Disease Detectives

Honor Pledge: "I have neither given nor received unauthorized aid on this test."

Signed:_____ Signed:_____

Name:_____ Name:_____

Team Name:_____ **Number/Division:** _____

Read problems carefully. **All questions are printed in bold.** All other text is used to give background information about the questions being asked. Point values for each question are listed so that you may monitor your time and use it accordingly.

Grading Rubric

	Question Topic	Possible Points	Points Earned
Question 1	antibiotics & tuberculosis	10	
Question 2	HPV	5	
Question 3	epidemiological terms	10	
Question 4	MRSA	14	
Question 5	public health	10	
Question 6	childhood obesity	11	
Question 7	disease transmission	6	
Question 8	dengue fever	6	
Total		72	

Rank ☐

1. In the March 23, 2007 edition of the Center for Disease Control's Morbidity and Mortality Weekly Report, an article was published entitled "Trends in Tuberculosis Incidence -- United States, 2006." This article examined the current state of tuberculosis in the world.

(a) Does a bacterium, virus, fungus or protist cause tuberculosis? (1 pt)

(b) What are the primary symptoms of active tuberculosis? (2 pts)

A March 20, 2007 article from the *New York Times* also highlighted tuberculosis as a growing threat. It said, "The spread of a particularly virulent form of tuberculosis in South Africa illustrates a breakdown in the global program that is supposed to keep the disease, one of the world's deadliest, under control." The program not only detects cases of tuberculosis but also makes sure patients take their antibiotics.

(c) What happens when antibiotics are not used property (e.g. a course of antibiotics is stopped prior to completion)? (3 pts)

Both articles highlighted an outbreak in the KwaZulu-Natal province of South Africa. Of 53 patients, 52 died from this virulent strain of tuberculosis.

(d) What is an outbreak? (2 pts)

(e) Think carefully. All 53 patients were infected with another deadly disease before contracting tuberculosis. What would be your best guess as to what this syndrome is (list name)? (2 pts)

2. Merck recently introduced a new vaccine for girls and young women aged 9-26 years.

(a) What type of cancer is this vaccine designed to help prevent? (1 pt)

The official name of the vaccine is "Quadrivalent Human Papilloma Virus (HPV) Recombinant Vaccine."

(b) What does quadrivalent mean when discussing vaccines? (2 pts)

(c) HPV is spread sexually. Other than abstinence, what is one way that a woman could lower her risk for either contracting HPV or developing the related cancer? (2 pts)

3. **Match each epidemiological term with its best description, formula or example. (1 pt each, total 10 pts)**

(a) _____ epidemiology

(b) _____ endemic

(c) _____ nosocomial infections

(d) _____ morbidity rate

(e) _____ epidemic

(f) _____ virulence

(g) _____ zoonosis

(i) _____ vector

(j) _____ reservoir

(k) _____ carriers

(A) deaths per total infected

(B) disease associated with animals but can be transmitted to humans

(C) acquired at a hospital

(D) science concerned with the prevalence and distribution of disease

(E) relative pathogenicity of infections microorganism

(F) constant low frequency of disease

(G) number of new cases during a period divided by total population

(H) number of cases in a susceptible population of 100,000

(I) disease occurring in a population at a higher than normal frequency

(J) percent of total population that has the disease at a given time

(K) worldwide epidemic

(L) various arthropods that transmit pathogenic organism from one host to another

(M) site where infectious disease is maintained between outbreaks

(N) sudden high incidence of disease in a given population

(O) infected individual who transmits an infection to another

4. This question is adapted from a paper published in the journal *Emerging Infectious Diseases* titled "Methicillin-resistant--*Staphylococcus aureus* Hospitalizations, United States." The study investigated 291,542 hospital discharges associated with *S. aureus* and methicillin-resistant--*S. aureus* (MRSA). The study found that overall 43.2% of *S. aureus* infections were MRSA. The following table takes a closer look the incidence of MRSA by patient age.

