Three Steps and a Hop

A Foodborne Illness Outbreak Investigation

TABLE TOP EXERCISE

Developed by the

Colorado Integrated Food Safety Center of Excellence

PARTICIPANT

Learning Objectives

After completing this case study, students should be able to:

- Explain what constitutes a foodborne illness outbreak.
- Describe the steps in a foodborne illness outbreak investigation.
- List different outbreak investigation team members and their roles and responsibilities.
- Establish and apply an outbreak case definition.
- Describe outbreak-associated cases by time, person, and place.
- Create and interpret an epidemic curve.
- Describe the types of epidemiological studies used during an outbreak investigation.
- Calculate and interpret measures of association.
- Describe the purpose of conducting an environmental assessment.
- Define and give examples of contributing factors.
- Explain how to summarize and share outbreak investigation findings.

This case study was developed by the Colorado Integrated Food Safety Center of Excellence. For additional information or to provide feedback, visit
www.COFoodSafety.org

PART A: BEGINNING THE INVESTIGATION

Initial Complaint Call

At 12:55pm on Monday, March 14th an epidemiologist from the El Paso County Public Health Communicable Disease Program received a phone call from the president of a Polka Dance Club, Joy Johnson. Joy was calling on behalf of dance club members who reported becoming ill following the annual Hippety-Hop Dance Festival.

Question 1: What additional information should you request from Joy Johnson? What questions would you ask her?

You ask Joy for more information about the ill people and the event.

Joy said she heard of at least 15 attendees who had become ill. She noted that some people were experiencing diarrhea and stomach pain, but did not get specifics from everyone. She believed that most became ill sometime on the Saturday and Sunday of the Hippety-Hop Dance Festival which was held from Friday, March 11 to Sunday, March 13.

The Hippety-Hop Dance Festival began on Friday evening with polka dancing and a welcome dinner. The dinner was prepared by "Catering by Charlotte" and took place from 4:00-7:00 PM. While over 100 people attended the Hippety-Hop Dance Festival, only about 80 people attended the Friday night events as many were still arriving from out of town.

Joy said she noted the names of some attendees who reported becoming ill. She said she had contact information of all festival attendees and the caterer, Charlotte North of "Catering by Charlotte".

Question 2: Do you think this represents an outbreak? Why or why not?

Question 3: What next steps would you take?

Wait Here!

After determining that an outbreak investigation should be conducted, you decided to contact some of the individuals from Joy's list to learn more about their illness and the event, and ask if they would be willing to submit a stool sample for testing. You notified the state health department and the public health lab expects samples. You also called a meeting with individuals on your team to inform them of the upcoming outbreak investigation.

Question 4: Who should be part of the outbreak investigation team? Briefly describe each role.

Initial Case Interviews

To generate a hypothesis about the cause of the outbreak, you contact three ill individuals from Joy's list to learn more about their illness and the event.

Question 5: What questions would you ask during these initial case interviews?

By speaking with three ill attendees you were able to gather specific symptom information, including the date and time of illness onset. All three persons reported having diarrhea and two reported experiencing cramping beginning on Saturday morning at 1:00am, 7:00am, and 10:30am, respectively. All three agreed to provide a stool sample for testing.

None of the attendees that you spoke to reported participating in other events besides the Friday welcome dinner. No one knew of anyone with a similar illness who did not attend the event.

You were also able to clarify which foods were served at the Friday welcome dinner (see menu below). You discovered that a variety of desserts were prepared by Polka Dance Club members and sold during the dinner by volunteers. Drinks were provided by the Polka Dance Club at the cash bar, served by Joy and several volunteers.

Friday Dinner Menu

Braised Brisket

*Haluski**

Buttered Peas

Cole Slaw

Homemade Gravy

Mashed Potatoes

Homemade Rolls

*Haluski is a noodle & cabbage dish

Question 6: Based on the information provided so far, develop a case definition for this outbreak.
Hint: a case definition should include person, place, time, and clinical information.

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PART B: EPIDEMIOLOGIC STUDY

A case was defined as a person having diarrhea (at least 3 or more loose stools in a 24-hour period) after attending the Friday night welcome dinner at the Hippety-Hop Dance Festival with onset of illness from March 11-13.

