

## Disease Detectives Test (2018)

Name: **ANSWER KEY**

Part 1: \_\_\_\_/16 Part 2: \_\_\_\_/54 Total: \_\_\_\_/70 Won Tiebreaker: \_\_\_\_

## Part One: General Epidemiology

(16 pts)

1. (4 pts) Explain the differences between the following terms: **Outbreak, Cluster, Epidemic, and Pandemic.**

*(1 point each for correct explanation of what makes term distinct- focus on underlined)*

**Outbreak:** The occurrence of more cases than normally expected in a given area or group of people over a given period. Outbreaks involve a small area, perhaps a town or several neighboring towns.

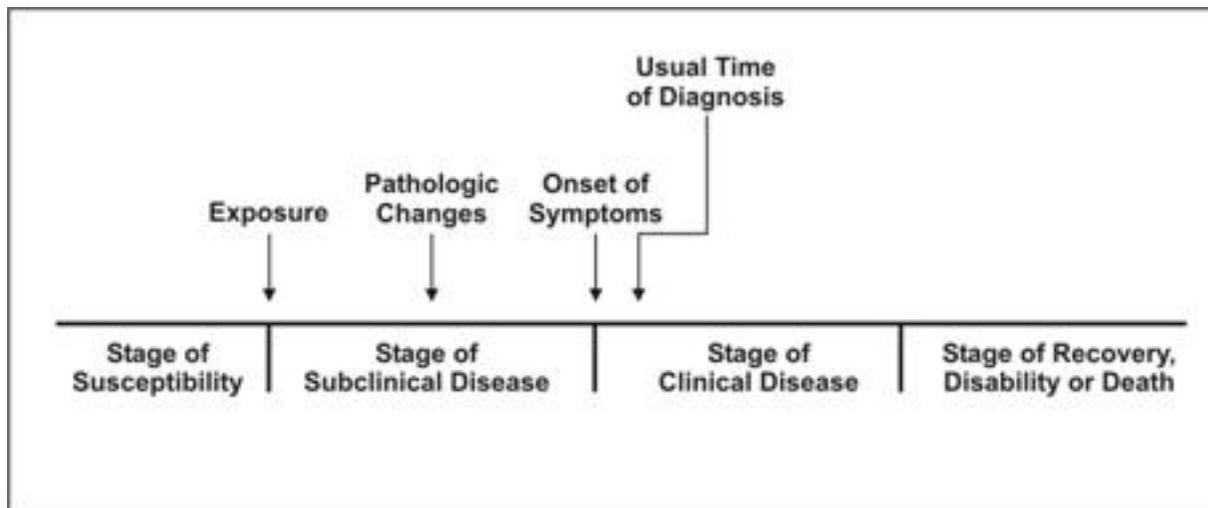
**Cluster:** An aggregation of cases of a disease or other health condition that are closely grouped in time and place. The number of cases may or may not exceed the number expected, unlike in an outbreak

**Epidemic:** situations somewhat more widespread than an outbreak, i.e. an increase in a particular illness across an entire country

**Pandemic:** A large epidemic usually occurring across several countries or continents and affecting a large proportion of the people in those areas.

2. (4 pts) On the timeline below, label where the following would occur: **Exposure, Pathologic Changes, Onset of Symptoms, and Usual Time of Diagnosis.**

*(1 pt each)*



3. (2 pts) Give an example of a vector of transmission and explain the process by which it transmits disease.

*(1 pt for naming accurate example, 1 pt for process explanation)*

Answers vary.

Possible answer: Mosquitoes are vectors of transmission for malaria. Mosquito bites infected person, malaria parasite in blood infects mosquito, mosquito bites another person and transmits the parasite

(1 pt each) For Questions 4-9, classify the study described using one of the following choices. Answers may be used more than once or not at all.

- A. Experimental
- B. Observational cohort
- C. Observational case-control
- D. Observational cross-sectional
- E. Not an analytical or epidemiologic study

4. D A representative sample of Toronto residents was surveyed by telephone and asked whether they smoke with any regularity and whether they have been diagnosed with heart disease.

5. E A pharmaceutical company offered low-cost trials of a pill designed to relieve chronic pain symptoms for a period of 6 months.

6. D Standardized weight and height measurements were taken for 16,875 participants between the ages of 2 and 19 and 27,395 participants 20 years or older.

7. C Persons from a physician's practice diagnosed with new-onset Lyme disease were asked how often they walk through woods, use insect repellent, wear short sleeves and pants, etc. Twice as many patients without Lyme disease from the same physician's practice were asked the same questions, and the responses in the two groups were compared.

8. A Two-month-old children enrolled in a study were vaccinated with one of two types of a new Hepatitis B vaccine. Parents were asked over telephone one week later whether the children had experienced any of a list of side effects.