Age (y)	*S. aureus* (%)*	*S. aureus* rate †	MR (%)**	MRSA rate †	MRSA RR***
<15	6.7	80.8	16.2		referent
15-44	19.6	56.9	29.3		
45-65	23.1	97.4	39.1		
>65	50.6	117.6	54.1		

* This percentage represents percentage of hospital discharges associated with *S. aureus*.
** This percentage represents percentage of *S. aureus* infections that were methicillin resistant (MR).
*** This is the relative risk of MRSA-related infections by age group.
† Rate, hospitalizations with *S. aureus* or MRSA-related discharge diagnoses per 1,000 discharges.

(a) The *S. aureus* rate (third column) has been adjusted for what? (2 pts)

(b) Calculate the MRSA rate to fill in the table. Show formula and **at least** one calculation so that full credit can be awards. **(5 pts)**

(c) Calculate the MRSA relative risk to fill in the table. Show formula and at least one calculation so that full credit can be awarded. **(4 pts)**

(d) What age group has the highest relative risk? (1 pt)

(e) Why might this be? (2 pts)

5. This question is based on Koch's Postulates. A baseball team held a cookout to celebrate the end of a winning season. The next day, many of the attendees reported being ill. Pretend you are a public health official who must determine the probable organism responsible for the outbreak. **List the steps you would take, in the proper order, that would be used to accomplish this task. Be brief.** You do not necessarily need to use all numbered blanks. **(up to 10 pts for overall concept)**

(a)

(b)

(c)

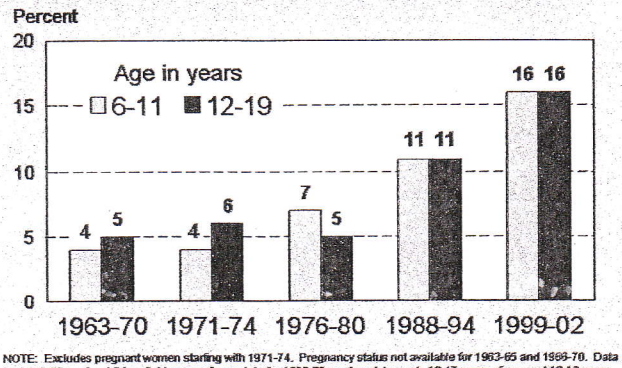
(d)

(e)

(f)

6. Carefully examine this graph from a NHANES survey on the prevalence of overweight children and adolescents in two age groups.

Figure 1. Prevalence of overweight among children and adolescents ages 6-19 years



NOTE: Excludes pregnant women starting with 1971-74. Pregnancy status not available for 1963-65 and 1966-70. Data for 1963-65 are for children 6-11 years of age; data for 1966-70 are for adolescents 12-17 years of age, not 12-19 years.
SOURCE: CDC/NCHS, NHES and NHANES

(a) Let's assume that this graph reflects true changes in prevalence over time. List two explanations for these trends. (2 pts each, total 4 pts)

1.

2.

(b) What is the study design for the NHANES study (trial study, cohort study, case-control study, cross-sectional study ? (1 pt)

(d) Suggest three different strategies concerned parents could implement to prevent their children from becoming overweight. (2 pts each, total 6 pts)

1.

2.

3.

7. **Match each disease with its mode of transmission.** Each disease will have one mode of transmission. Answers may be used more than once. **(1 pt each, total 6 pts)**

(a) _____ malaria	(A) food/water borne
(b) _____ cholera	(B) blood/sexual transmission
(c) _____ salmonella	(C) mosquito borne
(d) _____ lyme disease	(D) tick borne
(e) _____ HIV	
(f) _____ giardia	

8. Imagine you are a city official and there has been an increase in dengue fever. Dengue fever caused by a virus is spread by mosquito vectors. **Name three prevention strategies you would promote to help control the infection. (2 pts each, total 6 pts)**

1.

