2009 SCIENCE OLYMPIAD
DISTRICT 2 REGIONAL
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DISEASE DETECTIVES
DIVISION C

The Global Disease Detective

Ana Villanueva-Salacata, M.D.

DO NOT WRITE ON THE QUESTIONNAIRE. WRITE YOUR ANSWERS ON THE ANSWER SHEET.

Congratulations! You just graduated from the Centers for Disease Control and Prevention's (CDC's) Epidemic Intelligence Service (EIS) Program. You are now a Disease Detective.

Before you could celebrate your accomplishment, a call comes in. Your first assignment!

Destination 1: North America

The Scenario:

On December 12, 2008, your department was informed that three states, Minnesota, Michigan and Connecticut reported several cases of an illness that comprised of patients being admitted to the hospital for fever, diarrhea and abdominal cramps. Most patients recovered within a few days but a few developed severe complications and died.

Not all infectious cases are reported to the CDC. There is usually a more compelling reason to get a federal agency involved in investigations and management of diseases.

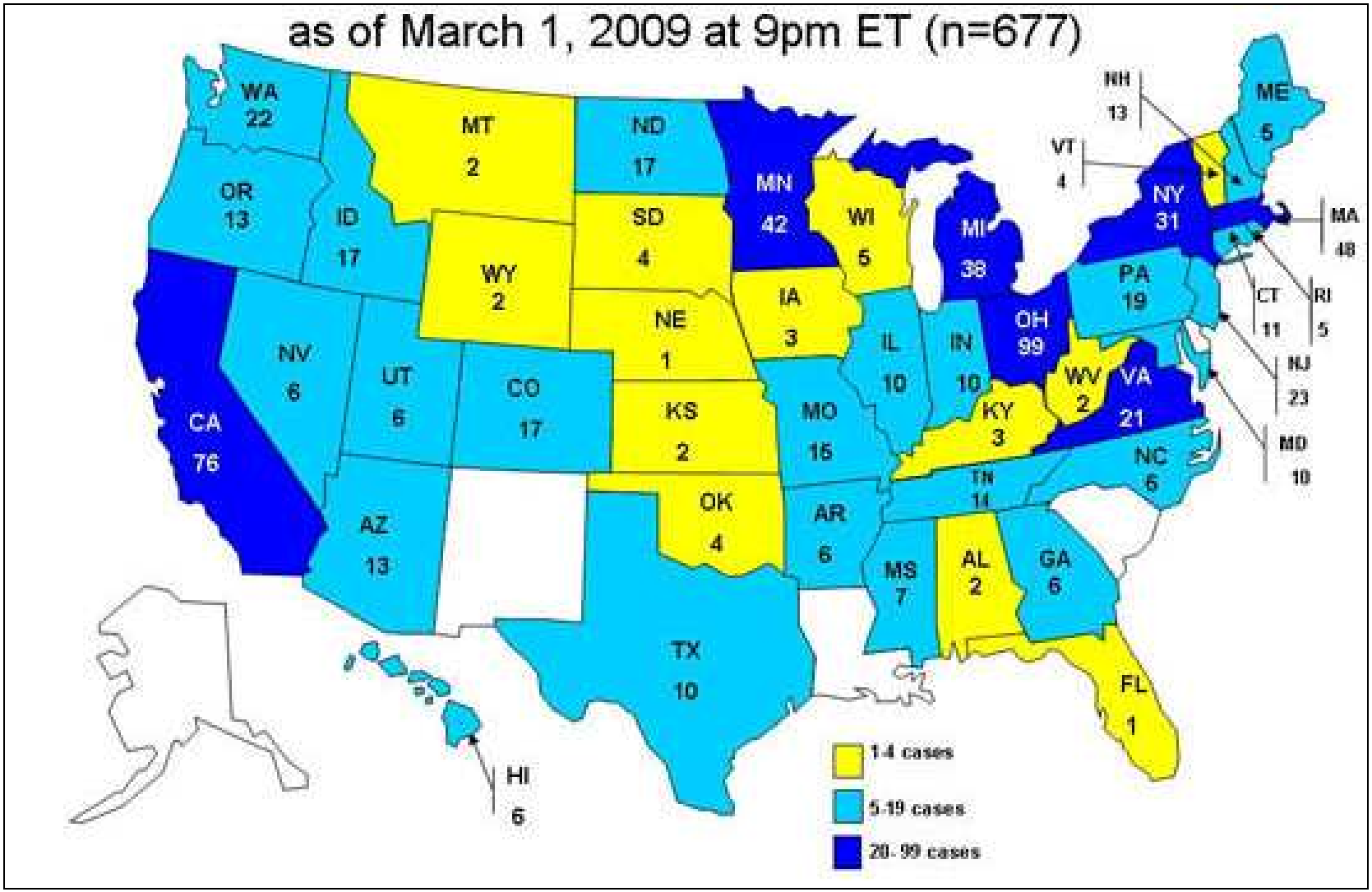
1. Why do you think the CDC was asked to help in this outbreak?
    a. The new EIS officers needed to get experience in their line of work
    b. All gastrointestinal infections have to be reported to the CDC
    c. There might be evidence of multistate outbreaks of the same disease requiring federal assistance
    d. State health investigators may not be able to handle these cases by themselves
    e. There are not enough infectious disease doctors in these states

