2009 SCIENCE OLYMPIAD REGIONAL COMPETITION
FEB 28, 2009
Region II Northeast Michigan

DISEASE DETECTIVES
DIVISION B

Ana Villanueva-Salacata, M.D.

DO NOT WRITE ON THIS QUESTIONNAIRE. PLEASE WRITE YOUR ANSWERS ON THE ANSWER SHEET!

You are a recent graduate of the CDC's (Centers for Disease Control and Prevention) Epidemic Intelligence Service (EIS). You are ready for an adventure in infectious disease investigation.
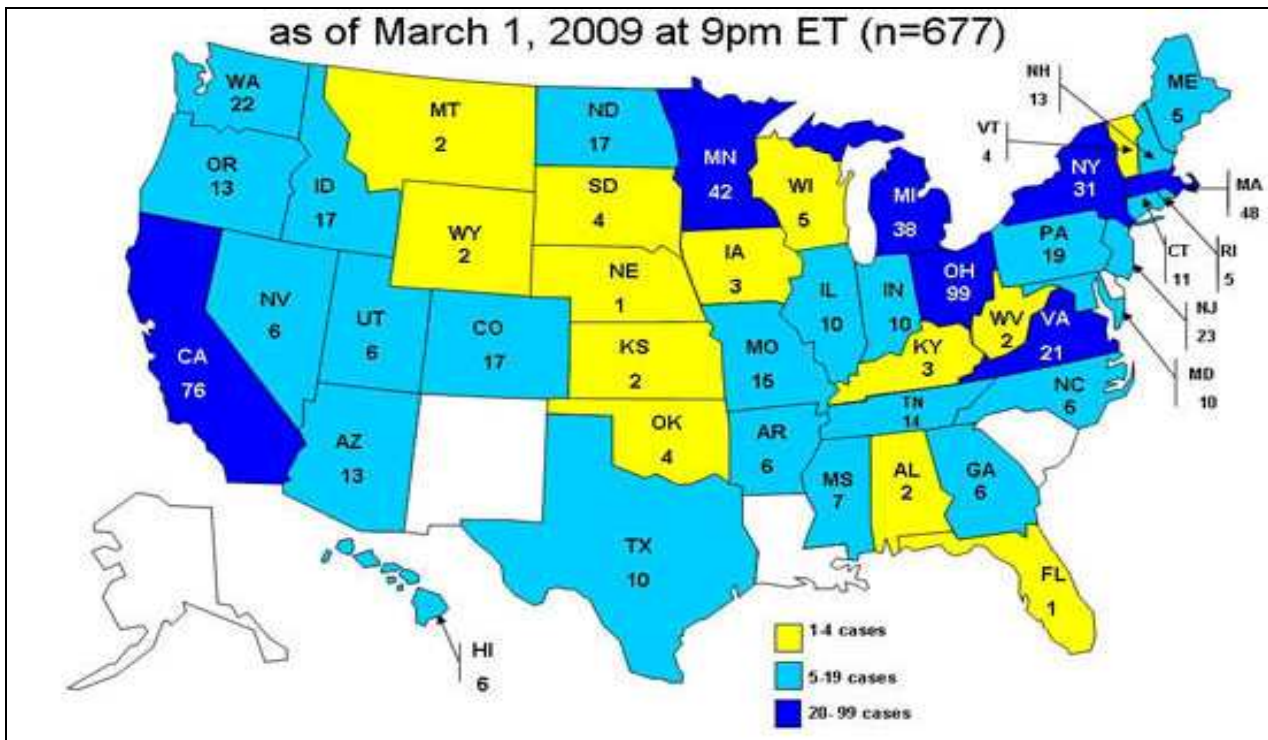
Infectious diseases are still one of the most common causes of illnesses and death around the world. With world population increasing and cities expanding at a steady rate, it is almost inevitable that certain infections will be transmitted easier.

