



Investigation of an Outbreak

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INVESTIGATION OF AN OUTBREAK

DESCRIPTION:

In this activity students will analyze the data of an outbreak of gastroenteritis that occurred in southern Oregon in 1993. They will follow steps used by epidemiologists to determine whether there is an outbreak and the cause of the outbreak.

RATIONALE:

In the Mysterious Illness Outbreak Scenario, students will need to develop a plan to help determine and verify the presence of an outbreak in Hydroville. This activity provides them with an opportunity to systematically analyze the data that they may encounter in the challenge problem.

PURPOSE/GOALS:

By the time students finish this activity they should be able to:

- Verify the existence of an outbreak.
- Develop a case definition.
- Analyze data collected to determine the source of an outbreak.
- Determine what actions must be taken.
- Communicate actions with public and press.

PREREQUISITE KNOWLEDGE:

- Students must be able to create and sort information on spreadsheets using MS Excel.
- Students must understand how to interpret tables and graphs.

TIME ESTIMATE:

Prep: Initial photocopying takes about 50 minutes

Activity: Three 50-minute class periods for activity
Varies for form of Public Presentation

Day 1-2: Student Instructions 1: Verify the Existence of an Outbreak and Collect Patient Data

Day 3: Student Instructions 2: Establish the Case Definition, Develop a Hypothesis, Determine the Food/Ingredient Source of the Outbreak

Day 4: Activity Assessment: Inform the Public (Depends upon form of presentation)

MATERIALS:

- Hydroville Learning Log

MATERIALS (PER GROUP OF 4 STUDENTS):

- Graph Paper
- Colored markers
- Computers with Microsoft Excel and Printer (Optional)
- Excel Spreadsheets 1 and 2 (Optional)

MATERIALS TO PHOTOCOPY:

- Transparency 1: *The Southern Oregon Outbreak* (page 15)
- Transparency 2: *Gastroenteritis* (page 16)
- Student Spreadsheets 1 and 2 - if teams are not sorting the spreadsheets on the computer (pages 17-18)
- Student Handout 1: *Steps in an Outbreak Investigation* (1 transparency and 1 copy/student, pages 21-22)

Team Packets: All student instructions and handouts in the packet except for the Map of Southern Oregon and Team Report can be laminated and used for all classes.

Team Packet**Laminated sheets**

- Student Instructions - Part 1: *Investigation of an Outbreak: Steps 1-2* (page 23-25)
- Student Handout 2: *Josephine County Outbreak Identification Form* (page 26)
- Student Handout 3: *Epidemic Curve 2 – Restaurant 1: Grants Pass* (page 27)
- Student Handout 3: *Epidemic Curve 3 – Restaurant 2: North Bend* (page 28)
- Student Instructions – Part 2: *Investigation of an Outbreak: Steps 3-6* (page 29-31)
- Student Instructions – Part 3: *Investigation of an Outbreak: Steps 7-8* (page 33)
- Student Handout 4: *A Presentation Planner* (page 34)
- Student Handout 5: *Team Presentation Scoring Guide* (page 35)

Non-laminated

- Map of Southern Oregon (1 copy/team, page 37)
- Team Report (1 copy/team or 1 copy/student, pages 39-42)

BACKGROUND INFORMATION:

Gastroenteritis is an inflammation of the stomach and intestinal tract caused by bacteria, viruses or certain parasites. These gastroenteritis-causing organisms may be found inhabiting the soil, and the intestinal tracts of wild and pet animals and humans. Illness occurs when these germs are taken in by mouth. Severity of the illness varies from transient diarrhea to life-threatening dehydration. Children and the very old are more at risk for serious illness. Most commonly the symptoms are nausea, vomiting, cramping, and diarrhea. Forms include food poisoning, cholera and traveler's diarrhea. Modes of transmission are through vomiting, coughing or sneezing, handling infected pets and other animals, eating undercooked meat, drinking contaminated water, or handling contaminated feces.

In the southern Oregon outbreak, the bacterium, *Escherichia coli* 0157:H7 (or 0157) caused gastroenteritis. Gastroenteritis caused by 0157 results in bloody diarrhea and is caused by eating undercooked animal products such as hamburger meat, or drinking raw milk, contaminated apple cider, or swimming pool water. *E. coli* 0157 is often found in the stomachs of cows, but does not cause disease in cows. Meat can get contaminated with the bacteria in slaughter houses when the meat comes in contact with stomach contents or cow feces. This strain of *E. coli* can be eliminated by cooking meat to a high temperature. It can be found in undercooked hamburger because the middle is not subjected to high enough temperatures. The *E. coli* bacteria produce a toxin that causes the symptoms associated with gastroenteritis. *E. coli* 0157 can be transmitted from one person to another by coming into contact with another person's infected feces, particularly within households, day care centers, or nursing home settings. The incubation period (from exposure to illness) is generally between 2 and 10 days, with an average of about 5 days.

Health providers (doctors, public health nurses, and emergency rooms) are required by state laws to report specific diseases, such as *E.coli* 0157, within a certain timeframe. Other concerned citizens commonly report cases of gastroenteritis to local health agencies. Cases occur randomly, but when larger numbers of people become infected, it causes concern for health officials. During an investigation of cases of gastroenteritis, the identification of certain features can assist in determining the cause of the outbreak. Identification of the pathogen through a careful assessment of the patients' symptoms, and examination of the patients' feces, can help identify the following:

- methods of transmission (how the patient contracted the disease)
- incubation period (the time between exposure and illness)
- periods of communicability (the time the patient is contagious to others)

TEAMWORK SKILLS:

- Everyone contributes and helps.
- Everyone listens to others with care.
- Encourage all in the group to participate.
- Praise helpful actions or good ideas.
- Ask teammates for help if you need it.
- Check to make sure that everyone understands.
- Stay on task with your group.

TERMINOLOGY:

Gastroenteritis	Case definition
Epidemic or outbreak	<i>Escherichia coli</i> (<i>E. coli</i> 0157)
Epidemic Curve	Histogram
Controls	

SUGGESTED LESSON PLAN:

Day 1:

Getting Started

1. **Learning Log Prompt:** Sometimes people will suffer from vomiting and diarrhea and blame it on “food poisoning”. What evidence might you have to gather to confirm that it is food poisoning? What could be some alternatives to the food poisoning hypothesis?
Food poisoning is often the common term for gastroenteritis. To confirm the diagnosis, test would have to be made on the feces to see if disease-causing organisms could be detected. Other causes of these symptoms are the flu or chemical poisoning.
2. Classes that have access to a computer with Microsoft Excel can use the spreadsheet templates on the Hydroville CD. Those classrooms without computer access can use a hard copy of these spreadsheets (pages 16-17). On the Hydroville CD, locate the folder “Background Activity 10”, and download *Student Spreadsheets 1 and 2* onto each computer.