2. By the time you start your investigation, multiple outbreaks involving more than 40 states have already been confirmed with one type of organism causing the infection. This has been in the news almost every day. What infectious agent is implicated in these recent outbreaks? (Genus and species)

3. Define: Outbreak_____
4. Define: Epidemic_____

5. The organism that is identified in this recent outbreak is a:
    a. virus
    b. bacterium
    c. fungus
    d. protozoan

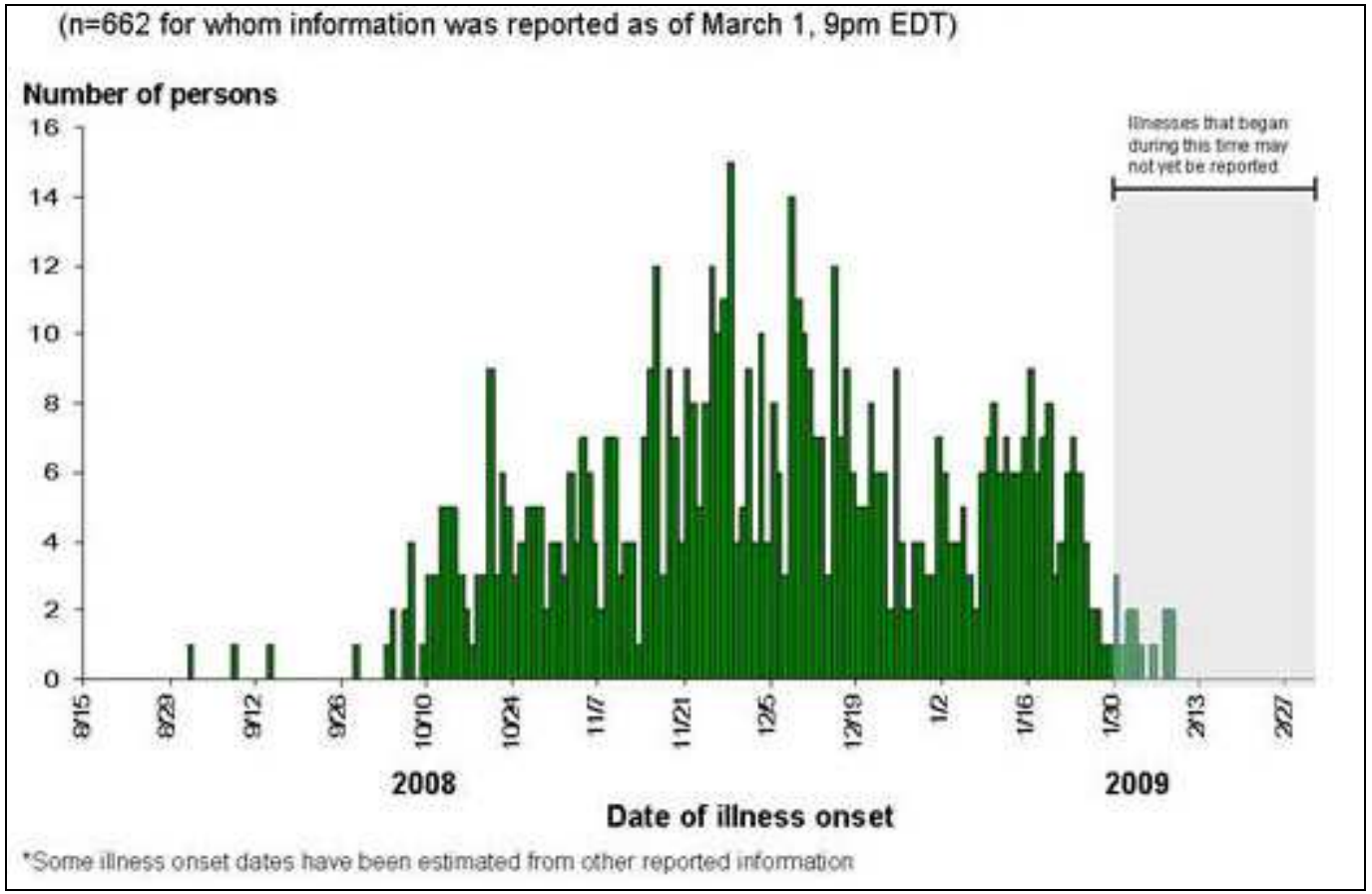
The number of cases with the outbreak strain of the disease is shown in this map.



