_____ Total Score

_____ Rank

School Name: _____

Team Number: _____

Student Name(s) (1): _____

(2): _____

DIVISION C
DISEASE DETECTIVES

National Science Olympiad
University of Illinois
Urbana-Champaign, Illinois
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Developed by the
Career Paths to Public Health Program
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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

African Sleeping Sickness

38 questions, 88 total possible points

Throughout history, death and disease have followed wars, conflict, and civil unrest. Crowded living conditions, limited clean water and toilet facilities, and displaced populations living in close contact with strangers make it easy for an epidemic to start and to spread.

Disease does not discriminate. Pathogens equally infect the fighting men and civilian populations. Once the battlefield moves on, civilians who remain to rebuild their lives can face increased incidence of a variety of diseases for years after the fighting has ended. Medical care is often limited, clean water is rare, and people struggle to survive the harsh conditions in lands that may have been fertile and prosperous before the conflict.

One disease that has been linked to civil conflict is African trypanosomiasis. The causative agent, *Trypanosoma brucei*, has three subspecies— *T. b. gambiense, T.b. rhodesiense,* and *T.b. brucei*. *T.b. brucei* infects mostly domestic and wild animals. Factors in normal human blood destroy this subspecies, and humans are generally immune to *T.b. brucei* infection. However, both *T.b. gambiense* and *T.b. rhodesiense* are resistant to the factors that protect humans against *T.b. brucei,* and both subspecies have the ability to infect humans. *T.b. rhodesiense* also often infects cattle and other hoofed mammals, and this trypanosome normally lives and multiplies in these mammals. *T.b. gambiense* is normally found in humans, but it can also infect pigs.

Trypanosomes are protistan parasites. They are transmitted to animals and humans by the bites of tsetse flies belonging to the genus *Glossina*. The life cycle of trypanosomes is shown in Figure 1. These flies tend to live in rural areas such as woodlands and thickets in the savannah or along streams. Less than 1% of tsetse flies in the endemic area are typically infected. The flies feed on the blood of humans and large mammals and are attracted to moving vehicles and bright colors.

The illnesses caused by the two subspecies that infect humans are somewhat different. In both instances, trypanosomes multiply where they first enter the body (e.g., portal of entry or site of the tsetse fly bite). An open skin sore or chancre often appears at the portal of entry. Trypanosomes soon spread to the blood, then to the lymph nodes, and finally throughout the rest of the body.

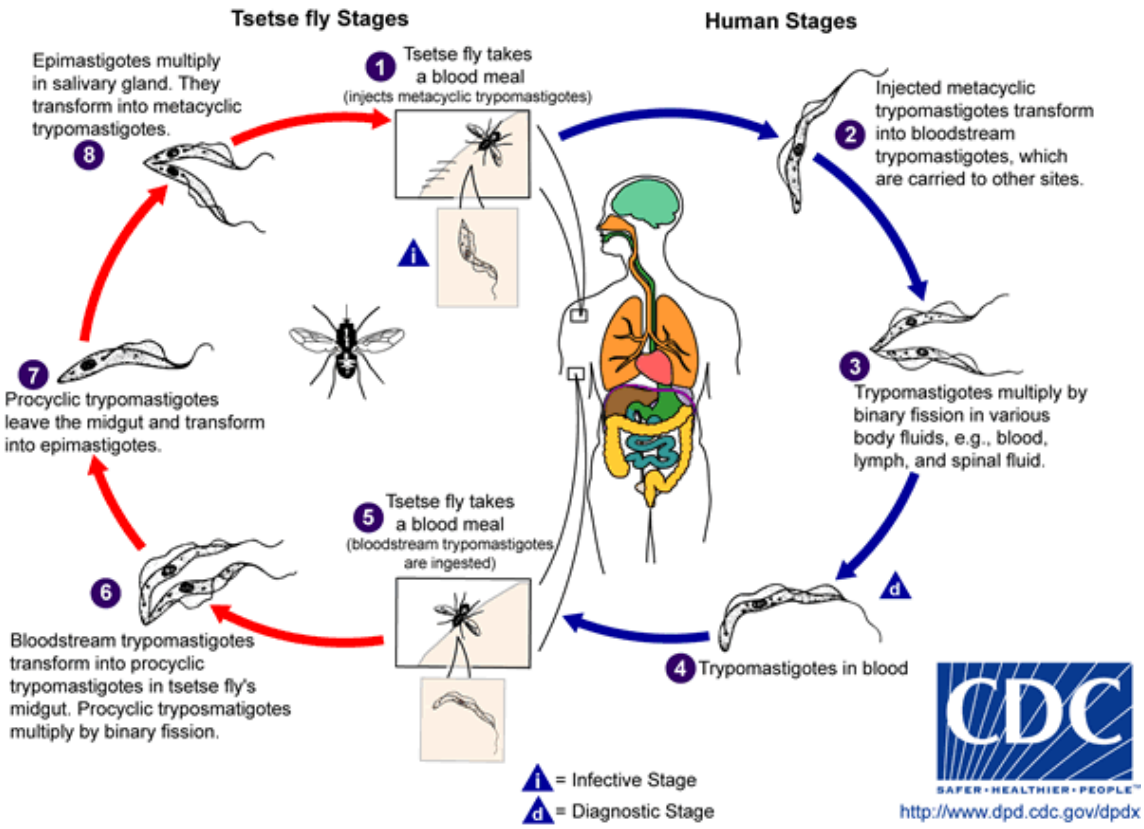
Illness due to infection by *T.b. gambiense* has a slow onset and is characterized by intermittent fever, feeling unwell, muscle pain (myalgia), joint pains (arthritis), rash, and swollen lymph nodes. If the infection spreads to the brain, symptoms can include headache, hallucinations, and lethargy. Symptoms can appear months or years after infection. Illness due to infection by *T.b. rhodesiense* has a more rapid onset and is characterized by high fever; weakness; weight loss; swelling (edema) of hips, hands, legs and eyes; inflammation of the heart muscle (myocarditis); inflammation of the liver (hepatitis); and low red blood cell count (anemia). Symptoms occur within three weeks after infection, and victims often die within a matter of months.