2.

3.

Jess's Copy - Modified Key for Score Room

Disease Detectives

Division B

NC Science Olympiad

2007 State Competition - April 21, 2007

North Carolina State University, Raleigh, NC

Honor Pledge: "I have neither given nor received unauthorized aid on this test."

Signed:_____ Signed:_____

Name:_____ Name:_____

Team Name:_____ **Number/Division:** _____

Read problems carefully. **All questions are printed in bold.** All other text is used to give background information about the questions being asked. Point values for each question are listed so that you may monitor your time and use it accordingly.

Grading Rubric

tie breaker #

		Question Topic	Possible Points	Points Earned
1	Question 1	antibiotics & tuberculosis	10	
8	Question 2	HPV	5	
5	Question 3	epidemiological terms	10	
3	Question 4	MRSA	14	
2	Question 5	public health	10	
4	Question 6	childhood obesity	11	
6	Question 7	disease transmission	6	
7	Question 8	dengue fever	6	
	Total		72	

Rank ☐

1. In the March 23, 2007 edition of the Center for Disease Control's Morbidity and Mortality Weekly Report, an article was published entitled "Trends in Tuberculosis Incidence -- United States, 2006." This article examined the current state of tuberculosis in the world.

(a) Does a bacteria, virus, fungi or protist cause tuberculosis? (1 pt)

0.5 pts for yes

(1 pt) bacteria

(b) What are the primary symptoms of active tuberculosis? (2 pts)

(2 pts for any two) bad cough, chest pain, coughing up blood/sputum/ phlegm, weakness/fatigue, weight loss, no appetite, chills, fever, night sweats

A March 20, 2007 article from the New York Times also highlighted tuberculosis and a growing threat. It said, "The spread of a particularly virulent form of tuberculosis in South Africa illustrates a breakdown in the global program that is supposed to keep the disease, one of the world's deadliest, under control." The program not only detects cases of tuberculosis but also makes sure patients take their antibiotics.

(c) What happens when antibiotics are not used property (e.g. a course of antibiotics is stopped prior to completion?) (3 pts)

(3 pts) increases the development of drug resistant strains OR leads to "stockpiling" of antibiotics in homes + does not cure infection or infection recurs

~~(2 pts) bacteria immune~~

(1 pt) does not cure infection or infection recurs

Both articles highlighted an outbreak the KwaZulu-Natal province of South Africa. Of 53 patients, 52 died from this virulent strain of tuberculosis.

(d) What is an outbreak? (2 pts)

(2 pts, must include bold terms) **sudden** high incidence of disease in a **given population**
(1 pt, one bold term)

(e) Think carefully. All 53 patients were infected with another deadly disease before contracting tuberculosis. What would be your best guess as to what this syndrome is (list name)? (2 pts)

(2 pts) HIV or AIDS

2. Merck recently introduced a new vaccine for girls and young women aged 9-26 years.

(a) What type of cancer is this vaccine designed to help prevent? (1 pt)

(1 pt) cervical cancer

The official name of the vaccine is "Quadrivalent Human Papilloma Virus (HPV) Recombinant Vaccine."

(b) What does quadrivalent mean when discussing vaccines? (2 pts)

(2 pts) vaccine is composed of four different strains many doses 1 pt
(1 pt) vaccine is a series of four shots

anything 4 all HPVs 0.5 pt

(c) HPV is spread sexually. Other than abstinence, what is one way that a woman could lower her risk for either contracting HPV or developing the related cancer? (2 pts)

(2 pts) regular pap smears at doctor recommended intervals
(1 pt) regular doctor visits

OR

(2 pts) proper condom use

(2) limit sexual partners

(2) vaccine

3. **Match each epidemiological term with its best description, formula or example. (1 pt each, total 10 pts)**