6. Which three states reported the most number of cases? (3 points) _____

7. In this map of the United States, can you determine the source of the outbreak? YES OR NO
   Briefly support your answer. (2 points) _____

The data below show the number of cases since the onset of this outbreak.



8. Which of this statement is TRUE about the graph above?

a. The incubation period of the illness can be ascertained from this graph
b. The etiology of the disease can be determined by this illustration
c. The majority of cases occurred in the weeks between Nov. 14 and Dec. 19
d. This outbreak is most likely caused by people eating contaminated food during a Fall Festival
e. None of the statements is true

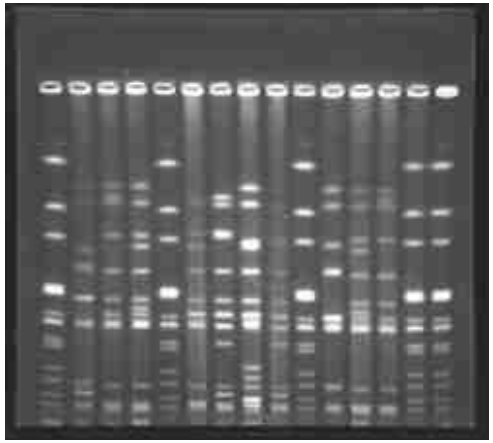
9. What is this graph called? _____

10. If you have been watching the news about this outbreak, you would know the source of contamination. What is it and how did it get spread in so many states? (2 points)

11. Define: Incubation period_____

12. You have been provided with data from the state health departments. You are asked to make suggestions regarding what steps to take. Choose the best answer:

a. Warn the public not to go to large gatherings where food or beverages are served
b. Perform laboratory tests on all the patients to determine if there is a common organism causing the outbreak
c. Close all restaurants in towns or cities where patients have eaten
d. Do microbiologic cultures in the houses and workplaces of the patients
e. None of the above



The photograph above is that of a Pulsed Field Gel Electrophoresis (PFGE) gel. This test is used to produce DNA fingerprinting of pathogenic organisms implicated in outbreaks or epidemics. This is an important tool in epidemiology.

