridium perfringens [91 points]

Source: https://www.cdc.gov/mmwr/volumes/66/wr/mm6635a3.htm

In September 2016, the Connecticut Department of Public Health was notified of a cluster of gastrointestinal illnesses among attendees of a catered lunch. Among the approximately 50 attendees, 30 filled out a survey. 19 respondents had symptoms of Clostridium perfringens infection, among whom 17 reported diarrhea, 15 reported abdominal pain, and 7 reported headaches.

Survey respondents were then asked to provide a list of food items at the lunch that they consumed. The results are listed in the following table:

Food/Drink exposure	Ill persons (n = 16)		Well persons (n = 10)		Strength of Association
	# Ate	# Did not eat	# Ate	# Did not eat	
Tripe	12	4	5	5	1.59
Fish	9	7	3	7	1.5
Pork	10	6	5	5	1.22
Chicken	9	7	6	4	0.94
Beef	16	0	7	3	**A**
Noodles	11	5	7	3	0.98
Vegetables	8	8	4	6	**B**
Spring rolls	14	2	7	3	1.67
Cake	10	6	2	8	1.94
Pudding	7	9	3	7	1.24
Yam dessert	10	6	4	6	1.43
Rice	15	1	9	1	1.25
Grapes	9	7	5	5	**C**
Mango salad	6	10	4	6	0.96
Muffin	5	11	1	9	1.52
Bagel	8	8	2	8	**D**
Coffee	11	5	2	8	2.2
Juice	5	11	2	8	1.23
Water	15	1	10	0	0.6
Soda	4	12	2	8	1.11

63. (6 points) Give 3 reasons why epidemiologists should investigate this outbreak.

Solution: Provide an opportunity to characterize a public health problem, identify risk factors associated with infection that are preventable, provide new research insights into diseases Accept any other reasonable answers

64. (5 points) Write a case definition for this outbreak.

Solution: Cases are defined as those who attended the catered lunch in Connecticut in September 2016 and reported symptoms of diarrhea, abdominal pain, or headaches. Confirmed cases are defined by laboratory confirmation of Clostridium perfringens infection.

65. (6 points) Define agent, host, and environment and identify them in the context of this outbreak.

Solution: Agent = pathogenic cause of an illness; Clostridium perfringens Host = susceptible individual to an illness; those who attended the catered lunch Environment = scenario that brings agent and host together; the catered lunch

66. (1 point) What type of study is this?

Solution: Cohort

67. (2 points) What is an advantage to this study design?

Solution: Examines to find a single exposure/cause; most accurate Accept any other reasonable answers

68. (8 points) Compute the missing strengths of association.

Note: You are tasked to compute the values of "A", "B", "C", and "D" in the table

Solution: A = 5.500. Note: Add 0.5 to all numbers when relative risk is unable to be computed because of dividing by 0. B = 1.167 C = 1.102 D = 1.600

69. (4 points) What is the probable source of the outbreak? What is the strength of association of that item? Interpret it.

Solution: Beef; 5.5; Those that ate beef were 5.5 times as likely to develop the illness as compared to those who did not.

70. (4 points) Determine the attributable risk of eating muffins. Interpret the meaning of your result. Is this interpretation valid?

Solution: 28.333%. 28.333% of cases could be avoided by the removal of muffins from the catered lunch. This interpretation is invalid because eating muffins is not soundly linked to developing an illness. It is confounded by the beef.

71. (4 points) Determine the number needed to harm (NNH) of eating tripe. Interpret the meaning of your result. Is this interpretation valid?

Solution: 3.825. 3.825 people would have to eat tripe for one additional person to have developed the illness that would not have otherwise. This result is invalid because there is no sound association between tripe and falling ill. The results are confounded by eating beef.

72. (3 points) What accounts for the difference in the number of initial survey responders and those that provided a food list? In which type of study is this problem most relevant?

Solution: Loss of follow-up after the initial survey. Most relevant in cohort studies.

73. (1 point) What part of the chain of infection does the food represent?

Solution: Reservoir

74. (1 point) What mode of transmission is involved in this outbreak?

Solution: Fecal-oral/foodborne 1/2 points for "vehicleborne"

Investigators in the study further computed p-values to test for the significance of the association between eating various food items and falling ill. A Fisher's Exact Test was used

75. (3 points) Why may investigators have used a Fisher's Exact test instead of a Chi-square goodness of fit test?

