DISEASE DETECTIVES

Division B

SCIENCE OLYMPIAD – Regional Competition

San Diego County

SAMPLE EXAM QUESTIONS

SCENARIO A (Questions 1 to 10)

CIGARETTE SMOKING PREVALANCE 2003

In the November 12, 2004 issue of the *Morbidity and Mortality Weekly Report* from the Center for Disease Control, it was noted that there are about 440,000 cigarette smoking related deaths in the United States every year. This accounts for 1 out of every 5 deaths. The 2003 Behavioral Risk Factor Surveillance System Survey (BRFSS) is a random-digit dialed telephone survey of United States civilian, non-institutionalized population over 18 years of age. The BRFSS is used by the CDC to collect information about personal behaviors that affect morbidity and mortality nationwide. In this survey, a current smoker was defined as a respondent who reported that he/she currently smoked every day or some days and had smoked at least 100 cigarettes in his/her life. On the next page is a list of prevalence data gathered by the BRFSS.

STUDY THE ATTACHED TABLE ON THE NEXT PAGE
The questions about this scenario and about the table will start on page 4

It is titled:

"THE PREVALENCE OF CURRENT CIGARETTE SMOKING AMONG   ADULTS"

TABLE. Prevalence of current cigarette smoking among adults*, by state/area and sex — Behavioral Risk Factor Surveillance System, 50 states, District of Columbia, Guam, Puerto Rico, and U.S. Virgin Islands, 2003

State/Area	Men %	Men (95% CI†)	Women %	Women (95% CI)	Total %	Total (95% CI)
Alabama	28.5	(±3.1)	22.4	(±2.0)	25.3	(±1.8)
Alaska	30.3	(±3.6)	21.9	(±3.0)	26.3	(±2.4)
Arizona	23.8	(±3.9)	18.2	(±2.7)	21.0	(±2.4)
Arkansas	27.6	(±2.5)	22.3	(±1.8)	24.8	(±1.5)
California	20.5	(±2.3)	13.2	(±1.5)	16.8	(±1.4)
Colorado	19.6	(±2.2)	17.5	(±1.7)	18.5	(±1.4)
Connecticut	19.7	(±1.9)	17.9	(±1.6)	18.7	(±1.2)
Delaware	26.0	(±3.0)	18.2	(±2.0)	21.9	(±1.8)
District of Columbia	26.2	(±4.2)	19.0	(±2.9)	22.3	(±2.5)
Florida	26.0	(±3.1)	22.1	(±2.3)	23.9	(±1.9)
Georgia	25.8	(±2.3)	20.0	(±1.5)	22.8	(±1.4)
Hawaii	20.1	(±2.5)	14.4	(±1.7)	17.3	(±1.5)
Idaho	19.5	(±2.1)	18.5	(±1.7)	19.0	(±1.3)
Illinois	28.3	(±2.8)	20.5	(±1.9)	24.3	(±1.7)
Indiana	28.6	(±2.2)	23.8	(±1.6)	26.1	(±1.3)
Iowa	22.8	(±2.2)	20.7	(±1.9)	21.7	(±1.5)
Kansas	21.0	(±2.3)	19.7	(±1.7)	20.4	(±1.4)
Kentucky	33.8	(±2.7)	28.1	(±1.9)	30.8	(±1.7)
Louisiana	30.3	(±2.5)	23.2	(±1.7)	26.6	(±1.5)
Maine	23.1	(±3.1)	24.0	(±2.5)	23.6	(±2.0)
Maryland	23.0	(±2.6)	17.7	(±1.8)	20.2	(±1.6)
Massachusetts	20.0	(±1.8)	18.4	(±1.4)	19.2	(±1.2)
Michigan	30.2	(±3.0)	22.3	(±2.1)	26.2	(±1.8)
Minnesota	22.4	(±2.4)	19.9	(±1.9)	21.1	(±1.5)
Mississippi	31.1	(±2.7)	20.7	(±1.7)	25.6	(±1.6)
Missouri	31.2	(±3.1)	23.8	(±2.5)	27.3	(±2.0)
Montana	19.5	(±2.5)	20.3	(±2.2)	19.9	(±1.7)
Nebraska	23.6	(±2.2)	19.0	(±1.6)	21.3	(±1.4)
Nevada	29.0	(±3.5)	21.3	(±2.9)	25.2	(±2.3)
New Hampshire	22.4	(±2.2)	20.2	(±1.8)	21.2	(±1.4)
New Jersey	21.2	(±1.5)	17.9	(±1.1)	19.5	(±0.9)
New Mexico	23.6	(±2.2)	20.5	(±1.7)	22.0	(±1.4)
New York	24.8	(±2.2)	18.8	(±1.6)	21.6	(±1.3)
North Carolina	28.0	(±2.4)	21.9	(±1.7)	24.8	(±1.5)
North Dakota	22.0	(±2.5)	19.0	(±2.2)	20.5	(±1.7)
Ohio	26.9	(±2.8)	24.0	(±2.2)	25.4	(±1.8)
Oklahoma	27.8	(±2.0)	22.7	(±1.4)	25.2	(±1.2)
Oregon	23.1	(±2.4)	18.9	(±1.8)	21.0	(±1.5)
Pennsylvania	27.1	(±2.7)	24.1	(±2.1)	25.5	(±1.7)
Rhode Island	23.8	(±2.7)	21.1	(±2.0)	22.4	(±1.6)
South Carolina	28.5	(±2.3)	22.8	(±1.6)	25.5	(±1.4)
South Dakota	24.7	(±2.3)	20.7	(±1.8)	22.7	(±1.4)
Tennessee	27.3	(±3.3)	24.2	(±2.4)	25.7	(±2.0)
Texas	26.7	(±2.2)	17.6	(±1.4)	22.1	(±1.3)
Utah	14.0	(±2.2)	9.9	(±1.6)	12.0	(±1.4)
Vermont	19.8	(±2.3)	19.4	(±1.9)	19.6	(±1.5)
Virginia	26.4	(±2.5)	18.0	(±1.6)	22.1	(±1.5)
Washington	20.9	(±1.2)	18.2	(±0.9)	19.5	(±0.7)
West Virginia	27.6	(±2.8)	27.2	(±2.3)	27.4	(±1.8)
Wisconsin	24.0	(±2.6)	20.3	(±2.0)	22.1	(±1.6)
Wyoming	25.2	(±2.4)	24.1	(±2.0)	24.6	(±1.6)
Median	*24.8*		*20.3*		*22.1*	
Guam	42.0	(±5.9)	25.8	(±4.6)	34.0	(±3.8)
Puerto Rico	19.3	(±2.6)	8.5	(±1.3)	13.6	(±1.5)
U.S. Virgin Islands	14.2	(±3.2)	6.6	(±1.6)	10.0	(±1.7)
Median	*19.3*		*8.5*		*13.6*	

* Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetimes and who currently smoke every day or some days.
† Confidence interval.

QUESTIONS 1-10 FOR SCENARIO A

1. If the survey is a highly accurate sampling, and if the population of Arkansas in 2003 was 2,725,714, how many adults in that state smoked during 2003?

2. From the data in the table, can you calculate what percentage of the United States population that lives in Nebraska?

3. Which of the following are possible reasons why the survey results may **not** accurately reflect true cigarette smoking rates?
    a. respondents (the people questioned) may not be honest
    b. people without phones may have different rates of smoking
    c. both a and b
    d. most respondents were children

4. Six states (California, Connecticut, Delaware, Maine, Massachusetts, and New York) have statewide laws against smoking in all indoor workplaces and public places. What is the <u>average</u> prevalence (%) of smoking in those 6 states?

5. Which of the 50 states had the lowest smoking prevalence(%) in 2003?

6. If the population of the United States is 290,000,000, what is the annual overall mortality rate in deaths per thousand per year.

7. Can the data in the table give you information about a woman's risk for becoming a smoker during a year in a particular state?
    a. yes
    b. no

8. Could these data be helpful in studying the usefulness of anti-smoking programs?
    a. Yes, because the survey could be repeated after anti-smoking programs
    b. No, because only states with high prevalence (%) would benefit
    c. No, because anti-smoking programs do not work
    d. No, everyone lies on surveys

9. The BRFSS
    a. was designed to predict how many people will die each year
    b. was developed by the World Health Organization (WHO)
    c. surveys every US civilian, non-institutionalized person over 18 with a phone
    d. provides useful information that could help lead to behavioral modification

10. If cigarette smoking was curtailed in the United States
    a. the mortality rate of breast cancer would probably increase
    b. occupational lung disease would increase
    c. people would live, on average, 10 years longer
    d. we could expect cigarette related deaths to account for less than 20% of all US mortality