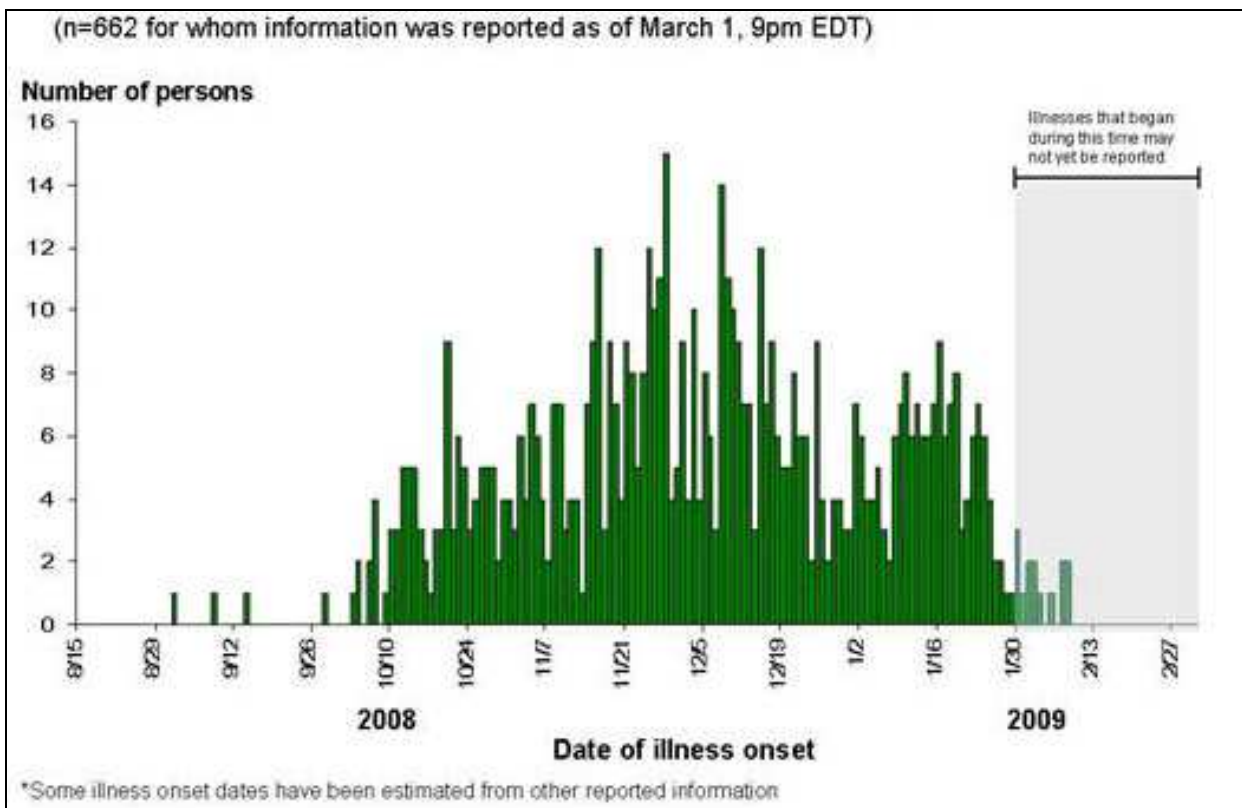There are many epidemics or outbreaks in the world still going on right now. Let's see what they are…
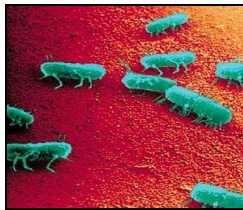
A. If you watch the news on TV or the internet, you would know that there is an outbreak of a disease that has spread to over 40 states since August 2008. This disease is caused by a Gram negative bacillus which is spread through ingestion of contaminated food items. The symptoms of the disease are diarrhea, fever, and abdominal cramps 12–72 hours after infection. Infection is usually diagnosed by culture of a stool sample. The illness usually lasts 4 to 7 days. Although most people recover without treatment, severe infections may occur. Infants, elderly persons, and those with impaired immune systems are more likely than others to develop severe illness. When severe infection occurs, the bacteria may spread from the intestines to the bloodstream and then to other body sites and can cause death unless the person is treated promptly with antibiotics.