1. (1 pt) What term do Epidemiologists use for the three-week interval between infection (entry of parasite from tsetse fly bites) and development of symptoms?

Incubation period

Early in the infection, fever and low platelet counts (thrombocytopenia) are the most common symptoms. Less than half of infected persons develop chancres, while less than 20% develop obvious heart problems. Infections of both *T.b. gambiense* and *T.b. rhodesiense* are diagnosed by using a microscope to look for trypanosomes in smears of blood, in cerebrospinal fluid (CSF), or in fluid taken from a chancre. The presence of parasites in CSF is proof of brain infection. Diagnosis through detection of antibodies (gamma globulin proteins produced by the body's immune system when it detects harmful substances such as parasites) in blood specimens is used only for infection with *T.b. gambiense*.

Figure 1. Life Cycle of Trypanosomes in Tsetse Flies and Humans



of 1 point

2. (1 pt) What term do epidemiologists use to describe the role that cattle and other hoofed mammals play in the epidemiology of *T.b. rhodesiense*, that is, they serve as a habitat in which it normally lives, grows, and multiplies?

Reservoir_____

3. (1 pt) Epidemiologists refer to an illness transmitted from a source to new host by an arthropod as:

Vector-borne_____

4. (1 pt) Epidemiologists refer to diseases, such as rabies and African trypanosomiasis, that are transmissible under normal conditions from animals to humans as

Zoonoses_____

5. (2 pts) Explain the difference between a mechanical vector and a biological vector.

_**Vectors** such as mosquitoes, fleas, and ticks may carry an infectious agent through purely mechanical means or may support growth or changes in the agent. Examples of mechanical transmission are flies carrying *Shigella* on their appendages and fleas carrying *Yersinia pestis*, the causative agent of plague, in their gut. In contrast, in biologic transmission, the causative agent undergoes maturation/multiplication in an intermediate host before it can be transmitted to humans

6. (1 pt) Which one of the symptoms of Trypanosomiasis infection is responsible for its common name, African sleeping sickness?

Lethargy_____

of 6 points

7. (4 pts) Describe two strategies, one population-based and one environment-based, that could be used to monitor sleeping sickness in a given area.

a) population based = screening people for antibody or trypanosome or infection; hospital surveillance or case finding; looking for sick or infected people THESE ANSWERS ARE RELATED TO THINGS FOR PEOPLE; ACCEPT ALL REASONABLE ANSWERS

b) environmental based = monitoring flies; setting fly traps; checking reservoirs; THESE ANSWERS ARE RELATED TO THINGS FOR THE ENVIRONMENT; ACCEPT ALL REASONABLE ANSWERS

8. (3 pts) Describe three things you could do to protect yourself from Trypanosomiasis infection.

a) pesticide, stay inside, wear light colored clothes

b) long sleeves, have screens on windows or doors

c) avoid infested areas

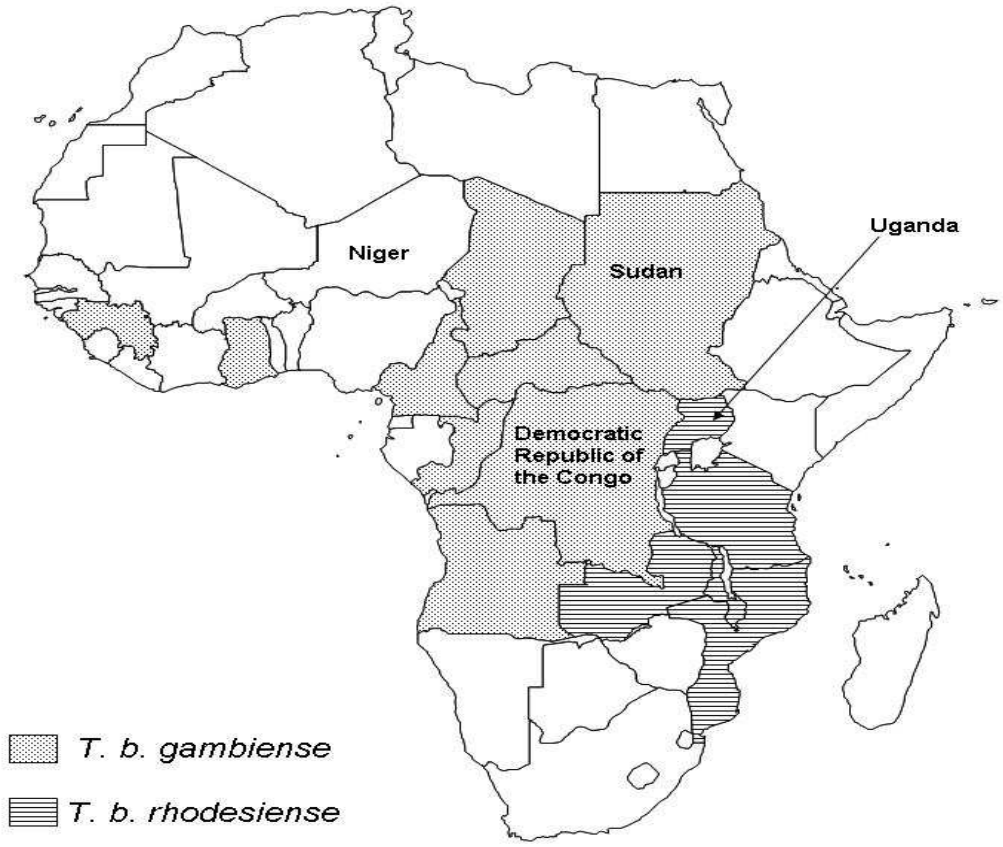
ACCEPT ALL REASONABLE ANSWERS

of 7 points

[1] CDC Yellow Book, listing of endemic areas for trypanosome infection; also see specific travel destinations

The ranges of the two different trypanosome subspecies that infect humans are shown in Figure 2 below.[1] Uganda is the only country where both subspecies of trypanosome are endemic. It also has undergone much conflict and civil upheaval during a civil war between 1979 and 1986.

