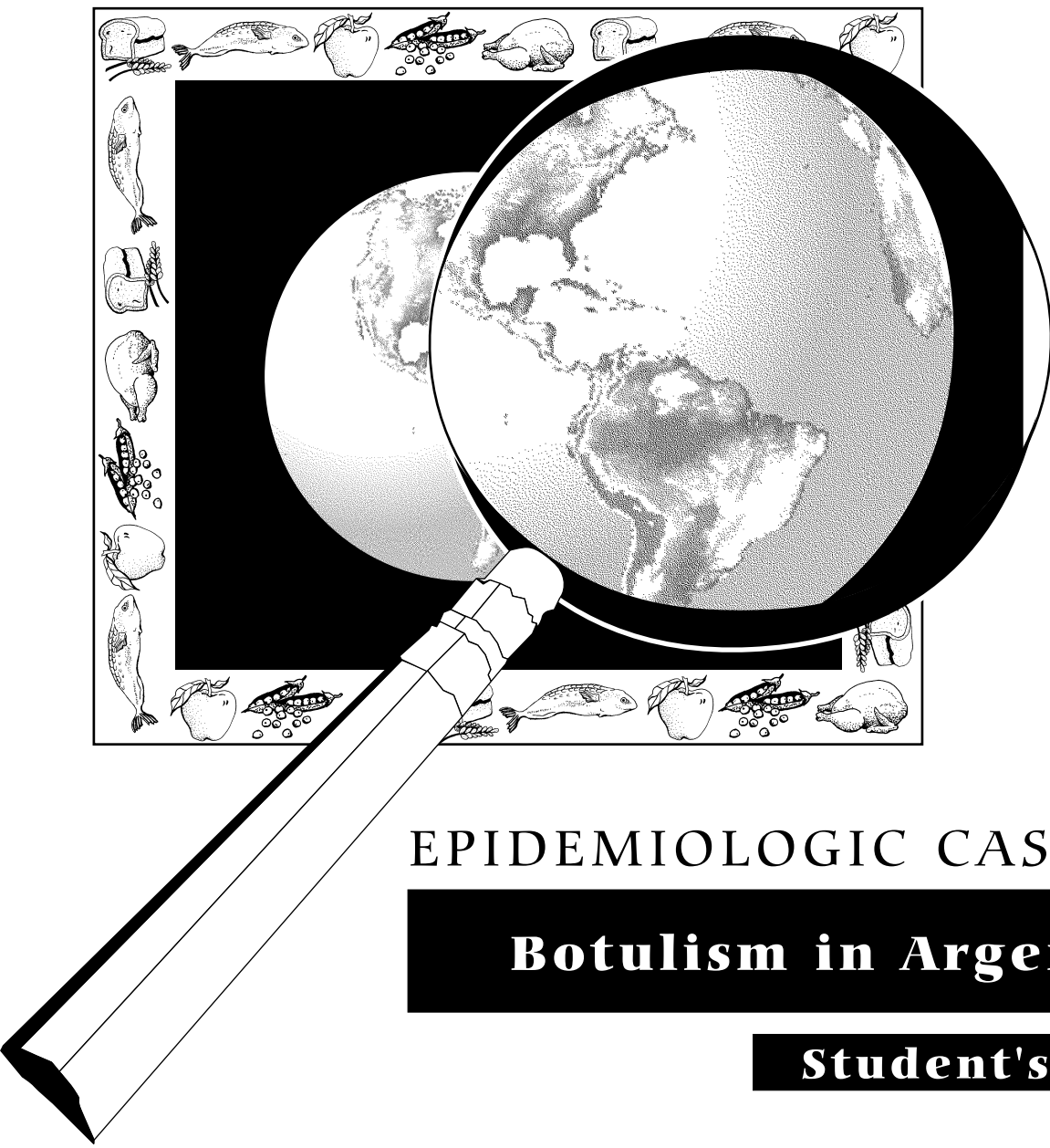
Foodborne Disease Outbreak Investigation



EPIDEMIOLOGIC CASE STUDY

Botulism in Argentina

Student's Version

April 2000

U. S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service

Centers for Disease Control and Prevention
National Center for Infectious Diseases
Epidemiology Program Office
Public Health Practice Program Office
Atlanta, Georgia 30333

Botulism in Argentina

STUDENT'S VERSION

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NOTE: This case study is based on a real-life outbreak investigation undertaken in Buenos Aires, Argentina, in 1998. Some aspects of the original outbreak and investigation have been altered, however, to assist in meeting the desired teaching objectives and allow completion of the case study in less than 3 hours.

Students should be aware that this case study describes and promotes one particular approach to foodborne disease outbreak investigation. Procedures and policies in outbreak investigations, however, can vary from country to country, state to state, and outbreak to outbreak.