Doing the Activity

Background Information for students – class discussion

1. Divide students into groups of 3 or 4 students.
2. Put Transparency 1: *The Southern Oregon Outbreak* on the overhead and have a student read the opening paragraph. Students answer questions A and B in their Learning Log. Have each group discuss their answers with one another and come to a consensus on their responses. Discuss the responses as a class.
3. Introduce the background information about gastroenteritis to the students using Transparency 2: *Gastroenteritis*. Have students take notes in their Learning Log.
4. Distribute Student Handout 1: *Steps of an Outbreak Investigation*. Discuss with the class that they are going to take on the role of medical sleuths or epidemiologists and using real data from an historical outbreak.
5. Go through the steps or protocol epidemiologists would use when investigating an outbreak. Use a transparency of *Steps of an Outbreak Investigation*. Point out that the steps listed on the handout are based on the protocol used by the Center for Disease Control.
 - a. Step 1: Establish the existence of an outbreak

- Certain symptoms occur all of the time in the population. Are these reported cases a normal amount or do they represent an outbreak?
 - E.coli 0157 is a notifiable disease. Doctors and clinics are required to report cases to the health department because of a public health threat. For this reason action should be immediate in response to these cases.
- b. Step 2: What are the symptoms? What do the cases have in common?
 - c. Step 3: Develop a case definition: What, who, where, and when
 - Review patients to see if they fall into your case definition. Determine who matches the criteria
 - d. Step 4: Generate a working hypothesis as to what caused the outbreak.
 - e. Step 5: Test your hypothesis with facts
 - Exclude patients or “tweak” your hypothesis
 - Patients have to match the hypothesis
 - f. Step 6: Continue to build knowledge about the outbreak
 - g. Step 7: Determine and implement control measures
 - h. Step 8: Communicate findings with public and press
6. Be certain that students understand the following terms:
- a. Histogram or epidemic curve
 - b. Spot map
 - c. Confirmed cases vs. probable cases
 - d. Hypothesis
 - e. Controls
 - f. Route of exposure

Have students put the handout Steps in an Outbreak Investigation in their Learning Logs. They will be referring to it often throughout the activity and scenario.

Day 1-2: Investigation of an Outbreak: Steps 1-2

7. Hand out Team Packets to each team
8. Go over the instructions on Student Instructions Part 1: *Investigation of an Outbreak: Steps 1-2*.
9. Student teams work with the spreadsheets to analyze the data from the patient interviews to develop a case definition. They will draw an epidemic curve or histogram, do a spot map, and sort the spreadsheet to look for patterns. (They can sort the data using a computer or by highlighting information on the hard copy)
10. Student teams write their answers on their Team Report. You might want each student to keep a team report rather than one report per team.

Day 3: Investigation of an Outbreak: Steps 3-6

11. Begin the day by going over Steps 3 to 6 from the *Steps of an Outbreak Investigation*.
12. Give the students 15 to 30 minutes to do numbers 1-5 on Student Instructions Part 2.
13. Then, as a class, discuss case definitions and working hypotheses.
14. If there is time remaining, teams can work through steps 5 and 6 or you can just read the following to the class:

Further questioning of identified cases revealed common foods eaten by the patients at the Chain ZZ restaurants. Although the macaroni salad showed a high correlation with the cases identified, it could not explain all the cases. Recipes were then examined, and mayonnaise was found to be a common ingredient for all cases. The mayonnaise was suspected to be the cause of the outbreak.

The mayonnaise was distributed to both Chain ZZ restaurants by a single truck. The truck also carried beef in the same refrigerated compartment in plastic bags in sealed boxes adjacent to the mayonnaise. In talking with Chain ZZ employees who accepted delivery of the mayonnaise on deliveries just before the outbreak, both were certain they inspected the mayonnaise boxes for defects or stains and neither reported any problems. In addition, the truck supplied a number of other restaurants between the two Chain ZZ restaurants, none of which have been associated with illness. The distribution company gets the mayonnaise from a single manufacturer in Portland. The manufacturer supplies mayonnaise to many other restaurants and supermarkets. No animal products, other than pasteurized eggs are involved in production. No other cases of 0157 have been associated with mayonnaise. Without finding jars of mayonnaise that tested positive for E.coli 0157, the exact source of the 0157 in this outbreak may never be determined.

Day 4: Investigation of an Outbreak: Steps 7 – 8

15. Decide whether you want the team to develop a presentation for a press conference or if you want to have students individually write press release for the newspaper.

Wrap-up

1. *Learning Log Prompt:* Neither Amy Joos and Frank Stine ate at a Chain ZZ restaurant. Look at the information on these patients on Spreadsheet 1, your team's case definition, and information about E.coli outbreaks. Should these patients be eliminated from your case list or should your case definition be modified?
These cases could be eliminated but another answer that shows more in depth understanding is to indicate that Amy Joos works in day care and could have gotten E.coli from contact with an infant that was carrying the disease. Frank Stine is a swimmer and also could have been exposed in that way. If the cases are included, the case definition should be modified to included cases that came in contact with people or feces from individuals who ate at Chain ZZ restaurants in Grants Pass and North Bend in March.

ASSESSMENT:

- Students hand in all worksheets and learning log prompt questions

- Students hand in their press release for grading.
- Criteria for a successful presentation/newspaper press release includes:
 - ✓ Identifies the Problem: Each group should thoroughly describe the outbreak and their investigation.
 - ✓ Identifies their Hypothesis: Each group should present all of the possible causes they considered in their investigation.
 - ✓ Communicating Solutions and Recommendations: Each group should provide an explanation for the outbreak and present evidence to support their conclusions.
 - ✓ Teamwork: All members of the group need to have an active role in the presentation or creating the newspaper article.
 - ✓ Communication/Visual aids (for Press Release only): Each group should have some type of visual aid to support and enhance their presentation.
 - ✓ Overall Presentation: Each group should have a clear, understandable presentation/newspaper article.

EXTENSIONS:

Mathematics

See Mathematics Extension section for the following activities:

- Mathematics Extension 4: Dice Odds and Probability
- Two By Two Contingency Tables and Odds Ratios (chi square exercise)

Language Arts and/or Social Studies Extensions

1. Have students read Chapter Two (Revenge Can Be Sour) from John D. Fitzgerald's book *The Great Brain*. The Great Brain series centers on the life and times of three brothers in rural Utah at the turn of the century. This chapter tells the story of the brothers being purposely exposed to the measles in order for their mother to get them all through it at the same time. One of the brother's friends is also quarantined when he and his family develop the mumps.

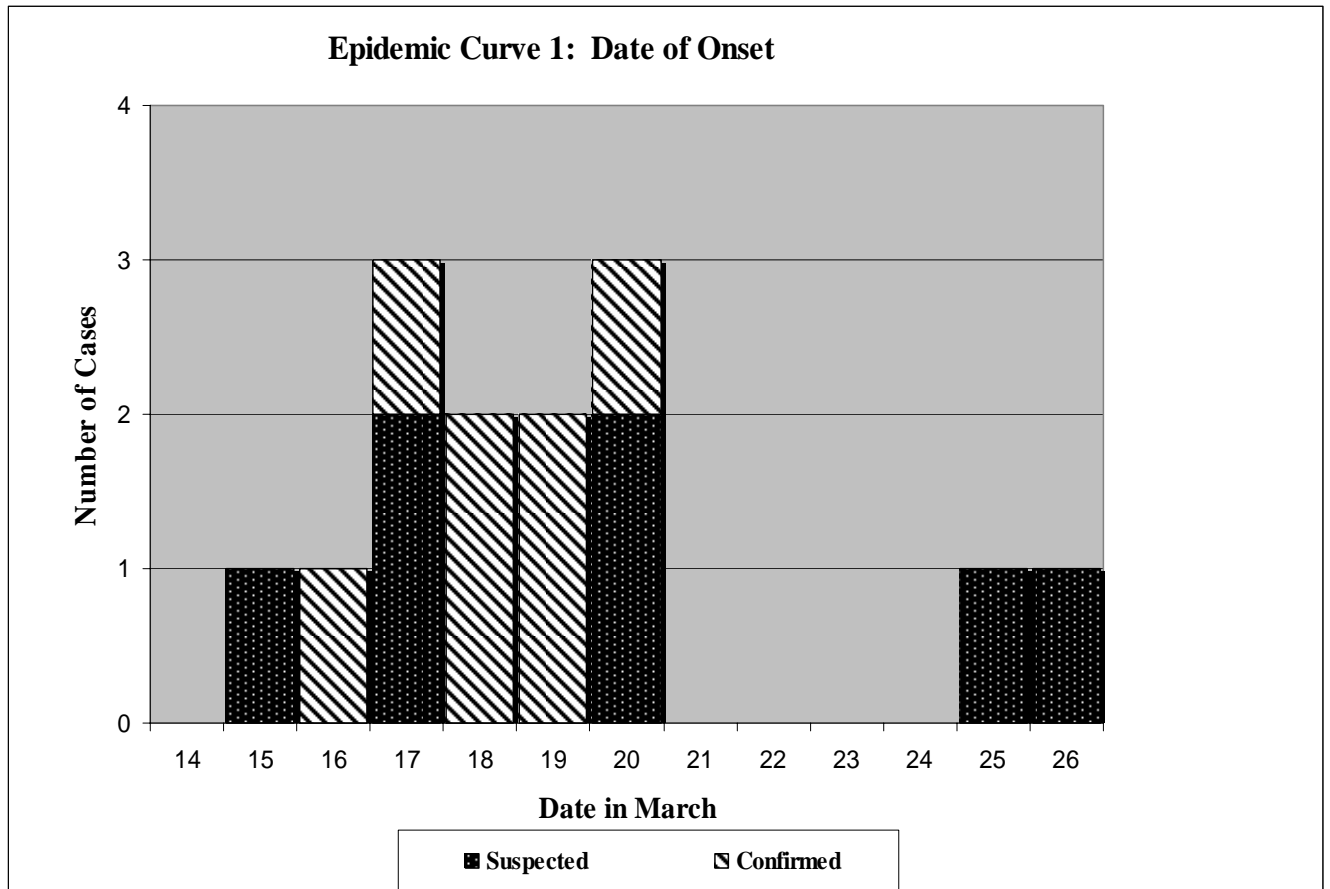
The purpose of the reading exercise is to give students a framework for understanding how Americans once dealt with outbreaks of childhood disease.

