Science Olympiad
Disease Detectives

B Division

10 Stations – 5 Minutes per Station

KEY

STATION 1 - Definitons

1. Define the following epidemiological terms:

(5) A. **Contagious –**

(5) B. **Host –**

(5) C. **Hypothesis -**

(5) D. **Necessary cause -**

(5) E. **Relative risk –**

(5) F. **Reservoir –**

(5) G. **Zoonosis -**

STATION 2 - Calculations

This table represents the results of a diagnostic test used to determine infection after exposure to a pathogen:

	# INFECTED	# NOT INFECTED	TOTAL
Positive test result	95	1485	1580
Negative test result	5	8415	8420
Total	100	9900	10000

1. From the table above, calculate the estimated prevalence:

2. From the table above, calculate the true prevalence:

3. What percentage of people received a false positive result from the above data?

STATION 3 – Situation #1

Use the following to answer questions 1 – 4.
On Sunday January 8, 2004 a veterinarian in New York, noticed that dogs in the kennels that had been boarded all weekend were acting sluggish and ill. The dogs were difficult to wake and were experiencing severe diarrhea. Eight of the ten dogs in this area were displaying the same symptoms.

1. What questions would you like to ask the vet?

2. Is this an epidemic why or why not?

3. What would be your initial steps of investigation of this problem be?

4. What would be a possible hypothesis to test related to this situation?

STATION #4 – Interpreting a table

Using the table answer the following questions:

Crude Death Rates for Ten Leading Causes by Race and Sex
Michigan Residents, 2001

Cause of Death	All Races			White			Black		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Heart Disease	271.4	268.5	274.0	277.8	272.7	282.8	261.0	271.1	252.1
Cancer	198.8	211.7	186.5	205.2	216.6	194.3	178.6	200.7	159.1
Stroke	57.4	45.7	68.6	59.7	46.5	72.4	50.0	45.4	54.0
Chronic Lower Respiratory Diseases	41.9	42.4	41.4	46.1	45.9	46.3	21.9	25.4	18.9
Unintentional Injuries	32.9	42.8	23.5	32.8	42.5	23.4	35.1	46.9	24.7
Diabetes Mellitus	26.8	24.2	29.2	26.7	24.5	28.7	29.0	24.4	33.1
Pneumonia/Influenza	20.9	19.8	22.0	21.5	19.8	23.2	19.6	21.5	17.9
Alzheimer's Disease	18.2	11.3	24.8	20.7	12.8	28.2	6.5	3.6	9.1
Kidney Disease	15.6	14.9	16.2	14.8	14.5	15.1	21.4	19.1	23.5
Septicemia	8.9	8.0	9.7	7.7	6.7	8.6	16.1	16.6	15.7
All Other Causes	181.6	189.2	174.3	176.0	177.3	174.7	226.9	274.7	184.7
Total	874.4	878.7	870.3	889.0	879.8	897.8	866.2	949.5	792.7

Note: Rates are per 100,000 population.

1. What was the second leading cause of death in all Races in Michigan in 2001?

2. What race and sex had the highest incidence of Diabetes Mellitus in 2001?

3. What was the actual number of people in Michigan that suffered a stroke in 2001?

4. Compare the occurrence of septicemia in relation to race.

Station #5 – General Questions

Answer the following questions.

1. Identify three modes of transmission.

2. Give an example of a fomite:

3. Give an example of a vector:

4. What is meant by random sampling?

5. What is bias?

STATION #6 – Make Graph

Represent the data presented in the following paragraph on a bar graph.

Status of the HIV/AIDS Epidemic in Michigan, 2005

Age at HIV Diagnosis 2000-2004: The proportion of persons diagnosed each year with HIV infection increased significantly among those diagnosed at 13-19 years from 2% to 4% (22 to 43 cases) and also increased significantly among those diagnosed at 20-24 years of age from 7% to 15% (61 to 142 cases). In all other age groups, the trends in new diagnoses are level. In 2004, there were 3 (<1%) persons diagnosed at 0-12 years of age, 43 (4%) 13-19 years, 142 (15%) 20-24 years, 116 (12%) 25-29 years, 150 (15%) 30-34 years, 159 (16%) 35-39 years, 140 (14%) 40-44 years, 92 (9%) 45-49 years, 63 (6%) 50-54 years, 35 (4%) 55-59 years, and 30 (3%) 60+ years.

STATION #7 – Situation #2

Given the following information answer the questions below.