(a) __D__ epidemiology

(b) __F__ endemic

(c) __C__ nosocomial infections

(d) __H__ morbidity rate

(e) __I__ epidemic

(f) __E__ virulence

(g) __B__ zoonosis

(i) __L__ vector

(j) __M__ reservoir

(k) __O__ carriers

(A) deaths per total infected

(B) disease associated with animals but can be transmitted to humans

(C) acquired at a hospital

(D) science concerned with the prevalence and distribution of disease

(E) relative pathogenicity of infections microorganism

(F) constant low frequency of disease

(G) number of new cases during a period divided by total population

(H) number of cases in a susceptible population of 100,000

(I) disease occurring in a population at a higher than normal frequency

(J) percent of total population that has the disease at a given time

(K) worldwide epidemic

(L) various arthropods that transmit pathogenic organism from one host to another

(M) site where infectious disease is maintained between outbreaks

(N) sudden high incidence of disease in a given population

(O) infected individual who transmits an infection to another

4. This question is adapted from a paper published in the journal *Emerging Infectious Diseases* titled "Methicillin-resistant--*Staphylococcus aureus* Hospitalizations, United States." The study investigated 291,542 hospital discharges associated with *S. aureus* and methicillin-resistant--*S. aureus* (MRSA). The study found that overall 43.2% of *S. aureus* infections were MRSA. The following table takes a closer look the incidence of MRSA by patient age.

Age (y)	*S. aureus* (%)*	*S. aureus* rate †	MR (%)**	MRSA rate †	MRSA RR***
<15	6.7	80.8	16.2	**13.1** (11.8-14.4)	referent
15-44	19.6	56.9	29.3	**16.7** (15.0-18.4)	**1.2** (0.94-1.6)
45-65	23.1	97.4	39.1	**38.1** (34.3-41.9)	**2.9** (2.2-3.8)
>65	50.6	117.6	54.1	**63.6** (57.2-70.0)	**4.8** (3.7-6.2)

* This percentage represents percentage of hospital discharges associated with *S. aureus*.
** This percentage represents percentage of *S. aureus* infections that were methicillin resistant (MR).
*** This is the relative risk of MRSA-related infections by age group.
† Rate, hospitalizations with *S. aureus* or MRSA-related discharge diagnoses per 1,000 discharges.

(a) The *S. aureus* rate (third column) has been adjusted for what? (2 pts)

(2 pts) population size OR number of discharges

(b) Calculate the MRSA rate to fill in the table. Show formula and **at least** one calculation so that full credit can be awards. **(5 pts)**

(1 pt) formula is *S. aureus* rate x MR%/100 = MRSA rate
(1 pt) one example calculation, any of the below
80.8 x .162 = 13.1 97.4 x .391 = 38.1
56.9 x .293 =16.7 117.6 x .541 = 63.6
(3 pts) the rest of the column

(c) Calculate the MRSA relative risk to fill in the table. Show formula and at least one calculation so that full credit can be awarded. **(4 pts)**

1 pt for low, high, extreme

(1 pt) formula is (MRSA rate <15)/MRSA rate other age group = MRSA RR
(1 pt) one example calculation, any of the below
16.7/13.1 = 1.2 63.6/13.1 = 4.8
38.1/13.1 = 2.9
(2 pts) the rest of the column

(d) What age group has the highest relative risk? (1 pt)

(1 pt) >65 age group

(e) Why might this be? (2 pts)

(2 pts for one) more likely to be hospitalized, immunocompromised, more likely to spend time with older and more susceptible individuals

1pt if is wrong but critical thinking is displayed for that (wrong) age group

5. This question is based on Koch's Postulates. A baseball team held a cookout to celebrate the end of a winning season. The next day, many of the attendees reported being ill. Pretend you are a public health official who must determine the probable organism responsible for the outbreak. **List the steps you would take, in the proper order, that would be used to accomplish this task. Be brief**. You do not necessarily need to use all numbered blanks. **(up to 10 pts for overall concept)**

investigate food & surroundings

(a) Collect bodily fluids from attendees (blood, urine, saliva).