2. Have students prepare interview questions for their parents, grandparents, or any older adult on the topic of how childhood disease was dealt with when they were growing up. They should go into their interview with prepared questions and also be ready to expand on the answers they get from their interviewee.

RESOURCES:

- A good website to learn more about Risk Communication and how to interview a someone about their illness is www.attcdr.cdc.gov/HEC/primer.html

TEACHER KEY



TEACHER KEY
TEAM REPORT: INVESTIGATION OF AN OUTBREAK

Information from the initial phone calls to the Josephine County Health Department.

1. How many gastroenteritis cases were reported to the health department? 4
2. What were the dates of the reported cases? *Between March 15 and March 21*
3. What was the cause of these gastroenteritis cases? E. coli 0157
4. Was this diagnosis confirmed by laboratory analysis? Yes

Step 1: Verification of an Outbreak

5. How many cases of E. coli 0157 were reported in Josephine County in 1992? 1
6. When were the 1992 cases reported? August
7. Does the number of cases of E. coli 0157 in 1993 exceed the expected number of cases?
 Yes
8. Is there an outbreak of E.coli 0157 in Southern Oregon? Yes
9. Write one or two sentences that support your answer to (d).
Within six days in 1993, there were four cases of E.coli 0157 reported in Josephine County plus one in Jackson County and two in Coos County. This number is much greater than the number that would be expected in a whole year.

Step 2: Collect Patient Data

10. What symptoms do most of the cases share? *Nausea, cramping, bloody diarrhea, and vomiting.*
11. Do the cases share anything else in common: age, sex, occupation, residence, eating specific foods or in specific restaurants? *Answers might vary but all should note that all but 2 of the cases ate in Chain ZZ restaurants.*
12. Do you see any patterns in the distribution of where the cases live? *The majority of cases live in Grants Pass (6 cases- 5 confirmed) and North Bend (4 cases - 2 confirmed). (some may even notice that all seven of the confirmed cases are in these two cities)*
13. What is the range of dates for the onset of symptoms? *March 15-26*
14. Do most cases cluster around certain dates? If so, what are these dates? *Yes, March 15-20*
15. What is the incubation period for E.coli 0157? *Between two and 10 days with an average of five days.*

16. During what dates might these people been exposed? *Using the average of 5 days, between March 10th and March 15th.*
17. When did the majority of cases eat at Chain ZZ restaurants in Grants Pass and North Bend? *Between March 12th and 15th.*
18. How do Epidemic Curves 2 and 3 differ? *The eating dates are more concentrated around the 12th to the 15th in Grants Pass but more spread out in North Bend.*

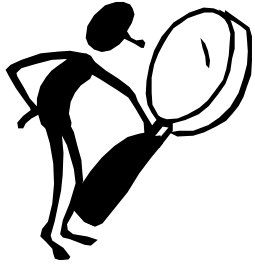
Table 1: Case Definition Information

Case Definition Information	Southern Oregon Outbreak	Supporting Data from Spreadsheets, spot maps and Epidemic Curves
WHO	<i>People who live in Southern Oregon Josephine and Coos Counties</i>	<i>Spot maps and interview spreadsheets show location of cases.</i>
WHAT	<i>Have symptoms of bloody diarrhea or positive test for fecal E. coli 0157</i>	<i>Data from interviews and doctors exams, all cases share this</i>
WHERE	<i>Ate at chain ZZ restaurants in Grants Pass or North Bend</i>	<i>All cases share this in common</i>
WHEN	<i>Between March 3 and March 26</i>	<i>Cases confirmed by lab test fall in these dates</i>

19. Write your team's case definition as a sentence. *Cases in the Southern Oregon Outbreak are people who live in Josephine and Coos County Oregon that have bloody diarrhea or confirmed fecal E.coli 0157 and ate at a Chain ZZ restaurant in Grants Pass or North Bend between March 3 and March 26.*
20. Write down your team's working hypothesis about the cause of the outbreak. *Answers will vary but should concentrate on a common food source as the cause.*
21. Which foods in Table 2 are possible sources for the illness? *Raw carrots, ranch dressing, macaroni salad, seafood salad, potato skins, and chocolate mouse.*
22. What further information do you need to be certain of the source of the outbreak? *The odds ratio for the macaroni salad is very high indicating that it might be the source. But only 8 cases ate it, so by itself, macaroni salad couldn't account for the outbreak. None of the foods by themselves can account for the outbreak, so we need to look at the recipes to see if there are any common ingredients.*

23. List some of the common ingredients. *Mayonnaise and sour cream*
24. How can you explain the raw carrots and potato skins as possible sources? *These foods themselves are not the source, but each can be dipped or topped with mayonnaise (ranch dressing) or sour cream.*
25. How would you confirm that the common ingredients that you identified were the source?
We would need to do a statistical analysis with cases and controls.
26. Is either mayonnaise or sour cream significantly related to the outbreak of this illness?
The mayonnaise consumption is significantly associated with illness ($X^2 > 6.635$).
27. Could either of these food items be the source of the E.coli 0157?
The majority of cases in the sample ate a food item with mayonnaise (88%). Further, when analysis is restricted to the original restaurant during the weekend when the majority of cases reported eating, the odds ratio reaches 15. In addition, when you look at the other menu items associated with illness: you find that 13/14 carrots eaters, 8/8 macaroni salad eaters, 9/9 corn nugget eaters, 4/4 mousse eaters, and 23/25 sour cream eaters also ate mayonnaise containing foods.
28. How could you confirm that the common ingredient that you identified was the source?
You would need to find the contaminated mayonnaise and test it.
29. Given what you know about the outbreak, what control and prevention measures would you be recommending to the restaurant chain and the public? *Answers will vary.*

TRANSPARENCY 1:



THE SOUTHERN OREGON OUTBREAK

You and your team are the public health epidemiologists responsible for communicable disease surveillance and control in Josephine County in Southwestern Oregon.