Your team decided to conduct an epidemiologic study to determine which exposure made people ill.

Question 7: What type of epidemiologic study should you conduct to investigate this outbreak? Why?

Hint: The two types of epidemiologic studies most commonly used in outbreak investigations are cohort studies and case-control studies.

- *A cohort study is used when there is a well-defined group of individuals. Cohort studies compare the incidence of disease in exposed persons versus unexposed persons.*

- *A case-control study is more often used when the disease or outcome of interest is rare, or when the group is not well-defined. Case-control studies compare the odds of exposure between the ill (cases) and not ill (controls).*

Given that this was a well defined group with a manageable number of people, the investigation team decided to conduct a cohort study. The team contacted and interviewed everyone who attended the Friday evening welcome dinner.

You created a hypothesis-testing questionnaire asking about symptoms, what foods and drinks they consumed, and potential secondary cases. Based on responses from the hypothesis-testing interviews, you built a line list of all individuals reporting symptoms (Appendix A).

Question 8: Apply the case definition to the line list of attendees reporting symptoms (Appendix A). How many outbreak-associated cases are there?

Wait Here!

Based on the case definition, you have determined a total of 26 outbreak-related cases. Your next step was to build an epidemic curve to provide a visual representation of the outbreak.

Question 9a: Build the epidemic curve for this outbreak. What pattern does the epidemic curve show? Use graph paper on page 21.

Hints for creating epidemic curves:

- *The epidemic curve is a histogram showing the number of outbreak-associated cases by their time of onset*
- *Should include a brief, but descriptive title (including place, time)*
- *The x/y axes should be clearly labeled*
- *The x axis represents the date or time of illness onset among cases*
    - *The unit of time is usually 1/4 to 1/3 of the median incubation period*
- *The y axis shows the number of ill cases*
- *There should be no gaps between the bars of the histogram*

Question 9b: Given that the Friday night dinner took place at 6 PM on Friday, March 11, what is the median incubation period for this illness?
Hint: You can use the line list or epidemic curve to calculate median incubation period.

Question 10: Use the information collected thus far and the symptoms and onset table (Appendix B) to determine a suspect etiology. Justify your answer.

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You notify the state laboratory of the suspected exposure to bacterial toxins including *Clostridium perfringens* and *Bacillus cereus.* Similar to your investigation findings, bacterial toxins cause lower gastrointestinal symptoms such as diarrhea and cramps, and have a shorter onset time that match the incubation period.

The illness incubation period and epidemic curve pattern further supported your hypothesis that food from the Friday welcome dinner was the point source cause of the outbreak. Based on the interviews with persons who attended the Friday night dinner, you collected their exposure information and performed statistical analysis.

Question 11: Use the information below to construct 2x2 tables for exposure to the Friday night dinner and foods including brisket, gravy, mashed potatoes, coleslaw.

- A total of 76 people attended the Friday evening dinner (26 ill and 50 non-ill)
- 26 ill and 33 non-ill people ate the dinner
- 24 ill and 36 non-ill people ate brisket
- 25 ill and 28 non-ill people ate gravy
- 26 ill and 26 non-ill people ate mashed potatoes
- 20 ill and 30 non-ill people ate coleslaw

Dinner	Ill	Not Ill
Ate		
Did Not Eat		

Brisket	Ill	Not Ill
Ate		
Did Not Eat		

Gravy	Ill	Not Ill
Ate		
Did Not Eat		

Mashed Potatoes	Ill	Not Ill
Ate		
Did Not Eat		

Coleslaw	Ill	Not Ill
Ate		
Did Not Eat		

Question 12a: What is the appropriate measure of association for this study design?
Hint: Risk Ratios (also called Relative Risks) are the measure of association for cohort studies and Odds Ratios are the measure of association for case-control studies.

Question 12b: Use the 2x2 tables to calculate the appropriate measure of association for the dinner and each food. Interpret the risk ratios associated with eating the brisket, gravy, and coleslaw.

