Campylobacter Outbreak at a Colorado Correctional Facility

A Foodborne Outbreak Investigation Case Study

Developed by the

Colorado Integrated Food Safety Center of Excellence

STUDENT

Summary

This case study is based on an outbreak caused by *Campylobacter* at several Department of Corrections facilities in Colorado. It is designed to be completed by public health students or new foodborne outbreak investigators. Participants should have a basic knowledge of epidemiologic concepts and methods.

Learning Objectives

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

- List the steps of an outbreak investigation.
- Create and interpret an epidemic curve.
- Use epidemiologic and clinical data to develop a hypothesis about the cause of the outbreak.
- Interpret results of an epidemiologic study and tests of statistical significance.
- Identify special considerations when investigating an outbreak in a correctional facility.

Intended Use

This case study is designed to be discussed in-person or via bi-directional video with a small group (8-15 participants) led by an instructor or facilitator with experience investigating foodborne outbreaks. We recommend allowing at least 2 hours to complete the case study.

Suggested materials may include pens, paper, a whiteboard, or calculators. Some activities may benefit from having internet access. Specific instructions for the instructor are provided in the text of the case study and in the appendix.

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: INTRODUCTION

On September 28, 2005, the Medical Director at the Colorado Department of Corrections (DOC) called the Colorado Department of Public health and Environment (CDPHE) to report *Campylobacter* among two inmates at different DOC facilities. Several other inmates at both facilities were also reporting gastrointestinal symptoms.

Background

Campylobacter is an organism that causes acute diarrheal illness. The incubation period is usually 2-5 days, ranging from 1 to 10 days. *Campylobacter* is the most commonly reported foodborne pathogen in Colorado and at the time of the outbreak approximately 800 cases are reported each year (a rate of 16.3 per 100,000). Reported outbreaks of campylobacteriosis are rare. *Campylobacter* is a zoonotic disease with reservoirs in poultry, cattle, puppies, kittens, and many other animals. Illness is often associated with the consumption of chicken, unpasteurized (raw) milk, and other food products that are contaminated with juice from raw meats. *Campylobacter* may also be transmitted by direct or indirect contact with animals or their environments and via ingestion of contaminated water. Person-to-person transmission is rare.

In 2005, Colorado DOC had over 13,000 inmates at 24 facilities around the state. These facilities house inmates at all levels of security. As with all correctional facilities, residents live in close quarters and there is a potential for inadequate hygiene. Meals are usually prepared by other inmates and served in the prison cafeteria. Vending items are also available. Contraband foods can bebought, sold, and prepared in creative ways including alcohol (“Hooch”). The DOC has several agricultural training programs. Inmates manage a vegetable garden, a dairy, and keep layer hens that produce eggs for public sale. The dairy has its own cattle herd and milk treatment (pasteurization) plant. Produce from the garden and milk from the diary are distributed to all 24 facilities. A dog training program is also housed at one of thel facilities and a wild horse training program at another. Inmates have a co-pay fee for medical care, which can deter them from seeking care. Inmates are frequently transferred between facilities.

Question 1: **Do you think this is an outbreak? Why or why not? What is the definition of an outbreak?**

To determine whether this was an outbreak, you asked the DOC medical director if the number of *Campylobacter* cases was unusual. In this case, even two cases of *Campylobacter* are more than would be expected in a typical week. Therefore, you decided to investigate this potential outbreak.

Beginning the Investigation

On September 29, you visited the Spruce facility, the prison with the most reported illnesses. The warden stated that five additional inmates received a laboratory-confirmed diagnosis of *Campylobacter*. The seven laboratory-confirmed cases first developed symptoms of diarrhea and/or abdominal pain on September 17, 19, 21, 23, 23, 24, and 25.

Question 2: **Based on these onset dates, when do you think inmates were exposed? How might the disease be spread?**

You suspected the exposure began on or around September 12-15 based on the incubation period for the earliest cases and that food was the most likely source of the outbreak.

The following steps were taken:

- Menus were obtained from the kitchen, and your environmental health colleagues interviewed kitchen staff about food preparation and handling practices.
- Environmental health specialists inspected the prison kitchen and the milk plant, including an inspection of the pasteurization process and packaging, storage and distribution practices.

