Palmyra-Macedon Science Olympiad Invitational

DISEASE DETECTIVES

TEAM #	
SCHOOL	
NAME	
NAME	
TOTAL SCORE	
PLACE	

Exploring the World of Science

Outbreak Summary

At least 70 people attending a national conference in a city in Texas became ill with what appeared to be food poisoning. Three hospitals in the area treated and released 48 attendees who complained of nausea and vomiting; others with similar symptoms were hospitalized overnight. A health official noted that all of the patients had eaten brunch or lunch at the same hotel.

The hotel's lunch menu included roast chicken, roast beef, and a vegetable pasta dish. Because some of the people who became ill were vegetarian, there was particular interest in determining whether the pasta dish might be contaminated. At the time of the report, health officials were still looking for the source of the outbreak. The hotel was cooperating in the investigation and had voluntarily halted food service for the time being.

Questions

1. Explain why you might consider this problem important enough to investigate. Give at least three reasons for investigating.

2. Briefly describe the initial steps that you would take in investigating this problem. Indicate the type of data needed to accomplish each step and give examples of sources of such data in a community.

1

3. Develop and specify probable hypotheses to explain the cause, source, and spread of the outbreak.

4. Describe approaches to testing alternative hypotheses.

5. Develop suitable recommendations and interventions for controlling the problem.

Tiebreaker #1

Please match the following outbreak settings with the agent causing the outbreak. Some diseases may be used more than once or not at all.

Outbreak Settings

1. __ Kitwit, Zaire, 1995
2. __ Jack-in-the-Box, Pacific NW, 1993
3. __ New Mexico/Arizona Four Corners, 1993
4. __ Meatpacking plant employees, Omaha, 1999
5. __ Public school students eating frozen strawberries, United States, 1997
6. __ Restaurant-associated, Kearney, 1999
7. __ Mosquito-associated, New York City, 1999
8. __ "Party in the Pasture" or Cornstalk, Illinois, 1999
9. __ Laboratory Monkeys, Reston, VA, 1989
10. __ Salad-bar associated bioterrorism event, Oregon, 1987

Agent Causing Outbreak

A. Shigella
B. Hepatitis A
C. Salmonella
D. Ebola/Ebola related viruses
E. E. coli O157:H7
F. Rubella
G. Hantavirus
H. Measles
I. West Nile Virus
J. Botulism

Problem: E. coli and Salmonella

Read the following summary.

An outbreak of E. coli O157:H7
gastroenteritis occurred in central
Nebraska in February and March of
1999. E. coli O157:H7 is a bacteria
that produces a toxin that can cause diarrhea (often
bloody), abdominal cramps, and can affect the
kidneys. E. coli O157:H7 can be transmitted person-
to-person via the fecal-oral route. E. coli O157:H7
can also be transmitted by contaminated food or
water. Nationwide, there has been evidence that ill
food handlers may have been the source of an
outbreak. Children aged less than 16 years and
adults aged greater than 65 years are at greater risk
of developing complications, including kidney failure.
A total of 72 persons became ill. Nearly all of the
affected person experienced diarrhea and abdominal
cramps. Eight persons required hospitalization,
including one child who required dialysis due to
kidney failure. Of the 72 ill persons, 65 were exposed
while dining at the family reunion on February 26 and
seven were exposed secondarily.

See Also...

Answer Key

Questions

1. Construct 2 case definitions differentiating how the ill
   persons were exposed. (5 points each)

   Primary case-patient:

   Secondary case-patient:

Telephone interviews were conducted over a period of two weeks to obtain food and illness history. Analysis of the food history and illness data yielded two food items associated with illness. The following are the 2 x 2 tables for the food items.

Ranch Dressing

	Got ill?		
	Yes	No	Total
Ate the dressing?			
Yes	18	17	35
No	46	54	100
Total	64	71	135

Iceburg Lettuce

	Got ill?		
	Yes	No	Total
Ate the lettuce?			
Yes	57	29	86
No	8	40	48
Total	65	69	134

2. Calculate the attack rate for each food item. (5 points each)

3. Which food item explains the greater percentage of illness? (3 points)

4. During the course of the environmental investigation, it was learned that the ranch dressing was used in preparation of the seafood salad. Describe how you would account for this in your analysis. (10 points)

5. As well as interviewing the attendees, another important group to interview is the food handlers. These interviews will help shed light on the origin of the outbreak. Please list five items of information that you should obtain from the food handlers. (10 points)

