Exploring the World of Science

University of Michigan Science Olympiad
2021 Invitational Tournament

<Disease Detectices <C>

Test length: 50 Minutes

Team name: KEY

Student names: KEY

[Q64 and Q69 will scored in the event of tiebreakers]

PART I : BACKGROUND AND SURVEILLANCE

1) During New Years weekend, a large holiday party resulted in several cases of E.coli within the community. Public health experts are relying on physicians and clinics to report all cases of E.Coli within the community to health agencies. What best describes this method?
    a) Active surveillance
    b) Outbreak surveillance
    c) Sentinel surveillance
    d) Syndromic surveillance
2) What are some limitations to the method of surveillance used in the previous question?
    a) It may not be effective for detecting rare diseases
    b) Incompleteness of reporting and variability
    c) It is not being used in conjunction with a specific epidemiologic investigation
    d) May result in incomplete monitoring of trends
3) The aforementioned community is located in a rural area of America, and therefore most members of the community are quite far from a healthcare professional. Propose another method for detecting the extent of the outbreak.
    a) Internet searches, calling in sick, OTC medicine, emergency department, school absences
4) For the surveillance method described in question 1, which of the following scenarios would be best fitting to use this method for?
    a) A outbreak of Ebola in a small village population of West Africa
    b) A COVID-19 outbreak in New York City
    c) A outbreak of Cholera in rural England
    d) Several cases of CJD throughout midwestern America
5) The US state health department traps mosquitos every summer to test for Zika and West Nile virus. What surveillance method is best described here?
    a) Active surveillance
    b) Outbreak surveillance
    c) Risk factor surveillance
    d) Passive surveillance
6) How is surveillance data used? Mark all correct answers
    a) Establishing baseline levels of disease
    b) Monitoring diseases at one specific point in time
    c) Allocate resources
    d) Detect increases in disease occurence
7) Public health surveillance includes which of the following activities:
    a) Acquiring case reports of patients with symptoms resembling those of COVID-19 from local clinics
    b) Circulating educational materials about preventative behaviors for COVID-19
    c) Diagnosing whether a case a pneumonia-like symptoms was due to COVID-19
    d) Creating graphs of the number of cases per day in a 5 mile radius
8) Public health experts in Southeastern Michigan decide to conduct a health education program in order to monitor cardiovascular health. Ann Arbor was maintained as the control city, whereas Ypsilanti and Detroit received the treatment program. All studied cities had dietary behavior, weight, and plasma cholesterol reported. What notable study is this study modeling?
    a) Stanford Three Community study
9) The CDC has stated that it has been difficult to accurately depict asymptomatic cases through case surveillance. What surveillance method can (and is being!) used to remedy this issue?
    Serology surveillance

Questions 8-10 pertain to the following passage

A local sandwich shop in Lakeshore, Michigan has been identified as the source of several reported cases of fever, muscle aches, and nausea. The agent causing the disease was determined to be found in the cheese used in the sandwiches. Most consumers reported exhibiting symptoms around 36 hours after ingestion.

10) Given the symptoms, food type, and incubation period, name the most likely disease described, as well as the primary treatment
    a) Listeriosis, treated with antibiotics. Also accept salmonella.
11) Name another common food source for this agent.
    Unpasteurized milk, soft cheeses, ready to eat deli meats, eggs
12) Name one group of people at heightened risk for this disease, and the primary symptom they may exhibit as noted by the FDA.
    Pregnant women - mild flu like illness, can lead to premature delivery or stillbirth
elderly/ immunocompromised- bacteremia or meningitis, young children -- severe nausea.

13) Public health officials still highly regard Koch's postulates when it comes to the microbiological etiology of disease. However, recent developments in modern medicine have called for a re-evaluation of his methods. Of the following, which is the most notable development that has caused this?
    a) Development of the Western Blot and PCR tests
    b) Antibiotic resistance
    c) Successful strain optimisation
    d) Inability of microorganisms to grow in cell free culture
14) The natural history of a disease timeline would NOT show which of the following?
    a) State of susceptibility
    b) Death
    c) Disability
    d) Risk factors
15) For the disease MERS, a species of coronavirus which spreads via respiratory droplets, what basic reproduction number seems most probable?
    a) 1.9-3.5
    b) 0.3-0.8
    c) 12-18
    d) 5-7
16) True or False: basic reproduction numbers are estimated from mathematical models and can be used to determine the spread of an emerging infectious disease. They are a strong estimator of how fast the infection may spread in a population.
17) Of the following, which is NOT one of Koch's rules for determining whether a specific living organism causes a particular disease?
    a) The organism must be present in every case of the disease
    b) The organism must be able to be isolated and grown in mixed culture
    c) The organism must then be recovered from the animal and identified
    d) The organism must cause the specific disease when inoculated in the animal
2) Which of the following is NOT an advantage of case-control studies?
    a) Usefulness of studying rare disease
    b) Ability explore several exposures simultaneously

c) Based on sample of general population
d) Easy utility for diseases with long latency periods