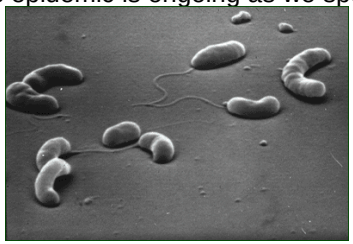
13. Why is it important to know the genetic fingerprint of organisms implicated in outbreaks or epidemics? (2 points)

You have done your job in this outbreak. You get another call! Off to the next case!

DESTINATION 2 : AFRICA

You are sent into the heart of one of the worst epidemics in the world- cholera in the country of Zimbabwe. The symptoms of this disease are severe profuse diarrhea and subsequent dehydration or even death.

This epidemic is ongoing as we speak, so far 60,000 persons have been infected in Zimbabwe and 3,100 have died.

14.  The bacteria in this electron micrograph caused this epidemic. What is the scientific name?_____

15. The public health infrastructure of Zimbabwe is ineffective with the collapse of its economy and failure of its government. You are part of an international group of health experts that was brought in to stop this epidemic. What are the steps you plan to implement to stop the epidemic? Remember, you have already established an epidemic. What next? (5 points)

BONUS QUESTIONS:

16. What is the capital of Zimbabwe? (1 pt)

17. Why do patients infected with the organism causing this epidemic get dehydrated very fast and often succumb to the illness if not given intravenous or oral fluids right away? (4 pts)

AFRICA PART 2

You have done your best to implement your recommendations. Now you travel to the other side of Africa to work on another case. You are doing a great job!

Since 2004, several outbreaks of POLIOMYELITIS have occurred in Nigeria. The disease has spread to previously polio-free provinces in Nigeria.

18. Poliomyelitis is caused by a virus. What system of the body does this virus primarily attack?
    a. nervous system
    b. circulatory system
    c. hematological system
    d. gastrointestinal system
    e, skeletal system

19. This virus is spread through:
    a. direct contact
    b. droplet nuclei (respiratory route)
    c. oral-fecal route
    d. mosquitoes
    e. prolonged direct contact

20. What recommendations would you suggest to stop the outbreak?
    a. quarantine all the villages and towns with affected cases
    b. spray the areas affected with insecticide to kill mosquitoes
    c. distribute masks and gowns to prevent spread
    d. frequently wash hands, make sure that foodstuffs are clean and cooked properly and vaccination efforts are intensified
    e. none of the above

21. True or False. It is possible to eradicate poliomyelitis just like in the case of smallpox. Although it seems like a daunting task, the objective is to vaccinate all susceptible persons.

In a town that you were invited to, the health officer has gathered some data about the outbreak. Here is what he found.
Population of town- 67,432

Cases identified - 545
Males-344 Female- 201
Number of infected persons -150
Signs and Symptoms:

Fever- 542
Headache- 284
Vomiting- 145
Diarrhea or Constipation- 267
Fatigue- 389
Back or Neck Pain or Stiffness- 62
Pain or stiffness in the arms or legs- 87
Muscle spasm or tenderness- 177
Weakness or paralysis of leg/arm- 126
Prolonged paralysis of an extremity- 24
Difficulty breathing- 32

The majority of persons who contract the polio virus will develop mild symptoms and will recover without medical treatment. Assuming that the data presented above represents those who developed symptoms serious enough to seek medical treatment, determine the following-

22. (2 pts) What is the Incidence Rate of Poliomyelitis in this town? Show your calculations.

23. Define Incidence Rate:_____

24. Which of these statements is correct?

a. Persons who develop fever, diarrhea, back stiffness and muscle spasms should be carefully monitored for possible development of paralysis
b. Since only 32 persons complained of breathing difficulty, this is probably not an important symptom of the disease
c. It is not necessary to observe sanitation and hygiene in households with possible polio cases
d. Vaccination should not be encouraged in this town because this will not be effective

25. BONUS question-

There are 2 vaccines currently in use to prevent poliomyelitis. The first one is the iinjectible or inactivated type and the second one is the oral or live attenuated vaccine.
Give the name of at least one of the discoverer of the polio vaccines (either one).

