Background:

Legionella is a genus of over 60 species of gram negative intracellular bacteria. In endemic areas, legionella are found in low concentrations in most freshwater sources like lakes, rivers, and sewers. In their natural habitat, legionella live inside bacteria eating amoeba and protozoa. All species are considered pathogenic, but Legionella pneumophila is the most common disease causing agent. Legionella spreads through aerosolized droplets and multiply inside alveolar macrophages in the body. They are capable of causing a severe pneumonia known as Legionnaires’ disease and a less severe form called pontiac fever. Legionnaires disease has an incubation of 20-10 days. Symptoms always include fever, myalgia and pneumonia and commonly include shortness of breath, headache, confusion, nausea, diarrhea. Hospitalization is common in cases of Legionnaires’ disease and the mortality rate is around 10 percent. However, only around 5% of those exposed actually develop the infection. Pontiac fever is theorized to be a reaction to Legionella endotoxins and occurs 24-72 hours after exposure. Though cases lack pneumonia, they still retain symptoms of fever and myalgia. Pontiac fever is self limiting to slightly less than a week. Some risk factors of Legionnaires’ disease are:

- Age ≥50 years
- Smoking (current or historical)
- Chronic lung disease (such as emphysema or COPD)
- Immune system disorders due to disease or medication
- Systemic malignancy
- Underlying illness such as diabetes, renal failure, or hepatic failure
- Recent travel with an overnight stay outside of the home, including stay in a healthcare facility
- Exposure to hot tubs
- Travel to hospital, nursing home or cruise within the last 10 days

Legionella is treated with with antibiotics but they must have high intracellular penetration. The incidence of legionella is increasing, with about 1.8 cases per 100,000 pop reported in 2016. However, many epidemiologists believe Legionnaires’ disease is underreported.

1. Define and provide 2 examples of a chronic and acute disease (6pts)

- Chronic example: Diabetes
- Acute example: Appendicitis
- Chronic example: Asthma
- Acute example: Malaria
- Chronic example: Hypertension
- Acute example: frostbite
- Chronic example: meningitis
- Acute example: pneumonia

2. According to your definitions, what is pontiac fever? (1pt)

   a. acute
   b. chronic

3. According to your definitions, what is legionnaires’ disease? (1pt)

   a. acute
   b. chronic

4. List the steps in the chain of transmission (6 pts)
5. Acanthamoeba, an ubiquitous freshwater bacterivore differs little on the cellular level with mammalian cells. Acanthamoeba are commonly found with legionella like endosymbionts. Bacteria isolated from Acanthamoeba are often associated with higher efficacy in invading human tissue and resistance to antibiotics. What would Acanthamoeba be to legionella? Explain why (4 pts)

a. A reservoir
b. A biological vector
c. A mechanical vector
d. A host

TB1: Acanthamoeba is also a human pathogen. List some diseases it causes, symptoms or risk factors (up to 6 points)

6. Droplets of legionella are around (1pt)

a. 100-10 μm
b. 10-5 μm
c. Less than 5 μm

Pneumonia outbreak at [REDACTED]

It is July 12th, 2014, the dog days of summer, your family is on vacation in Singapore but you’re stuck working at your local health office in the sleepy town of [REDACTED], population . You receive a call.”we would like to report a case of Legionnaires’ disease” says hospital clerk.”Ok” you say, “tell me about the case”. The hospital clerk happily obliged. “2 days ago, a 17 year old hispanic male was admitted to our hospital. The patient was brought in by his mother after he experienced coughing and a fever of 39.7 degrees celsius. His mother said that he started complaining of chest pains on the 9th. When we performed a radiograph on him, we
found he had pneumonia. He was attending the summer school at [REDACTED] high school. We issued a culture, but the results are not yet conclusive. However, the urine antigen test we performed yesterday turned out positive. The patient is still in our ICU, receiving treatment. “keep us updated you say, we’ll give you [DATA EXPUNGED] in return” you say. You put down your phone, surprised, immediately your mind begins to race.