Figure 2. Range of human-infective trypanosomes in Africa, 2010: Countries where focal points of infection have been identified



9. (1 pt) Based on the above map, which trypanosome subspecies is endemic across the most land area of Africa?

T.b. gambiense

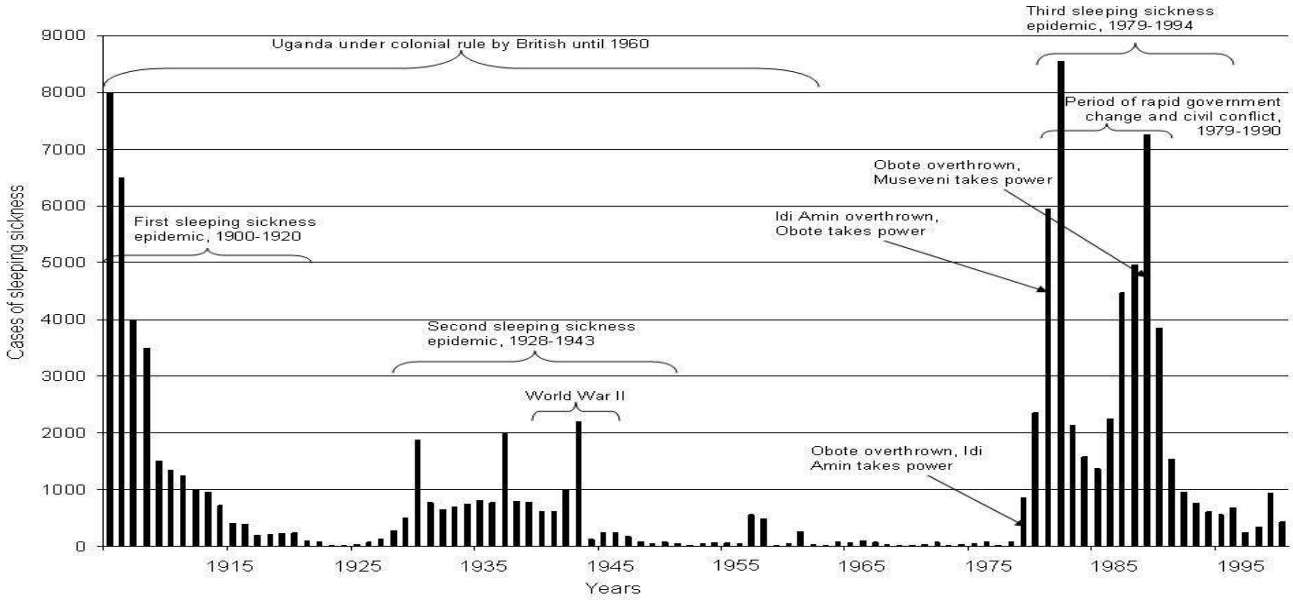
10. (1 pt) The map above does not show either trypanosome being present in Niger. If a trypanosome were to be present, which subspecies would you expect to find in Niger?

T.b. gambiense

of 2 points

Epidemiologists have plotted the number of sleeping sickness deaths and cases from 1905 to 2000 and have identified political events that took place during this time. This is shown in Figure 3. [1]

Figure 3. Cases of sleeping sickness in Uganda, 1905–2000



11. (1 pt) According to Figure 3, there appears to have been a rapid rise in the incidence of sleeping sickness beginning with the first change of government in 1979. Is the relationship causative or correlative?

_correlative_____

12. (3 pts) Give three reasons why civil conflict could be linked to a rise in recorded incidence of infectious diseases post-conflict.

a). medical infrastructure collapses, diagnostics and treatment may not be available, limited access to clean water and food makes people more susceptible to infection, collapsed living structures means more habitat for vectors, Cluttered environment – anything left behind that could become habitat for vectors – i.e. old tires, plastic buckets, etc, not just houses

_____

b)._ people are living close together in resettlement camps/refugee areas,_____

c)._ international aid brings new infrastructure and better surveillance, ACCEPT ALL REASONABLE ANSWERS_____

of 4 points

[1] Adapted from Ford, L.B. (2007). Civil conflict and sleeping sickness in Africa in general and in Uganda in particular. *Conflict and Health* available at http://www.conflictandhealth.com/content/1/1/6

In 1996, the Tambura County hospital in Sudan admitted 87 persons with sleeping sickness. This was a 4-fold increase over the number of cases admitted during 1995. In order to determine the magnitude and geographic distribution of this problem, Epidemiologists collected serum samples and information about activities from a random sample of 1,358 persons from the total population of 25,000 residents in southwestern Tambura County. Serum samples were tested for antibody against *T.b. gambiense.* Seropositivity, or the presence of antibody in serum, usually means that the person has been infected with *T.b. gambiense.* Blood smears from seropositive persons were examined microscopically (using a microscope) to confirm current infection. Participants were divided into three categories: those with early-stage disease (parasites in the blood) who were treated with the medication pentamidine; those with late-stage disease (parasites in the CSF) who were treated with the medication melarsoprol; and patients whose serum was positive, but infection could not be confirmed by microscopic analysis. These patients received monthly check-ups. Some of the data from this study is shown in Table 1.

Please use Table 1 to answers questions 13-23.