Hint: Here are the formulas to calculate Risk Ratios and Odds Ratios:

Risk Ratio = (Incidence of Exposed) / (Incidence of Unexposed)
RR = [a / (a+b)] / [c / (c+d)]

	Ill	Not Ill
Exposed	a	b
Unexposed	c	d

$$\text{Odds Ratio} = \frac{[(\text{Exposed Ill})/(\text{Unexposed Ill})]}{[(\text{Exposed Not Ill})/(\text{Unexposed Not Ill})]}$$

$$OR = \frac{a/c}{b/d} = \frac{a*d}{b*c}$$

Another Hint: Epi Info 7 can do this math for you and has a free app.

Question 12c: Based on the risk ratios, are any foods implicated by the cohort study? If yes, which one(s)?

Wait Here!

PART C: THE ENVIRONMENTAL ASSESSMENT

The results of your statistical analysis indicated that mashed potatoes (RR=undefined) and gravy (RR=10.1) are all implicated in the outbreak.

In addition to the epidemiologic investigation, the environmental health team conducted an environmental assessment. An environmental assessment is defined as a systematic, detailed, science-based evaluation of environmental factors that contributed to the transmission of disease in an outbreak. In this outbreak investigation, the environmental health investigators planned to conduct an environmental assessment at the Catering by Charlotte facility. They evaluated a variety of policies, processes, and critical violations to help explain how food contamination, pathogen survival, or pathogen proliferation caused disease transmission.

Question 13: What activities would the environmental health staff perform during an environmental assessment?

At 3:00pm on Wednesday, March 16, the environmental health investigator visited Charlotte at her place of work to conduct an interview. While investigating Catering by Charlotte, they discovered she did not have a Retail Food Establishment (RFE) license on file. The environmental health team was unable to perform an investigation of the catering kitchen because Charlotte did not have an RFE and prepared all food at her private residence. However, the team was able to conduct an investigation of the Polka Dance Club kitchen because food was stored, reheated, and served from the facility. Details of the interview and investigation are provided in the Environmental Health Investigation Report (Appendix C).

Question 14: What are some of the contributing factors that may have increased the risk of foodborne illness from the Friday dinner food or drink? Use the Environmental Health Investigation Report (Appendix C)

Hint: Contributing factors are categorized as contamination, proliferation, and survival.

On March 17th, the public health laboratory contacted you with the stool specimen test results. All three specimens were positive for *Clostridium perfringens*.

Question 15: Relate the environmental assessment findings to your suspicions about the cause of the outbreak. Use the IAFP Keys to support your case (Appendix D)

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PART D: CONCLUDING THE INVESTIGATION

After conducting the environmental assessment, confirming the pathogen, and identifying the contributing factors, you ordered a cease and desist on Catering by Charlotte until she obtains the proper licensing. Your final steps in concluding the investigation were to write the outbreak report and communicate your findings to the outbreak stakeholders.

Question 16: To whom should you communicate your findings?

Question 17: What communication and collaboration between outbreak team members practiced during this table top exercise will you apply to your agency's next outbreak?

Wait Here!