7. Please fill out the case report (the case report is attached next to the test files) (10 points)  

8. According to the case report, is this patient a probable or confirmed case? (1 point)

____________________________________________________________________________

9. Please define both terms (2 points for each)

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

10. Define sensitivity (2pts)

____________________________________________________________________________

11. If the urine antigen test for legionella has a 73.2% sensitivity rate, how many false negatives would you expect to find in a sample of 829 cases? Show work (3pts)

____________________________________________________________________________

12. Using the above information, find the PPV, if possible. (3pts)

____________________________________________________________________________

13. What type of error would be a false negative be? (2pts)

____________________________________________________________________________

The CDC prefers 2 methods to diagnose legionella: culture or a urinary antigen test, here are some pros and cons to these tests:

**Culture:**
Can detect all serotypes and species of legionella  
Takes longer to get a confirmation  
  
Slightly higher specificity  
Lower sensitivity  
  
Can be taken anywhere  
More expensive  
  
Urinary test:  
  
Cheaper  
only detects legionella pneumophila serogroup 1  
  
Quicker  
slightly lower specificity  
  
Higher sensitivity  
For questions 14-19 (1pt each), say which test would be better to use  

14. An immunocompromised patient who already has all the clinical symptoms of Legionnaires’ disease, including pneumonia
____________________________________________________________________________

15. A patient reporting symptoms of Legionnaires’ disease without an immediately identifiable cause of infection
____________________________________________________________________________

16. Someone who insists he or she must have gotten Legionnaires’ disease because he or she visited a place where an outbreak occurred.
____________________________________________________________________________

17. An air conditioning cooling tower suspected to have caused an outbreak of legionella
____________________________________________________________________________

18. A patient that tested positive in paired serology (another diagnostic test) who you want to compare to other patients and environments.
____________________________________________________________________________

19. An elderly person who attends a nursing home which recently had an outbreak of Legionella pneumophila serotype 1 and who has been complaining of coughing.
____________________________________________________________________________

20. According to the above information, would this be considered an outbreak? List 2 reasons why or why not. (5pts)
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

21. Define active and passive surveillance and provide an example (6pts):
____________________________________________________________________________
____________________________________________________________________________
TB2: define either sentinel, public health or syndromic surveillance and provide an example (up to 2 pts, ONLY DO 1)

22. The hospital themselves reported the first case, is this active or passive surveillance (1pt)?

23. By offering [DATA EXPUNGED] what have you done to the mode of surveillance (2pts)?

24. What type of surveillance, active or passive is more likely to underreport cases and why? (3pts)

25. Why would you want to investigate this? Give 3 reasons (3pts):

Your team decides to investigate further. You make calls to arrange an investigation. Soon, your assistant returns with some papers. “Sir, I have bad news. We found 9 more cases of Legionnaires disease and 11 cases of Pontiac fever, additional reports might still be coming in, All cases seem to have occurred at [REDACTED] high school”.

26. Which step of an outbreak investigation are you on now? (1pt)

27. After 5 more steps, which step would you be on? (2 pts)

28. Is a general or specific case definition better right now? Please explain why (3pts)
### Cases of Legionnaires’ Disease

<table>
<thead>
<tr>
<th>Case #</th>
<th>Date of onset</th>
<th>Chest pain</th>
<th>coughing</th>
<th>Diarrhea</th>
<th>fever</th>
<th>gender</th>
<th>age</th>
<th>occupation</th>
<th>culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/9</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>m</td>
<td>17</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>7/9</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>f</td>
<td>15</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>7/10</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>f</td>
<td>39</td>
<td>teacher</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>7/10</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>m</td>
<td>73</td>
<td>Substitute</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>teacher</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7/10</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>y</td>
<td>m</td>
<td>25</td>
<td>Teaching assistant</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>7/11</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>m</td>
<td>56</td>
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<td>+</td>
</tr>
<tr>
<td>7</td>
<td>7/11</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>m</td>
<td>56</td>
<td>administrator</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>7/11</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>45</td>
<td>SRO</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>7/12</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>m</td>
<td>61</td>
<td>teacher</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>7/13</td>
<td>n</td>
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<td>y</td>
<td>y</td>
<td>f</td>
<td>14</td>
<td>Student</td>
<td>-</td>
</tr>
</tbody>
</table>