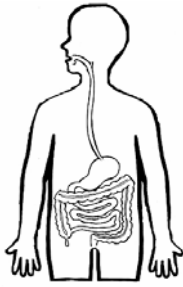
One Thursday afternoon in late March, you receive three phone calls from physicians in Josephine County reporting the following:

1. A total of four patients had visited the doctors complaining of similar symptoms that cause gastroenteritis: nausea, vomiting, cramping, and bloody diarrhea
2. These doctor visits had occurred between March 15 and 21, 1993.
3. The doctors took blood samples and stool samples.
4. The bacterium, *Escherichia coli* 0157, was identified in feces of all of the patients.
5. These reports came only weeks after the 0157 outbreak in Washington in which about 500 people were infected and three children died.

As a team of epidemiologists, discuss the following questions among yourselves. Each student records the team answer in your Learning Log under the section for Background Activity 10.

- A. How do you determine whether this is an outbreak? An outbreak occurs when an illness occurs in greater numbers than is predicted by what occurs randomly.
- B. Could there be other cases? How do you find out?

TRANSPARENCY 2:



Gastroenteritis

Gastroenteritis is an inflammation of the stomach and intestinal tract that results in nausea, vomiting, cramping, and diarrhea. During an investigation of cases of gastroenteritis, public health officials must determine the cause of the outbreak. It can be caused by several types of organisms.

Identification of the pathogen, through a careful assessment of the patients' personal history, symptoms, and laboratory diagnosis of the patients' feces, can help identify possible:

- Methods of transmission (how the patient contracted the disease)
- Incubation period (the time between exposure and illness)
- Periods of communicability (the time the patient is contagious)

In this activity, we will consider an outbreak of gastroenteritis caused by the bacterium *Escherichia coli* 0157:H7 (or 0157). *E.coli* bacteria produce a toxin that causes the gastroenteritis symptoms.

Symptoms	Causes	Transmission	Incubation Period
<ul style="list-style-type: none">• Nausea• Vomiting• Cramping• Bloody diarrhea	<ul style="list-style-type: none">• Eating undercooked animal products.• Drinking raw milk, non-pasteurized apple cider, contaminated water, or swimming pool water.• Handling Pets (domestic & wild)	From one person to another within households, day care, or nursing home settings.	Generally between 2 and 10 days with an average of 5 days.

Student Spreadsheet 1: Patient Information and Symptoms

Name	Sex	Age	City of Residence	Occupation	Others with similar symptoms	Eaten Suspected Food?*	Date Onset	Symptoms					<i>E. coli</i> 0157	
								Nausea	Cramping	Bloody Diarrhea	Vomiting	Fever	Suspected	Confirmed
Felicia M. Fairplay	F	63	Grants Pass	Retired	Husband	No	3/20	1	1	1				1
Mae B. Knottwell	F	62	Grants Pass	Manager	None	No	3/19	1	1	1				1
Karin Akin	F	12	North Bend	Student	None	No	3/17			1				1
Verti Goh	M	20	North Bend	Dance Instructor	None	No	3/18	1	1	1	1			1
Al R. Geaz	M	60	Myrtle Point	Hairdresser	Grand daughter	No	3/16	1	1	1				1
Amy G. Joos	F	41	Grants Pass	Day Care Provider	Husband daughter	Apple Juice	3/26	1	1	1	1		1	
Willa Wise	F	74	Bandon	Retired	None	No	3/17	1		1			1	
Clarence Nightingale	M	41	Rogue River	Nurses Aide	None	No	3/20	1		1	1		1	
John Diss	M	66	Grants Pass	Retired	Wife	No	3/19	1		1	1			1
Alice S. Goode	F	35	Grants Pass	Teacher	Husband	No	3/18	1	1	1	1			1
Mary Williams	F	19	North Bend	Student	Mother, Brother, Sister	Apple Juice	3/15	1		1	1		1	
Melanie Dugan	F	36	Grants Pass	Legal Secretary	None	No	3/20	1			1	1	1	
Alex K. Horn	M	42	Myrtle Point	Radio Announcer	None	No	3/17	1	1		1	1	1	
Frank N. Stine	M	75	North Bend	Retired	None	Swimming pool	3/25	1			1	1	1	

*Undercooked meat, raw milk, unpasteurized apple juice, swimming pool water

STEP 2: COLLECTING PATIENT DATA

Student Spreadsheet 2: Case Restaurant Meals

Name	RESTAURANTS											
	Chain XX	Chain YY			Chain ZZ		Rest. A	Rest. B	Rest. C	Rest. D	Rest. E	Rest. F
	Grants Pass	Medford	Grants Pass	Coos Bay	Grants Pass	North Bend	Grants Pass	Myrtle Point	Grants Pass	Rogue River	North Bend	Coquille
Felicia M. Fairplay					3/14				3/16			3/11
Mae B. Knottwell					3/13					3/18	3/14	
Karin Akin					3/14			3/9				
Verti Goh	3/15				3/13		3/10		3/14			
Al R. Geaz					3/14		3/13	3/15				3/15
Amy G. Joos	3/10						3/15				3/14	
Willa Wise				3/16	3/12						3/14	3/8
Clarence Nightingale						3/14	3/5	3/8				
John Diss		3/15	3/18		3/14							
Alice S. Goode		3/15			3/13		3/11		3/17			
Mary Williams				3/2		3/10					3/13	
Melanie Dugan	3/15			3/20		3/25					3/10	
Alex K. Horn					3/14	3/25					3/13	
Frank N. Stine				3/8 3/15 3/22								



**STUDENT PAGES
FOR
INVESTIGATION OF AN OUTBREAK**

FOLLOW THIS PAGE

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STUDENT HANDOUT 1:

STEPS OF AN OUTBREAK INVESTIGATION

.....
Successful investigation of a reported outbreak by a health department or the Center for Disease Control requires a thorough collection of information in the field and careful evaluation of the data collected. Epidemiologists follow a protocol or series of steps in the initial investigation of an outbreak.
.....

1. Establish the Existence of an Outbreak

- Certain symptoms and illness are going on all of the time. Are these reported illnesses a normal amount or do they represent an outbreak?
- Does the number of cases exceed the expected number of cases?
- Expected cases = number of cases from comparable period in previous months or years
- Expected numbers can be obtained from local health departments, hospital discharge records, death records, cancer registries or the Center for Disease Control.

2. Collect Patient Data (develop a spreadsheet to record all information from patient interviews)

- Person: Determine age, sex, occupation, race/ethnicity, residence, recent travel, attendance at events
- Time: Determine date and/or hour of onset. Construct a epidemic curve/histogram: graph dates vs. number of cases
- Place: Prepare spot maps of cases with respect to home, work, recreational activities, restaurants, special meetings, etc.

3. Develop Case Definition

Case definition includes:

- WHAT :Clinical information about the disease – symptoms and lab results
Confirmed cases have laboratory verification
Probable cases have clinical symptoms without laboratory verification
- WHO: Characteristics of people affected – age, sex, etc.
- WHERE: Information about place or food source
- WHEN: Specifications of time during which outbreak occurred – dates of onset

4. Generate a Working Hypothesis

- How is disease transmitted?
- What is the incubation period for the disease?
- What are the symptoms of the disease?
- What are the environmental factors that contribute to the spread of the disease?

