

Princeton Invitational Disease Detectives Answer Key

Part 1 (38 points):

1. Cluster
2. Outbreak or epidemic
3. Pandemic
4. Vector
5. Vehicle or fomite
6. Zoonosis
7. Incubation or latency period
8. Bradford Hill criteria
9. Public health surveillance
10. Endemic
11. Mortality Rate
12. Biological Transmission
13. Carrier
14. Seasonal Trend
15. Years of potential life lost (YPLL)
16. Sexual Transmission
17. Observational Study

18. Half a point each:
 - Prepare for field work
 - Establish the existence of an outbreak
 - Verify the diagnosis
 - Define and identify cases
 - Describe and orient data in terms of person, place, and time
 - Develop hypothesis
 - Evaluate hypothesis
 - Refine hypothesis
 - Implement prevention and control measures
 - Communicate findings

19. Immune

20. Morbidity is the incidence of ill health in a population while mortality is the incidence of death in a population. [1 pt. each for correct definition of mortality and morbidity; -0.5 pts if difference between the two is not made clear]

21. Incidence is the rate of new cases of the disease while prevalence is the number of all cases in the population.[same scoring as question 20]

22. Berkson's Bias
23. Information bias
24. Simpson's Paradox
25. Recall Bias
26. Selection Bias
27. Healthy Worker Effect Bias
28. Loss to follow-up
29. Confounding Bias
30. Observer Bias
31. Volunteer Bias
32. Measurement Bias

Part II (28 points)

1. Verify the diagnosis [1pt]
2. A test result which incorrectly indicates that particular condition or attribute is present. There are 4995 false positives [1pt. for correct definition of false positive and 1pt. for number of false positives]
3. A test result which correctly indicates that the particular condition or attribute is not present. There are 94905 true negatives. [1 pt. for correct definition of true negative and 1 pt. for number of true negatives]
4. Sensitivity = $a/(a+c) = 90/(90 + 10) = 90\%$. Specificity = $d/(d + b) = 94905/(4995+94905) = 95\%$. Sensitivity is the ability to find correctly identify those with the disease (true positive rate). Specificity is the ability to correctly identify those without the disease (true negative rate)[1 pt. correct sensitivity, 1pt. correct specificity, 1 pt. interpretation of sensitivity, 1 pt. interpretation of specificity, no points deducted for not specifically stating 'true positive rate' or 'true negative rate', but both of these are correct]
5. $90/(90 + 4995) = 1.8\%$. There are many more people in the population who don't have the disease vs. those who have it. [1 pt. correct probability, 1pt. explanation]
6. Null hypothesis: Drug A is not more effective than the placebo in relieving pain symptoms. Alternative hypothesis: It is significantly more effect at relieving pain symptoms [2pts. Null hypothesis, 2 pts. Alt. hypothesis]
- 7.

	Relieved (Expected)	Not Relieved (Expected)
Placebo	53.9	203.1
Drug A	51.1	192.9

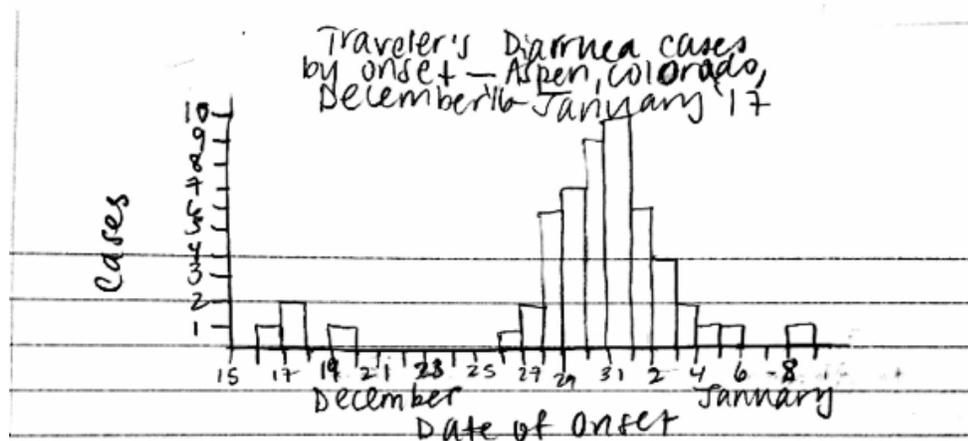
[1pt. for each correct entry in table, max. 4 pts.]