Table 1. Association between *T.b. gambiense* seropositivity and demographic characteristics or clinical symptoms among residents of Tambura County, Sudan[2]

	Number	Seropositive (%)	RR*	95% CI†
Demographics				
Survey population	1,358	19.4	–	16.9, 21.8
Male	731	19.2	Referent	
Female	627	19.6	1.01	0.96, 1.06
Age group (years)				
6–9	65	7.7	0.40	0.16, 0.98
10–19	369	18.7	0.97	0.68, 1.38
20–29	275	17.8	0.92	0.66, 1.28
30–39	213	19.2	1.00	0.68, 1.46
40–49	191	28.8	1.49	1.06, 2.09
50–59	126	16.7	0.86	0.65, 1.14
≥60	119	19.3	Referent	
Village of residence				
Andari	80	5.0		2.6, 7.5
Bariguna	160	8.3		5.7, 10.6
Ezo	440	37.0		31.6, 42.5
Mangbangau/Madoro	160	13.1		10.7, 15.7
Source Yubu	79	21.5		19.1, 24.0
Resided away from home	190	13.2	0.63	0.4, 1.0
Within Tambura County	72	9.7	0.47	0.2, 1.1
Elsewhere, southern Sudan	26	15.4	0.74	0.2, 2.3
Central African Republic	59	13.6	0.65	0.3, 1.4
Democratic Republic of Congo	37	10.8	0.52	0.2, 1.6
Clinical history/symptoms				
Screened, treated before 1994	31	32.3	1.70	1.12, 2.57
Family member treated	234	23.5	1.20	1.03, 1.55
Fever	450	20.8	1.11	0.93, 1.34
Fever >1 month (mean = 3.2)	32	44.1	2.30	1.59, 3.48
Pruritis	251	19.4	1.00	0.76, 1.32
Myalgia/arthralgia	246	28.9	1.67	1.22, 2.29
Myalgia/arthralgia >1 month (mean = 6.9)	99	36.4	2.00	1.35, 3.02
Mood/sleep disturbance	12	25.0	1.29	0.31, 5.42
Edema	9	55.6	2.90	1.55, 5.45

[2] Adapted from Moore, A., Richer, M., Enrile, M., Losio, E., Roberts, J., and Levy, D. (1999). Resurgence of sleeping sickness in Tambura County, Sudan. *American Journal of Tropical Medicine and Hygiene* 61(2): 315-318.

13. (1 pt) What study design was used in the above study? cross sectional

14. (2 pts) Based on information in Table 1 (above), which two factors have the strongest association with being seropositive for trypanosomiasis?

a). Living in Source Yubu

b). living in Ezo village

15. (1 pt) Write a statement describing the difference in seroprevalence between males and females.

There is no difference.

ACCEPT ALL REASONABLE ANSWERS

16. (1 pt) As used in this study, is seropositivity a prevalence or incidence measure?

prevalence

17. (1 pt) Write a statement describing the seropositivity rate among children less than 10 years old with that in adults between 40–49 years of age.

children = about ¼ rate of adults; less than adults

adults = about 4 times rate of children; more than children

ACCEPT ALL REASONABLE ANSWERS

18. (3 pts) List three symptoms from Table 1 that are significantly associated with testing seropositive.

a). myalgia/arthralgia

b). myalgia/arthralgia > 1 month

c). fever > 1 month, edema__ACCEPT ANY 3 OF THESE 4

of 9 points

19. (4 pts) Use the information in Table 1 to fill in the shaded cells in the following 2x2 table. Please round to the nearest whole number. *Each box is worth ½ a point.*

	Seropositive	Not Seropositive	Total
Lives in Ezo village	163	277	440
Does not live in Ezo village	100	818	918
Total	263	1,095	1,358

20. (2 pts) Calculate the risk of seropositivity among persons from Ezo Village? Please show your work and report your answer to three decimal places. Circle your final answer.

163/440 = 0.370454545 = 0.371

21. (3 pts) Calculate the relative risk of being seropositive for sleeping sickness if you live in Ezo village. Show your work and report your answer to three decimal places. Circle your final answer. *(1 point for a/a+b and c/c+d; 2 points for dividing correctly; 3 points for correct answer to 3 decimal places; focus on method and not necessarily numbers since the numbers may be incorrect from question 19)*

163/440 = 0.3704545
100/818 = 0.1089324

0.3704545/0.1089324 = 3.4007742 = 3.401

22. (2 pts) If the sample is large enough and an event rare enough, the relative risk can be approximated by calculating an odds ratio. Use the information in the 2x2 table from question 19 to calculate the odds of having sleeping sickness if you live in Ezo village. Please show your work and round to three decimal places. Circle your final answer. *(1 point for ad/bc; 2 points for correct answer to 3 decimal places; focus on method and not necessarily numbers since the numbers may be incorrect from question 19)*

163x818 = 133334
100 x 277 = 27700

133334/27700 = 4.8135018 = 4.184

of 11 points

23. (3 pts) In this particular case, is a relative risk or an odds ratio the most appropriate measure of risk? Explain your answer.

The appropriate measure in this case is the relative risk. The relative risk compares the probability of becoming infected with a disease between two different populations, one of which is exposed and the other of which is not. It is most commonly used for cross-sectional studies like this one.

24. (2 pts) The total survey population included approximately 25,000 people. Given the documented prevalence of infection in the survey sample, about how many trypanosomiasis cases would you expect to find in the total population? Please show your work and round to the nearest whole number. Circle your final answer.

25,000 x 0.194 = 4850

of 5 points

Table 2. Association between *T.b. gambiense* seropositivity and routine activities among residents of Tambura County, Sudan, 1997[3]

	Done regularly				Done where tsetse flies may be present			
Activity	**Number**	**Percent Seropositive**	**RR***	**CI†**	**Number**	**Percent Seropositive**	**RR***	**CI†**
Collecting water	1,117	19.5	1.1	0.7, 1.5	1034	21.3	1.6	1.1, 2.3
Farming	1,149	19.4	1.0	0.7, 1.6	926	22.6	1.8	1.4, 2.5
Fishing	204	11.8	0.6	0.3, 9.7	493	16.6	0.8	0.6, 1.0
Collecting firewood	511	17.4	0.8	0.6, 1.1	431	21.1	1.1	0.9, 1.5
Soaking cassava	145	15.2	0.8	0.4, 1.3	245	23.3	1.2	0.9, 1.7
Hunting	67	11.9	0.6	0.3, 1.2	148	18.2	0.6	0.3, 1.2
Going to market	403	16.4	0.8	0.6, 1.1	140	16.4	0.8	0.5, 1.4
Caring for livestock	11	9.1	0.5	0.1, 2.7	11	27.3	1.4	0.5, 3.8
Hiding	35	14.3	0.7	0.3, 1.8	182	22.0	1.1	0.8, 1.6

*RR = relative risk
†CI = confidence interval

25. (2 pts) According to Table 2, which two daily village activities have the strongest association with trypanosomiasis when performed in an area where tsetse flies may be present?

collecting water

and farming

of 2 points

[3] Copied from Moore, A., Richer, M., Enrile, M., Losio, E., Roberts, J., and Levy, D. (1999). Resurgence of sleeping sickness in Tambura County, Sudan. *American Journal of Tropical Medicine and Hygiene* 61(2): 315-318.