HANDOUT 1(CONTINUED)

STEPS OF AN OUTBREAK INVESTIGATION

5. Test Your Hypothesis with facts

- Design experiments or laboratory tests
- Review clinical findings and laboratory results
- Compare hypothesis with established facts
- Revise hypothesis to reflect findings
- Exclude patients – patients have to match hypothesis

6. Continue to Build Knowledge about the Outbreak

- Why did the outbreak occur? Is it ongoing or the result of a single event?
- Is the infection from a common source or is it spread through the population?
- If a food source, analyze what people ate and find the cause.
- How can we prevent others from being exposed to the source of infection?
- How can we prevent similar outbreaks in the future?
- By the conclusion of the investigation, all of the known facts should be consistent with one and only one hypothesis.

7. Implement Control and Prevention Measures

- What actions should government and public agencies take to reduce risk?
- What actions can individuals take to reduce risk?
- What are the financial and social implications of these measures?

8. Communicate Findings and Interact with Public and Press

- Disseminate information to physicians, other health officials and departments about the nature of the outbreak and the control measures being implemented.
- Interact with the public and the press. Use opportunities for educating the public about prevention. Write press releases, hold public meetings, etc.

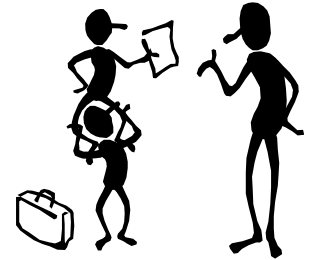
*Adapted from EXCITE Web site of the Center for Disease Control
<http://www.cdc.gov/excite/>*

STUDENT INSTRUCTIONS - PART 1:

INVESTIGATION OF AN OUTBREAK: STEPS 1-2

Materials:

Student Handout 1: *Steps of an Outbreak Investigation*
Team Packet
Graph Paper



Procedure:

A. Steps of an Outbreak Investigation

1. Obtain a team packet from your teacher.
2. As a team, go over the *Steps in an Outbreak Investigation* discussed by the class.
3. Define the following terms in your Learning Log:
 - a. Histogram or epidemic curve
 - b. Spot map
 - c. Confirmed cases vs. probable cases
 - d. Hypothesis
 - e. Route of exposure

B. Step 1: Establish the Existence of an Outbreak

1. Working as a team, review what you know from the initial information on the overhead *The Southern Oregon Outbreak* and fill in the answer to questions 1-4 on the Team Report.

INFORMATION FOR YOUR TEAM

- *Your team checks data on the web site for the Oregon State Department of Health and finds that over the last year, only one case of 0157 was reported in Josephine County and that was in August of 1992.*
 - *Part of your team makes calls to emergency room doctors, clinical laboratories in the county, adjacent county health departments and the state department of health to search for other reported cases of bloody diarrhea or diagnosed 0157. From these calls, you learn that another patient with 0157 was reported to Jackson County Health Department the previous day. Two other patients with 0157 were reported to Coos County Health Department the same week. The emergency rooms and laboratories you contacted have not seen any other cases of bloody diarrhea.*
2. Using this information, answer questions 5-9 on your *Team Report* to verify the existence of an outbreak.

STUDENT INSTRUCTIONS - PART 1: (CONTINUED)

C. Step 2: Collect Patient Data

1. Your team needs to review the data from interviews (case histories) carried out by the health department. A copy of the interview form for Alice S. Goode is in your packet (*Student Handout 2*). Interviews were carried out with each of the seven patients who were tested and confirmed having the bacterium, *Escherichia coli* 0157, in their feces and seven others who showed similar symptoms but did not have the lab tests performed.
2. This data is summarized on the *Spreadsheet 1 Patient Information* and *Spreadsheet 2 Case Restaurant Meals*. Copies of the spreadsheets are on the computer or will be provided to you by your teacher.

INFORMATION FOR YOUR TEAM

As the public health epidemiologist, your task is to determine the possible source of the outbreak. Escherichia coli 0157 are found in undercooked animal products, such as hamburger meat. The bacteria are also present in raw milk, unpasteurized apple cider, and contaminated swimming pool water. It can also be transmitted from one person to another.

3. On the computer, use Excel to sort and analyze the patient data on *Spreadsheet 1 and Spreadsheet 2* to look for trends and patterns. (If you don't have access to a computer, analyze the paper copy). Answer questions 10-11 on your Team Report.
(10.) What symptoms do most of the cases share?
(11.) Do the cases share anything else in common: age, sex, occupation, residence, eating specific foods or eating in specific restaurants?
4. Divide your team into 2 groups. One group work on the spot map (5) and the other on the epidemic curve (6).
5. *Spot Map*: A **Spot Map** shows the location of confirmed and suspected cases within a designated geographical location.
 - Use the information on *Student Spreadsheet 1* to create a spot map for this outbreak.
 - On the map of southern Oregon in your team packet, locate the towns where the cases live.
 - Draw an arrow from the town to the margins.
 - Draw a box in the margin.
 - Establish a key in the bottom right corner of the map, showing the color ink used for confirmed cases and another color ink for suspected cases.
 - In the box for each city, put the number of confirmed and suspected cases in colored ink
 - Answer question 12 on the Team Report

STUDENT INSTRUCTIONS - PART 1: (CONTINUED)

6. *Epidemic Curve*: An **epidemic curve** is a histogram or bar graph that plots the date of onset (x axis) versus the number of cases (Y axis).
- Obtain a piece of graph paper.
 - Sort the spreadsheet by date of onset.
 - Use the information on *Student Spreadsheet 1* to create an epidemic curve of the date of onset for this outbreak
 - Draw a bar graph plotting date of onset vs. number of cases. Color confirmed cases red and suspected cases blue. Label your axis and your graph as Epidemic Curve 1: Date of Onset.
 - Answer the questions 13-16 on your Team Report.

INFORMATION FOR YOUR TEAM

By now you hear about more probable cases from routine statewide reporting, local laboratories, emergency clinics, and the public. You collect information about these persons' age, gender, whether they ate at Chain ZZ, how many others ate with them, and how many of those got sick. The illness has been reported from persons eating at Chain ZZ restaurant.

There are 11 Chain ZZ restaurants in southern Oregon. In addition to 43 cases (9 of whom had positive feces laboratory tests for 0157) who ate at the original restaurant Chain ZZ in Grants Pass), you identify 17 cases who patronized a second Chain ZZ restaurant in North Bend in Coos County. Five of these cases had 0157 identified in their feces. A total of 60 cases ate at the two Chain ZZ restaurants were identified. Epidemic curves 2 and 3 in your team packet graph the meal date vs. the number of cases that ate on that date. Confirmed cases are in black and suspected in grey.

7. Look at Epidemic Curves 2 and 3 in your team packet. Analyze these graphs to answer questions 17 - 18 on your Team Report.

STUDENT HANDOUT 2: JOSEPHINE COUNTY OUTBREAK IDENTIFICATION FORM

JOSEPHINE COUNTY REPORT DATE: 3/25/93

Health Department

OUTBREAK IDENTIFICATION FORM 1 PATIENT NO: 5

NAME: ADDRESS:
 OCCUPATION:
 PHONE:
 WORK / MESSAGE: AGE: F M

SYMPTOMS:

DATE OF ONSET:

NAUSEA CRAMPING BLOODY DIARRHEA VOMITING FEVER 015 7 CONFIRMED

FOOD: DID YOU CONSUME ANY OF THE FOLLOWING IN THE LAST 14 DAYS? IF SO, WHEN AND WHERE?

	NO:	YES:	DATE:	LOCATION:
UNDERCOOKED MEAT	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
RAW MILK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
APPLE JUICE OR CIDER, OR PRODUCTS CONTAINING APPLE JUICE OR CIDER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
WATER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>
SWIMMING POOL WATER	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="text"/>	<input type="text"/>

RESTAURANTS: WHAT RESTAURANTS DID YOU EAT AT IN THE LAST 14 DAYS? WHEN?