8. Drug A relieved more people than expected while the placebo did less (2 points). We cannot conclude causality though (or even significant deviation without a statistical test) [1 point]
9. If the null hypothesis is correct, there is a 0.47% chance that the data observed (or more extreme) occurs due to chance [2 points-full explanation needed-all or nothing]
10. Yes, we can [1 point] because it is beneath the threshold of 0.05 [1 point]

11. Type I: Incorrect rejection of true null hypothesis. Type II: Incorrectly retaining a false null hypothesis. [1 pt. each for definitions of Type I and Type II errors]

Part III (97 points)

1. Accept all reasonable answers that are not repeated, such as:
 - a. Health department surveillance records
 - b. Hospital discharge records
 - c. Mortality statistics
 - d. State or national data
 - e. Telephone surveys of physicians
 - f. Surveys of community[1 pt. for each reasonable source; max 3 pts]
2. 4 points for accurate plotting of data, 1 point for it being a histogram, 3 points for title and both axes labelled



3. Point source outbreak.[2pts] Foodborne diseases are typically point source because the source (food) is short-lived[2pts]
4. 1-3 weeks (accept any range that is around 10 days) [2pts]
5. There are 4 outliers at the beginning of the time period and one at the end [1 point]. These could indicate (accept other reasonable answers) [3 points]:
 - a. Unusually short/long incubation periods
 - b. Original sources of disease (the 4 outliers)
 - c. Secondary cases
6. Incidence = $10/200 = 5\%$, Prevalence = $(0 + 1 + 2 + 6 + 7 + 9 + 10) / 200 = 17.5\%$ [1 pt. incidence rate, 1 pt. prevalence rate]
7. Identifying information, demographic information, clinical information, risk factor information [1 pt. each, max. 4]

8. Case Control: Odds Ratio, Cohort: relative risk [1 pt. each for type of study, 1pt. each for correct corresponding statistic]

9. [1/2 point for each pro or con, only need two pros and two cons for each type to get max 4 pts.]

Case Control—Pros: Can study rare diseases, relatively fast, relatively less expensive; Cons: Time-order confusion, Error in recalling past exposures, Bias when selecting controls, can't calculate relative risk

Cohort—Pros: Most accurate observational study (can calculate relative risk), can study rare exposures, prospective/chronological in time; Cons: Time consuming, expensive, can lose subjects to followup

10. Case control [1 pt.]

11. Odds ratio. Can't use relative risk because we don't know total population sizes.[1 pt.]

12. Calculations shown:

Staying at Holiday Chalet or Ski Resorts Intl: $(50 * 93) / (4 * 7) = 166$

In Aspen longer than 1 week: $(46 * 59) / (8 * 41) = 8.3$

Drink bottled water only: $(6 * 89) / (48 * 11) = 1$

Skier or snowboarder: $(26 * 13) / (28 * 87) = 0.14$

Age under 6: $(26 * 85) / (28 * 15) = 5.3$

Hotel's restaurant or room service food: $(25 * 39) / (29 * 61) = 0.55$

Employed in Aspen: $(6 * 92) / (48 * 8) = 1.4$

[lose 1 pt. from the max 5 for each incorrect/skipped calculation but can't go below Opts]

13. Staying at one of the hotels and being in Aspen longer than a week, and being under the age of 6 seem to be strongly associative (odds ratio $\gg 1$). Being a skier and being a hotel employee seems to be protective (OR $\ll 1$) [0.5 pt. each for associative factors (max 1 pt.) and 0.5 pt. each for protective factors (max 1 pt.)]