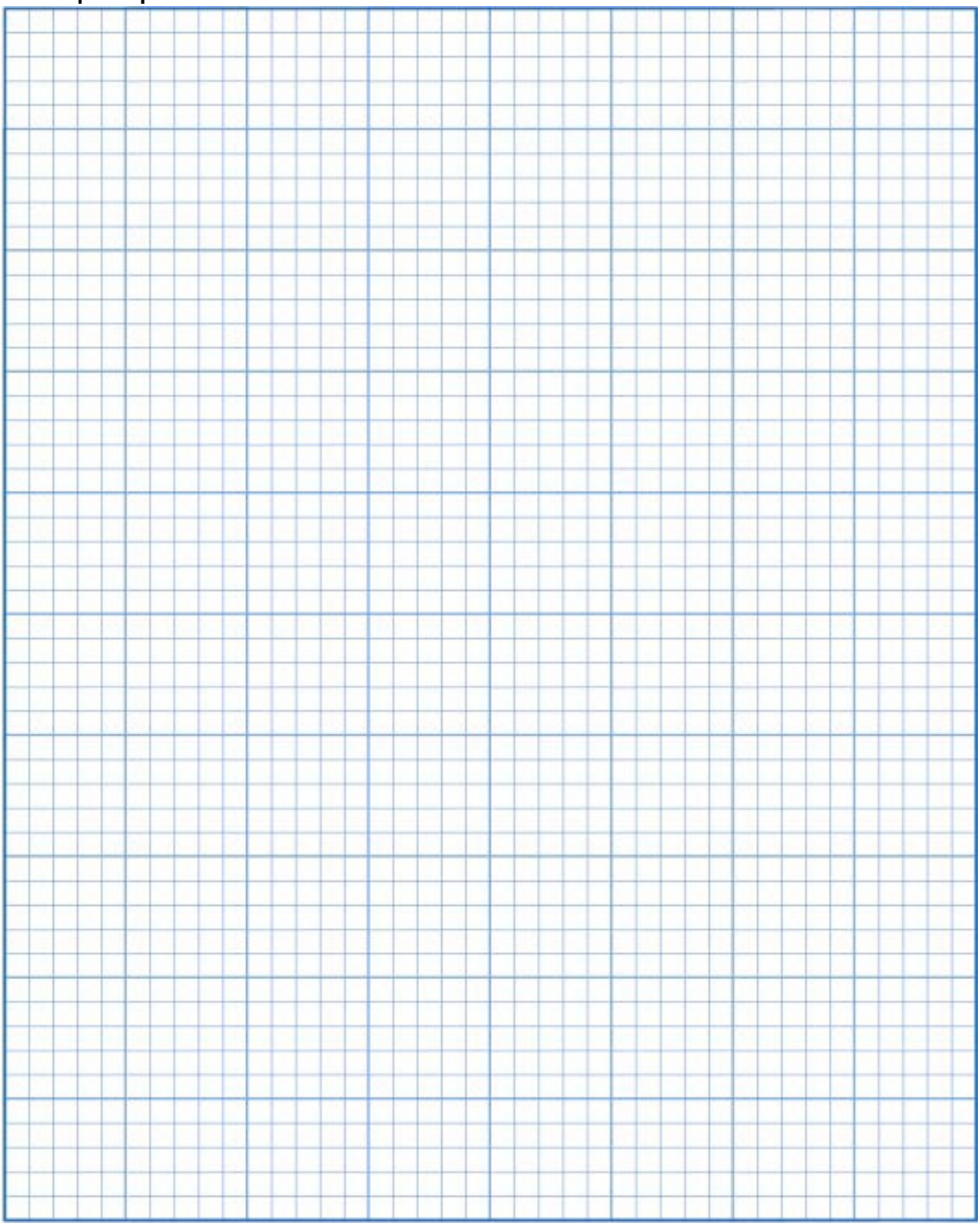
You wrap up the outbreak by communicating your findings in an outbreak report for the state health department and a NORS report for the Centers for Disease Control and Prevention. The environmental health program issued a cease and desist order to Catering by Charlotte until she obtains the proper license. You also presented your findings to Joy, President of the Polka Dance Club. Joy asked many questions regarding best practices of finding and hiring a licensed caterer, which you answer in hopes of helping to prevent any future illnesses at the Hippety-Hop Festival. Joy invites your investigation team to attend the Hippety-Hop Festival next year.

As you go through the outbreak investigation, use the timeline to track important developments in the investigation.

March

Thursday 10	Friday 11	Saturday 12	Sunday 13	Monday 14	Tuesday 15	Wednesday 16	Thursday 17

Graph Paper



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This case study was developed by the Colorado Integrated Food Safety Center of Excellence in collaboration with the original investigators. Some aspects of the outbreak investigation have been altered for the purposes of this case study. Additionally, the methods utilized in this case study reflect the approach used for this particular outbreak. Outbreak response procedures, policies, and methods may vary by country, state, or local jurisdiction.

