Virginia Science Olympiad
Division B
Disease Detectives
February 28, 2009

Team Number: _____ School Name: _____

Student Names: _____, _____

I. Water Quality, Water Pollution, Water Demands

Giardiasis outbreak from a chlorinated community water supply.
Can J Public Health. 1990 Sep-Oct;81(5):358-62

"A giardiasis outbreak from a chlorinated, unfiltered surface water supply in Penticton, British Columbia (pop. 25,000) from June to August 1986 resulted in 362 laboratory-confirmed cases. A telephone survey estimated an attack rate of over 12%. A reservoir pond containing Giardia-infected beaver was implicated as the source. A case-control study with 65 cases did not find any significant associations. A retrospective case-finding survey of records from eight (out of 35) general physicians estimated that 1,500 physician visits occurred and produced an epidemic curve in close parallel with that from laboratory-confirmed and reported cases. Despite improvements on the reservoir, another outbreak occurred when this water source was reinstituted in October for several weeks, confirming our conclusion that it was the source of the first outbreak. Various options for reducing the risk of future outbreaks are being explored including full water treatment."

1. An important step in an epidemiological investigation is choosing the appropriate study design. Each design has strengths and weaknesses. The above study used a case-control design. Name 3 other study designs and list one strength and one weakness for each type of study design including the case-control design. (5 points)

Study Design	Strength	Weakness
Case-Control	Good for rare disease or long latency, examine multiple exposures from a single outcome; less expensive and quicker to conduct than cohort study	Possible error in recalling past exposure (*Recall Bias*). Possible time-order confusion
Cohort Study	Examining multiple outcomes for a single exposure; examine rare exposures (such as asbestos but not for rare disease); can	Not good for rare diseases; costly in time and resources; possible loss to follow up over time; factor, which may be many years

	calculate the incidence of disease (while case control cannot); best technique for an outbreak in a small, well-defined population; most accurate observational study	in the past or may be seen as socially (un)desirable
Cross sectional	Relatively short duration; can study several outcomes; least expensive	Since exposure and disease status are measured at the same point in time, it may not always be possible to distinguish whether the exposure preceded or followed the disease.
Experimental or Trial	Most scientifically sound; best measure of exposure	Time consuming and expensive

2. A model known as "chain of infection" is used to describe the process for an infection and disease to occur in an individual. Speculate on the "chain of infection" for the Giardia outbreak above and propose a mechanism for control or prevention in each part of the chain. (20 points)

Chain of infection
Reservoir: Beavers, dogs, cattle, sheep
Infectious Agent: protozoa - *Giardia lamblia*
Susceptible Host: High risk groups include infants, young children, internationally adopted children travelers and the immunocompromised;
Portal of Entry: Gastrointestinal system via ingestion
Mode of transmission: fecal-oral, food-borne, water-borne
Portal of exit: gastrointestinal tract; defecation

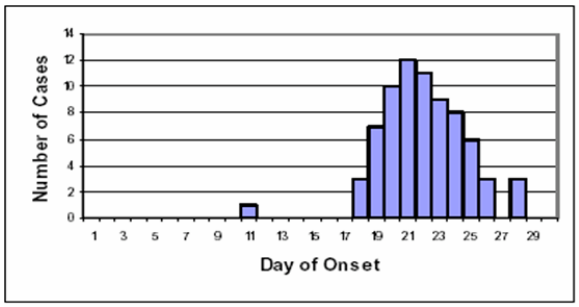
Control/Prevention
Treat water: Boiling water for 10 minutes
Treat with iodine
Filtration to remove Giardia cysts
Strict handwashing
Treat the infected such as food handlers.

3. The above study used an epidemic curve which is an important method to graphically depict outbreaks.

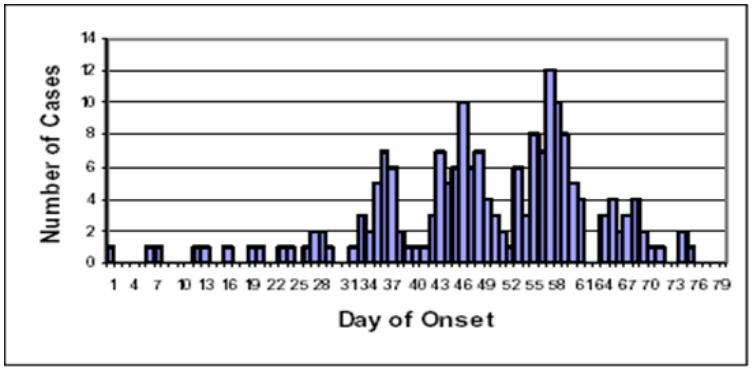
a) An epidemic curve can be useful to evaluate the pattern of spread. Please list 3 other uses of an epidemic curve. (3 points)