RESTAURANT: <input type="text" value="RESTAURANT A"/>	DATE: <input type="text" value="3/11/93"/>	CITY: <input type="text" value="GRANTS PASS"/>
RESTAURANT: <input type="text" value="CHAIN ZZ"/>	DATE: <input type="text" value="3/13/93"/>	CITY: <input type="text" value="GRANTS PASS"/>
RESTAURANT: <input type="text" value="CHAIN YY"/>	DATE: <input type="text" value="3/15/93"/>	CITY: <input type="text" value="MEDFORD"/>
RESTAURANT: <input type="text" value="RESTAURANT C"/>	DATE: <input type="text" value="3/17/93"/>	CITY: <input type="text" value="GRANTS PASS"/>
RESTAURANT: <input type="text"/>	DATE: <input type="text"/>	CITY: <input type="text"/>

CONTACTS:

Do you work at, visit or go to a day care center?

NAME OF CENTER(S)

Do you work at, visit, or live in a nursing home?

NAME OF N. HOME(S)

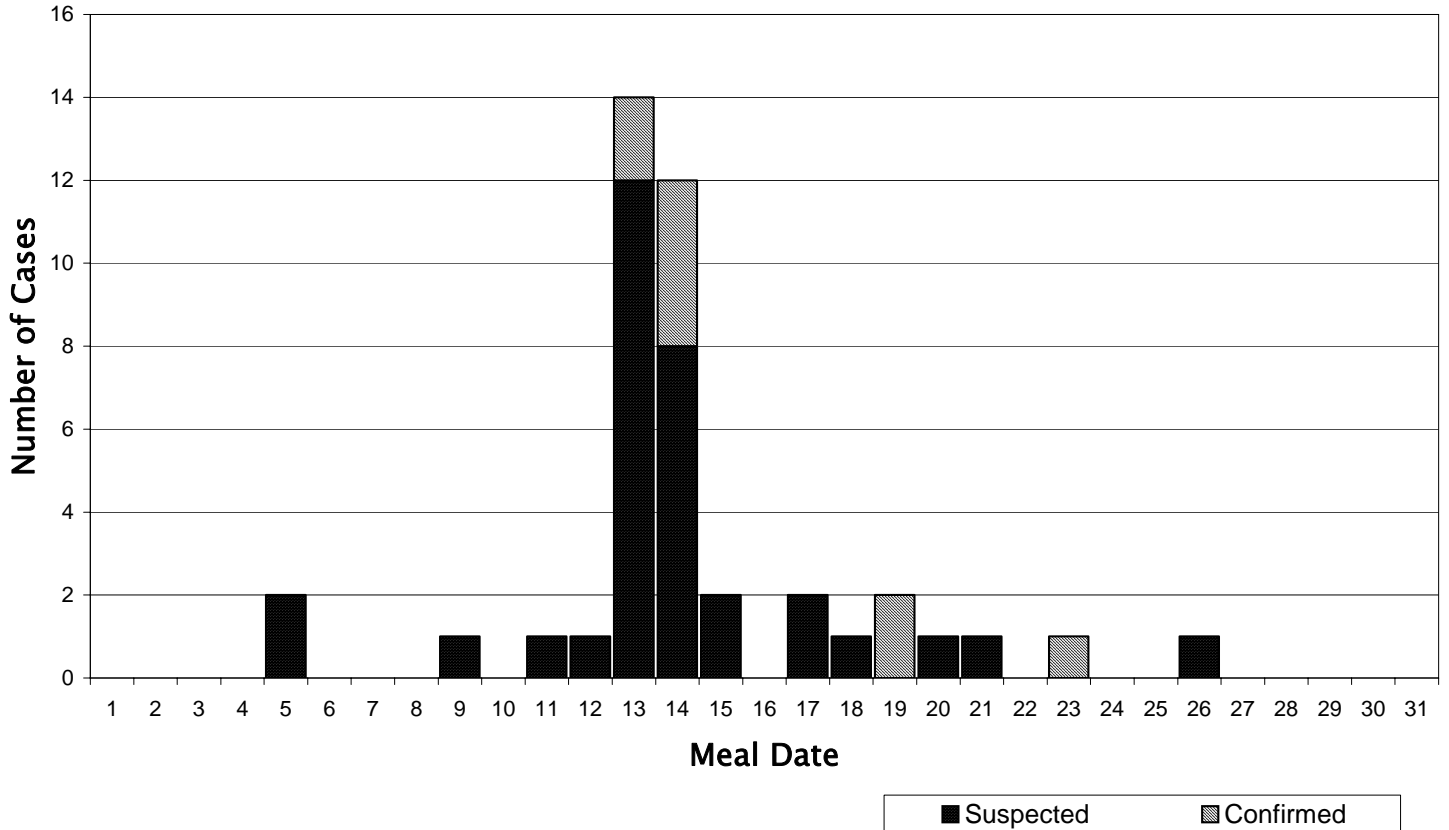
Does anyone else live in your household have similar symptoms? If so, who?

NAME: RELATIONSHIP TO YOU:

STUDENT HANDOUT 3:

EPIDEMIC CURVE 2 - RESTAURANT 1: GRANTS PASS

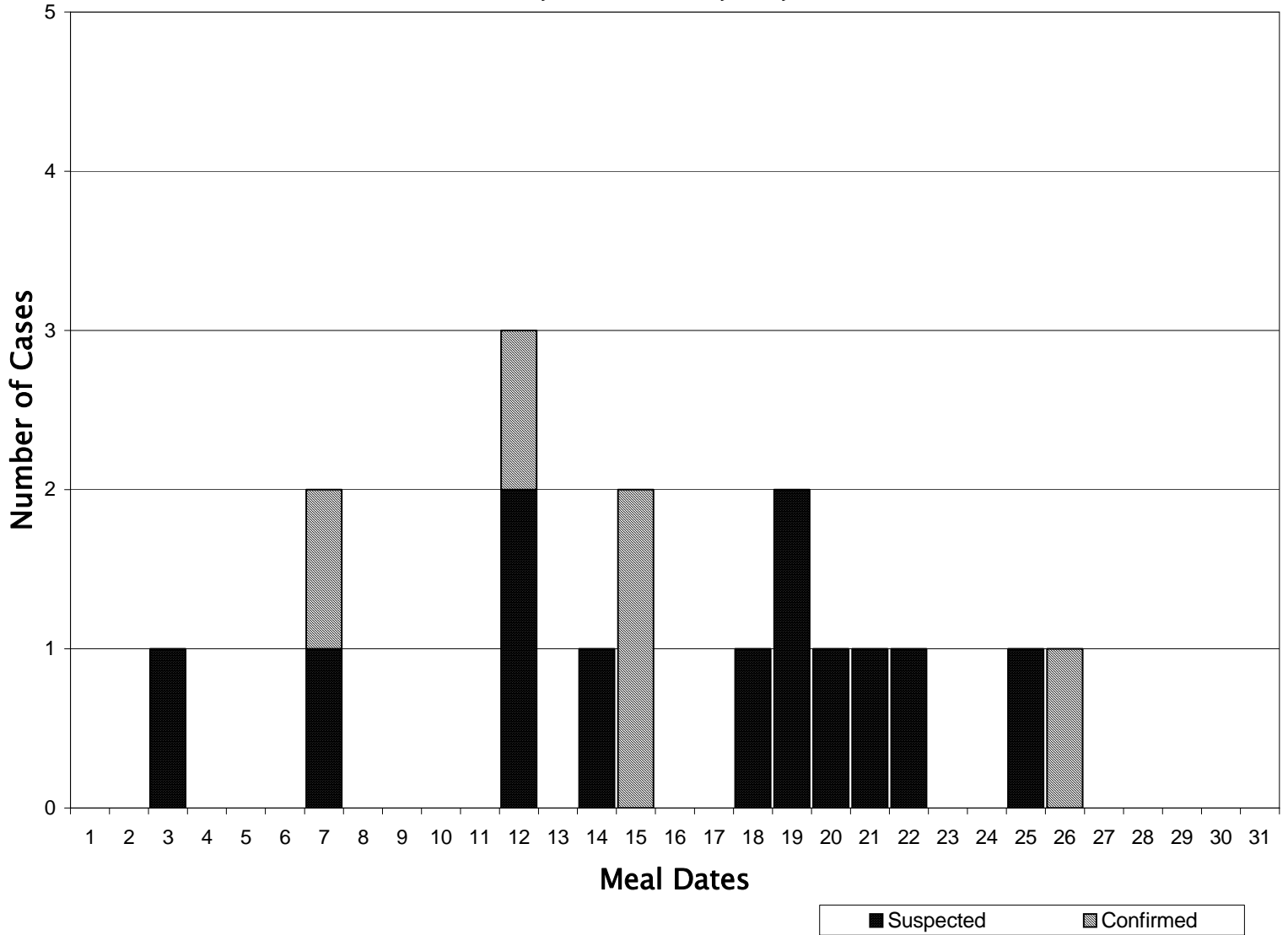
0157 Case Patients by Date of Visit to Chain ZZ
Restaurant 1, Grants Pass, OR, March 1993