Question 3: What measures would you implement to prevent further spread of *Campylobacter?*

To prevent further spread of *Campylobacter* among inmates, you implemented the following control measures:

- Ill inmates were sent to the infirmary until symptoms resolved.
- Increased cleaning and hand-washing was encouraged.
- Ill food handlers were excluded from work until their symptoms resolved and a negative stool culture was obtained.
- Fact sheets were distributed to inmates and staff.
- All unnecessary movement of inmates was halted.

Question 4: What case definition would you use to identify an "outbreak case"? What elements should a case definition include?

PART B: EPIDEMIOLOGIC STUDY

A case was defined as illness in an inmate in a Colorado DOC facility with laboratory-confirmed *Campylobacter* infection with onset September 1-October 1.

The investigation team decided to search for additional cases.

Question 5: How would you find additional cases?

To identify additional cases, you:

- Sent out a bulletin to the entire DOC asking prison staff to report and culture suspected cases immediately.
- Reviewed medical records at the Spruce facility. Three additional cases were treated on September 25th and 26th.
- The guards conducted cell-to-cell checks for illness at the Spruce facility and requested stool specimens from all from symptomatic inmates.

After actively searching for cases, you identified a total of 40 laboratory-confirmed cases.

Question 6: Construct an epidemic curve of cases by onset of symptoms listed in Appendix A. What can you infer from the shape of the epidemic curve?

Based on the epidemic curve, you suspected cases were exposed over several days.

All case-patients were male. The median age was 35 years (range: 20–65). Symptoms are described below. All patient isolates were sent to CDPHE laboratory for confirmation, speciation, and PFGE.

Table 1. Characteristics of Illness among Case-Patients (n=39)*

Characteristic	N	%
Diarrhea	39	100
Abdominal pain	37	95
Headache	30	77
Fever	24	62
Bloody diarrhea	13	33
Vomiting	13	33
Hospitalized	1	3

*Information was not available for one case

As most cases were found from the Spruce facility, investigators decide to focus their epidemiological investigations on that facility.

Question 7: What are the two most common types of epidemiological studies used to investigate the source of an outbreak? Which would you use to investigate the source of this outbreak? Why?

You decided a case-control study would be more efficient in this setting. Although a sizeable outbreak, the disease was still relatively rare in the total population (there are over 2,000 inmates at the Spruce facility yet there were only 34 laboratory-confirmed cases). It was less resource intensive to start with 34 laboratory-confirmed cases than to try and interview a cohort of over 2,000 inmates.

Question 8: Who would you select as controls? What inclusion/exclusion criteria would you use for controls?

You interviewed 31 cases at the Spruce facility. One control was selected per case, and controls were matched to cases by prison unit using a random selection from rosters by prison staff. Controls were excluded if they reported a gastrointestinal illness from September 1-October 1 or chose not to participate.

Question 9: What does it mean to "match" cases and controls? What is the difference between a matched and an un-matched analysis? What are the advantages and disadvantages of matching?

You decided to match the *Campylobacter* cases with controls from the prison based on age and prison unit. Matching cases with controls on prison unit was a way of controlling for other potential confounders, such as illicit foods and other social/behavioral factors specific to different units that were difficult to measure. You decided to ask the cases and controls about exposures in the five days prior to illness onset.

Question 10: What questions would you include on your questionnaire?

Based on what you know about *Campylobacter*, you determined that it was important to ask the cases and controls about consumption of items on the prison menu, vending items, "hooch" and illicit foods, contact with animals, and contact with others who are ill.

Question 11: What "measure of association" is used in a case-control study? That is, how is the association between exposure and disease quantified? How is it interpreted?

Here are the results of the case-control study:

Table 2. Cases and controls reporting consumption of food items in the past 5 days

FOOD ITEM	CASES (N=31)	CONTROL (N=31)	MATCHED OR	95% CI	P-VALUE
Milk	29 (94%)	14 (45%)	16.0	(2.1, 120.6)	0.0071
Foods made w/milk	28 (90%)	21 (68%)	8.0	(1.0, 64.0)	0.0499
Any turkey	24 (77%)	20 (65%)	1.8	(0.6, 5.4)	0.2920
Fresh fruit	30 (97%)	27 (87%)	4.0	(0.5, 35.8)	0.2150

Question 12: Interpret the odds ratios for the above exposures in the matched analysis. What exposures appear to be risk factors for *Campylobacter* in this outbreak?

The findings of the case-control study suggest that consumption of milk or foods containing milk were a significant risk factor for *Campylobacter*. You decided to examine the amount of milk consumed to determine if there was a dose-response.

