340.721 Epidemiologic Inference in Public Health I

ACTIVITY:
Outbreak Investigation

Activities provide experience in applying epidemiologic methods, interpreting findings, and drawing inferences.

This Activity follows from the corresponding set of PRE-Activity Questions that should be completed prior to the start of the Activity. The PRE-Activity Questions prepare you for a productive and collaborative experience during the Activities.

Expectations for the Activities

1. *Individually, read the Activity and attempt to answer all the questions.*

2. *"Meet" with your group and discuss challenging concepts, questions and compare answers*

3. *Formulate group consensus of answers if possible (sometimes there is no right or wrong answer!)*

4. *Post questions to the Discussion Forum if there is disagreement in your group or if there is need for a clarification to answer the question.*

5. *If your group is presenting at the LiveTalk, review your answers with a TA by posting to the Discussion Forum in your Group's Category/Topic by 12PM EST of the Tuesday preceding the LiveTalk*

Introduction and Background

On April 11, 2014, the Baltimore City Health Department (BCHD) received reports of illness from attendees of the 2014 Food Safety Summit, which took place at the Baltimore Convention Center April 8-10, 2014. The reports stated that attendees became ill with diarrhea between April 8th and April 10th. Caterer A supplied food for the entire conference and all food was served buffet style. Food was also available for purchase at vendors and concession stands in the convention center. Approximately 1,300 people attended, exhibited at, or spoke at the conference.

On April 16, 2014 the BCHD, in collaboration with the Maryland Department of Health and Mental Hygiene, initiated an outbreak investigation to develop a hypothesis about what caused the outbreak. Their methods included an epidemiologic investigation, environmental investigation, and laboratory analysis.

The BCHD conducted open-ended interviews with several conference attendees. They also obtained a food menu from Caterer A, a list of sessions and activities from the conference's website, and created an online survey for all conference participants.

Question 1

Imagine you were the lead epidemiologist on the BCHD outbreak investigation team. What information would you need to collect in order to develop a hypothesis about what caused the outbreak? (*Hint*: Make sure to include person, place, and time characteristics).

Case Definition and Exposure Assessment:

Based on information obtained from preliminary reports and open-ended interviews, the BCHD established the following case definition:

Diarrhea or vomiting in a person who attended the Food Safety Summit Conference, with an onset up to 72 hours after the conference.

Of the 1,300 conference participants, a total of 669 individuals responded to the online survey administered by the BCHD and of those, 246 reported feeling ill around the time of the conference. Of the 246 ill respondents, 2 reported onsets more than 72 hours after the conference took place. An additional 14 of the 246 ill respondents reported feeling unwell, but did not have diarrhea or vomiting, and another 14 respondents reported an onset of illness before attending the conference. A total of 35 respondents were missing information on illness symptoms and/or food consumed.

Question 2

The online survey response rate among conference participants was 51% (669/1,300 *100). What concerns might you have about whether the group who responded to the survey is representative of everyone who was at risk of becoming ill? Can you think of ways that you could assess the representativeness of survey respondents?

Question 3

Based on the information provided, what is the (1) total number of cases and (2) total number of well individuals (i.e., non-cases) that should be included in the BCHD's analysis? Please justify your answer (*Hint*: Think about who is at-risk of becoming ill).

The BCHD calculated the relative risk (RR) of developing illness for each session, activity, and food item. Data from each session are summarized in Table 1 below.

	Sick		Well		Attack Rate Yes	Attack Rate No	RR
	Yes	No	Yes	No			
Attended 4/7	22	179	24	364	22/(22+24) = 48%	179/(179+364)= 33%	0.48/0.33 = 1.45
Attended 4/8	159	42	232	156	41%	21%	1.92
Attended 4/9	171	3	344	44	33%	6%	5.20
Attended 4/10	31	9	287	101	10%	8%	1.19

Question 4

What is the purpose of calculating attack rates and RR's? Of calculating attack rates and RR's by session?

Question 5

As the lead epidemiologist on the BCHD outbreak investigation team, you suspect that exposure likely occurred on April 9th. How would you interpret the RR of 5.20 to your colleagues?