14. Accept reasonable answers. Includes:

-More controls

-Match control demographics with case demographics

-Separate the two hotels

[1 pt. per response, max. 2 pts]

15. Accept reasonable answers. Includes:

-Being from Russia and attending the trade conference

-Employees at the hotel

-being under 6 years old and attending a daycare

-Stayed at one of the hotels
[1 pt. each, max. 3 pts]

16. [1/2 point for each name, 1/2 point for each example, max. 6 pts.]

Susceptible host: human
Infectious agent: pathogen
Reservoir: Contaminated water
Portal of exit: Not really applicable
Means of transmission: Water
Portal of entry: Oral ingestion

17. [1/2 point for naming, 1/2 point for example, max. 4 pts.]

Person: A person who has visited Aspen, especially at one of the hotels or as a worker
Place: Aspen
Time: In the months of December 2016-January 2017
Clinical Information: Exhibits symptoms listed in case exposition

18. Possible, probable, confirmed [1/2 point for naming and explanation each]

Accept reasonable examples:
Possible: Had contact with hotel, has some symptoms
Probable: Had contact with hotel, exhibits most symptoms
Confirmed: confirmed with laboratory analysis

19. $25/104 = 24\%$ [1 pt.]
 $2/39 = 5.1\%$ [1 pt.]

20. Infectivity: $48/104 = 46\%$ [2 pts.]
Pathogenicity: $25/48 = 52\%$ [2 pts.]
Virulence is a relative term, but accept $2/48 = 4.2\%$ [2 pts.]

21. Accept reasonable reasons [1 pt. each, max 3 pts]. Includes:

ELISA test was a false positive (no actual presence)
Symptoms did not manifest themselves
Still in incubation period

For ELISA positivity without disease, accept false positive or asymptomatic carrier [1 pt.]

22. Ski babies: 25/104
All others: 3/83

Relative risk: $(25/104)/(3/83) = 6.65$ [3 pts. For correct relative risk; if correct relative risk not calculated give 1 pt. each for correct ski babies risk or 'other' risk above]

23. Accept reasonable answers, including:

Recommend to parents to not bring sick children to school
Clean and disinfect surfaces
Inspect water stores
Clean and disinfect kitchen utensils
[1 pt. each correct measure, max 4pts.]

24. Production, processing, distribution, preparation, mishandling at multiple points. If the cook is implemented, it is probably preparation, although others could be explained. [1 pt. each stage in chain listed, max. 5, plus 1 pt. for reasonable method, for max. total 6 pts.]

25. Foods that are not boiled (examples okay) [1 pt.]

26. [0.5 pts. each component in triad, 0.5 pts each component in context of study, max 6 pts.]
Agent: *Giardia*
Host: Human
Environment: Water

27. Accept reasonable answers, including:

Wash hands and surfaces often
Separate raw produce from other foods
Cook to right temperature and boil water
Refrigerate foods promptly
Don't bring sick kids to school
Seek medical attention if needed
[1 pt. each, 4 pts. max]

28. Written or oral report [1 pt. each, max 2 pts.]

Part IV (49 points)

All questions: 1 pt. each, all or nothing

1. Parasite
2. Virus
3. Parasite
4. Bacteria
5. Bacteria
6. Bacteria
7. Parasite
8. Virus
9. Bacteria
10. Bacteria

11. I
12. B
13. G
14. H
15. C
16. J
17. A
18. F
19. K
20. E
21. D

22-35 2 points each, if multiple answers, need all for credit; all or nothing

22. A
23. B,D
24. B,C,D,E
25. B, D
26. D
27. C
28. E
29. A,B,C
30. A,B,C
31. A, C, D
32. B
33. B
34. All answers accepted because of typo on test
35. A,B,C

Part V (10 points)

Grade holistically

Approximate Breakdown

2 pts. Identifying a relevant, recent outbreak

3-4 pts. Details of outbreak

up to 6 pts. Detailing CDC response and management of outbreak