……..

III. DESTINATION: ASIA

Your international pager beeped and you were instructed to leave Africa and take the next flight to Beijing, China. You were informed that new cases of Influenza A H5N1 have been reported in a remote province and your assistance is needed to determine the validity of said cases.

26. Influenza A H5N1 is commonly known as:
    a. Pandemic influenza
    b. Swine flu
    c. Bird flu
    d. Spanish flu
    e. Severe Acute Respiratory Syndrome or SARS

27, Outline the steps in investigating an outbreak or epidemic. (5 points)

You drove to a small village about 8 hours south of Beijing. A major industry in this village is the raising of ducks and production of duck eggs for restaurants in Beijing. About a month ago, a wave of illness and death occurred among ducks in several farms. Preliminary studies showed the following:

Persons with confirmed H5N1 who were exposed to sick birds.....11
Persons with confirmed H5N1 who were not exposed to sick birds……...4
Persons without confirmed H5N1 who were exposed to sick birds……..6
Persons without confirmed H5N1 who were not exposed to sick bird……24

28. Determine the Odds' ratio of acquiring H5N1 infection. Show your calculations and explain your findings briefly (5 points)

Questions 29-32 will be based on the table below.

Cumulative Number of Confirmed Human Cases of Avian Influenza A/(H5N1) Reported to WHO 11 February 2009

Country	2003		2004		2005		2006		2007		2008		2009		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Azerbaijan	0	0	0	0	0	0	8	5	0	0	0	0	0	0	8	5
Bangladesh	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
Cambodia	0	0	0	0	4	4	2	2	1	1	1	0	0	0	8	7
China	1	1	0	0	8	5	13	8	5	3	4	4	7	4	38	25
Djibouti	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
Egypt	0	0	0	0	0	0	18	10	25	9	8	4	4	0	55	23
Indonesia	0	0	0	0	20	13	55	45	42	37	24	20	0	0	141	115
Iraq	0	0	0	0	0	0	3	2	0	0	0	0	0	0	3	2
Lao People's Democratic Republic	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2	2
Myanmar	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Nigeria	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Pakistan	0	0	0	0	0	0	0	0	3	1	0	0	0	0	3	1
Thailand	0	0	17	12	5	2	3	3	0	0	0	0	0	0	25	17
Turkey	0	0	0	0	0	0	12	4	0	0	0	0	0	0	12	4
Viet Nam	3	3	29	20	61	19	0	0	8	5	6	5	1	0	108	52
Total	4	4	46	32	98	43	115	79	88	59	44	33	12	4	407	254

Total number of cases includes number of deaths.
WHO reports only laboratory-confirmed cases.
All dates refer to onset of illness.

29. What is the total mortality rate of confirmed Influenza H5N1 from 2003-2009?
30. Construct an epicurve of H5N1 cases in Egypt for the years of 2003-2009 (2 pts)
31. Which country has the most cases of confirmed H5N1 infection from 2003-2009?
32. The most populous nation in the world, China, has less H5N1 cases than Vietnam. Can you give 1 or 2 explanations about this finding? (Hint: this table shows lab-confirmed cases) (2 pts)
33. As the Epidemiologist on the case, give 3 specific recommendations to stop the spread of this disease. (3 points)

IV. DESTINATION SOUTH AMERICA

Your next assignment brings you to Brazil. An outbreak of dengue fever is still ongoing. The World Health Organization estimates that 2.5 billion people, two fifths of the world's population, are now at risk from dengue infection. It estimates that there may be 50 million cases of dengue worldwide every year. The disease is now endemic in more than 100 countries. This disease is a major cause of economic losses in many parts of the world due to illnesses (morbidity) and deaths (mortality).