Epidemiologists worked with entomologists (people who study insects) to study the distribution of tsetse flies in Kinshasa, Democratic Republic of the Congo (DRC), and to study the characteristics of the environment that could favor the transmission of sleeping sickness. Most of the DRC is an endemic area for *T.b. gambiense*, with some areas of *T.b. rhodesiense* along the eastern border.

Epidemiologists set up 610 fly traps for four consecutive days at six different sites around Kinshasa. Flies were collected twice a day, identified, and dissected to check for trypanosome presence using two different methods—direct observation and polymerase chain reaction (PCR) analysis. During two collection periods, the 610 fly traps collected 897 flies — 624 in the rainy season and 273 in the dry season.

Since tsetse flies feed on other animals as well as humans, investigators used PCR to determine how often flies fed on humans. They then compared the proportion of flies which had taken a blood meal during the rainy season with the number that had taken a blood meal during the dry season (Table 3).

Table 3. Human blood meals found in tsetse flies during both rainy and dry seasons Kinshasa, Democratic Republic of the Congo, 2005

	Flies that had taken a human blood meal	Flies that had not taken a human blood meal	Total
Rainy season	35	589	624
Dry season	43	230	273
Total	78	821	897

26. (7 pts) Fill in the shaded cells in the above table.

27. (1 pt) Based on Table 3 above, are flies that have taken blood meals more common during the rainy season or the dry season?

Dry season

28. (2 pts) List two other explanations for the results of this study.

a) trap behavior, may be fewer flies in dry season but they are more likely to feed;

b). people are inside more and have less contact with flies ACCEPT ALL REASONABLE ANSWERS

of 10 points

29. (3 pts) Using flies that had taken a human blood meal as a proxy for being infected with trypanosomes, what is the relative risk of the likelihood of a fly being infected during the rainy season when compared to the dry season using the numbers from question #26? Please show your work and round to three decimal places. Circle your final answer. *(1 point for a/a+b and c/c+d; 2 points for dividing correctly; 3 points for correct answer to 3 decimal places)*

35/624 = 0.0560897
43/273 = 0.1575091

0.0560897/0.1575091 = 0.3561045 = 0.356

30. (6 pts) Give the definitions of the following patterns of disease occurrence:

a) Endemic disease

present at a continuous level throughout a population or geographic area; the constant presence of an agent or health condition within a given geographic area or population; can also refer to the usual prevalence of an agent or condition.

b) Epidemic

the occurrence of more cases of disease, injury, or other health condition than expected in a given area or among a specific group of persons during a particular period. Usually, the cases are presumed to have a common cause or to be related to one another in some way (see also **outbreak**);

c) Outbreak

Synonymous with epidemic. Sometimes the preferred word, as it may escape sensationalism associated with the word epidemic. Alternatively, a localized as opposed to generalized epidemic; the occurrence of more cases of disease, injury, or other health condition than expected in a given area or among a specific group of persons during a specific period. Usually, the cases are presumed to have a common cause or to be related to one another in some way. Sometimes distinguished from an epidemic as more localized, or the term less likely to evoke public panic (see also **epidemic**).

of 9 points

Results from Test Method B (comparison test)	Results from Test Method A (gold standard)	
	Positive	Negative
Positive	A (True Positive)	B (False Positive)
Negative	C (False Negative)	D (True Negative)

When epidemiologists perform two or more different diagnostic tests for the same disease on the same person, the results do not always agree. One test is usually considered to be the gold standard or the one that gives the best results, while the other is a comparison test. The above table shows how the results are organized.

31. (1 pt) Using the above table, give the formula for "sensitivity" as it applies to a diagnostic test.

__a/a+c_____

_____

32. (1 pt) Using the above table, give the formula for "specificity" as it applies to a diagnostic test.

__d/b + d_____

_____

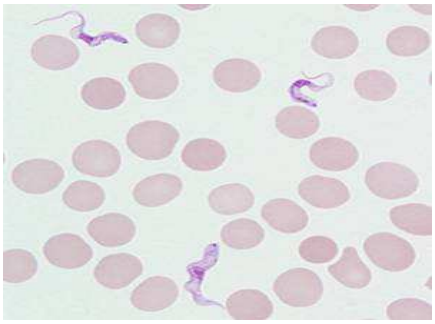
33. (1 pt) Using the above table, give the formula for "positive predictive value" as it applies to a diagnostic test.

__a/ a+b _____

_____

of 3 points

Figure 4. Trypanosomes in blood smear, Giemsa stain



(Taken from Centers for Disease Control and Prevention, Division of Parasitic Diseases; available at http://www.dpd.cdc.gov/dpdx/HTML/TrypanosomiasisAfrican.htm)

Sleeping sickness caused by *T.b. gambiense* can be diagnosed through a variety of diagnostic tests, shown in Table 4. All methods are used on blood from patients.

Table 4. Comparison of various laboratory techniques used to test humans for trypanosomiasis.

Type of test	Organisms detected	Minimum organisms /mL of fluid	Additional required equipment
Whole blood films	Trypanosomes, microfilariae, and malaria	10,000	Microscope, slides
Quantitative Buffy Coat (QBC) Test	Trypanosomes, malaria	450	Centrifuge, capillary tubes, stains, UV light, darkroom
Mini-anion-exchange	Trypanosomes	100	Chromatography equipment, capillary tubes, microscope
Giemsa staining	Trypanosomes, microfilariae, and malaria	5,000	Microscope, slides, stain

34. (1 pt) Which one of the above laboratory techniques has the greatest sensitivity?