9. B Occurrence of cancer for a 10-year period was compared between 10,000 persons residing within 1 mile of a facility using ethylene oxide in sterilization and 10,000 persons who resided elsewhere during the same period.

## Part Two: Outbreak Investigation

(56 pts)

### Cholera

Cholera is an acute, diarrheal illness caused by infection of the intestine with the toxigenic bacterium *Vibrio cholerae* serogroup O1 or O139. An estimated 2.9 million cases and 95,000 deaths occur each year around the world. The infection is often mild or without symptoms, but can sometimes be severe. Approximately one in 10 (10%) infected persons will have severe disease characterized by profuse watery diarrhea, vomiting, and leg cramps. In these people, rapid loss of body fluids leads to dehydration and shock. Without treatment, death can occur within hours.

Dadaab Refugee camp in Garissa County, Kenya, hosts nearly 340,000 refugees in five subcamps. On November 18 and 19, 2015, during an ongoing national cholera outbreak (2), two camp residents were evaluated for acute watery diarrhea (three or more stools in  $\leq 24$  hours); *Vibrio cholerae* serogroup O1 serotype Ogawa was isolated from stool specimens collected from both patients. Within 1 week of the report of index cases, an additional 45 cases of acute watery diarrhea were reported. (CDC- SEE ORIGINAL REPORT: [https://www.cdc.gov/mmwr/volumes/67/wr/mm6734a4.htm?s\\_cid=mm6734a4\\_w#modalIdString\\_CDCTable\\_o](https://www.cdc.gov/mmwr/volumes/67/wr/mm6734a4.htm?s_cid=mm6734a4_w#modalIdString_CDCTable_o))

1. (5 pts) Write a case definition for the outbreak. Make sure to define both a suspected case and a confirmed case.

*(1 pt each for: clinical information, person, place, and time. 1 pt for specifying laboratory confirmation in confirmed cases.)*

Answers may vary.

Possible answer- Case definition from the [actual study](#): A suspected cholera case was defined as the occurrence of acute watery diarrhea in any person aged  $\geq 2$  years seen at a camp health facility on or after November 18, 2015, or in a child aged  $< 2$  years who was epidemiologically linked to a confirmed cholera case. Suspected cases with a stool culture positive for *V. cholerae* were considered to be laboratory-confirmed.

2. (6 pts) Draw a logical chain of infection for the spread of cholera.

*(1 pt for each part of the chain: 0.5 for using the correct terminology- agent/pathogen, reservoir, portal of exit, mode of transmission, portal of entry, susceptible host- and 0.5 for correct answer specific to cholera)*

Answers vary.

Possible answer: Agent (bacterium, *Vibrio cholerae*) leaves reservoir (human gut, or body of water) through portal of exit (defecation) and through the mode of transmission (water/food) goes through the portal of entry (ingestion by human) to infect the susceptible host (human).

3. (4 pts) Name and explain two possible risk factors for cholera associated with living in a refugee camp.

*(1 pt for each risk factor, 1 pt for each explanation)*

Answers vary.

Possible answers (not limited to):

- Refugee camp is densely populated, making disease transmission more likely
- Shared latrines increase likelihood of contact with infected feces
- Insufficient handwashing facilities increase likelihood of ingesting infected feces
- Poor water sanitation (substandard chlorine levels) allows bacterium to thrive
- Etc. (see [original report](#) for more)

4. (2 pts) Describe two strategies for preventing future cholera outbreaks in the camp.

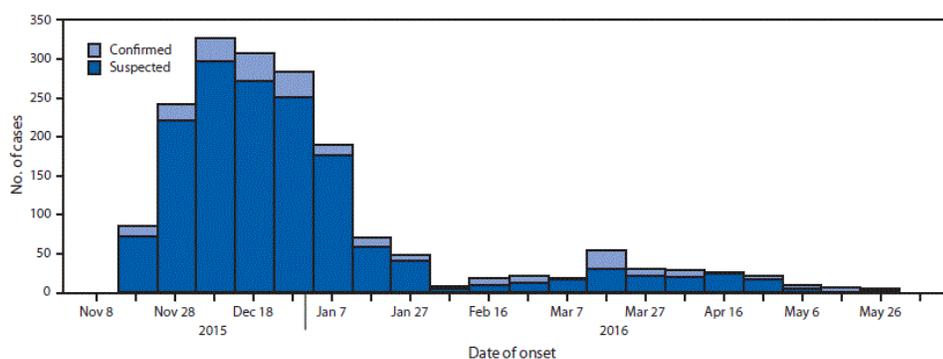
*(1 pt for each plausible strategy)*

Answers vary.