STUDENT HANDOUT 4:

EPIDEMIC CURVE 3 - RESTAURANT 2: NORTH BEND

0157 Case Patients by Date of Visit to Chain ZZ
Restaurant 2, North Bend, OR, March 1993

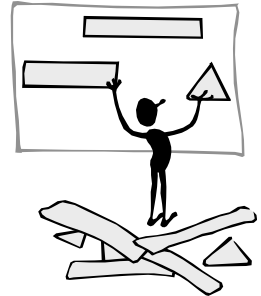


STUDENT INSTRUCTIONS - PART 2:

INVESTIGATION OF AN OUTBREAK: STEPS 3-6

STEP 3 DEVELOP A CASE DEFINITION

1. It is time for your team to put your heads together and use the data that you have collected and analyzed to develop your **case definition**.
2. Refer to the *Steps in an Outbreak Investigation* for what should be in your case definition.
3. Use the answers to the questions 1-18 on your team report, your spot map and epidemic curves to fill out the Table 1 and answer question 19 in your team report.



STEP 4 GENERATE A WORKING HYPOTHESIS

INFORMATION FOR YOUR TEAM

Look again at Epidemic Curves 2 and 3. Epidemic curve 2 shows a cluster of cases who ate at the Grants Pass restaurant on the weekend of March 12-14, suggesting a possible point source of infection such as an infected food handler or improper food handling practice. Epidemic curve 3 is more scattered showing a low level of contamination over several days. Chain restaurants such as Chain ZZ get the majority of their food from a common distribution center.

4. As a team discuss what you know about the outbreak and propose a possible cause of the outbreak. Write your working hypothesis after question 20 in the Team Report.
5. Share your team's case definition and hypothesis with your class. Be prepared to defend your answers.

STUDENT INSTRUCTIONS - PART 2: (CONTINUED)

STEP 5-6: TEST YOUR HYPOTHESIS AND BUILD KNOWLEDGE ABOUT THE OUTBREAK

6. In order to isolate a possible food source, you need to ask people who got sick and those who didn't about the specific foods that they ate at the restaurants during that time period.
7. Table 2 lists foods from the Chain ZZ menu eaten by cases and **controls** (those that didn't get sick).



**Table 2: Chain ZZ Menu Items Associated with 0157
Cases (n = 48) Controls (n = 62)**

Food Item	Cases (n = 48)		Controls (n = 62)		Odds Ratio*	X ² Value**
	Ate the item?		Ate the item?			
	Yes	No	Yes	No		
Steak	22	26	26	36	1.17	0.167
Hamburger	1	47	2	60	0.64	0.133
Chicken Malibu	6	42	11	51	0.66	0.569
Rice	5	43	2	60	3.49	2.348
Cantaloupe	6	42	4	58	2.07	1.198
Carrots (raw)	14	34	8	54	2.78	4.472
Celery	5	43	2	60	3.49	2.348
Ranch dressing	12	36	5	57	3.80	5.939
Thousand Island dressing	5	43	6	56	1.09	1.643
Bleu Cheese dressing	21	27	23	39	1.32	0.499
Macaroni salad	8	40	1	61	12.2	8.161
Seafood salad	9	39	3	59	4.54	5.387
Potato skins	9	39	3	59	4.54	5.387
Chocolate mousse	4	44	0	62	---	5.362

*The odds ratio is a statistic that is used to judge the strength of the association or link between two categories. In general, the larger the odds ratio, the stronger the association between the categories. However, the statistical significance of an odds ratio also depends on the number of people in the sample and the marginal totals.

**This statistic called a chi-square value and indicated as X² can tell us if the odds ratio is significant, that is not just due to chance. The larger the chi-square value, the less likely it is that the odds ratio is largely due to mere chance. In our case, if X² > 3.841, then there is only a 5% (1 in 20) chance that the odds ratio was due to mere chance and we can say that a food could have been the source of the *E. coli*.

8. Use the information in Table 2, to answer questions 21-22 on your Team Report. Discuss your answers as a class.

STUDENT INSTRUCTIONS -PART 2: (CONTINUED)

None of these foods alone could explain all the illness that occurred. To further isolate the food source, it is necessary to look at the recipes to see if there are any common ingredients. The following is the list of the menu items and their ingredients. Prepackaged indicates that this menu item was not prepared in the restaurant.

Table 3: Chain ZZ Menu Item Ingredients

Food Item	Ingredients
Steak	Steak
Hamburger	Ground Beef
Chicken Malibu	Prepackaged
Rice	rice
Cantaloupe	cantaloupe
Carrots (raw)	carrots
Celery (raw)	celery
Ranch dressing	flavorings, vinegar, sour cream, mayonnaise
Thousand Island Dressing	Prepackaged
Blue Cheese Dressing	Prepackaged
Macaroni salad	pasta & vegetables, mayonnaise, Parmesan cheese
Seafood salad	celery, sour cream, mayonnaise, crab
Potato skins	potato skins
Chocolate mousse	Prepackaged

9. Use Table 3 to answer questions 23-25 on your Team Report.

10. Table 4 summarizes the statistical analysis done for mayonnaise and sour cream. Answer questions 26 - 29 on your Team Report.

Table 4: A Statistical Analysis of Chain ZZ Ingredients Associated with 0157

Food Item	Cases (n = 48)		Controls (n = 62)		Odds Ratio*	Percentage of cases	X² Value*
	Ate the item?		Ate the item?				
	Yes	No	Yes	No			
Mayonnaise	42	6	38	24	4.4	88%	34.65
Sour Cream	25	23	23	39	1.8	52%	2.27

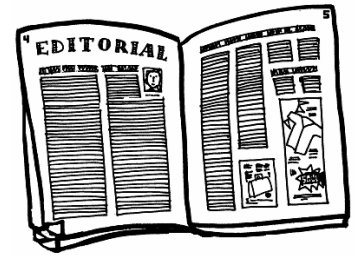
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STUDENT INSTRUCTIONS - PART 3:

INVESTIGATION OF AN OUTBREAK: STEPS 7-8

Your group has determined the extent of the outbreak and developed a case definition and described the signs and symptoms of illness. You must now communicate this information to the public. Your teacher will assign either a newspaper article or a presentation at a press conference to communicate your findings.