1. What is the bacterium that is causing this multi-state outbreak? (Be specific)
2. The CDC has identified the source of this outbreak as a commonly eaten food item (especially young kids!). What is it?
3. If you were the first epidemiologist to investigate this outbreak, enumerate the steps you plan or will do. (10 points)

4. This map shows where laboratory-confirmed cases have been identified. Name the three states with the most number of cases. (3 points)

as of March 1, 2009 at 9pm ET (n=677)

5. What is this next illustration called?

(n=662 for whom information was reported as of March 1, 9pm EDT)

Number of persons

Illnesses that began during this time may not yet be reported

Date of illness onset

2008   2009

*Some illness onset dates have been estimated from other reported information

3

6. Can you determine the source of the outbreaks from the graph above? Briefly explain.

7. There are many infectious diseases that can be prevented. These measures can be used to prevent the spread of an outbreak or epidemic EXCEPT:
        a. hand washing and hygiene
        b. respiratory precautions
        c. vaccination campaign
        d. institute strict quarantine measures
        e. avoid eating all vegetables because they are hard to clean of germs

B. Measles is a highly contagious disease spread through coughing or sneezing. Symptoms can include rash, high fever, coughing, and runny nose. The disease can also cause more serious problems, such as ear infections, pneumonia, encephalitis (inflammation of the brain)—even death. It remains a leading cause of death among young children globally, despite the availability of a safe and effective vaccine. An estimated 197,000 people died from measles in 2007, mostly children under the age of five.

8. Measles is caused by a: a. bacterium b. virus c. fungus d. parasite e. protozoa

9. What are the ways to prevent this disease from spreading?
        a. identify cases as soon as possible and separate them from susceptible cases
        b. vaccinate susceptible persons
        c. eliminate mosquitoes by fumigation
        d. a & b
        e. b & c

From January through July 2008, CDC received reports of 131 measles cases from 15 states and the District of Columbia—the highest year-to-date number since 1996. More than 90% of those infected had not been vaccinated, or their vaccination status was unknown. Many of these individuals were children whose parents chose not to have them vaccinated. Fifteen of the patients, including four infants, were hospitalized.

10. The measles vaccine is included in one of these:
        a. OPV   b. DTP   c. MMR   d. HBV   e. BCG

11. True or False. Through the decades, the immunization of susceptible persons against many diseases like measles, rubella, chickenpox, diphtheria, polio and mumps has dramatically decreased their incidence and prevented many deaths.

C.   A massive epidemic is occurring in Zimbabwe, Africa today. According to the World Health Organization, over 600,000 cases have been identified and over 3,000 persons have died. This epidemic is caused by a bacterium that looks like a letter C. It has a tail called flagellum and its main symptoms are severe and profuse diarrhea causing rapid dehydration.

The Bad Bug

12. What is this disease called?

13. What is the organism that causes this (Genus & species)

14. What is the mode of transmission?
    a. direct contact   b. respiratory transmission c. oral-fecal route   d. mosquitoes

15. Some patients can die within hours of exhibiting the symptoms. Why is that?
    a. the bacterium is so virulent that it can cause septic shock and multiorgan failure within a few hours
    b. this infection causes a secretory type of diarrhea that causes rapid loss of fluids and electrolytes
    c. all patients affected have some form of malnutrition or immunodeficiency making them succumb faster to the infection
    d. the mosquito that is the vector in this infection also produces a special toxin that paralyzes the patient making breathing difficult

D. Match the Columns- Match Column A with Column B

16. **KNOW YOUR INFECTIOUS AGENT! (10 points)**

COLUMN A	COLUMN B
____1. Aspergillosis	a. virus
____2. Ebola	b. bacterium
____3. Malaria	c. protozoa
____4. *Giardia lamblia*	d. fungus
____5. *Ascaris lumbricoides*	e. helminth
____6. Dengue	
____7. AIDS	
____8. Rabies	
____9. *E. coli*	
____10. *Staphylococcus aureus*	