Upon review of additional evidence (not provided in this Activity), you and your team determine that the contaminated food was likely served at lunch on April 9th. Table 2 summarizes the food-specific attack rates for lunch served on April 9th.

| | Sick | | Well | | Attack Rate | Attack Rate | RR |
	Yes (Ate)	No (Did not eat)	Yes (Ate)	No (Did not eat)	Ate	Did not eat	
Spring lettuce salad	120	37	157	63	43%	37%	1.17
Tomato &mozzarella	113	44	148	72	43%	38%	1.14
Chicken Marsala	146	11	153	67	49%	14%	3.46
Grilled vegetable white lasagna	115	42	139	81	45%	34%	1.33
Roasted vegetables	106	51	139	81	43%	39%	1.12
Roll	53	104	85	135	38%	44%	0.88
Focaccia	36	121	44	176	45%	41%	1.10
Butter	37	120	50	170	43%	41%	1.03
Tiramisu cake	87	70	104	116	46%	38%	1.21
Iced tea	77	80	113	107	41%	43%	0.95
Coffee	27	130	45	175	38%	43%	0.88
Water	76	81	95	125	44%	39%	1.13
Creamer	15	142	25	195	38%	42%	0.89
Sugar	18	139	15	205	55%	40%	1.35
Sweetener	17	140	21	199	45%	41%	1.08
Honey	3	154	2	218	60%	41%	1.45
Lemon	12	145	10	210	55%	41%	1.34

[5]

Question 6

Based on the information presented in Table 2, you suspect that the chicken marsala is the contaminated food (RR = 3.46). Some of your colleagues argue that other foods (such as honey and the grilled vegetable white lasagna) might be contaminated because they also have RR's >1.0. Describe to your colleagues a potential reason why these food items could have RR's that are >1.0, even if they are not the contaminated food source.

Question 7

To illustrate the point you made in Question 6, show your colleagues how they could use cross-tabulation to calculate the attack rates and RR's and determine which food is the likely cause of the outbreak, using the information in the following table:

	Number Sick	Number Well	Total	Attack Rate	RR
Ate chicken marsala only	74	95	169		
Ate lasagna only	43	81	124		
Ate both chicken marsala and lasagna	72	58	130		
Didn't eat either food	53	148	201		

[*Hint*: See how we organized attack rates for the cross-tabulation in the PRE-Activity Questions (Tables 3b and 4b)]