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Appendix A: Line list of Friday night dinner attendees with illness symptoms

ID	Food Handler	Sex	Age	Diarrhea	Max Stool	Bloody	Nausea	Vomiting	Ab Cramps	Fever	Onset date	Onset Time
1	N	M	78	Y	15	Y	Y	N	Y	U	3/5/11	2200
2	N	M	79	Y	3	N	Y	N	Y	N	3/12/11	130
3	N	F	76	Y	4	N	N	N	Y	N	3/12/11	200
4	N	M	69	Y	4	N	N	N	N	N	3/12/11	200
5	N	F	72	Y	25	N	Y	N	Y	N	3/12/11	300
6	N	M	U	Y	"lots"	N	Y	N	Y	Y	3/12/11	300
7	N	F	67	Y	5	N	N	N	Y	N	3/12/11	300
8	N	M	72	Y	5	N	Y	N	Y	N	3/12/11	300
9	N	F	77	Y	4	N	N	N	Y	N	3/12/11	300
10	Y	M	79	Y	5	N	N	N	N	N	3/12/11	300
11	Y	M	74	Y	7	N	N	N	N	N	3/12/11	300
12	N	M	78	Y	3	N	N	N	Y	N	3/12/11	300
13	N	M	70	Y	7	N	N	N	Y	N	3/12/11	300
14	N	M	75	Y	2	N	N	N	Y	N	3/12/11	410
15	N	F	65	Y	2	N	N	N	Y	N	3/12/11	530
16	N	M	70	Y	4	N	N	N	Y	N	3/12/11	530
17	N	M	77	Y	"lots"	N	N	N	Y	N	3/12/11	700
18	N	F	76	Y	"lots"	N	N	N	Y	N	3/12/11	700
19	N	F	77	Y	4	N	N	N	Y	N	3/12/11	700
20	N	M	76	Y	4	N	N	N	N	N	3/12/11	700
21	N	F	82	Y	2	N	N	N	N	N	3/12/11	700
22	N	M	76	Y	3	N	N	N	Y	N	3/12/11	700
23	N	M	84	Y	3	N	N	N	N	N	3/12/11	800
24	N	F	69	Y	5	N	Y	N	Y	N	3/12/11	830
25	N	M	72	Y	4	N	N	N	Y	N	3/12/11	900
26	N	M	82	Y	4	N	N	N	Y	N	3/12/11	1030
27	N	F	62	Y	4	N	Y	N	Y	N	3/12/11	1100
28	N	F	68	Y	20	N	Y	N	Y	N	3/12/11	1600
29	N	F	67	Y	5	N	Y	N	Y	Y	3/12/11	1600
30	N	F	71	Y	5	N	N	N	Y	N	3/13/11	300
31	N	M	72	Y	1	N	N	N	N	N	3/13/11	400