6. John Snow detected the source of an outbreak of (2 points)

   A. Typhoid fever
   B. Cholera
   C. Malaria
   D. Plague

7. John Snow stopped the above outbreak by removing the handle of a neighborhood water pump. (2 points)

   True/False

8. A cohort study is used in an outbreak setting when a complete list of participants is available. (2 points)

   True/False

9. The measure of risk used in a cohort study is the odds ratio. (2 points)

   True/False

10. A case-control study is used in an outbreak setting when a complete list of participants is available. (2 points)

    True/False

11. The measure of risk used in a case-control study is the odds ratio. (2 points)
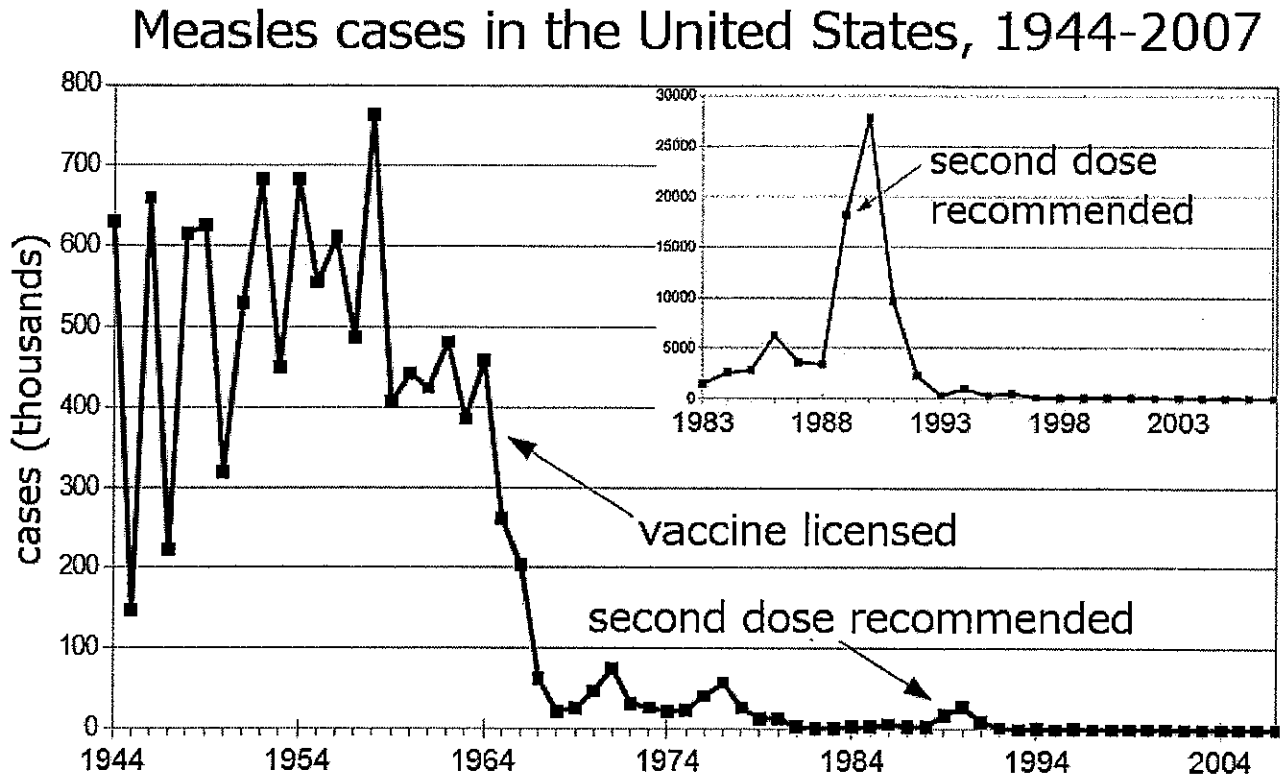
    True/False

The following co-workers became ill following an in-office Chinese New Year celebration held on February 3 at 12:00 PM:

Chris (February 4, 4:00 a.m.)
Karen (February 4, 7:30 a.m.)
Bob (February 4, 10:00 a.m.)
Tom (February 4, 10:00 a.m.)
Josh (February 4, 8:00 p.m.)
Jane (February 4, 11:30 p.m.)
Adi (February 4, 12:00 p.m.)
Wayne (February 4, 11:00 a.m.)
Kim (February 4, 9:00 a.m.)
John (February 4, 4:12 p.m.).