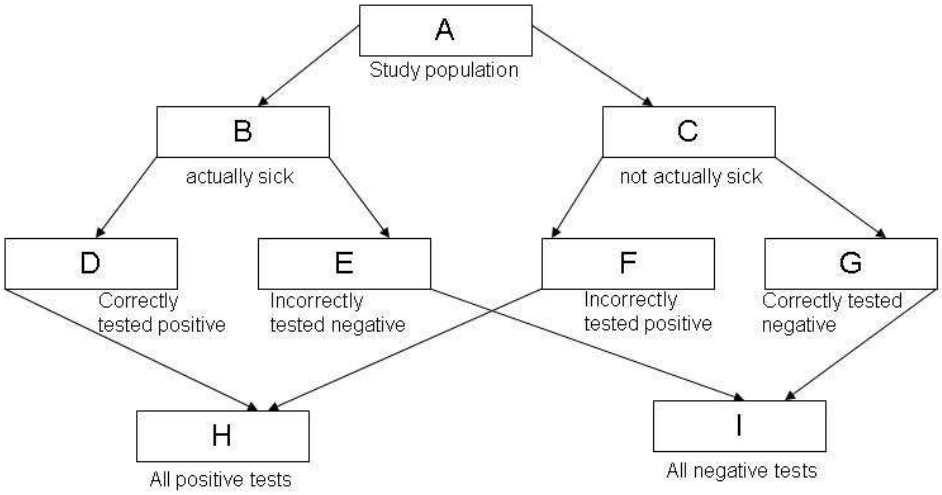
_mini anion exchange_____

35. (1 pt) Which one of the above laboratory techniques has the least sensitivity?

__whole blood films_____

of 2 points

36. (9 pts) In one study, 3,526 patients were screened for trypanosomiasis using w
films, and 684 patients had a positive result. If an additional 264 patients were found to have
trypanosomiasis when cerebrospinal fluid was examined using PCR, and 23 of the positive tests were found to be incorrect, fill in the following chart.



A: 3526 (given)

B: 925

C: 2601

D: 661

E: 264 (given)

F: 23 (given)

G: 2578

H: 684 (given)

I: 2842

of 9 points

37. (4 pts) What is the probable sensitivity of the whole blood film test? Please show your work and give your answer as a percent to two decimal places. Circle your final answer. *(2 pts for showing work and 2 pts for correct answer)*

Sensitivity = 1 – p (false negatives)
P (false negative) is P(test negative | have trypanosomiasis) = 264/925
= 0.2854 x 100%
Sensitivity of whole blood test is 1- 28.54%
= 71.46%

OR

661/925 = 0.7145945 = 71.46%

38. (4 pts) If 23 patients from the previous question were not confirmed to have trypanosomiasis upon examination of cerebrospinal fluid, what is the specificity of the whole blood film test? Please show your work and give your answer as a percent to two decimal places. Circle your final answer. *(2 pts for showing work and 2 pts for correct answer)*

Specificity = 1 – p (false positives)
P (false positive) is P (test positive | don't have trypanosomiasis) = 23/2601
= 0.008843%
Specificity of the whole blood film test is 1-0.008843
= 0.9912

OR

2578/2601 = 0.9911572 = 99.12%

of 8 points

Road Safety is No Accident

26 questions, 66 total possible points

Road traffic injury (RTI) is defined as any injury resulting from a road traffic crash regardless of the severity or outcome. Worldwide, RTIs are a major public health problem and cause a majority of the deaths resulting from unintentional injuries. RTIs are the third leading cause of mortality in the world, and they contribute to around 10% of total deaths, or 5.8 million deaths annually.

India is the largest country in the South Asian region. According to the World Health Organization (WHO), RTIs are the sixth leading cause of death in India. India has the second highest reported mortality rate from RTIs in the world (29.2 per 100,000 people).

Key Statistics about Road Traffic Injuries in India

- Males have a 3–4 times higher risk of road traffic injury than females.
- Males account for 85–95% of all road traffic injuries, hospitalizations, and deaths.
- More than 60% of all road traffic injuries and fatalities occur among people aged 15–44
- Most RTIs occur between 5:00 and 7:00 p.m.
- Overall, 77% of registered motor vehicles are two-wheelers (e.g., motorcycles, scooters and mopeds).
- More than 90% of riders and passengers (pillions) do not wear a helmet.
- Pedestrians and motorized two-wheeled vehicle (MTV) riders are at higher risk of road traffic fatalities and injuries in India than other persons.

These patterns are similar to those in other developing countries. Some of the reasons for the high burden of RTIs in developing countries include increases in the numbers of motor vehicles and numbers of people killed or injured per crash, as well as poor enforcement of traffic safety regulations, inadequacy of health infrastructure, and poor access to health care.

39. (2 pts) The two primary morbidity frequency measures for diseases, injuries, and disabilities are incidence and prevalence. Give the definition for each.

Incidence__ number of new cases per population at risk per unit time; a measure of the ____ frequency with which new cases of illness, injury, or other health condition occurs among a population during a specified period (key part is ”new cases”)_____

Prevalence__ number of existing cases per population; the number or proportion of cases or events or attributes among a given population (key part is “existing cases”)_____

PLEASE ACCEPT ALL REASONABLE ANSWERS_____

40. (2 pts) Which of these two frequency measures is most appropriate for RTIs and why?

Incidence because a road traffic injury is a one-time event_____

_____

of 4 points

Epidemiologists often use descriptive data for non-infectious disease, injuries, and disabilities to characterize an epidemiological problem as well as to determine an increasing or decreasing trend associated with that problem. They use this information to implement prevention and control measures to decrease the burden of a disease, injury, or disability in a population. The following RTI data are from the Indian National Crime Records Bureau.