Epi curve outbreak 2014-119
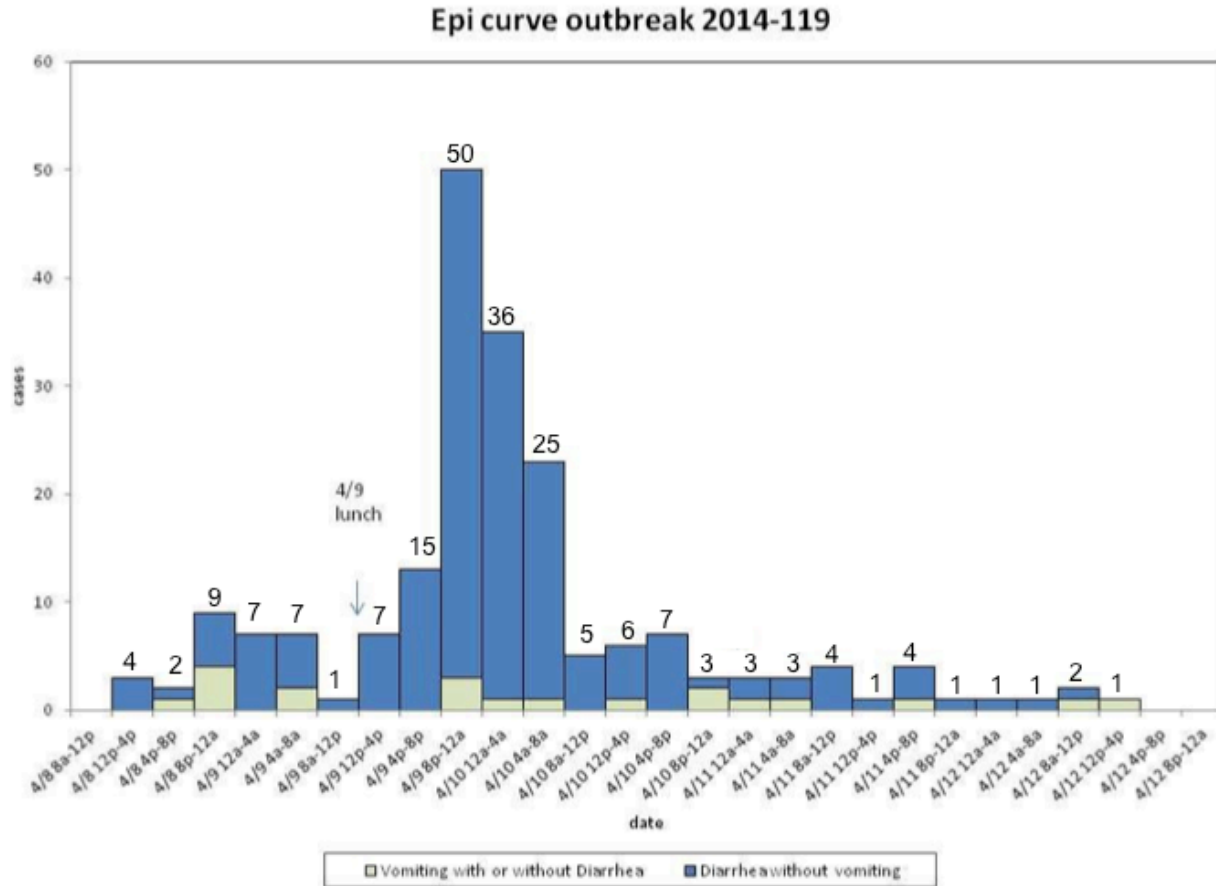
Question 8

Using the epidemic curve, calculate the estimated median incubation period for the onset of illness (defined as diarrhea *without* vomiting)? Assume that exposure occurred at 12pm on 4/9.

[7]

Laboratory Analyses:

Individuals who were ill were asked to submit a stool sample for testing. Samples were tested for *Salmonella, Shigella, E. coli, Camplyobactor*, Shiga toxins, norovirus, rotavirus, sapovirus, and astrovirus. Specimens were also sent to the Centers for Disease Control and Prevention's (CDC) Enteric Diseases Laboratory Branch for *C. perfringens* culture and testing for *C. perfringens* enterotoxin (CPE).

Table 3 shows the symptoms, median incubation period, and sources associated with selected etiologic (i.e., causative) agents.

Table 3. Possible Etiologic Agents Associated with Outbreak			
Agent	**Symptoms**	**Median Incubation Period**	**Source**
Salmonella	Diarrhea, fever, abdominal cramps, vomiting	12 to 72 hours	Eggs, poultry, meat, unpasteurized dairy, raw produce
Shigella	Abdominal cramping, fever watery/bloody diarrhea, nausea and vomiting	1 to 3 days	Salads and sandwiches that involve a lot of contact in their preparation
E. coli	Severe diarrhea that is often bloody, abdominal pain and vomiting	1 to 10 days	Undercooked contaminated ground beef, unpasteurized dairy, contaminated water
Campylobacter	Diarrhea, cramps, fever, and vomiting	2 to 5 days	Raw and undercooked poultry, unpasteurized milk
C. perfringens	Diarrhea and abdominal cramps	6 to 24 hours	Beef, poultry, gravies
Norovirus	Diarrhea, vomiting, nausea and stomach pain	12 to 48 hours	Produce, shellfish, ready-to-eat foods

Source: http://www.foodsafety.gov/poisoning/causes/bacteriaviruses/index.html

Question 9

Based on the information presented in Table 3 and the median incubation period estimated from the epidemic curve (Question 8), what is the likely agent associated with this outbreak? Justify your answer.

Question 10

Recall that a case was originally defined as: "diarrhea _or_ vomiting in a person who attended Conference A, with an onset of up to 72 hours after the conference". However, in the epidemic curve, a case was defined as, "diarrhea _without_ vomiting". What is the difference between the two case definitions? [Hint: Think about Question 1 in the PRE-Activity Questions.] Why do you think the investigators changed their case definition during the course of an outbreak investigation?

Question 11

As the lead epidemiologist on the BCHD outbreak investigation team, briefly summarize the outbreak for public health officials at the BCHD. Are there other groups of individuals who should be informed about this outbreak? How might your summary differ depending on your audience?