Noroviruses are a group of viruses that cause the “stomach flu,” or gastroenteritis, in people. The “stomach flu” is NOT related to the flu (or influenza), which is a respiratory illness caused by a different virus. The term norovirus was recently approved as the official name for this group of viruses; previously it had been referred to as “Norwalk virus” or “Norwalk-like virus.” Norovirus illness usually begins 24 - 48 hours after exposure, but can appear as early as 10 hours after exposure. Symptoms usually include nausea, vomiting, diarrhea, and stomach cramping. Sometimes people have a low-grade fever, chills, headache, muscle aches, and a general sense of tiredness. The illness is usually brief, with symptoms lasting only 1 or 2 days. Norovirus disease is usually not serious, but people may feel very sick. Most people get better within 1 or 2 days, and have no long-term health effects from the illness. Sometimes people are unable to drink enough liquids to replace what they lose from vomiting and diarrhea, and they can become dehydrated and need to see a doctor. This problem usually occurs only among the very young, the elderly, and persons with weakened immune systems. Noroviruses are very contagious and spread easily from person to person. The virus is found in the stool and vomit of infected people. People can become infected in several ways, including eating food or drinking liquids that are contaminated by infected food handlers, touching surfaces or objects contaminated with norovirus and then touching their mouth before hand washing, or having direct contact with another person who is infected and then touching their mouth before hand washing. Outbreaks also have occurred from eating undercooked oysters harvested from contaminated waters - cooking kills the virus. Drinking water contaminated by sewage can also be a source of these viruses. Persons working in day-care centers or nursing homes should pay special attention to children or residents who have norovirus illness.

1. Identify prevention and control strategies for the containment of the norovirus.

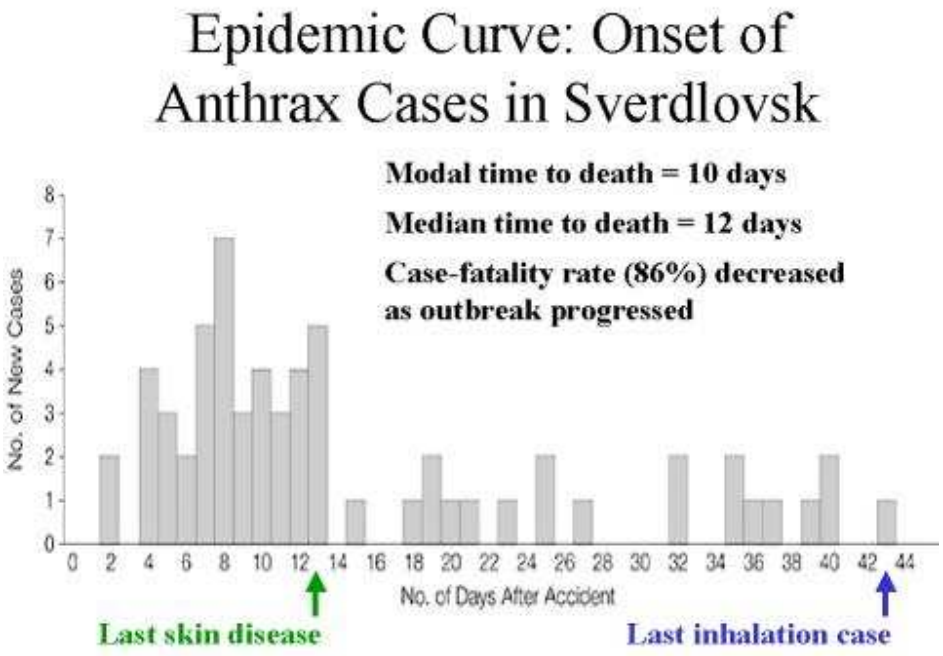
2. Why does the norovirus cause so much illness on cruise ships?

3. Who is at greatest risk from this virus?

4. Identify ways you can prevent the spread of norovirus?

STATION #8 – Epidemic Curve

Interpret the following epidemic curve and answer the question below.



1. Interpret the data presented on this Epidemic Curve.

STATION #9 – Situation #3

Read this excerpt from the FDA News and then answer the following questions.

FDA News

FOR IMMEDIATE RELEASE
P07-32
March 1, 2007

Media Inquiries:
Michael Herndon, 301-827-6242
Consumer Inquiries:
888-INFO-FDA

FDA Update on Peanut Butter Recall

Salmonella found in the ConAgra Plant

As a follow-up to the recent Salmonella outbreak linked to peanut butter, the U.S. Food and Drug Administration (FDA) is conducting an extensive inspection of ConAgra's Sylvester, Georgia processing plant. Samples collected by the FDA revealed the presence of Salmonella. The fact that FDA found Salmonella in the plant environment further suggests that the contamination likely took place prior to the product reaching consumers. Last week, tests by several states identified Salmonella in many open jars of Peter Pan and Great Value peanut butter recovered from consumers. In these instances, the Salmonella found in the plant and in the open jars matched the outbreak strain recovered from consumers who became ill.