1. Write a press release for the newspaper that includes:
 - A short descriptions of the events that have happened in Josephine County and Coos County
 - The evidence used to confirm an outbreak
 - The case definition for the outbreak
 - Graphs and tables that summarize the data
 - The suspected cause of the outbreak
 - Steps that are being taken to prevent a further outbreak
2. Prepare a 10-minute press conference presentation. Each member of your group should take part in the presentation with one person chosen as the spokesperson who begins and ends the press conference and takes audience questions. Use Student Handout 4: *A Presentation Planner* as a guide. Your presentation should include:
 - A short descriptions of the events that have happened in Josephine County
 - The evidence used to confirm an outbreak
 - The case definition for the outbreak
 - Graphs and tables that summarize the data
 - The suspected cause of the outbreak
 - Steps that are being taken to prevent a further outbreak



RISK COMMUNICATION

Risk communication is a very important part of any outbreak because it acts as a tool for relating the new information to the public and educating the public on safe practices. Communicating risk should be done in a way that does not scare the public or undermine their prior knowledge. It should include the public in a discussion about the process. Merely broadcasting information without the regard for communicating the complexities and uncertainties of risk does not necessarily ensure effective risk communication. Carefully thought out communication with the public will help ensure that your message are transmitted, well received, and result in meaningful actions. The seven cardinal rules of risk communication are:

1. Accept and involve the public as a partner.
2. Plan carefully and evaluate your efforts.
3. Listen to the public's specific concerns.
4. Be honest, frank, and open.
5. Work with other credible sources.
6. Meet the needs of the media.
7. Speak clearly and with compassion.

STUDENT HANDOUT 4:

A PRESENTATION PLANNER

Hypothesis:

City/County/State:

Date:

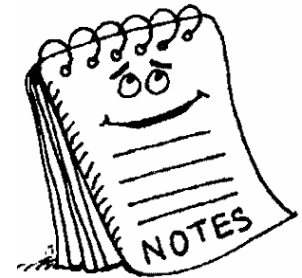
Audience:

Introduction

- **Statement of personal concerns:**
- **Purpose and plan for the meeting:**

Key Messages

- **Content:**
 - ✓ The microbial cause of the outbreak
 - ✓ The location and ingredient source of the outbreak
 - ✓ The number of cases reported along with the case definition
 - ✓ An assurance to the public that the outbreak has been contained
 - ✓ A short piece educating the public on the microbe containing specific information on:
 - Symptoms
 - Causes
 - Transmission
 - Incubation
- **Supporting Data**



Conclusion - Summary Statement

Questions and Answers (Think about audience questions and your response)

Keep the following in mind when preparing your press conference:

- **Know your Audience:** Anticipate interests, concerns and questions
- **Prepare Your Presentation:** Develop a strong introduction, then give a maximum of three key messages with supporting data, and audiovisual aids
- **Practice:** Practice your presentation until it goes smoothly and fits within the timeframe.
- **Prepare for Answering Questions:** Anticipate what questions will arise and prepare answers to them. Practice questioning and responding.
- **Prepare Presentation Aids** such as charts, illustrations, diagrams, maps, posters and handouts.
- **Presentation Reminders:** Volume, pronunciation, pace/pitch, facial expressions, posture, gestures and dress/grooming.

Student Handout 5:

Team Presentations Solving Scoring Guide

Team: _____

Evaluator: _____

Please use the following ratings to provide feedback to the presenters. CIRCLE the appropriate rating for each section. Provide comments to support your evaluation underneath each rating.

Rating	Identifying the Problem	Identifying hypotheses	Communicates Solution(s)	Makes Recommendations
Very Successful	Thoroughly and accurately describes the outbreak. Identifies information needed to investigate the outbreak, including information not immediately apparent.	Proposes multiple possible hypotheses to account for the outbreak. Hypotheses are creative and viable. Solutions address the central issues of the problem.	Gives a clear, comprehensive, rational, and defensible summary of the most viable explanation for the outbreak and why alternatives were rejected...	Includes many reasonable recommendations to control the problem. Provides support for the recommendations. Includes information still needed to develop a complete solution.
Successful	Provides a description of the outbreak. Accurately identifies the most important information needed to investigate the outbreak.	Proposes more than one possible hypothesis to account for the outbreak. Hypotheses are plausible and address the central issues of the problem.	Describes how the final solution to the outbreak was chosen. Description is rational and defensible.	Describes and supports recommendations to control the problem. Includes additional research possibilities.
Somewhat Successful	Describes some events associated with the outbreak. Identifies information needed to investigate the outbreak. Some inaccuracies.	Proposes more than one possible hypothesis to account for the outbreak, but the solutions do not adequately or completely address the most important issues.	Describes how the final solution to the outbreak was chosen, but the description does not provide a clear rationale for selecting the solution.	Provides recommendations to control the problem.
Not yet successful	Does not describe the outbreak. Omits the most significant information needed to investigate the outbreak.	Hypotheses proposed do not address the most important issues.	Description of how the solution to the outbreak was chosen is illogical.	No recommendations provided.

1. What did you like best about this presentation? (Please note comments on the back of this sheet)

2. What suggestions can you give that might be useful for future presentations? (Please note comments on the back of this sheet)

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TEAM REPORT
INVESTIGATION OF AN OUTBREAK

Information from the initial phone calls to the Josephine County Health Department.

1. How many gastroenteritis cases were reported to the health department? _____
2. What were the dates of the reported cases? _____
3. What was the cause of these gastroenteritis cases? _____
4. Was this diagnosis confirmed by laboratory analysis? _____

Step 1: Verification of an Outbreak

5. How many cases of E. coli 0157 were reported in Josephine County in 1992? _____
6. When were the 1992 cases reported? _____
7. Does the number of cases of E. coli 0157 in 1993 exceed the expected number of cases? ____
8. Is there an outbreak of E.coli 0157 in Southern Oregon? _____
9. Write one or two sentences that support your answer to (d).

Step 2: Collect Patient Data

10. What symptoms do most of the cases share?
11. Do the cases share anything else in common: age, sex, occupation, residence, eating specific foods or in specific restaurants?
12. Do you see any patterns in the distribution of where the cases live?
13. What is the range of dates for the onset of symptoms?
14. Do most cases cluster around certain dates? If so, what are these dates?
15. What is the incubation period for E.coli 0157?

TEAM REPORT- PAGE 2

16. During what dates might these people been exposed?

17. When did the majority of cases eat at Chain ZZ restaurants in Grants Pass and North Bend?

18. How do Epidemic Curves 2 and 3 differ?

Step 3: Develop a Case Definition

Table 1: Case Definition Information

Case Definition Information	Southern Oregon Outbreak	Supporting Data from Spreadsheets, spot maps and Epidemic Curves
WHO		
WHAT		
WHERE		
WHEN		

19. Write your team’s case definition as a sentence.

Step 4: Generate a Working Hypothesis

20. Write down your team’s working hypothesis about the cause of the outbreak.

TEAM REPORT- PAGE 3

Step 5-6: Test Your Hypothesis

21. Which foods in Table 2 are possible sources for the illness?

22. What further information do you need to be certain of the source of the outbreak?

23. List some of the common ingredients.

24. How can you explain the raw carrots and potato skins as possible sources?

25. How would you confirm that the common ingredients that you identified were the source?

26. Is either mayonnaise or sour cream significantly related to the outbreak of this illness?

27. Could either of these food items be the source of the *E.coli* 0157?

28. How could you confirm that the common ingredient that you identified was the source?

29. Given what you know about the outbreak, what control and prevention measures would you be recommending to the restaurant chain and the public?