3) Which of the following is NOT a disadvantage for cross-sectional studies
   a) More difficult statistical methods needed for analysis
   b) Can result in misclassification of cases in remission
   c) Are biased towards cases of long duration
   d) Difficult to separate cause and effect
4) Which of the following is NOT a measure of association
   a) Odds ratio studies
   b) Cohort studies
   c) Prevalence
   d) Attributable risk
5) Which of the following is FALSE regarding specificity and sensitivity
   a) They are most useful for screening a free-living population
   b) The interdependence of the tests is best illustrated by continuous tests where the cut-off for a positive test is fixed
   c) A test with high sensitivity has few false negatives
   d) A test with a high cut off for a positive test has low sensitivity compared to a low cut off

PART II: OUTBREAK INVESTIGATION

Questions 1-3 pertain to the following passage

In Novi, several cases of food poisoning were reported. On a given day, six patients reported to the hospital with symptoms of severe nausea, vomiting, and cramps. Most patients report symptoms only lasting for 1-2 days. Over the next few days, the number of patients with these symptoms continues to grow.

Of the 34 reported patients, 22 had recently eaten at Lucky Larry's. Of the 67 uninfected family members of the 34 patients, 17 had eaten at Lucky Larry's. Out of the 34 patients, 8 had eaten at Tropical Smoothie recently. Of the 67 uninfected family members, 9 had eaten at Tropical Smoothie.

1) Calculate the odds ratio for Lucky Larry's and Tropical Smoothie. Which restaurant is more likely to be the source of the outbreak? Show all work.
   a) Tropical Smoothie: (8*58)/(9*26) = 1.98
   b) Lucky Larrys: (22*55)/(17*12) = 5.39
   Lucky Larry is more likely

2) Provide an interpretation for the odds ratio
   Eating at Lucky Larry's is associated with contracting this disease. People who ate at Lucky Larry's were 5.39 times more likely to become ill.

3) Which of the following would best describe the restaurant where the outbreak occured?
   a) An infected chef served cooked food that was improperly reheated
   b) A fried chicken joint with reports of improperly thawed chicken
   c) A breakfast diner that serves uncooked or raw seafood, primarily shellfish
   d) A new juice bar specializing in raw juices

Questions 4-8 refer to following passage

The University of Michigan has a population of nearly 50,000 students. In September, the university reported an increase in individuals with respiratory illness symptoms. 72 undergraduate and 23 graduate students sought care for severe breathing difficulties, and multiple students were hospitalized. (As a general rule, undergrads are 18-22, and graduate students are older than 22)

Respiratory illnesses include asthma, chronic obstructive pulmonary disease, pulmonary fibrosis, and others. Viral respiratory diseases typically last 2-14 days, and symptoms typically include coughing, wheezing, and shortness of breath.

4) What are the four basic elements of a case definition?
   Person, place, time, clinical features

A.

		U of M			Ann Arbor		
Age	# of Hospital Visits	Population	Rate (per 50k/day)	# of Hospital Visits	Population	Rate (per 50k/week)	
18-22	?	46,982	18.4	82	48,132	?	
22+	23	14,569	?	109	121,124	41.2	
Total	?	61,551	?	?	169,256	32.4	

B.

1. Due to a difference in measurement between U of M students and the Ann Arbor population, the overall rates are not directly comparable. Calculate the relative risk for Ann Arbor residents as compared to U of M students. Show all work.
   I(um) = 95/61,551 = 77.17 hospital visits/day/50k persons
   I(aa) = 191/169,256 = 56.42 hospital visits/day/50k persons
   RR = 77.17/56.42 = 1.367

2. According to the difference in age specific rates, which group would you expect an outbreak in?
   The 18-22 age group
3. Given the 4 elements of a case definition, write a basic case definition for this outbreak.
   UM student or A2 resident with one of the above diagnosed respiratory illnesses reporting respiratory symptoms in September
4. What additional piece of information would be most commonly used in order to determine time of exposure and mode of transmission?
   An epi-curve displaying the number of cases per day

Questions 9-13 refer to the following passage

You are the chief epidemiologist on the U of M campus. You receive reports that students in a particular English 125 class are experiencing severe diarrhea and dehydration. The diarrhea has not been bloody thus far, and has been causally attributed to food sensitivities or antibiotic use.

9) List four methods to reduce the risk of food-borne illnesses
Cook meat/poultry/eggs thoroughly, don't cross-contaminate, chill leftovers promptly, wash all produce, report suspected foodborne illnesses to local health dept

10) What pH level do foodborne pathogens best thrive in?

a) 4.6-5.7
b) 6.0-6.4
c) 6.6-7.5
d) 7.6-8.4

In order to develop a hypothesis, you decide to ask the students several questions.