Peanut Butter Toppings Part of Recall

FDA has learned that the ConAgra plant in Sylvester, GA, sent bulk Peter Pan peanut butter to its plant in Humboldt, TN. The three brands described below are part of the original Peter Pan recall. These brands have been recalled and are no longer being sold. However, some consumers may still have these products in their home.

Consumers who have any of the products listed below should discard them. Individuals who are not sure if the purchased product contains the recalled peanut butter topping should contact the store where the product was purchased.

1. What caused the peanut butter recall?

2. What are signs and symptoms of Salmonella poisoning?

3. In this instance what was the reservoir?

4. What was the portal of entry?

5. Give examples of how this situation can be prevented in the future.

STATION #10 – Stages of an Epidemiological Study
To be used as a tie-breaker if necessary.

Define each of the following steps of an epidemiological study, you may use examples.

Step 1: Prepare for Field Work -

Step 2: Establish the Existence of an Outbreak -

Step 3: Verify the Diagnosis -

Step 4: Define and Identify Cases -

Step 5: Describe and Orient the Data in Terms of Time, Place, and Person -

Step 6: Develop Hypotheses -

Step 7: Implementing Control and Prevention Measures -

Step 8: Evaluate Hypotheses -

Step 9: Communicate Findings -

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STATION 1 - Definitons

1. Define the following epidemiological terms:

(5) A. **Contagious -** Capable of being transmitted from one person to another by contact or close proximity.

(5) B. **Host -** A person or other living organism that is susceptible to an infectious agent under natural conditions.

(5) C. **Hypothesis -** A supposition, arrived at from observation or reflection, that leads to refutable predictions; any conjecture cast in a form that will allow it to be tested and refuted.

(5) D. **Necessary cause -** A factor that must be present for a disease or other health problem to occur.

(5) E. **Relative risk -** A comparison of the risk of a health problem in two groups.

(5) F. **Reservoir -** The habitat in which an infectious agent normally lives, grows, and multiplies. Humans, animals, and the environment can serve as reservoirs.

(5) G. **Zoonosis -** An infectious disease that is transmissible from animals to humans.

STATION 2 - Calculations

This table represents the results of a diagnostic test used to determine infection after exposure to a pathogen:

	# INFECTED	# NOT INFECTED	TOTAL
Positive test result	95	1485	1580
Negative test result	5	8415	8420
Total	100	9900	10000

1. From the table above, calculate the estimated prevalence:

100/10000 = 1%

2. From the table above, calculate the true prevalence:

95/10000 = 0.95%

3. What percentage of people received a false positive result from the above data?

1485/10000 = 14.85%

STATION 3 – Situation #1

Use the following to answer questions 1 – 4.
On Sunday January 8, 2004 a veterinarian in New York, noticed that dogs in the kennels that had been boarded all weekend were acting sluggish and ill. The dogs were difficult to wake and were experiencing severe diarrhea. Eight of the ten dogs in this area were displaying the same symptoms.

1. What questions would you like to ask the vet?
Any reasonable question would receive one point up to a total of 5.

2. Is this an epidemic why or why not?
This is an epidemic because there is a greater than expected number of cases for the K-9 population. (5)

3. What would be your initial steps of investigation of this problem be?
Question the vet, obtain samples, question the owners, assess the dogs, question the staff, collect information on breeds, any reasonable responses up to a total of 5.

4. What would be a possible hypothesis to test related to this situation?
Any reasonable hypothesis is worth 5 points.

STATION #4 – Interpreting a table

Using the table answer the following questions:

Crude Death Rates for Ten Leading Causes by Race and Sex
Michigan Residents, 2001

Cause of Death	All Races			White			Black		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Heart Disease	271.4	268.5	274.0	277.8	272.7	282.8	261.0	271.1	252.1
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Total	874.4	878.7	870.3	889.0	879.8	897.8	866.2	949.5	792.7

Note: Rates are per 100,000 population.

1. What was the second leading cause of death in all Races in Michigan in 2001? **(3)** **CANCER**
2. What race and sex had the highest incidence of Diabetes Mellitus in 2001? **(3)** **BLACK FEMALES**
3. What was the actual number of people in Michigan that suffered a stroke in 2001? **(3)** **5,740,000**

4. Compare the occurrence of septicemia in relation to race. **The occurrence of septicemia is higher among the black population. (3)**

Station #5 – General Questions

Answer the following questions.