Table 3. Results of dose response variables

MILK SERVING	CASES (N=31)	CONTROL (N=31)	MATCHED OR
None	2	21	Ref
1	2	3	7.0
2	4	6	7.0
3	6	3	21.0
4	19	9	22.2

Chi square test for linear trend p = 0.00001

Question 13: What is meant by "dose-response"? Interpret the results in Table 3.

PART C: ENVIRONMENTAL ASSESSMENT

During the environmental investigation, the epidemiologist and the milk program specialist inspected the dairy. They observed pasteurization, packaging processes, pasteurization records, and they collected environmental swabs and samples of raw and pasteurized milk. You also collected shipping logs to determine distribution of milk to each DOC facility.

The dairy was relatively small and produced 3,000 gallons of milk 3 days per week. All milk provided to inmates was 1% milk fat. The cream was sold to another diary. Most work was performed by inmates, who were supervised by the plant manager. The state health department conducted a routine milk plant inspection on August 30, and all samples had been within normal limits.

Milk was packaged in two container types: ½ pint cartons and 5-gallon plastic bladders, or 'mags.' An automated package system was used for the ½ pint cartons. 'Mags' were filled by hand.

No problems with pasteurization records or processes were noted, such as equipment failures. Heat and time records were within normal limits. No cows had recently had mastitis. There were no ill workers whose illness had preceded the outbreak. You noted some potential sources for contamination post-pasteurization. In particular:

- Workers filled milk bladders by hand, and bare-hand contact with the bag's opening could have occurred. Also, investigators noted a pipe dripping with condensation directly above the mag dispenser.
- There was some mixing of milk plant and dairy workers in a shared break room, which could facilitate spread of pathogens from shoes or cloths of dairy workers to that of the milk plant workers.
- Milk bladders had the potential to be splashed by dirt on the floor when placed in crates near the floor, which was usually wet.

In the cafeteria, milk was served from dispensers that were stocked with 5-gallon plastic bladders, or 'mags.' Inmates in 'segregation units' were served milk in half-pint cartons (n=288). Both types were packaged on site at the prison dairy.

You examined the attack rate by type of milk container. There were no cases reported among the 288 inmates in segregation units. The 34 cases at the Spruce facility occurred among the 2,157 non-segregated inmates.

QUESTION 14: Calculate the attack rate among inmates who were able to drink from a bladder milk container and a carton milk container.

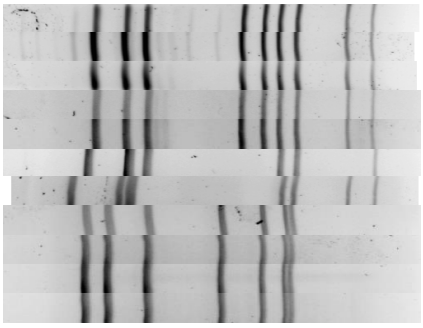
PART D: CONCLUDING THE INVESTIGATION

Campylobacter jejuni was found in both milk samples from the balance tank, which is a holding tank for milk that has had the cream removed but has not yet been pasteurized. Samples from all equipment swabs, finished and raw milk tank samples, and all cultures from prison staff were negative.

From the epidemiologic and environmental findings (milk samples), you concluded the outbreak was due to contaminated milk. Since cases were identified in several facilities the milk was likely contaminated at the milk plant. The exact source of the contamination remained unknown. No correlation between specific production dates and delivery dates to particular facilities could be established. *Campylobacter* could have been present in the milk because of a failure of pasteurization, or contamination of finished milk with raw milk or splatter from the environmental or a worker. Further, it remains possible that this outbreak was a result of intentional contamination by a worker (inmate) in the plant.

PFGE was performed on isolates from 8 of the cases and on isolates recovered from milk obtained at the dairy. Four different PFGE patterns were identified, named patterns A, B, C and H. Pattern "A" was identified from two patients at the Mesa and Spruce facilities and from the milk at the dairy. Pattern "C" from one patient at the Elk facility, Pattern "H" from one patient at the Beaver facility, and Pattern "B" from 4 patients at Spruce and Beaver facilitates. It is not uncommon to have different PFGE patterns for a Campylobacter outbreak associated with milk, especially if that milk was not pasteurized, since cows can carry multiple strains and multiple cows can contaminate a batch of milk or the environment. In this case because no deficiencies with the pasteurization process were identified, we suspected that the contamination happened post-pasteurization from something (or someone) in the dairy environment so having multiple patterns does not refute that. Therefore, finding the same pattern in milk and at least one patient supported our hypothesis about milk.