Appendix B: Symptoms and Onset Table – Adapted from the CIFOR Guidelines

Upper gastrointestinal trace symptoms (nausea, vomiting) occur first or predominate		
Approx. Onset Time to Symptoms	**Predominant Symptoms**	**Associated Organism or Toxin**
<1 hr	Nausea, vomiting, unusual taste, burning of mouth	Metallic salts
1-2 hrs	Nausea, vomiting, cyanosis, headache, dizziness, dyspnea, trembling, weakness, loss of consciousness	Nitrites
1-6 hrs (mean 2-4 hrs)	Nausea, vomiting, retching, diarrhea, abdominal pain, prostration	*Staphylococcus aureus* and its enterotoxins
6-24 hrs	Nausea, vomiting, diarrhea, thirst, dilation of pupils, collapse, coma	Amanita species mushrooms
Sore throat and respiratory symptoms occur		
Approx. Onset Time to Symptoms	**Predominant Symptoms**	**Associated Organism or Toxin**
12-72 hrs	Sore throat, fever, nausea, vomiting, rhinorrhea, sometimes a rash	*Streptococcus pyogenes*
2-5 days	Inflamed throat and nose, spreading grayish exudate, fever, chills, sore throat, malaise, difficulty swallowing, edema of cervical lymph node	*Corynebacterium diphtheriae*
Lower gastrointestinal tract symptoms (abdominal cramps, diarrhea) occur first or predominate		
Approx. Onset Time to Symptoms	**Predominant Symptoms**	**Associated Organism or Toxin**
2-36 hrs (mean 6-12 hrs)	Abdominal cramps, diarrhea, sometimes nausea and vomiting	*Clostridium perfringens, Bacillus cereus,*
12-74 hrs (mean 18-36 hrs)	Nausea, vomiting, abdominal cramps, diarrhea, fever, chills, headache Bloody diarrhea is often associated with *Salmonella* species.	*Salmonella* species, *Shigella* species
3-4 days	Abdominal cramps, bloody diarrhea	*Escherichia coli* O157:H7
3-5 days	Diarrhea, fever, vomiting abdominal pain, respiratory symptoms	Enteric viruses
1-6 weeks	Mucoid diarrhea (fatty stools), abdominal pain, weight loss	*Giardia lamblia*
1 to several weeks	Abdominal pain, diarrhea, constipation, headache, drowsiness, ulcers, often asymptomatic	*Entamoeba histolytica*
Neurologic symptoms (visual disturbances, vertigo, tingling, paralysis) occur		
Approx. Onset Time to Symptoms	**Predominant Symptoms**	**Associated Organism or Toxin**
<1 hr	Gastroenteritis, nervousness, blurred vision, chest pain, cyanosis, twitching, convulsions	Organic phosphate
	Excessive salivation, perspiration, gastroenteritis, irregular pulse, pupils constricted, asthmatic breathing	Muscaria-type mushrooms
1-6 hrs	Tingling and numbness, gastroenteritis, dizziness, dry mouth, muscular aches, dilated pupils, blurred vision, paralysis	Ciguatera toxin
	Nausea, vomiting, tingling, dizziness, weakness, anorexia, weight loss, confusion	Chlorinated hydrocarbons
2 hrs – 6 days (usually 12-36 hrs)	Vertigo, double or blurred, loss of reflex to light; difficulty swallowing, speaking and breathing; dry mouth; weakness; respiratory paralysis	*Clostridium botulinum* and its neurotoxins
>72 hrs	Numbness, weakness of legs, spastic paralysis, impairment of vision, blindness, coma	Organic mercury

Appendix C: Environmental Assessment Report

Environmental Health Investigation Report

On 03/17, the environmental health (EH) team conducted an interview with Ms. Charlotte North, owner of an unlicensed Retail Food Establishment (caterer) called “Catering by Charlotte.” The owner provided a menu of food items served at the Hippety-Hop Dance Festival on 03/11. A formal investigation of the caterer’s facility was not performed as the caterer was preparing the food out of her private home. EH conducted an investigation of the Polka Dance Club kitchen because food was stored, reheated, and served from the facility.

All food was prepared by the caterer, at her home, with the exception of the coleslaw, which was prepared onsite at the Polka Dance Club. The EH team was provided a list of names of crew members that assisted her with catering the event, and the following food preparation, delivery and serving steps were discussed:

- Food was purchased from Slow Roasters Restaurant, in Colorado Springs, CO. Slow Roasters purchased the food from approved wholesale and retail distributors.
- Cooling of brisket, mashed potatoes, haluski and gravy was conducted in a home-style freezer and refrigerator at the caterer’s house. The food was cooled the day prior to the event. Container size is unknown.
- All food was transported in ice-cooled Cambro units in her truck to the Polka Dance Club location and temperatures were checked with a dial thermometer during transport. Transport took approximately 45 minutes. No temperature logs were kept by caterer.
- Braised brisket, mashed potatoes, gravy, and haluski were removed from Cambro units and reheated to 160*F – 180*F at the Polka Dance Club kitchen. The stove at the dance club was used to reheat the food. Oven roasters owned by the dance club were used to hot hold food temperatures because the dance club’s buffet table was not keeping temperatures of 165*F or higher, according to the caterer.
- Food was served by food handler employed by the caterer. Clients would bring their plates to food servers and made their selections. After food was served on the plate it was handed back to clients.
- Desserts served at the event were prepared by the dance members and brought to the Polka Dance Club.
- Beverages were provided by the Polka Dance Club at the facility bar.
- Caterer stated that neither she nor her staff members were ill before or during the catering event.

Supplemental notes for 03/14:
A caterer storing or preparing foods for human consumption at a private home is in direct violation with 6 CCR 1010-2, *Colorado Retail Food Establishment Rules and Regulations.* EHS issued a compliance letter to the caterer on March 17 advising her of the process to obtain a Retail Food Establishment (RFE) license. She was also advised to cease operation of the catering business immediately until she obtained a current RFE license.