### Cases of Pontiac Fever

<table>
<thead>
<tr>
<th>Case #</th>
<th>Date of onset</th>
<th>headache</th>
<th>Muscle aches</th>
<th>Diarrhea</th>
<th>fever</th>
<th>gender</th>
<th>age</th>
<th>occupation</th>
<th>culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/8</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>m</td>
<td>43</td>
<td>teacher</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>7/9</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>m</td>
<td>29</td>
<td>Teaching assistant</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>7/10</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>17</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>7/10</td>
<td>n</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>15</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
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<td>y</td>
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<td>y</td>
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<td>38</td>
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<td>+</td>
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<tr>
<td>6</td>
<td>7/11</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>35</td>
<td>teacher</td>
<td>+</td>
</tr>
<tr>
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<td>---</td>
</tr>
<tr>
<td>7</td>
<td>7/11</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>m</td>
<td>18</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>7/11</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>60</td>
<td>administrator</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>7/12</td>
<td>y</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>m</td>
<td>16</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>7/12</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>y</td>
<td>m</td>
<td>15</td>
<td>student</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>7/13</td>
<td>y</td>
<td>y</td>
<td>n</td>
<td>y</td>
<td>f</td>
<td>17</td>
<td>student</td>
<td>+</td>
</tr>
</tbody>
</table>

**New cases of Legionnaires disease and pontiac fever**

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013 (current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legionnaires disease</td>
<td>8</td>
<td>0</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>pontiac fever</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

**Census data of the town of [REDACTED] (in 100,000)**

* In the year of 2011, the town of [REDACTED] was split in two to deal with the booming population

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>population</td>
<td>1.1</td>
<td>0.4</td>
<td>0.47</td>
<td></td>
</tr>
</tbody>
</table>

29. What are the 4 components of a case definition (4pts)?

______________________________________________________________________________

______________________________________________________________________________

30. What are the 3 components of the epi triad? (3pts)

1. _______________________________________________________________________

2. _______________________________________________________________________

3. _______________________________________________________________________

31. What are the 3 components of the *descriptive* epi triad? (3pts)

1. _______________________________________________________________________

2. _______________________________________________________________________

3. _______________________________________________________________________

32. What part of the descriptive epi triad would column 2 of the graph be? (1pt)

______________________________________________________________________________

33. What part of the descriptive epi triad would column 9 of the graph be? (1pt)

______________________________________________________________________________
34. Based on your current knowledge, write a case definition for this outbreak: (6 pts)
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

35. What are the first and second graphs called? (2 pts)
____________________________________________________________________________

36. Please construct an epi curve for cases of Legionnaires’ disease. Label the axes and the title. (10 pts)

37. Define an epi curve (2 pts)
____________________________________________________________________________
____________________________________________________________________________

38. What type of epicurve is this? (2 pts)
____________________________________________________________________________

39. What does this type of epi curve tell you about the exposure period of the outbreak? (4 pts)
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

40. What do the cases of pontiac fever tell you about the outbreak? (4 pts)
____________________________________________________________________________
____________________________________________________________________________
41. Calculate the incidence of Pontiac fever in 2010 (per 100,000 people) (2pts)

42. If the incidence of Legionnaires disease in 2012 was 2.3 per 100,000 people, what was the population at the time in 100,000s? Round to the nearest hundredth. (3 pts)

43. What is the period prevalence of Pontiac fever between 2010-2012 (3pts)

As you gaze over your results, you see the majority of the outbreak seems concentrated at [REDACTED] high. You order an investigation quickly. You need to hire some people: To the left are the positions you need. To the right are the people you are considering hiring or recruiting. Match the candidates to their jobs (6pts):

<table>
<thead>
<tr>
<th>person</th>
<th>role</th>
</tr>
</thead>
<tbody>
<tr>
<td>44. sanitarian</td>
<td>A. interviews cases and provides first aid</td>
</tr>
<tr>
<td>45. School officials</td>
<td>B. Tells of the general school layout and student activities</td>
</tr>
<tr>
<td>46. janitor</td>
<td>C. informs and enforces relevant health related legislation</td>
</tr>
<tr>
<td>47. Lab technician</td>
<td>D. informs the public of necessary health measures</td>
</tr>
<tr>
<td>48. nurse</td>
<td>E. has extensive knowledge of cleanliness in the school</td>
</tr>
<tr>
<td>49. reporter</td>
<td>F. Cultures and performs diagnostic tests</td>
</tr>
<tr>
<td></td>
<td>G. provides medication to cases</td>
</tr>
</tbody>
</table>
After a long day of calling and hiring, you dive to your empty apartment and slump down on the couch. You see that your wife has sent pictures from their vacation in Singapore. As you scroll through the photos you absentmindedly turn on the TV to your favorite channel. Instead, you are met with the blare of a news jingle, “Deadly outbreak of Legionella at [REDACTED] high school, are health officials doing enough!!??” says the news anchor with too much hairspray in her hair. You audibly groan.