Possible answers (not limited to):

- Encourage handwashing
- Improve water/sanitation facilities
- Implement an enhanced disease surveillance system
- Educate the community
- Etc. (see [original report](#) for more)

**Figure 1.** Suspected and confirmed cholera cases (N = 1,797), by week of illness onset — Dadaab refugee camp, Kenya, November 18, 2015–June 6, 2016



The incubation period of cholera is 1-3 days.

5. (2 pts) Based on the epidemic curve, what type of outbreak is this and why?

*(1 pt for correct answer, 1 pt for correct explanation)*

Continuous common source. Exposure lasts for weeks; single peak.

In December 2015, the Kenya Ministry of Health conducted a study in the subcamps most affected (Dagahaley and Hagadera) to identify risk factors for cholera. A standardized questionnaire was developed that adopted some questions from previous efforts, and it was administered to study participants (or their caregivers) to collect demographic and exposure information.

**Table 2.** Reported exposures among Dadaab refugee camp residents during a cholera outbreak – Kenya, December 2015

Exposure	Sick (N=32)	Healthy (N=64)
Factor X	13	3
Factor Y	15	5

6. (2 pts) What type of epidemiological study was conducted? How do you know?

*(1 pt for correct answer, 1 pt for correct explanation)*

Case-control (observational, retrospective). Study participants were grouped based on disease status, and exposures were compared between groups.

7. (4 pts) Calculate the appropriate measure of risk (relative risk or odds ratio) for each possible risk factor. Round to two decimal places. Show your work.

*(For each factor: 1 pt for correct answer, 1 pt for correct work.)*

Factor X:

$$(13/19)/(3/61) = \mathbf{13.91}$$

Relative Risk (INCORRECT, 1/2 credit):  $(13/16)/(19/80) = 3.42$

Factor Y:

$$(15/17)/(5/59) = \mathbf{10.41}$$

Relative Risk (INCORRECT, 1/2 credit):  $(15/20)/(17/76) = 3.35$

8. (2 pts) Write a one-sentence conclusion interpreting your findings for each exposure.

*(1 pt for each. Partial credit at grader's discretion. No penalty if answer to #7 incorrect)*

Factor X:

Participants exposed to Factor X were [answer from above] times more likely than those unexposed to Factor X to have cholera.

Factor Y:

Participants exposed to Factor Y were [answer from above] times more likely than those unexposed to Factor Y to have cholera.

## Indoor Air Pollutants

In June 2017, the Alabama Department of Public Health (ADPH) conducted a Community Assessment for Public Health Emergency Response (CASPER), focusing on indoor air pollutants in seven neighborhoods in Madison County, Alabama, where a large percentage of homes were built before 1980. Local health partners had concerns about indoor air quality and environmental risks such as radon. According to ADPH's Radon Program, Madison County's underground geology, which allows radon gas to accumulate and more readily enter houses and other buildings above ground, places it at high risk for elevated radon levels.

The sampling frame for the CASPER included seven neighborhoods identified by community partners as having a majority of homes built before 1980. Within each cluster, seven households were selected for interviews using systematic random sampling, for a target of 210 interviews. If one of the original seven households was not available or the residents refused to participate, systematic random sampling was used to select another household. Two-person interview teams conducted interviews with one respondent aged  $\geq 18$  years from each selected household. (CDC- ORIGINAL REPORT: [https://www.cdc.gov/mmwr/volumes/67/wr/mm6715a3.htm?s\\_cid=mm6715a3\\_w](https://www.cdc.gov/mmwr/volumes/67/wr/mm6715a3.htm?s_cid=mm6715a3_w))

9. (4 pts) What are two possible biases/limitations of this study? Explain.

*(2 pts for each bias/limitation- must be adequately explained to receive full credit)*

Answers vary. Possible answers include (not limited to):

- Self-selection bias: although households were systematically selected, participation was voluntary
- Response/social desirability bias: respondents may have overreported their knowledge about indoor pollutants
- Low external validity- information gathered is only representative of the sampling frame and cannot be used to draw conclusions about other communities

10. (2 pts) Name one other indoor air pollutant and describe its health effects.

*(1 pt for example of indoor air pollutant, 1 pt for some health effects)*

Answers vary. Possible answers include (not limited to):

- Smoking- increased risk of lung cancer, COPD, heart disease, cancer
- Lead- weakness, developmental issues, brain/kidney damage
- Mold- allergic reaction (sneezing, runny nose, red eyes, rash, respiratory issues)
- Carbon monoxide- death

Respondents in 70.2% of households reported awareness of radon. Although 87.8% of household respondents who reported awareness of radon agreed with the statement that prolonged exposure to radon could be harmful, only 23.9% were aware that prolonged radon exposure could cause lung cancer. Among 131 respondents reporting awareness of radon, 7.3% stated that their homes had been tested.