11) In order to determine time, what would be the best question to ask?

a) When did you first arrive ill to the classroom?
b) When did you first become ill?
c) When do you believe you were exposed?
d) What exposures did you have the week you became ill?

Date	9/3-9/10	9/10-9/17	9/17-9/24	9/24-9/10/1	10/2-10/9	10/9-10/18	10/18-10/25	10/25-11/1
# of Diarrhea cases	0	1	1	4	7	6	9	8
# in class	73	69	68	72	64	62	71	66

12) Calculate the incidence of diarrhea among students from October 9- October 18 for the given weeks shown in the data table, for the given year. (3 points)
=(6*52)/(545)=0.572 cases per child year (-1 point without units)

13) What is the most recognized mode of transmission for diarrheal diseases as noted by APHA?
Vehicleborne

The next 8 questions refer to the following passage

You are the chief epidemiologist of Los Angeles, California, and you were recently notified of several instances of New Year's Eve parties, despite COVID-19 restrictions. Several people who had attended a party that Friday weekend reported symptoms including vomiting, fever, and bloody diarrhea. Between January 1st - January 3rd, seven cases were reported to local hospitals and clinics. Between January 3rd - January 6th, twenty four more cases were reported. Most patients reported symptoms lasting for around a week.

1) List five essential components the epi curve for this scenario should include, and define the type of epi curve this is.
   Correct number of bars (2), Title, X axis with title, y axis tilted, clear peak and correct ordering of bars
   1) The outbreak's time trend, that is, the distribution of cases over time.
   2) Outliers, that is, cases that stand apart from the overall pattern
   3) General sense of the outbreak's magnitude
   4) Inferences about the outbreak's pattern of spread
   5) The most likely time period of exposure

Point source curve

2) What type of study should be done in this situation? Briefly explain why.
   Case control, to determine the source of the outbreak

After questioning the patients, you compile a list of possible foods that may be responsible for the outbreak.

3) Fill out the table below

	# of people who ate the food		# of people who didn't eat the food		Odds ratio
Food Type	Sick	Total	Sick	Total	
Canned peaches	22	73	13	73	1.99
Salad Bar	31	73	14	73	3.11
Cheese plate	19	73	8	73	2.85
Chicken Piccata	27	73	5	73	7.98

4) Which food is likely the source of this outbreak?
   Chicken Piccata
5) Given the previous information, as well as the calculated source of the outbreak, which of the following is most likely to be the agent causing the disease?
   a) Campylobacteriosis
   b) Cyclosporiasis
   c) Bacillary dysentery
   d) V. vulnificus infection
6) Name one group of people that might be at heightened risk for this disease
   Immunocompromised people, patients with HIV, children under 1, pregnant women, people receiving chemotherapy, elderly people

7) Which of the following is NOT one of the types of data the CDC uses to link illnesses to contaminated foods?
   a) Epidemiologic data
   b) Food and environmental testing
   c) Traceback data
   d) Risk data

8) As the chief epidemiologist of Los Angeles, you must decide if you must inform the general public of an outbreak with a food safety alert, as in line with CDC regulations. List three considerations you must take when deciding whether or not to warn consumers.
   If the outbreak is ongoing, if the contaminated food is still for sale/in people's homes, if the investigation has identified a specific type of food linked to the illness, if the number of new illnesses is increasing rapidly, if

the illness is severe, if a large number of people are sick who are more likely to get a severe illness, if the outbreak strain is resistant to antibiotics

The next six questions pertain to the COVID-19 pandemic

COVID-19 is a contagious respiratory disease caused by SARS-CoV-2. Symptoms of COVID-19 can vary from person to person, but will frequently include fever, cough, breathing difficulties, and loss of smell and taste. Most patients report symptoms 1-14 days after exposure. The virus typically spreads through close contact via small droplets or aerosols.

In November, the University of Michigan reported an increase in COVID-19 cases among its students. The University uses LynxDx saliva tests in order to monitor the number of cases.