1. Identify three modes of transmission.

(3) Direct, Indirect, Airborne, Droplet

2. Give an example of a fomite:

(3) Any inanimate object.

3. Give an example of a vector:

(3) Any injecting insect like a mosquito or a deer tick.

4. What is meant by random sampling?

(3) Everyone has the same likely hood of being selected in the sample.

5. What is bias?

(3) A systematic deviation from the truth; any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth.

STATION #6 – Make Graph

Represent the data presented in the following paragraph on a bar graph.

Status of the HIV/AIDS Epidemic in Michigan, 2005

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TITLE (1)

LABEL (1)

INCREMENTS (1)

(1) For the overall appearance

INCREMENTS (1)
LABEL (1)

STATION #7 – Situation #2

Given the following information answer the questions below.

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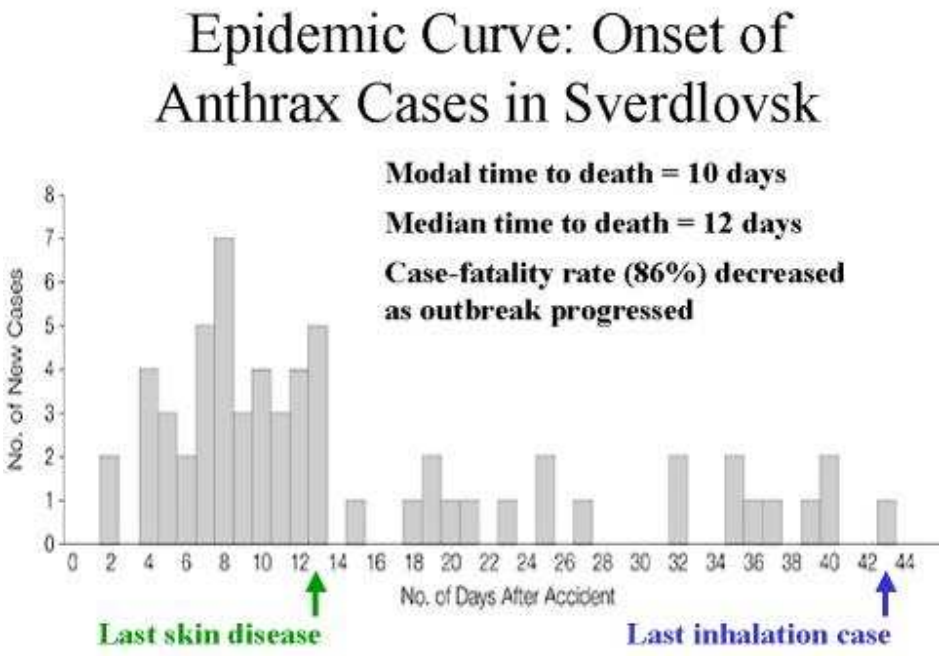
1. Identify prevention and control strategies for the containment of the norovirus. **Accept all appropriate answers up to a total of 5.**

2. Why does the norovirus cause so much illness on cruise ships?
(5) Close quarters, poor hand hygiene, large number of people, the use of hand rails, any acceptable response up to 5.
3. Who is at greatest risk from this virus?
(3) the very young, the elderly, and persons with weakened immune systems.
4. Identify ways you can prevent the spread of norovirus? **Avoid stool and vomit of infected people, don’t eat or drinking liquids that are contaminated by infected food handlers, hand washing, don’t eat undercooked oysters harvested from contaminated waters, avoid drinking water contaminated by sewage can also be a source of these viruses. (5)**

STATION #8 – Epidemic Curve

Interpret the following epidemic curve and answer the question below.



1. Interpret the data presented on this Epidemic Curve.

(10) This epidemic curve shows Anthrax cases in Sverdlovsk. The greatest occurrence happened within 2 weeks of exposure with the peak of 7 cases on the 8th day after exposure. The last case occurred on the 43 day after exposure. On the 13th day was the last time that the skin disease was present and on the 43rd day was the last inhalation case. Case fatality decreased as the outbreak progressed. Modal time to death was 10 days. Median time to death was 12 days.

STATION #9 – Situation #3

Read this excerpt from the FDA News and then answer the following questions.