SCENARIO B – FOOD POISONING - Questions 11 - 22

In the early 1990s, "1,364 children became ill out of a total of 5,824 who had eaten lunch served at 16 elementary schools in Texas. The lunches were prepared in a central kitchen and transported to the schools by truck. Epidemiological studies revealed that 95% of the children who became ill had eaten a chicken salad. The afternoon of the day preceding the lunch, frozen chickens were boiled for 3 hours. After cooking, the chickens were de boned, cooled to room temperature with a fan, ground into small pieces, placed into l2-inch-deep aluminum pans and stored overnight in a walk-in refrigerator at 42°-45°F. The following morning, the remaining ingredients of the salad were added and the mixture was blended with an electric mixer. The food was placed in thermal containers and transported to the various schools at 9:30 AM to 10:30 AM. It was then kept at room temperature until served between 11:30 AM and noon. Bacteriological examination of the chicken salad revealed the presence of large numbers of *Staphylococcus aureus*.
Contamination of the chicken probably occurred when it was de boned. The chicken was not cooled rapidly enough because it was stored in l2-inch-deep layers. The temperature in the storage refrigerator was not less than 40^0 F.Growth of the staphylococcus probably also occurred after delivery to the schools during the period when the food was kept in the warm classrooms. Prevention of this incident would have involved screening the individuals who de boned the chicken for carriers of the staphylococcus, more rapid cooling of the chicken, and adequate refrigeration of the salad from the time of preparation to its consumption."
It is thought that Staphylococcal food poisoning is caused by eating the enterotoxins that some strains of staphylococcus aureus produce. Staphylococci are present in the nasal passages of at least 50% of all healthy individuals. But not all such individuals pass on disease to others. Growth of the bacteria and production of the toxin need to occur. This usually happens in foods that are not kept cold enough or hot enough.

QUESTIONS 11-22 FOR SCENARIO B

11. What was the absolute risk in % of becoming ill in this outbreak?

12. If the illness was indeed due to ingestion of chicken salad contaminated with staphylococcus, then how can you explain that only 95% of children who became ill had eaten a chicken salad?
    a. they could have had another illness that looked like food poisoning
    b. they could have forgotten that they ate the chicken salad
    c. their food could have been contaminated by the chicken salad
    d. a, b, & c are all correct

13. What type of epidemiological study was used to gather the information above?
    a. retrospective
    b. double-blind
    c. prospective
    d. randomized

14. If a randomized, controlled, prospective, double blind study is the gold standard (best) for the least biased method of study, then why shouldn't you do one of those to study food poisoning rates?

15. Would isolating these children from their siblings for 3 days be important to help prevent the siblings from contracting the illness?

16. What was the approximate relative risk of a brown bagger (someone who brings his/her lunch to school) getting sick that day with similar symptoms?

SCENARIO E
AVIAN INFLUENZA AND THE RISK OF A GLOBAL PANDEMIC

QUESTIONS 37-55

Prior to 1997, the H5N1 strain of avian influenza virus began infecting poultry populations of certain regions of Asia. H5N1 initially caused only mild disease, but after being passed between chickens, the virus mutated to a highly pathogenic form that could kill chickens within 48 hours, with mortality approaching 100%. Greater than 150 million birds have died from disease and killing to prevent spread.

So far, H5N1 has shown an extraordinary evolutionary ability. H5N1 viruses jumped species to infect tigers that fed on infected bird carcasses, and they transmitted H5N1 to other cats. Ducks infected with H5N1 are now shedding more virus for longer periods of time without showing any symptoms of illness. Between 2004 and January 19, 2006, a total of 149 laboratory-confirmed human infections, 80 fatal, were reported by public health authorities mostly in Vietnam, Thailand, and Cambodia. In contrast, human to-human transmission of the virus is rare but has been described, most recently in a family cluster in Thailand. This jump from animals to humans, and rare human to human transmission raises concern for a pandemic of H5N1 influenza.

Should the virus mutate to more efficiently pass between humans, everyone in the world would be vulnerable to infection by a pathogen (transmitted by a cough or a sneeze) entirely novel to the human immune system. Such events are believed to have preceded the influenza pandemics of 1918 (Spanish flu), 1957, and 1968. The mortality associated with human H5N1 infection is remarkably high (54%) as compared with an estimated 2.5% for Spanish influenza. This could result in more than 300 million deaths globally. Therefore, the public health system must be prepared for the unexpected.