34. Dengue fever is also known as:
    a. “Quartan Fever”
    b. “Tertian Fever”
    c. “Breakbone Fever”
    d. “Yellow Fever”
35. This disease is transmitted through a vector. What is this vector?
    a. rat flea- *Xenopsylla cheopis*
    b. tick- *Ixodes scapularis*
    c. snail- *Oncomelania quadrasi*
    d. mosquito- *Aedes aegypti*
36. Define: Endemic

The following epidemiological data has been collected as of February 6, 2009.

Suspected dengue cases- 12,372
Confirmed classic dengue- 1,326
Suspected dengue hemorrhagic fever (DHF)- 55
Deaths- 7
Serotypes detected- DEN 1 and DEN 3

Dengue hemorrhagic fever is the most serious form and potentially-fatal form of the disease.

37. What is the Fatality Rate for those patients with DHF?

Your international travels are over for now! Good Job EIS Officer!

38. When you want to apply a laboratory test to a clinical situation, you would like to see a test that is highly sensitive and highly specific. Define sensitivity and specificity. (4 points)

39. KNOW YOUR INFECTIOUS AGENT!

Match Column A with Column B (10 points)

COLUMN A	COLUMN B
____1. *Mycobacterium tuberculosis*	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*	

40. One of your jobs as an epidemiologist is to publish your findings in a peer-reviewed medical journal. If you were to study a disease and it effects and had all the resources and time, what is the best possible type of study design can you use?

a, case-control study

b. cohort study with historic control

c. double-blind placebo-controlled prospective study

d. . single blind prospective study

e. Meta-analysis

2009 DISEASE DETECTIVES SCIENCE OLYMPIAD
REGION 2 ANSWER KEY

1. C
2. Salmonella typhimurium
3. Outbreak- occurrence of disease greater than expected at a particular time and place
4. Epidemic- increased occurrence of a disease that is spread easily among a given population. Usually more widespread than an outbreak.
5. B
6. (3 POINTS) Ohio, California and Massachusetts
7. (2 POINTS) No. The data is not sufficient to pinpoint the source of the outbreak.
8. C
9. Epidemic curve/ epicurve
10. (2 POINTS0 Peanut butter from a peanut butter processing plant in Georgia.
11. Incubation period- moment of exposure to an infectious agent until signs and symptoms of the disease appear
12. B
13. (2 POINTS) PFGE can be used to determine if the infectious agent is the same strain for all the cases. This knowledge is very useful in determining source of outbreaks/epidemic especially if it involves many areas.
14. *Vibrio cholerae*
15. Cholera is a relatively easy disease to diagnose even with minimal lab work-up especially in settings of economically-disadvantaged developing countries where most cholera occurs. Since diagnosis is not the issue, the more important steps that need to be pursued are how to stop the spread of the disease and to decrease mortality in patients.

    a. Implement effective control measures- isolate cholera patients in dedicated health facilities (dedicated is used in a medical term- that is, the facility is solely used for cholera….hopefully the personnel are also dedicated to their patients!)

    b. Strict precautions in handling of body fluids- preferably health personnel are gowned and gloved. Adequate water and soap solutions should be widely available. Strict hand washing and universal health precautions apply.

    c. Symptomatic patients have to be treated with aggressive IV +/- oral fluid therapy as determined by triage. However as an epidemiologist your concern is mainly to stop the spread of the disease

    d. Identify other persons exposed to symptomatic patients and educate them in precautions

    e. Determine possible sources of the epidemic- is it the water source? Food source? Secondary infection from family members?

    f. Very important- waste disposal systems have to be assessed. Sewage infrastructure should be examined

    g. Give recommendations to the community

    h. Communicate your findings to the public - community leaders, media, medical personnel

16. BONUS. (1 POINT) Harare
17. BONUS. (4 POINTS). *Vibrio cholerae* causes secretory diarrhea where tremendous amount of fluids is excreted oftentimes described as “rice water stool”. Patients get dehydrated within a few minutes to hours because of the severe fluid loss and this is the main cause of mortality in this disease.