12. Please construct an epidemic curve using 2-hour increments on the graph paper provided. Please include a legend for the figure. (5 points)
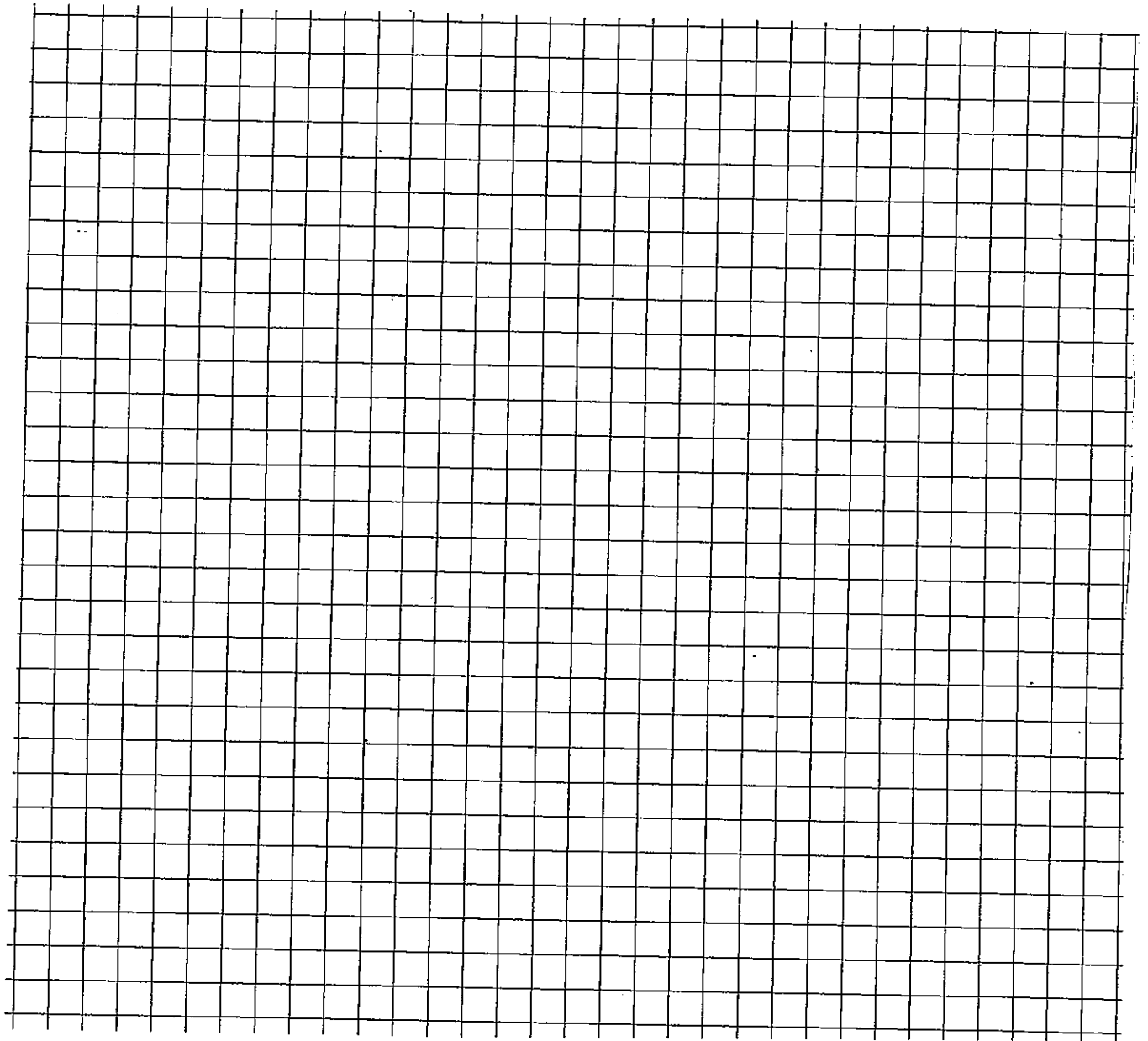
13. Describe the historical (1950 to 1996) trend of measles in the United States, using the graph below. Include your interpretation of the impact of the measles vaccine. (10 points)