17. **DEFINITIONS**

COLUMN A	COLUMN B
____1. Epidemiology	A. relative pathogenicity of an infectious organism
____2. Prevalence	B. arthropods that transmit pathogens from one host to another
____3. Mortality Rate	C. sudden high incidence of disease in a given population
____4. Zoonosis	D. a worldwide epidemic
____5. Incidence	E. diseases seen in animals that can be passed on to humans
____6. Vector	F. constant low frequency of disease
____7. Endemic	G. science concerned with the prevalence & distribution of disease
____8. Pandemic	H. percent of total population that has the disease at a given time
____9. Outbreak	I. deaths per total infected
___10. Virulence	J. number of new cases during a period divided by the total population

E. Infectious diseases are spread faster in crowded places. The rapid increase in population due to high birth rate and migration in many cities in developing countries have contributed to outbreaks of certain diseases. One of the oldest infectious diseases that has devastated mankind throughout centuries is still prevalent. Tuberculosis continues to be a formidable disease. Over 8 million new cases of TB occur worldwide and 2 million deaths are attributed to this disease every year.   In the United States, it is estimated that 10-15 million people are infected with the TB bacteria and 22,000 new cases of TB occur each year.

18. Tuberculosis is caused by a bacterium called _____

19. True or False. Tuberculosis is transmitted through the respiratory route when an infected person coughs or sneezes and the bacteria are inhaled by a susceptible person. TB can spread from the lungs to almost every part of the body.

20. The following are people at risk of developing tuberculosis EXCEPT:

    a. persons with immunodeficiencies like cancer, on chemotherapy or infected with HIV
    b. those who live with persons who have untreated active TB
    c. nursing home residents
    d. foreign-born persons from high-prevalent countries
    e. people who have allergies to cats or dogs

In a hypothetical town in a developing country in Southeast Asia, the municipal health officer became alarmed by an increase in cases of tuberculosis. The persons he saw came down with a chronic cough, fever, night sweats and weight loss. The patients he sees are mostly poor and specialized laboratory tests are unaffordable. The doctor collected sputum from suspected cases for analysis.

21. Why is it important to get the sputum for testing? What are you looking for?

The following data were collected from this clinic:
　　　Total number of patients- 85
　　　　　Patients with symptoms of fever, weight loss & cough- 65
　　　　　　Of the 65:
　　　　　　　Sputum smear-positive- 49　　　Sputum smear-negative-16

　　　　　　Patients without symptoms- 20
　　　　　　　Sputum smear-positive- 2　　　Sputum smear-negative- 18

22. What is the Odds' Ratio that those who have symptoms have tuberculosis? Show your calculations.
　　　(5 points)

23. Looking at the data above, is it possible to have tuberculosis without actually having symptoms? Briefly discuss. (2 points)

24. Is it possible to have tuberculosis without having smear-positive sputum? Briefly discuss. (2 points)

25. As a public health officer, you can also make recommendations to stop the transmission of tuberculosis in the community. Which of the following would be **practical** recommendations for this town?

a. Tuberculosis is highly-infectious especially in closed living quarters where many people live in small spaces. You will start a case-finding mission to determine who else may have exposed to the patients who have tuberculosis and treat them as needed,

b. You will request the government to provide appropriate medicines to those who cannot afford to buy them and make sure the patients get their medications everyday (direct observational therapy or DOT) for 6-9 months.

c. You will organize educational outreach programs to the townspeople to dispel the stigma of tuberculosis and educate them on transmission, symptoms, prevention and treatment.
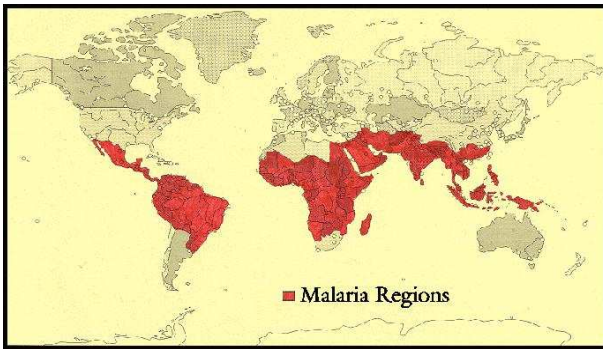
d. Provide masks and respirators for the whole town to use for the next 6-9 months while TB patients are under treatment

e. a, b & c

f. all of the above

g. none of the above

BONUS/TIE-BREAKERS:

Malaria Regions

About 40% of the world's population, mostly those living in the poorest countries, are at risk of malaria. Of these 2.5 billion people at risk, more than 500 million become severely ill with malaria every year and more than 1 million die from the effects of the disease.

Malaria is especially a serious problem in Africa, where one in every five (20%) childhood deaths is due to the effects of the disease. An African child has on average between 1.6 and 5.4 episodes of malaria fever each year. And every 30 seconds a child dies from malaria. (WHO April 2007)

26. Malaria is caused by what organism?
27. It is transmitted by what kind of vector?
28. What is the name of this vector?
29. T or F. If you are a millionaire, you most likely will not get malaria.
30. T or F. Long-lasting insecticidal nets can be used to provide protection to risk groups, especially young children and pregnant women in high transmission areas. This provides personal protection against the vector for malaria.

DIVISION B DISEASE DETECTIVES 2009

ANSWER KEY

1. *Salmonella typhimurium*
2. Peanut butter (a processing plant in Georgia)
3. 10 Points
   - a. Prepare to travel for field work. Gather your necessary equipment/
   - b. Establish the existence of an outbreak
   - c. Verify the diagnosis
   - d. Define and identify cases
   - e. Describe & orient the data in terms of time, place & persons. Create a line listing.
   - f. Develop hypotheses
   - g. Evaluate hypotheses
   - h. Refine hypotheses & carry out additional studies
   - i. Implement control & prevention measures
   - j. Communicate findings (reports, print or electronic media, scientific journals)
4. Ohio, California, Massachusetts
5. Epidemic curve (Epicurve)
6. No. There is no data that can be used to determine the source of contamination. There is no information on location, point-sources or incubation periods.
7. E
8. B
9. D
10. C
11. True
12. Cholera
13. *Vibrio cholerae*
14. C
15. B
16. Matching Type (10 Points)

1. D	6. A
2. A	7. A
3. C	8. A
4. C	9. B
5. E	10. B

17. Matching Type (10 Points)

1. G	6. B
2. H	7. F
3. I	8. D
4. E	9. C
5. J	10. A

18. *Mycobacterium tuberculosis*
19. True
20. E
21. The sputum can be collected, stained (Ziehl-Nielsen stain) and examined under light microscopy to look for the characteristic acid-fast bacilli (red or pink-staining rod-shaped bacteria) characteristic of *Mycobacterium tuberculosis.*
22. 5 POINTS

		SYMPTOMS OF THE DISEASE	
		Positive	Negative
T	Positive	49	2
E			
S	Negative	16	18
T			

8

Odds' Ratio= $\dfrac{a/b}{c/d}$

$= \dfrac{49/2}{16/18}$ $= 24.5/ 0.889$ $= \mathbf{27.6}$

Explanation- Patients who had symptoms had 27.6 times the likelihood of having tuberculosis than those who are asymptomatic.

23. 2 POINTS

Yes. There are two patients with positive sputum specimens who did not have symptoms. It is possible for a person to have minimal symptoms but can be highly-infective with TB.

24. 2 POINTS

Yes. Simple microscopic examination of a sputum specimen is not sensitive enough to detect all cases of tuberculosis so there might be some missed cases by sputum exam despite having symptoms. (More sensitive tests for sputum exam for TB is DNA assay)

25. E

Bonus/Tie Breaker-
26. *Plasmodium* species
27. Mosquito
28. *Anopheles* specie
29. False
30. True

Total points including bonus/tie breaker: 65 points

Source of map/epicurve- (updated today Mar 4)
http://www.cdc.gov/salmonella/typhimurium/update.html