Appendix D: IAFP Keys

Meat and Poultry

✕ =Principal Factor to Consider
✓ =Factor to Consider
▲ =Potential Factor to Consider
● =Source of contamination, but likely to be destroyed during later processing
T=Toxin Survives Heat Processes

		Farm/Field								Processing														Retail/Store/Food Service/Home											
			Contamination Issues							Contamination Issues						Holding/Storage				Processing						Contamination				Holding/Storage				Processing			
		Colonized/ Infected/ Toxigenic Animals	Animal Feces/Manure	Feed	Sewage	Soil/Grass/Mud	Water	Worker	Inadequate/Improper Cooling	Cross Contamination	During Cooling	Environment	Improper Cleaning of Equipment	Manipulation /Spread	Worker	Improper Hot Holding	Inadequate Refrigeration	Prolong Storage	Room/Outdoor Temperature Holding	Heat Process Failure	Improper Cooling	Improper pH Adjustment	Improper Water Activity (a_w)	Inadequate Reheating	Organism/Toxin Survives Process	Cross Contamination	During Reconstitution	Improper Cleaning of Equipment	Worker/Person	Improper Hot Holding	Inadequate Refrigeration	Prolong Storage	Room/Outdoor Temperature Holding	Heat Process Failure	Improper Cooling	Inadequate Reheating	Organism/Toxin Survives Process
MEAT																																			
Cooked, Pasteurized, and Other Heat Processes	**Bacteria**																																		
	Bacillus anthracis	●				●							▲												✕											✕
	Clostridium botulinum		●			●													✕	✕	✓	✓			✕					✕		✕		✓	✓	✕
	Clostridium perfringens	✕	✕	▲		✕	▲			▲	▲	▲	▲	▲		✕	✕		✕		✕				✕	▲		▲	▲	✕	✕		✕		✕	✕	✕
	Escherichia coli STEC/VTEC	●	●	●		●	●		●	✕			✓	✕	▲	✕	✕		✕	✕	✕					✕		✓	▲	✕	✕		✕	✕	✕	✕	
	Listeria monocytogenes	●	●	●		●	●		●	✓			✕	▲			✕	✓	✓	✕	✓					▲		▲			✓	✕	▲	✓	▲	▲	
	Salmonella	●	●	●			●		●	✕	▲		✓	✓	▲	✕	✕		✕	✕	✕					✕		✓	▲	✕	✕		✓	✕	✕	✕	
	Staphylococcus aureus	●						●		▲			▲		✕	✕	✕		✕	▲	✕				✕	▲		▲	✕	✕	✕		✕	▲	✕		✕
	Yersinia enterocolitica	●	●				●		●	▲			▲	▲			✕		✕	✕	✓					▲		▲			✕		▲	✕	✓	✓	
	Parasite																																		
	Taenia spp.	●																		✕												✕				
	Toxoplasma gondii	●																		✕												✕				
	Trichinella spiralis	●																		✕												✕				
	Virus																																		
	Hepatitis A virus							●							✕					✓									✕				✕			
	Norovirus							●				✓			✕											▲			✕							
Cured/Dried / Fermented/ Smoked	**Bacteria**																																		
	Escherichia coli STEC/VTEC	●	●			●				▲		▲	▲	▲	▲					✓		✓	✓		✕	▲	▲	▲	▲							▲
	Salmonella	●	●	●			●		●	✓		▲	✓	▲	▲					✓		✓	✓		✕	▲	▲	▲	▲							▲
	Listeria monocytogenes	●	●	●		●	●		●	✓			✕	▲			✕		✓	✓	✓	✓	✓		✕	▲		▲			✕		▲		▲	▲	▲
	Staphylococcus aureus	●						●		▲			▲	▲	✓					✓		✓	✓		✕		▲	▲	▲							T	▲
Retorted	**Bacteria**																																		
	Clostridium botulinum		●			●				✓										✕					✕										✓	
	Staphylococcus aureus	●						●							✕						▲				✓											