(b) Attempt to grow contents of samples on Petri plates/test tubes

(c) If growth appears on plates, identify similar appearances among attendees

(d) Choose individual colonies from plates and inoculate into healthy animals

(e) Wait for symptoms.

(f) Isolate organism from diseased animal.

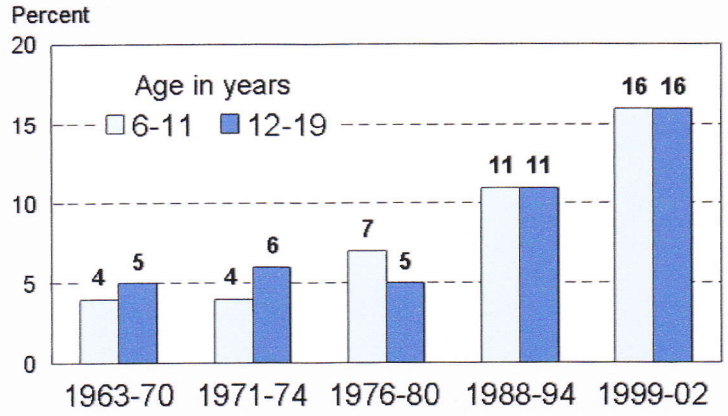
adjusted ↑ key

"observations" 1

interview 2
samples from people 2
test 2
compare 2
if not start again 2

6. Carefully examine this graph from a NHANES survey on the prevalence of overweight children and adolescents in two age groups.

Figure 1. Prevalence of overweight among children and adolescents ages 6-19 years



NOTE: Excludes pregnant women starting with 1971-74. Pregnancy status not available for 1963-65 and 1966-70. Data for 1963-65 are for children 6-11 years of age; data for 1966-70 are for adolescents 12-17 years of age, not 12-19 years.
SOURCE: CDC/NCHS, NHES and NHANES

(a) Let's assume that this graph reflects true changes in prevalence over time. List two explanations for these trends. (2 pts each, total 4 pts)

(2 pts each, need 2) **energy imbalance** (calorie intake more than calorie expenditure), **poor diet** (high in sugar and fat), **cultural/social pressure to gain weight**, **decreased exercise** (e.g., reduction in school PE sources, sports programs, community elimination of bike paths, closed stairwells in public buildings), "**couch potato syndrome**", **poor urban planning/safety**

hormones in meat ?

availibity / transport

(b) What is the study design for the NHANES study (trial study, cohort study, case-control study, cross-sectional study ? (1 pt)

(1 pt) cross-sectional or survey

(d) Suggest three different strategies concerned parents could implement to prevent their children from becoming overweight. (2 pts each, total 6 pts)

(2 pts each, need 3) healthy meals and snacks, family physical activity, restrictions on TV/video game/computer time, parent role models, social support for physical activity, availability of outdoor activities at home to include trampolines, swing sets, bikes, basketball hoop

7. **Match each disease with its mode of transmission.** Each disease will have one mode of transmission. Answers may be used more than once. **(1 pt each, total 6 pts)**

(a) __C__ malaria	(A) food/water borne
(b) __A__ cholera	(B) blood/sexual transmission
(c) __A__ salmonella	(C) mosquito borne
(d) __D__ lyme disease	(D) tick borne
(e) __B__ HIV	
(f) __A__ giardia	

8. Imagine you are a city official and there has been an increase in dengue fever. Dengue fever caused by a virus is spread by mosquito vectors. **Name three prevention strategies you would promote to help control the infection. (2 pts each, total 6 pts)**

(2 pts each, need 3) elimination of mosquito habitat esp. standing water, limit outdoor activity, install screens over windows and doors, provide mosquito nets, wear mosquito repellent with DEET, community spraying for mosquitos, educate communities

after dusk 2pts

vaccine 1pt

avoid perfumes, lotion 2pts

~~education~~

destroy virus from mosquitos 2pts