Solution: Chi-square goodness of fit tests are less accurate for smaller samples because it relies on the assumption of fit to the expected chi-squared distribution. A Fisher's Exact gives an exact statistical significance value and is especially relevant for small samples.

76. (4 points) What is the rare disease assumption? How does it play a role in the interpretation of an odds ratio in this study?

Solution: The rare disease assumption states that the Odds Ratio and Relative risk approach as a disease becomes rarer. This means that the odds ratio is a valid means of measuring risk for this study due to the small sample size, which is typically not true as the odds ratio has no basis for measuring population-level statistics.

77. (4 points) After p-values were computed, multiple food items had significant and approaching significant deviations. Propose 2 possible hypotheses as to why multiple foods were so significantly associated with illness.

Solution: Cross-contamination between beef and other items. People who enjoyed beef also enjoyed other food items and ate them together. Accept any other reasonable answers

Having identified the likely contaminated food item at the lunch that led to the outbreak, epidemiologists were tasked to determine the cause of the outbreak at the caterer. The caterer had four food workers who reported no recent illness. However, all four workers were culture positive for Clostridium perfringens. Epidemiologists from the local health department established safety guidelines, which included ensuring that food workers washed their hands for a sufficient duration before returning to work from the restroom.

78. (1 point) What component of the chain of infection does this step break?

Solution: Mode of transmission

79. (1 point) What step of outbreak investigation does this fall under?

Solution: Implement control and prevention measures

80. (2 points) What is an example of secondary prevention that is applicable to this outbreak?

Solution: Treatment of lunch attendees that have fallen ill to Clostridium perfringens food poisoning. Accept any other reasonable answers.

81. (3 points) Are Koch's Postulates applicable in this case? Why or why not?

Solution: No. The microorganism causing the illness is found in those that do not appear to be ill, violating the first postulate.

82. (3 points) How does colonization resistance play a role in this outbreak?

Solution: Protection of individuals from gastrointestinal infections due to existing bacterial colonies on the intestinal wall may lead to asymptomatic individuals in this outbreak.

83. (10 points) What are the 9 Bradford Hill criteria (list and describe)? Do any of them fail in this outbreak? If so, which ones?

Solution: 1. Strength: the relationship between exposure and outcome is clear and high; 2. Consistency: observation of association must be repeatable; 3. Specificity: A single cause produces a single effect; 4: alternative explanations: multiple hypotheses have been considered in determining a causal relationship; 5. Temporality: exposure precedes outcome; 6. Dose-response relationship: an increase in exposure leads to an increase in risk; 7: Biological plausibility: association agrees with currently accepted understanding of biological and pathological processes, 8. Experimental evidence: condition can be altered by appropriate experimental process; 9. Coherence: association is compatible with existing knowledge from past cases/studies Yes: Dose-response relationship

84. (3 points) Is misclassification bias relevant in this study? Why or why not?

Solution: Yes. In ideal circumstances, asymptomatic individuals would be considered cases as they have developed an infection from exposure but simply do not display symptoms of it. In this study, asymptomatic carriers are relevant and may influence the analysis of food items' contamination.

85. (6 points) What are two other biases that may be relevant in this investigation? Explain.

Solution: Recall bias. Study participants are asked to recall which food items they have eaten. Voluntary response bias: only those that felt compelled to participate volunteered to fill out the survey; volunteers may not represent the entire population Neyman bias: those with the most severe illnesses are unable to fill out the survey and are excluded from the study

86. (1 point) An epicurve was not created for this outbreak. However, if one were, what would the shape look like?

Solution: common point source

87. (1 point) If the outbreak were uncontrolled and spread from the initial cases, what shape would the epicurve take on?

Solution: Propagated

88. (4 points) Epicurves, though useful, are not perfect. What are 2 potential problems that epicurves have in reporting the distribution of cases of time in an outbreak?

Solution: Reporting delays Changes in case definition

Congratulations!

You have completed the 2022 BirdSO MiniSO Division C Disease Detectives Test! Good luck with the rest of your events!

- Greycen =)

Conclusion:

Congratulations on completing the 2022 BirdSO MiniSO Division C Disease Detectives test! I hope you enjoyed the test as much as I enjoyed writing it. Good luck with all your other events!

Once again, best of luck with the rest of your events!

-Greycen :)