Table 5. India Road Traffic Injury Data, 2000–2008

Year	Accidents	Injuries	Fatalities	Total Population[1] (in thousands)
2000	308,260	340,163	80,118	1,014,000
2001	323,720	353,133	80,262	1,030,000
2002	329,434	367,282	81,873	1,046,000
2003	336,468	382,898	84,430	1,050,000
2004	361,343	413,892	91,376	1,065,000
2005	390,378	447,851	98,254	1,080,000
2006	394,432	452,922	105,725	1,095,000
2007	418,657	465,352	114,590	1,130,000
2008	415,855	469,156	118,239	1,148,000

[1] *From CIA World Factbook*

41. (3 pts) What was the incidence of injuries per 100,000 people in India in 2002? Please show your work, and round to two decimal places. Circle your final answer. *(1 point for division; 2 points for correct multiplication; 3 points for correct rounding; numbers from chart must be correct; if all correct but not enough zeros, then minus 1 point)*

(367282/1046000000)x100,000 = 35.1130 = 35.11

of 3 points

42. (3 pts) What was the mortality rate per 10,000 people in India in 2008? Please show your work and round to two decimal places. Circle your final answer. *(1 point for division; 2 points for correct multiplication; 3 points for correct rounding; numbers from chart must be correct; if all correct but not enough zeros, then minus 1 point)*

(118329/1148000000)x10000 = 1.029956 = 1.03

43. (1 pt) Is the above mortality rate an example of a crude mortality rate, a cause-specific mortality rate, or a proportionate mortality rate?

__cause-specific mortality rate_____

44. (2 pts) What was the proportion of death to injuries in India in 2006? Please show your work and round to two decimal places. Circle your final answer. *(1 point for correct division; 2 points for correct rounding; numbers from chart must be correct)*

(105725/452922) = 23.34287% = 23.34% OR 0.23

Most road traffic injury and fatality rates are based on population data, but they also can be determined for vehicles. There were 72,718,000 registered motor vehicles in India in 2004.

45. (3 pts) What was the road traffic injury rate per 10,000 vehicles in India in 2004? Please show your work and round to two decimal places. Circle your final answer. *(1 point for division; 2 points for correct multiplication; 3 points for correct rounding; numbers from chart must be correct)*

(413892/72718000) x 10000 = 56.9174 = 56.92

46. (3 pts) What was the road traffic mortality rate per 1,000 vehicles in India in 2004? Please show your work and round to two decimal places. Circle your final answer. *(1 point for division; 2 points for correct multiplication; 3 points for correct rounding; numbers from chart must be correct)*

(91376/72718000)x1000 = 1.25658 = 1.26

of 12 points

Several different models of disease causation have been described. Among the simplest of these is the epidemiologic triad or triangle, the traditional model for infectious disease. This model can also be used for non-infectious diseases, injuries, and disabilities. In an injury model, the agent is not an infectious microorganism or pathogen, but it is the vehicle involved in the road traffic incident (motorized two-wheeler).

47. (3 pts) List three host factors that may increase the risk of RTIs.

age, gender, occupation, alcohol use, drug use, helmet use,

driver experience, tiredness, wearing glasses or not,_____

distracted (talking to/looking at people across the street; on the phone) FOCUS ON THE PERSON; PLEASE ACCEPT ALL REASONABLE ANSWERS

48. (3 pts) List three agent factors that may increase the risk of RTIs.

no lights or reflectors, no horn, brakes, speed, poorly____

maintained/raggedy, no seat belt or restraints, no mirrors,_

type of vehicle FOCUS ON THE VEHICLE; PLEASE ACCEPT ALL REASONABLE ANSWERS

49. (3 pts) List three environmental factors that may increase the risk of RTIs.

weather (rain,fog); lighting/time of day, traffic, urban/rural,

road curvature or gradient (hills) FOCUS ON ROADS AND

SURROUNDINGS; PLEASE ACCEPT ALL REASONABLE ANSWERS

of 9 points

The following study was done on all cases of RTI death victims on whom a medical autopsy had been carried out at the mortuary of Maulana Azad Medical (MAM) College and Associated Hospitals in New Delhi, India during a 10-month period. For all 230 victims, the types of road users and the vehicles involved were recorded.

Please use Tables 6 and 7 to answer questions 50 and 51.

Table 6. Distribution of Victims in Relation to Nature of Accident*

Road Users	Total	Knocked Down	Run Over	Collision with Motor Vehicle	Fall from Moving Vehicle	Over-turning	Hitting Against Object
Pedestrian	90 (39.1%)	67 (74.4%)	23 (25.6%)	–	–	–	–
Motor-cyclist	42 (18.1%)	3 (7.1%)	8 (19.0%)	18 (42.9%)	2 (4.8%)	8 (19.0%)	3 (7.1%)
Pedal-cyclist	35 (15.2%)	26 (74.3%)	7 (20.0%)	2 (5.7%)	–	–	–
Vehicle occupant	44 (19.0%)	1 (2.3%)	4 (9.1%)	13 (29.5%)	22 (50.0%)	4 (9.7%)	–
Vehicle driver	11 (4.8%)	–	–	6 (54.4%)	–	3 (27.3%)	2 (18.2%)
Other	8 (3.7%)	4 (50.0%)	3 (37.5%)	–	–	–	–
Total	230	101 (43.9%)	45 (19.6%)	39 (17.0%)	25 (10.9%)	15 (6.5%)	5 (2.2%)

**(Ghosh PK, J Indian Med Assoc. 90:309-312, 1992)*

Table 7. Distribution of Vehicles Involved in Relation to Nature of Accident*

Road Users	No. Involved	DTC Bus	Private Bus	Cars, Jeeps, and Taxis	Tempo	Truck	Vans	Motor cycle & Scooter	Three-Wheeler	Pedal Cycle	Tonga	Bullock Cart and Hackney Carriage
Pedestrian	90	29	12	10	2	6	3	18	8	---	1	1
Motor-cyclist	42	9	6	2	---	14	---	8	2	---	---	1
Pedal-cyclist	35	12	5	3	---	6	1	3	3	1	1	---
Vehicle occupant	44	14	16	---	---	11	---	---	3	---	---	---
Vehicle driver	11	3	2	---	1	4	---	1	---	---	---	---
Other	8	4	1	---	---	3	---	---	---	---	---	---
Total	230	71	42	15	3	44	4	30	16	1	2	3

**(Ghosh PK, J Indian Med Assoc. 90:309-312, 1992)*

50. (2 pts) The pedestrian victims in this study were either knocked down or run over. What were the two most likely vehicle categories that either knocked down or ran over these pedestrians?