50. What are 2 benefits of widespread news coverage of an outbreak (2pts)?
   a. ______________________________________________________________________
   b. ______________________________________________________________________

51. What are 2 disadvantages of widespread news coverage of an outbreak (2pts)?
   a. ______________________________________________________________________
   b. ______________________________________________________________________

The next morning, you arrive bright and early to the school. The school Principal, Dr. Vasich, greets you. “I promise to do everything I can to aid in your investigation. He says as sweat forms on his brow.” “Tell me about your school, you say”. “[REDACTED] high school is one of the biggest high schools in the region.” Vasich begins. “As, such it is the perfect campus for summer school. Students from schools across the county come here to attend our prestigious summer school which began on Monday July 7th. Before then the school had been closed down for repairs. [REDACTED] high has a North and East campus. Each campus has separate amenities like plumbing, air conditioning and electricity though they all come from a single underground pipe. The east campus has been used extensively for summer school while our sports teams have also been utilizing the north. Teachers usually go between the buildings to relax at the several teachers lounges we have scattered through the building. he finishes. “Thank you” you say

At this point you are considering closing the school

52. What are 2 benefits of closing the school? (2pts)
   a. ______________________________________________________________________
   b. ______________________________________________________________________

53. What are 2 downsides of closing the schools (2pts)?
   a. ______________________________________________________________________
A day later your assistant briefs you on the current status of the outbreak. “After narrowing our reach to the school we’ve sent out a custom questionnaire to everyone attending the school. “ she says. “There have been 2 additional cases of Legionnaires’ disease and we’ve discovered 117 probable cases of Pontiac fever. Parents of those hospitalized filled out the cases forms to the best of their ability”. I’m happy to say that we only have 2 non responses! Next up is the sanitarian “I’ve reviewed the school and found many unsanitary places.” he says, straightening his glasses “First, there are stagnant pools in the greenhouse that the biology teachers use for breeding fish, secondly there is an open fountain in the school’s atrium that students used to toss coins into but is now scummy with biofilms, there is also a hot tub in the north teacher’s lounge which the janitor ahs told me is not regularly emptied.” his look of disdain at the school shines clearly through his forced neutrality. “Tomorrow I’m going with the janitor to take samples and start and environmental investigation”.

54. Why would a custom questionnaire be more beneficial than a general form? List 2 reasons (2pts)
   a.  
   b.  

55. Why would Pontiac fever likely be underreported as seen above? (3pts)
   
Here are a list of the risk factors your assistant included on the questionnaire:
   - Attended class in the east campus
   - Attended class in the north campus
   - Ate lunch in the atrium (has an uncovered bird bath)
   - Had class in the greenhouse (uncovered fish breeding pools)
   - Bathed in the hot tub (teachers only)
   - Visited a hospital within the last 10 days
   - Washed themselves in the river (sports teams)

55. Please write a hypothesis supporting eating lunch in the atrium as the cause of the outbreak. (4pts)
56. Please write a null hypothesis for washing themselves in the river being the cause of the outbreak. (4pts)

Cases of Legionnaires’ disease at REDACTED high by exposure

<table>
<thead>
<tr>
<th></th>
<th>Sick</th>
<th>Not sick</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attended east building</td>
<td>10</td>
<td>116</td>
<td>126</td>
</tr>
<tr>
<td>Attended north building</td>
<td>3</td>
<td>34</td>
<td>37</td>
</tr>
<tr>
<td>Exposed to covered atrium fountain</td>
<td>10</td>
<td>69</td>
<td>79</td>
</tr>
<tr>
<td>Entered the greenhouse</td>
<td>1</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Visited a hospital within the last 10 days</td>
<td>1</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>Bathed in river</td>
<td>3</td>
<td>23</td>
<td>26</td>
</tr>
<tr>
<td>Visited hot tub</td>
<td>7</td>
<td>23</td>
<td>30</td>
</tr>
</tbody>
</table>

Note: REDACTED high has 153 students in total, there are 12 total cases of Legionnaires’ disease.