11. (2 pts) Imagine you work at the ADPH. After collecting this information, what steps would you take to promote the health of the Madison County community? Name two strategies.

*(1 pt for each plausible strategy)*

Answers vary. Possible answers include (not limited to):

- Educating residents about the dangers of radon in the home
- Offer radon testing/increase awareness of radon testing

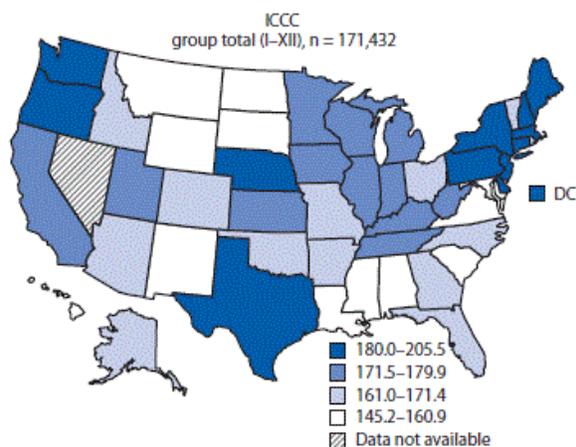
## Cancer

During 2003–2014, CDC identified 171,432 new cases of pediatric cancer (using data collected by local cancer registries). Rates were highest in the Northeast U.S. Census region, followed by the Midwest, the West, and the South. Rates were highest in the Northeast across all age groups.

(CDC- SEE ORIGINAL REPORT:

[https://www.cdc.gov/mmwr/volumes/67/wr/mm6725a2.htm?s\\_cid=mm6725a2\\_w#modalIdString\\_CDCTable\\_o](https://www.cdc.gov/mmwr/volumes/67/wr/mm6725a2.htm?s_cid=mm6725a2_w#modalIdString_CDCTable_o))

**Figure 1.** Age-adjusted incidence of cancer among persons aged <20 years, by U.S. state — United States, 2003–2014



12. (2 pts) Identify units for the data depicted on the map.

*(1 pt for “cases per \_\_\_\_” or “per \_\_\_\_\_,” 1 pt for “(cases) per 1 million”)*

Cases per 1 million population

13. (4 pts) Why would there be geographic variation in pediatric cancer incidence? Explain two possible factors.

*(2 pts for each plausible reason)*

Answers vary. Possible answers include (not limited to):

- Differences in exposures to carcinogenic chemicals or radiation may vary by region
- Genetic variation in certain populations, ethnicities
- Ease of detection and access to healthcare may vary by region (with economic status)

14. (4 pts) Explain two potential limitations/sources of bias in this study.

*(2 pts for each limitation/bias- must be adequately explained to receive full credit)*

Answers vary. Possible answers include (not limited to):

- Unavailability of data from Nevada limits representativeness of data
- Differences in cancer reporting among states may have resulted in varied reported incidence rates
- Misrepresentation of race/ethnicity- some groups may be undercounted in census or have less accurate reporting

15. (3 pts) What is the epidemiological triad, and would it be appropriate to apply it to a type of cancer? Why or why not?

*(1 pt for epidemiological triad, 2 pts for defense of second part of answer)*

Epidemiological Triad: Agent, Host, Environment. Model for the occurrence of disease.

Either “yes” or “no” could be correct. The author would prefer the use of causal pies (component causes) as a model for cancer because this model takes into account the presence of many factors in the occurrence of cancer. However, the agent-host-environment model could be adapted to model cancer with the presence of multiple “agents” contributing to cancer instead of one infectious agent. No credit should be given for a simple “yes” or “no.” Up to 2 points can be given for an adequately defended answer.

16. (6 pts) If you wanted to conduct a study analyzing possible risk factors for a very rare cancer, what type of epidemiological study would you use? Why? List two benefits and two drawbacks of using this type of study.

*(1 pt for type of study, 1 pt for why, 1 point per benefit/drawback)*

Case-control study. A cohort study would be extremely difficult, as one would have to enroll huge numbers of participants to find an individual who developed the cancer; the author cannot dream up an experimental trial that would not be wildly unethical (and have the same major issue as the cohort study).

Answers vary. Possible answers include (not limited to):

- Benefits
  - Less expensive
  - Faster
  - Ability to study rare diseases- data is easier to obtain, can locate individuals who are already affected
  - Effective when follow-up is difficult
- Drawbacks
  - Recall bias- Possible error in recalling past experiences
  - Subject to interviewer bias, possible risk factors may be overemphasized in interviewing (can be fixed through blinding)
  - Possible selection bias in selecting case-patients and controls
  - Difficult when exposure is rare

**\*\*TIEBREAKER:** Describe the steps you would take to conduct the study you described in Question 16.

Answers vary. Grade this section only if necessary to break a tie.