Measles cases in the United States, 1944-2007

second dose recommended

vaccine licensed

second dose recommended

14. In the late 1980s and early 1990s, outbreaks of measles occurred on numerous college and high school campuses. Give your impression(s) as to what factors allowed this to occur. (5 points)

15. As a result of this increase of measles, what public health recommendation(s) was/were made? (5 points)

16. Describe the trend of salmonellosis in the United States from 1966 to 1996 and include three possible reasons for the change. (10 points)

17. Salmonella is detected and grown during routine stool culture for enteric pathogens. Salmonella is further typed by identifying antigens on its cell body (O antigen) and flagella (H antigen) to determine setotypes. Serotypes are very useful epidemiologically. For example, S. enteriditis is the serotype most frequently associated with eggs. An increase in an uncommon serotyope raises suspicion of an outbreak. Using the graph on salmonella serotypes, describe the trend of salmonellosis in the United States from 1971 to 1996. How does this change your previous interpretation of salmonellosis in the United States? (10 points)

Disease Detectives Investigate West Nile Virus

CDC

Background: In late August 1999, an infectious disease specialist in a New York City hospital called the New York City Health Department to report 2 patients hospitalized with encephalitis (a clinical illness related to an inflammation of the brain tissues and frequently caused by viral infection). The health department contacted other hospitals in the area and identified 6 additional patients with similar illness. Public health surveillance conducted during August and September 1999 identified a total of 62 patients with encephalitis and positive tests for recent West Nile virus. Three of the 62 had only fever and headache and were not hospitalized.

✎**1. Define *Public Health Surveillance*.**

Background: Table 1 below shows the age and sex distributions of the 59 patients who were hospitalized and who had symptoms and positive lab tests for West Nile virus.

Table 1. Number of hospitalized patients with laboratory confirmed West Nile virus infection, New York City Department of Health, August 1 – September 31, 1999.

Age (yrs)	No. Patients (%)	Population At Risk	Calculations
0-19	2 (3)	2,324,081	_____
20-29	1 (2)	1,553,981	_____
30-39	3 (5)	1,549,111	_____
40-49	1 (2)	1,177,190	_____
50-59	9 (15)	867,331	_____
60-69	13 (22)	814,838	_____
70-79	18 (31)	534,785	_____
≥80	12 (20)	281,054	_____
Sex			
Male	31 (53)	4,289,988	_____
Female	28 (47)	4,812,383	_____

Source: Nash D, Mostashari F, Fine A, et al. 1999 West Nile Outbreak Response Working Group. The outbreak of West Nile virus infection in the New York City area in 1999. *NEJM 2001;344(24):1807-14.*

✎2. Based on the data in Table 1, for which two age groups was the apparent risk of West Nile virus infection greatest? In the space in Table 1, show each calculation to support your answer and give all units. (Note: units must be given to receive credit.)

(a)

(b)

✎3. For which single age group was the apparent risk the least? In the space in Table 1, show a calculation to support your answer and give all units. (Note: units must be given to receive credit.)

✎4. Given that mosquitoes transmit this disease, give two explanations for the age distribution.

(a)

(b)

✎5. For which gender group is the risk of infection highest? In the table, show your calculations and give all units. (Note: units must be given to receive credit)

✎6. For the group you determine to be at greatest risk, give one explanation that might account for the increased risk.

Background: Next, the investigators collected data for various risk factors for more severe illness, using three measures: muscle weakness, encephalitis, or death. The results are shown below in Table 2.

Table 2. Risk Factors for West Nile virus infection, New York City Department of Health, August 1 – September 31, 1999.

Risk Factor	Relative Risk (95% Confidence Interval)		
	Muscle Weakness	Encephalitis with muscle weakness	Death
Known history of immunosuppression	1.6 (1.0 – 2.6)	1.4 (0.4 – 11.1)	2.1 (0.5 – 8.1)
Coronary artery disease	1.2 (0.5 – 2.6)	1.4 (0.7 – 2.6)	2.0 (0.6 – 6.6)
Hypertension	1.6 (0.9 – 2.5)	1.2 (0.6 – 2.3)	2.1 (0.3 – 12.2)
Diabetes mellitus	1.0 (0.5 – 1.9)	1.3 (0.6 – 2.7)	5.1 (1.5 – 17.3)

Source: Nash D, Mostashari F, Fine A. et al., op cit

✎7. **From Table 2, the relative risk of death among people with diabetes mellitus appears to be substantially increased. Explain the quantitative meaning of this relative risk.**