57. Please define and provide the pros and cons of a case control study (5pts):

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
57. Please define and provide the pros and cons of a cohort study (5pts):

______________________________________________________________________________
______________________________________________________________________________

58. For this case which study design would you choose and why? (6 pts):

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

59. For this study, how would you measure association? (1pt)
   a. Odds ratio
   b. Fisher’s exact test
   c. ANOVA
   d. Relative risk

60. Calculate the risk associated with visiting the greenhouse (show work) (3pts):

______________________________________________________________________________

61. Calculate the attributable risk of eating in the atrium (show work) (3pts):
62. List the top 3 risks most likely to have caused the disease, ranked lowest to highest (6pts):
1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________

63. Please calculate the chi square values for those 3 (with Yates correction) (show work) (12 pts)
1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________

1. ________________________________________________________________
2. ________________________________________________________________
3. ________________________________________________________________

### Percentage Points of the Chi-Square Distribution

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Probability of a larger value of $\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.99</td>
</tr>
<tr>
<td>1</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>0.020</td>
</tr>
<tr>
<td>3</td>
<td>0.115</td>
</tr>
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<td>4</td>
<td>0.297</td>
</tr>
<tr>
<td>5</td>
<td>0.554</td>
</tr>
<tr>
<td>6</td>
<td>0.872</td>
</tr>
<tr>
<td>8</td>
<td>1.647</td>
</tr>
</tbody>
</table>

64. Using the above p value table, please determine if the chi square values you calculated above are statistically significant (use 95%) (3pts)
1. ________________________________________________________________
2. ________________________________________________________________
3. What does this mean? (4pts)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

65 The health data gathered in your investigation was from a voluntary survey. What bias may this have caused? (3pts)

______________________________________________________________________________

66. This type of bias has a tendency to _______ estimate incidence. (2 pts)
   a. Over
   b. under

67. Though the hot tub showed the highest risk, you don’t trust the results completely. Why so? (3pts)
   a. Selection bias
   b. Confirmation bias
   c. Congruence bias
   d. Confounding
   e. Recall bias

68. Explain your reasoning:

______________________________________________________________________________
______________________________________________________________________________

69. You decide to do something about this and separate those who visited the hot tub above age 55 and above with those under 55

<table>
<thead>
<tr>
<th></th>
<th>&lt;55 yrs</th>
<th>≥ 55 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case</td>
<td>control</td>
<td>Case</td>
</tr>
<tr>
<td>Entered hot tub</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Did not enter hot tub</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

70. Now calculate the mantel haenszel test for you risk entry (show work) (4pts)
71. What seems to be the cause of the outbreak (2pts)?

72. Provide 3 reasons why you believe so (use Hill’s criteria) (6pts)
   a. ____________________________________________________________
   b. ____________________________________________________________
   c. ____________________________________________________________

74. List Hill’s criteria (4pts):
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

While you have been investigating the outbreak, the lab tech has fervently been culturing samples that you collected from around the school. Soon he calls you back with results “we’ve completed our environmental study” he says, I’ll fax you the results!

75. When the lab tech was culturing the bacteria, what step of Koch’s postulates would he be on? (2pts)

76. List Koch’s postulates (4pts):
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

Results from the Lab

Lake strain
Hospital strain
Sewer strain
Fountain strain
TB3. What is this technique called and what is its purpose? (4pts)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

77. Do the lab results support or contradict your investigation? Explain. (3 pts)
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

78. What strain looks seems to me the original strain that contaminated the fountain? (2pts)
   a. Lake
   b. Hospital
   c. sewer

79. List up to 5 control methods to deal with the outbreak
   a. ____________________________________________
   b. ____________________________________________
   c. ____________________________________________
   d. ____________________________________________
   e. ____________________________________________

Finally the investigation concludes, you smile. Helping save people's lives is so great, you think. It’s days like this that you’re proud to be an epidemiologist.
.........................................................................................
And that's all I wrote.