18. A
19. C
20. D
21. True

22. (2 POINTS)

Prevalence rate= 545/67,432 = 0.81%

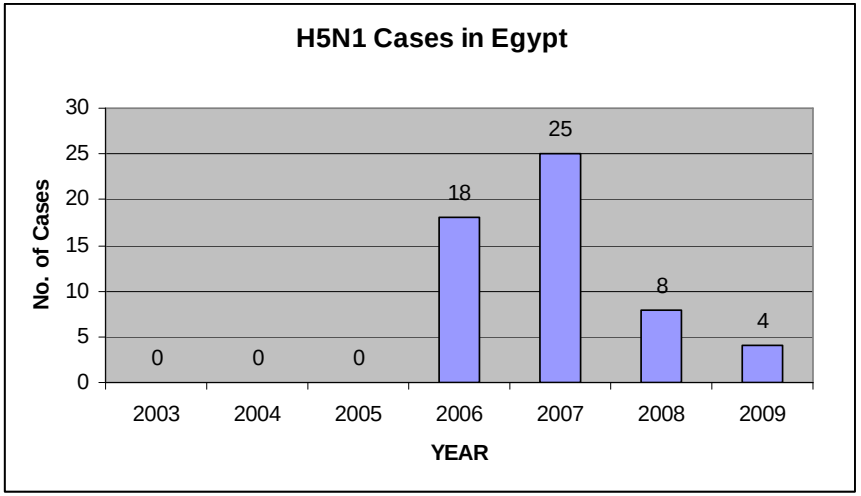
23. Prevalence rate= total number of cases of a disease in a given population at a specific time
24. A
25. BONUS (1 POINT) - Dr. Jonas Salk (IPV- injectible or inactivated polio vaccine) or Dr. Albert Sabin (OPV- oral polio vaccine)
26. C
27. 5 POINTS
    a. Prepare to investigate. Prepare for field work/travel. Bring necessary equipment.
    b. Verify the diagnosis and confirm the outbreak.
    c. Define your cases (Case definition)
    d. Look for cases (Case finding)
    e. Perform descriptive epidemiology. Create line listing (person, time, place)
    f. Formulate hypothesis- how and why
    g. Evaluate the hypothesis through statistics
    h. Perform additional environmental studies
    i. Implement control and preventive measures
    j. Communicate your findings
28. 5 POINTS

		CONFIRMED H5N1 (DISEASE)	
		POSITIVE	NEGATIVE
E X P O S U R E	POSITIVE	11	6
	NEGATIVE	4	24

Odds Ratio= $\frac{a/b}{c/d} = \frac{11/6}{4/24} = \frac{1.83}{0.17} = 10.76$ or 11

Explanation= Those who were exposed to sick birds were 11 times more likely to get Influenza H5N1 than those who were not exposed.

29. Total Mortality Rate= 245/407 x 100= **62.4%**



30.
2 POINTS

31. Indonesia
32. 2 POINTS
    a. inadequate reporting
    b. lower exposure to sick birds
    c. few access to medical care so cases go undiagnosed
33. 3 POINTS
    a. destroy all sick & exposed birds
    b. change how domesticated birds are kept to minimize exposures to wild birds infected with H5N1
    c. educate at-risk population about mode of disease transmission & signs/symptoms to watch out for
    d. use safety masks and other precautions when handling sick birds
34. C
35. D
36. Endemic- disease is constantly present to greater or lesser extent in a particular locality

37. Fatality rate= 7/55 x 100= 12.72%

38. 4 POINTS
    Sensitivity- measures the proportion of actual positives which are correctly identified as positive
        - number of true positives divided by the number of true positives plus number of false negatives

    Specificity- measures the proportion of negatives which are correctly identified as negatives
        -the number of true negatives divided by the no. of true positives plus the no. of false positives

39. 10 POINTS

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

40. C

TOTAL POINTS= 77

Bonus can be used as tie breaker and would be the best of 6 points