PFGE-SmaI



ENF-2005000570	05-A	Elk
ENF-2005000571	05-A	Elk
ENF-2005000571-1	05-A	Elk
PHM-2005009491	05-A	Mesa
PHM-2005009536	05-A	Spruce
PHM-2005009675	05-C	Elk
PHM-2005009913	05-H	Beaver
PHM-2005009490	05-B	Spruce
PHM-2005009539	05-B	Spruce
PHM-2005009686	05-B	Beaver
PHM-2005009797	05-B	Beaver

PUBLIC HEALTH RECOMMENDATIONS

The state health department instructed the facility to correct the minor deficiencies noted that could lead to contamination of finished milk.

While results of all routine milk testing had been within acceptable limits, the state health department realized that only milk from half pint containers was routinely tested, due to logistical issues related to testing the 5 gallon containers. Milk testing is now performed on both packaging types at the state health department.

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References:

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.

The Colorado Integrated Food Safety Center of Excellence (CoE) is a collaborative partnership between the Colorado Department of Public Health and Environment (CDPHE) and the Colorado School of Public Health (CSPH), one of six Integrated Food Safety Centers of Excellence designated by the Centers for Disease Control and Prevention (CDC). We are dedicated to identifying and developing model practices in foodborne disease surveillance and outbreak response. We provide trainings, continuing education opportunities, and serve as a resource for local, state, and federal public health professionals who respond to foodborne illness outbreaks. Learn more at www.COFoodSafety.org

Appendix A: Line list of onset date and symptoms for inmates with laboratory-confirmed *Campylobacter* infection.

Case ID	Onset Date	Facility	Age	Diarrhea	Bloody diarrhea	Abdominal pain	Fever	Headache	Vomiting
1	09/15/05	Spruce	25	+	+	+	+	+	
2	09/17/05	Spruce	63	+		+	+	+	+
3	09/19/05	Spruce	21	+		+	+	+	
4	09/20/05	Spruce	20	+		+			
5	09/20/05	Spruce	37	+	+	+	+	+	
6	09/20/05	Spruce*							
7	09/20/05	Spruce	27	+		+		+	+
8	09/21/05	Spruce	29	+		+	+		+
9	09/21/05	Spruce	33	+		+	+		+
10	09/21/05	Spruce	31	+		+	+	+	
11	09/21/05	Spruce	30	+		+	+	+	
12	09/21/05	Spruce	34	+	+	+			+
13	09/22/05	Spruce	22	+		+	+	+	
14	09/22/05	Spruce	25	+		+	+	+	
15	09/23/05	Spruce	25	+			+	+	+
16	09/23/05	Spruce	59	+	+	+		+	
17	09/23/05	Spruce	62	+		+	+	+	+
18	09/23/05	Spruce	29	+		+	+		+
19	09/23/05	Spruce	51	+	+	+	+		
20	09/23/05	Spruce	25	+		+	+	+	
21	09/24/05	Spruce	50	+		+	+	+	+
22	09/24/05	Spruce	27	+	+	+	+	+	
23	09/24/05	Spruce	44	+	+	+	+	+	
24	09/24/05	Spruce	23	+	+	+	+	+	
25	09/24/05	Spruce	31	+		+		+	+
26	09/25/05	Spruce	52	+		+		+	+
27	09/25/05	Spruce	39	+	+		+	+	
28	09/25/05	Spruce	33	+		+	+	+	
29	09/25/05	Spruce	20	+		+	+	+	
30	09/25/05	Spruce	25	+	+	+		+	
31	09/25/05	Spruce	47	+		+		+	
32	09/27/05	Spruce	34	+	+	+	+	+	
33	09/27/05	Spruce	65	+	+	+			
34	09/28/05	Spruce	22	+		+		+	
35	09/25/05	Beaver	45	+		+	+		
36	09/26/05	Beaver	23	+		+		+	
37	10/01/05	Beaver	51	+		+		+	+
38	09/13/05	Elk	29	+	+	+		+	
39	09/25/05	Elk	34	+		+		+	+
40	09/15/05	Mesa	33	+		+			

*Information was unavailable for one case.