FDA News

FOR IMMEDIATE RELEASE
P07-32
March 1, 2007

Media Inquiries:
Michael Herndon, 301-827-6242
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FDA Update on Peanut Butter Recall

Salmonella found in the ConAgra Plant

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Peanut Butter Toppings Part of Recall

FDA has learned that the ConAgra plant in Sylvester, GA, sent bulk Peter Pan peanut butter to its plant in Humboldt, TN. The three brands described below are part of the original Peter Pan recall. These brands have been recalled and are no longer being sold. However, some consumers may still have these products in their home.

Consumers who have any of the products listed below should discard them. Individuals who are not sure if the purchased product contains the recalled peanut butter topping should contact the store where the product was purchased.

1. What caused the peanut butter recall?
(3) Salmonella contamination

2. What are signs and symptoms of Salmonella poisoning?
(5) Nausea, vomiting, diarrhea, fever, malaise, weakness, chills, any five.

3. In this instance what was the reservoir?
(3) Tanks at the factory or jars of peanut butter.

4. What was the portal of entry?
(3) Oral consumption of contaminated peanut butter.

5. Give examples of how this situation can be prevented in the future.
(5) All acceptable answers up to 5.

STATION #10 – Stages of an Epidemiological Study
To be used as a tie-breaker if necessary.

Define each of the following steps of an epidemiological study, you may use examples.

Step 1: Prepare for Field Work – (5)

- **Research the disease and gather the supplies and equipment you will need**
- **Make necessary administrative and personal arrangements for such things as travel, and**
- **Consult with all parties to determine your role in the investigation and who your local contacts will be once you arrive on the scene.**

Step 2: Establish the Existence of an Outbreak – (5)

One of your first tasks as a field investigator, or disease detective, is to verify that a suspected outbreak is indeed a real outbreak. Before you can decide whether an outbreak exists (i.e., whether the observed number of cases exceeds the expected number), you must first determine the expected number of cases for the area in the given time frame.

Step 3: Verify the Diagnosis – (5)

First, you must ensure that the problem has been properly diagnosed—that it really is what it has been reported to be. Second, for outbreaks involving infectious or toxic-chemical agents, you must to be certain that the increase in diagnosed cases is not the result of a mistake in the laboratory. Verifying the diagnosis requires that you review the clinical findings (the symptoms and features of illness) and laboratory results for the people who are affected. Finally, you should visit several of the people who became ill. If you do not have the clinical background to verify the diagnosis, a doctor or other qualified clinician should do so.

Step 4: Define and Identify Cases – (5)

Establish a case definition. Your next task as an investigator is to establish a case definition, or a standard set of criteria for deciding whether, in this investigation, a person should be classified as having the disease or health condition under study. A case definition usually includes four components:

1. **clinical information about the disease,**
2. **characteristics about the people who are affected,**
3. **information about the location or place, and**
4. **a specification of time during which the outbreak occurred.**

Step 5: Describe and Orient the Data in Terms of Time, Place, and Person – (5)

Once you have collected some data, you can begin to characterize an outbreak by time, place, and person. In fact, you may perform this step several times during the course of an outbreak. First, by becoming familiar with the data, you can learn what information is reliable and informative (e.g., the same unusual exposure reported by many of the people affected) and what may not be as reliable (e.g., many missing or "don't know" responses to a particular question). Second, you provide a comprehensive description of an outbreak by showing its trend over time, its geographic extent (place), and the populations (people) affected by the disease. This description lets you begin to assess the outbreak in light of what is known about the disease (e.g., the usual source, mode of transmission, risk factors, and populations affected) and to develop causal hypotheses.

Step 6: Develop Hypotheses – (5)

In real life, we usually begin to generate hypotheses to explain why and how the outbreak occurred when we first learn about the problem. The hypotheses should address the source of the agent, the mode (vehicle or vector) of transmission, and the exposures that caused the disease. Also, the hypotheses should be proposed in a way that can be tested.

Step 7: Implementing Control and Prevention Measures – (5)

Control measures, which can be implemented early if you know the source of an outbreak, should be aimed at specific links in the chain of infection, the agent, the source, or the reservoir. For example, an outbreak might be controlled by destroying contaminated foods, sterilizing contaminated water, destroying mosquito breeding sites, or requiring an infectious food handler to stay away from work until he or she is well.

Step 8: Evaluate Hypotheses – (5)

The next step is to evaluate the credibility of your hypotheses. There are two approaches you can use, depending on the nature of your data: 1) comparison of the hypotheses with the established facts and 2) analytic epidemiology, which allows you to test your hypotheses.

Step 9: Communicate Findings – (5)

Your final task in an investigation is to communicate your findings to others who need to know. This communication usually takes two forms: 1) an oral briefing for local health authorities and 2) a written report.