Thus far, two conditions for the next influenza pandemic have been met, namely, the generation of an unknown virus to which we have no immunity, and its ability to replicate in humans. The third condition, efficient human to human transfer, has not yet been met.

Vaccines are universally regarded as the most important medical intervention for preventing influenza. In the past, however, vaccines were never available early enough to decrease morbidity and mortality during a pandemic. A vaccine to H5N1 does not yet exist. New anti-viral drugs have been produced which can destroy various influenza viruses after infection of human hosts but, only in limited quantities.

QUESTIONS 37-50 FOR SCENARIO F

35. Which of the following are recently discovered human infections in which animals are the vectors(carriers)?
    a. Avian flu
    b. cholera
    c. West Nile viral encephalitis
    d. a and c

36. Which group is most susceptible (easily infected) to avian flu?
    a. Western travelers to southeast Asia
    b. chicken farmers in rural Cambodia
    c. pigeon keepers in New York City
    d. duck farmers in Nepal

37. H5N1 influenza is not yet a pandemic (world-wide infection) because

a. it is isolated to poor regions of the southern tip of Vietnam
b. it kills poultry before the birds can infect humans
c. human to human transmission is very inefficient
d. infected tigers don't bite and infect humans

38. A pandemic (world-wide infection) of H5N1 might be more lethal than Spanish flu of 1918 because
a. global air travel didn't exist in 1918
b. we have less lead time between identifying the influenza strain and the beginning of a pandemic
c. inadequate medical advances have been made to support infected individuals in intensive care units between 1918 and now
d. all of the above

39. A global pandemic (world-wide infection) of H5N1 could be prevented through
a. getting vaccinated to this year's influenza type A virus strain
b. avoiding hospitals with known cases of H5N1 flu
c. killing all chickens and waterfowl in endemic areas and along migratory routes
d. stockpiling at least 2 months of food at home

40. Human influenza strains are easier to transmit between humans than
a. Hepatitis C
b. HIV
c. Mad cow disease
d. all of the above

41. Influenza is most easily transmitted between humans by
a. blood donations
b. rodent droppings
c. standing within 3 feet of an infected person
d. using an airplane bathroom

42. As we enter the 21st century of genetic medicines and vaccines, H5N1 will be
a. the last potential global pandemic
b. the first disease to be eradicated from the world by vaccination
c. more deadly because the virus is mutated
d. a true test of President Bush's ability to mobilize a global response to a new threat to human life

43. A disaster preparedness plan put together by the Centers for Disease Control will
a. be "too little too late" once the pandemic starts sweeping into the US
b. decrease the disruptive effects of H5N1 on US morbidity and mortality
c. be modeled after the plan Nepal has put into place
d. a and c

44. If an H5N1 pandemic develops, individuals who have recovered from infection should
a. stay home and avoid contact with susceptible individuals who can reinfect them
b. care for those who are infected and ill
c. wear a mask to avoid re-infection
d. avoid touching their mucous membranes after touching public doorknobs and bathrooms used by infected individuals

45. An outbreak of H5N1 was first detected in Europe in January, 2006, a significant cause for concern about spread out of southeast Asia. Which country has had an outbreak of approximately 20 infections?
    a. Nepal
    b. Greece
    c. Turkey
    d. Iraq

46. The most likely natural reservoir for human infections at the beginning of a pandemic (world-wide infection) will be
    a. chickens, because so many people eat chicken
    b. migratory waterfowl, because they act as a silent reservoir of H5N1
    c. cats, since they are house pets
    d. Chimps, species which are closest phylogenetically to humans

47. If clusters of cases of influenza appear in health care workers in San Francisco, Vancouver, and Paris at the same time that cases are spiking in countries known to have H5N1, is a pandemic (world-wide infection) of H5N1 starting?
    a. no, because health care workers are susceptible to many viral respiratory infections
    b. yes, if genetic sequencing of the virus confirms H5N1 is the cause of the influenza in the Western world, and if it has mutated to more easily infect humans
    c. yes, if the health care workers have recently purchased chickens from countries also reporting increased H5N1 infections
    d. by definition, a global pandemic requires greater than 10,000 new infections per week

48. Migratory birds and ducks have rarely been implicated in spreading viral infections, as they appear to be doing with H5N1.
    a. True
    b. False