	Has COVID-19	Does not have COVID-19
Tested positive	18	2
Tested negative	5	34

1) Calculate the specificity of this particular test used by the University of Michigan.
   34/(2+34)
2) Calculate the sensitivity of this particular test used by the University of Michigan.
   18/(18+5)
3) The B.1.1.7 variant has recently reached the University of Michigan. President Schlissel is concerned about the efficiency of the Pfizer vaccine, which is currently the main vaccine being administered by the school. Is this a valid concern?
   a) Yes, because the B.1.1.7 variant has been associated with greater disease severity
   b) Yes, because the B.1.1.7 variant is associated with immune escape that would impact vaccine efficacy
   c) No, because the Pfizer vaccine is able to neutralize B.1.1.7 spike proteins.
   d) No, because the relative risk of mortality is lower among individuals with B.1.1.7 when compared to wild type infections.
4) True or false: SARS-CoV-2 has been detected in non-respiratory specimens, and has shown to consistently contain replicative specimen.
5) Many young college students may be asymptomatic or report very mild symptoms. According to the CDC, what percent of overall transmissions can be roughly attributed to individuals without symptoms?
   a) 20%
   b) Over 80 %
   c) 60%
   d) 75%
6) Which of the following can be used to inactivate SARS-CoV-2? Select all that apply
   a) Sunlight
   b) Ethanol at concentrations between 60-70%
   c) Sodium dichloroisocyanurate
   d) UVB light

PART III: PATTERNS, CONTROL, AND PREVENTION

For questions 1-5, match the level of prevention with the given scenario. Answers may be used more than once.

a) Primordial
b) Primary
c) Secondary
d) Tertiary

1) A mastectomy is done on a woman with stage 2 breast cancer D
2) Large scale COVID-19 vaccination A/B
3) Michelle Obama institutes the Let's Move! public health campaign to reduce childhood obesity A
4) A breast biopsy is conducted on a teenage girl who has a family history of breast cancer. C
5) A man who has recently recovered from a stroke engages in a daily exercise program. C

6) A cohort study was done for the correlation of respiratory disease and muscle tremors. The sample of participants was taken from a hospital. The hospital sample indicated that people with respiratory disease were much more likely to suffer from muscle tremors. This incorrect conclusion is due to the fact that people with both diseases are much more likely to be hospitalised than people with one. What type of bias is present here?
   a) Measurement Bias
   b) Confounding Bias
   c) Berkson's Bias
   d) Selection Bias
7) Define the difference between information bias and selection bias
   Systematic difference in collection of data regarding participants vs systematic difference in enrollment of participants

8) What test would be used to determine independence between two categorical variables? Would sample size affect the utility of the test?
   Chi-square test-- Fisher's exact test would be used for small sample sizes

For questions 9-12, match the type of prophylaxis to the scenario

a) Primary prophylaxis
b) Secondary prophylaxis
c) Tertiary prophylaxis
d) Quaternary prophylaxis

9) After the age of 18, it's highly recommended that women frequently visit their gynocologist to receive pap smears A

10) A patient responds poorly to the first round of chemotherapy, and looks towards alternative treatments D

11) A patient who has recently suffered from a heart attack is recommended to engage in a lifestyle disease management program. C

12) An athlete who has recently tore his achilles tendon is advised to take the next few seasons off. B

13) Which of the following is true regarding food storage?
   a) Freezer burn indicates food has been contaminated and is unsafe to eat
   b) Onions should be stored away from light
   c) Refrigerators should be set at 32 or lower, freezers at 0 or lower
   d) Canned foods in high acid content pose risks for botulism

14) Which of the following gastroenteritis causing diseases commonly occurs on cruise ships?
   a) Cholera
   b) Norovirus
   c) E.coli
   d) Salmonella

17) Which of the following diseases are incorrectly matched to their mode(s) of transmission?
   a) Cryptococcosis ; inhaling fungi
   b) Paralytic shellfish poisoning ; Toxic scallops
   c) CJD ; contaminated poultry
   d) Anthrax ; contaminated wool

18) According to WHO, which of the following is the leading cause of vector-borne diseases?
   a) Global travel and trade
   b) Unplanned urbanization
   c) Environmental and social factors
   d) Education and wealth

19) Which of the following is incorrectly matched?
   a) Lymphatic filariasis; parasite
   b) Schistosomiasis; parasite
   c) Typhus; bacteria
   d) Rickettsial diseases; parasite

20) Which of the following viruses have been identified to be of the same family as SARS-CoV-2?
   a) MERS-CoV
   b) SARS-CoV
   c) SARS-CoV-2
   d) MERS-CoV-2
   e) A, B and C
   f) All of the above

21) Which of the following is true of SARS-CoV-2 rapid tests?
   a) The test detects the virus by amplifying viral genetic materials to detectable levels
   b) The tests detect antigens on the surface of the virus
   c) These tests have a higher sensitivity as compared to the PCR test
   d) The tests perform best when sampled during the individual close to the time of exposure

22) The Trump Administration's project for distributing vaccines, Operation Warp Speed, has resulted in far fewer Americans being vaccinated than initially expected. Which of the following are explanations for the below expected vaccination numbers? Select all that apply
   a) Chronically underfunded public health infrastructure

b) Operation Warp Speed did not put enough focus into quickly producing and shipping vaccines
c) Distribution was left to overwhelmed state and local public health departments
d) Rural and low-income communities are difficult to reach