Assess the magnitude
Evaluate time trends
Examine Outliers
Estimate the exposure period

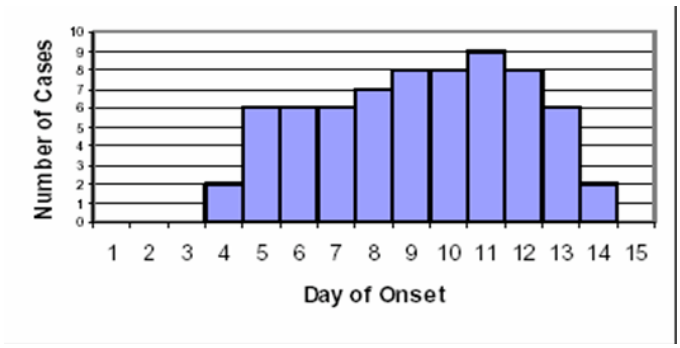
b) Please identify and label the type epidemic curves below. One example of a type of epi curve is Common Source with Intermittent Exposure. (3 points)



Type: Point Source Outbreak



Type: Propagated Outbreak



Type: Common Source Outbreak with Continuous Exposure

4. Giardia is a parasite that is a public health concern with water contamination. Name two other types of infectious agents and an example for each that can cause waterborne diseases. (4 points)

Type Infectious Agent	Example
Parasite	Giardia
Bacteria	E. coli, Vibrio cholerae, shigella, salmonella, legionella,
Virus	Hepatitis A, polio virus, adenovirus, coronavirus

5. Among the 139 households interviewed, the investigators identified 147 laboratory-confirmed cases of giardiasis and 239 controls who had neither diarrhea nor positive stool samples. 108 cases reported drinking 2 or more glasses of municipal water per day and 86 controls reported drinking 2 or more glasses of municipal water per day. Please calculate the association between drinking 2 or more glasses of municipal water and giardiasis, and interpret the findings. (10 points)

	Cases	Controls
Yes to ≥ 2 glasses of municipal water	108	86
No	39	153

Odds Ratio = (108)*(153) / (86 * 39) = 4.9
Interpretations: People who consumed ≥ 2 glasses of municipal water are 4.9 times more likely to develop giardiasis than those who do not.

II. Food Quality and Food Contamination

Multistate Outbreak of Salmonella Infections Associated with Peanut Butter and Peanut Butter-Containing Products --- United States, 2008—2009
(http://www.cdc.gov/mmwr)

On November 25, 2008, an epidemiologic assessment began of a growing cluster of Salmonella serotype Typhimurium isolates that shared the same pulsed-field gel electrophoresis (PFGE) pattern in PulseNet. As of January 28, 2009, 529 persons from 43 states and one person from Canada had been reported infected with the outbreak strain.

Confirmed, reported onset of illness dates have ranged from September 1, 2008, to January 16, 2009. A total of 116 patients were reported hospitalized, and the infection might have contributed to eight deaths. Sequential case-control studies have indicated significant associations between illness and consumption of any peanut butter and specific brands of prepackaged peanut butter crackers but no association with national brand jarred peanut butter sold in grocery stores. Epidemiologic and laboratory findings indicate that peanut butter and peanut paste produced at one plant are the source of the outbreak. These products also are ingredients in many foods produced and distributed by other companies. This outbreak highlights the complexities of "ingredient-driven" outbreaks and the importance of rapid outbreak detection and investigation. Consumers are advised to discard and not eat products that have been recalled.

6. Each year there are an estimated 76 million cases of food borne illness. Salmonella is one infectious agent responsible for 33,000 hospitalizations and 1,600 deaths per year in America. Please list 3 other pathogens that are also responsible food borne illnesses. (3 points)

E. coli
Campylobacter
Listeria
Toxoplasma

7. For this study, a case was defined as infection with the outbreak strain of *S. Typhimurium* in a person without preceding diarrheal illness in household members and who did not live in an institutional setting, with illness onset (or, if that date was not known, with date of isolation of Salmonella) on or after November 1, 2008. Please list the 4 components of a case definition. (4 points)

a. Clinical information
b. People: characteristics of people with the condition/disease.
c. Location or place
d. Time

8. Please list 4 recommendations for food handlers to prevent food borne illnesses. (4 points)

- Wash hands, knives, and cutting boards and other work surfaces after each handling of uncooked food.
- Wash raw produce thoroughly before serving it or placing it on work surfaces for preparation.
- Keep prepared produce refrigerated until served.
- Keep uncooked meats separate from vegetables, cooked foods, and ready-to-eat foods.
- Cook raw meat thoroughly.