DTC buses and

motorcycles/scooters

51. (1 pt) What percentage of the autopsied pedestrians in this study was involved in RTIs with motorcycles and scooters? Please show your work.

18/90 = 20%

of 3 points

Epidemiologists conducted a study in Hyderabad city to explore the differences in crash characteristics and injury outcomes between riders and passengers that presented to a hospital after the crash. Hyderabad city in India has a population of 3.8 million persons and had 1.2 million registered motor-vehicles in 2008, with the majority being motorized two-wheeled vehicles (MTVs) (77%). A total of 781 consecutive RTI patients reported to two large public hospitals and three branches of a large private hospital.. People of all ages with RTIs who reported to the emergency department or were brought to these hospitals were included. Trained interviewers conducted interviews using a questionnaire designed for this study after obtaining written informed consent from the injured person or the caretaker, or a responsible adult family member for those that had died.

52. (1 pt) What type of epidemiological design did the Epidemiologists use in this study?

cross sectional study_____

Among the 781 RTI patients recruited to the study, 378 were MTV riders and passengers, with 252 of these being riders. The mean age of riders and passengers was 32.8 and 28.3, respectively, and 97.2% of riders were male while 69.8% of passengers were female. Of the two types of crashes in the study, 41% (involving 47 passengers) were single vehicle crashes and 59% (involving 79 passengers) were multiple vehicle crashes. Most of single vehicle crashes involved a skidding vehicle (45.2%), and most multiple vehicle crashes involved a bus or heavy vehicle (35.9%). Alcohol use was confirmed for 12.7% (involving 35 riders) of the patients, and only 19.6% of all patients wore a helmet, including 0.8% of passengers wearing a helmet.

53. (2 pts) How many passengers were female? Please show your work and round to the nearest whole number.

378-252 = 126 x 0.698 = 88

54. (2 pts) How many riders were involved in multiple vehicle crashes? Please show your work and round to the nearest whole number.

(378 x 0.59) = 223.02 -79 = 144.02 = 144

55. (2 pts) How many riders and passengers wore a helmet? Please show your work and round to the nearest whole number.

378 x 0.196 = 74

of 7 points

Table 8. ICD-10 coded head injuries, and helmet use, and relative risk of injury for riders and passengers

ICD-10 Head Injury	**Helmet Worn (n=74)** *N (%)*	**Helmet Not Worn (n=304)** *N (%)*	**Not worn relative risk (RR) of injury to worn** *RR*	*95% confidence interval*
Superficial	22 (29.7%)	106 (34.9%)	?	0.80-1.72
Open wound	16 (20.3%)	118 (38.8%)	1.91	1.19-3.07
Fracture	6 (6.8%)	0 (0%)	–	–
Intracranial	2 (2.7%)	41 (13.5%)	?	1.23-20.1
Crush	1 (1.4%)	6 (2.0%)	1.46	0.17-11.9
Traumatic amputation	0 (0%)	2 (0.7%)	–	–
Other unspecified	5 (6.8%)	31 (10.2%)	1.51	0.61-3.74

56. (6 pts) Using the head injury and helmet use data from Table 8, calculate the relative risk for superficial head injuries associated with not wearing a helmet. Please show your work and round to two decimal places. Circle your final answer. *(4 points for a correct box; 2 points for correct relative risk) no points for calculations since they have already done this earlier and the box is leading)*

	Injury Yes	Injury No
Helmet Not Worn	106	198
Helmet Worn	22	52

106/304 = 0.3486842
22/74 = 0.297297297

0.3486842/0.297297297 = 1.172846 = 1.17

RR = 1.17

of 6 points

57. (2 pts) Write a summary statement interpreting the results from question 56 for your peers.

Riders and passengers who did wear a helmet were X times more likely to have a superficial head injury than those who did not wear a helmet. *(answer = 0.85; accept this if students flipped the relative risk in the previous question)*
Riders and passengers who did not wear a helmet were X times more likely to have a superficial head injury than those who did wear a helmet. *(answer = 1.17)*

58. (2 pts) Riders and passengers who did not wear helmets were at higher risk for which two types of head injury?

open wound and

intracranial

59. (1 pt) Why do two of the head injury subtypes not have a relative risk (RR) provided?

Not enough people in the group

of 5 points

60. (7 pts) In a neighboring country Nepal, there is a similar pattern of RTIs occurring in the same age group and in similar months. Many of the RTIs in Nepal happen during the rainy season. Please refer to the following table of the number of RTI cases collected at a Nepalese hospital and recreate these numbers as an epidemic curve on the next page.

Grading criteria for the epi curve: (total – 7 pts)
(1 pt) does it have a title?
(1 pt) is the x-axis labeled? (actually, this sample answer isn't…)
(1 pt) does it have the correct scale? (same as above…)
(1 pt) is the y-axis labeled?
(1 pt) does it have the correct scale?
(2 pts) are the numbers correctly graphed?

Table 9. Monthly RTI Cases, Nepal May 1997 to April 1998

Month	RTI Cases	Month	RTI Cases
January	120	July	126
February	76	August	102
March	64	September	94
April	30	October	31
May	60	November	30
June	63	December	96

of 7 points

61. (3 pts) According to your epidemic curve above, what three consecutive months are most likely the rainy season in Nepal?

July, August, September

62. (2 pts) Give two reasons why more accidents happen in the rainy season than during other times of the year.

Roads wet, cause more accidents; mudslides on steep slopes;

low, decreased visibility due to, mud slides, improper rain;

equipment on vehicles, no windshield wipers, etc.
ACCEPT ALL REASONABLE ANSWERS

63. (2 pts) What is the total percentage of RTIs during the rainy season months? 36%

Several epidemiological research studies are done each year on RTIs, road traffic fatalities, and ways to prevent them.

64. (3 pts) List three prevention and control measures that can be implemented in India to reduce the incidence and mortality of RTIs for riders and passengers of MTVs.

Helmet laws, Speed limits

Clearly marked driving lanes

Traffic lights, Lights/reflectors
ACCEPT ALL REASONABLE ANSWERS

of 10 points

THE END!!