- Cook leftover foods or ready-to-eat foods until they are steaming hot.
- Do not allow food workers to work when they are experiencing a gastrointestinal illness.

III. Infectious Disease Outbreaks

Methicillin-Resistant *Staphylococcus aureus* Among Players on a High School Football Team --- New York City, 2007

On September 12, 2007, the New York City Department of Health and Mental Hygiene (DOHMH) was notified of three players on a Brooklyn high school football team with culture-confirmed methicillin-resistant *Staphylococcus aureus* (MRSA) skin and soft tissue infections (SSTIs). During August 19—24, the team had attended a preseason football training camp, where all 59 players on the team lived together in the school gymnasium. An investigation by DOHMH revealed four culture-confirmed and two suspected cases of MRSA (total of 6 cases) among 51 players interviewed. Of the six cases, three involved abscesses that required incision and drainage. The risk for MRSA infection was higher among those who shared towels during the training camp than among those who did not. In addition, the six players with MRSA infections had a mean body mass index (BMI) that was significantly higher than the mean for those who were not infected. Similar outbreaks have been reported among football teams in which inadequate hygiene, combined with skin injuries and living in close quarters, contributed to the spread of MRSA infection. Such outbreaks might be prevented by better educating players and coaches regarding SSTIs and by better promoting proper player hygiene, particularly during training camps.

9. What is the attack rate? (1 point)
Attack rate = 6/51 = 11.8%

10. Interviews with the players revealed that 10 had shared towels and 4 of those who shared towels developed SSTIs, while 41 did not share towels and 2 of those who did not share towels developed SSTIs. Please calculate the association between sharing towels and SSTIs, and interpret the findings. (10 points)
Attack rate for towel sharer = 4/10 = 40%
Attack rate of not sharing towels = 2/41 = 4.9%

Relative Risk = 40/4.9 = 8.16

Interpretation: The risk of SSTIs in those who shares towels is 8.16 times higher than the risk in those who do not share towels

11. Describe the steps for an outbreak investigation. (8 points)
1. Establish the existence of out break
2. Verify the diagnosis
3. Define and identify cases
    a. Establish a case definition

b. Identify and count cases
4. Perform descriptive epidemiology
5. Develop hypothesis
6. Evaluate hypothesis
7. Implement control and prevention
8. Communicate finding

12. One factor leading to the emergence of infectious diseases is population growth. Name 5 other factors. (5 points)
Speed of travel
Global climate changes
War and social disruptions
Increase antibiotics use in both human and animals
Dam building
Human and animal contact

13. Define the following terms. (7 points total; 1 point each)
a. Virulence the severity of disease that the agent causes in the host; the propensity of an agent to cause severe disease and is measured by case fatality ratio; refers to the proportion of persons with clinical disease who become severely ill or die.

b. Infectivity the capacity to cause infection in a susceptible host; the propensity for transmission measured by secondary attack rate

c. Pathogenicity: the capacity to cause disease in a host; the propensity of an agent to cause disease or symptoms; refers to the proportion of infected persons who develop clinical disease

d. Incubation period: The period between exposure to the agent and the onset of disease or infection

e. Carrier is a person without apparent disease who is nonetheless capable of transmitting the agent to others.

f. Herd immunity People who are resistant to agent can limit spread to the relatively few whom are susceptible by reducing the probability of contact between infected and susceptible persons.

g. Fomite: a physical object that can transmit infectious agents from person to person

Tie Breaker

Every team should answer the following question, but it will be used only to break a tie.

Please fill in the table below with different modes of transmission for infectious disease, and for each mode of transmission give examples of the transmission mode, examples of the disease, and examples of a control/prevention method. (Give as many examples as possible; each example given is worth 1 point.)

Mode of Transmission	Example of the Mode	Example of the disease	Example of control/prevention
Direct contact	Kissing, skin to skin contact, blood transfusion	infectious mononucleosis Hepatitis	
Droplet Spread (direct spray over a few feet)	Coughing, sneezing	Influenza,	
Airborne	Suspended air particles	Plague, tuberculosis	
Vehicleborne	Contaminated food, clothing	E. coli, salmonella, listeria, cholera	
Vectorborne	Fleas, ticks, mosquitoes	Lyme disease (tick); Yellow fever (mosquitoes); rocky mountain spotted fever (tick)	