It is anticipated that the epidemiologist investigating a foodborne disease outbreak will work within the framework of an "investigation team" which includes persons with expertise in epidemiology, microbiology, sanitation, food science, and environmental health. It is through the collaborative efforts of this team, with each member playing a critical role, that outbreak investigations are successfully completed.

Please send us your comments on this case study by visiting our website at http://www.phppo.cdc.gov/phtn/casestudies. Please include the name of the case study with your comments.

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STUDENT'S VERSION
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Learning objectives:

After completing this case study, the student should be able to:

1. describe outbreak situations in which acute control measures should be undertaken
2. communicate information on an outbreak or outbreak investigation and write a press release
3. given the leading hypothesis(es) in an outbreak, develop a questionnaire
4. given details on the origin, distribution, and preparation of an implicated food item, identify critical points for the control of contamination and microbial survival and growth
5. discuss possible barriers to implementation of specific interventions following an outbreak investigation
6. describe measures that can be used to monitor the success of an intervention
7. describe the occurrence, signs and symptoms, and control of foodborne botulism

PART I - OUTBREAK DETECTION

Foodborne botulism is a severe illness that results from the ingestion of a preformed toxin produced by a bacterium, *Clostridium botulinum*, in contaminated food. Death can occur in up to 60% of untreated cases; supportive care and prompt administration of antitoxin have reduced mortality in the United States to less than 10%. Outbreaks of botulism have been linked to improperly preserved vegetables, fruits, and meats including fermented fish products, sausages, smoked meat, and seafood.

On January 13, 1998, an infectious diseases physician at a Buenos Aires hospital telephoned the Directorate of Epidemiology of the Argentine Ministry of Health (MOH) to report two possible cases of botulism. The patients, both men, presented with drooping eyelids, double vision, difficulty swallowing, and respiratory problems. One patient had onset of symptoms on January 5 and the other on January 6. The physician had drawn sera and collected stool specimens from the men to test for botulinum toxin but no results were available.

Question 1: As a public health practitioner in Argentina, what are the major concerns raised by these two possible cases of botulism in Buenos Aires?

The clinical syndrome of botulism is dominated by neurologic signs and symptoms. Dryness of the mouth, drooping eyelids, and blurred and double vision are usually the earliest neurologic complaints. These initial symptoms may be followed by disturbances in speech, difficulties swallowing, and peripheral muscle weakness. If respiratory muscles are involved, ventilatory failure and death may result unless supportive care is provided. The average incubation period for botulism is 18-36 hours, but symptoms can occur as early as six hours or as late as 10 days after exposure.

Because botulism is rare, many physicians are unfamiliar with its presentation. As a result, patients with botulism can be misdiagnosed as other illnesses (e.g., stroke, myasthenia gravis, Guillain-Barré syndrome) delaying the administration of life-saving botulinum antitoxin for days and increasing the mortality rate among cases.

Question 2: How might you go about swiftly determining if there are other cases of botulism associated with the cases in Buenos Aires?

The Directors of the National Laboratory and the Environmental Health and Sanitation Program were notified of the possible cases of botulism. The two patients, still in the hospital, were interviewed by an MOH epidemiologist.

Upon questioning, it was learned that both patients were drivers for the same bus company and drove the same route and shift. The patients knew each other but worked on different days of the week. They had not eaten together in more than a month.

To find additional cases, the MOH contacted all employees of the bus company with the ill drivers to see if any had symptoms suggestive of botulism. Hospitals in the area of Buenos Aires, where the two cases occurred, were asked to report any patients with acute neurologic illnesses that could be botulism. Family members of cases were questioned about whether they also had symptoms of botulism. Additionally, the MOH developed a press release for distribution to the local news media.

Question 3A: What key points would you include in the press release?

Question 3B: Who should be involved in developing the press release or notified before its distribution?

On January 14, the MOH distributed the following press release:*

On Monday, January 13, two bus drivers, Pablo Esteban and Juan Rojas, from south central Buenos Aires were diagnosed with botulism by an infectious diseases physician at Hospital F. J. Muñiz. The men had been ill for several days before the diagnosis was made. The attending physician, Dr. Jorge San Juan reported that botulinum antitoxin was requested from the U. S. Centers for Disease Control and Prevention last night.

Because botulism is potentially fatal if untreated, the Argentine Ministry of Health is working with local public health officials and health care providers to identify the source of the botulism. Officials worry that other persons may have been exposed and need treatment or that the source may still exist and cause more people to become ill.

Botulism is a rare but serious paralytic illness caused by a nerve toxin produced by a bacterium, Clostridium botulinum. The symptoms of botulism can easily be confused with other illnesses and include diplopia, ptosis, dysphagia, dysarthria, and muscle weakness. If untreated, these symptoms may progress to cause paralysis of the arms, legs, trunk and respiratory muscles, and ultimately death. If diagnosed early, botulism can be treated with an antitoxin which blocks the action of the toxin circulating in the blood.

Previous outbreaks of botulism in Argentina have been caused primarily through eating improperly preserved vegetables and meats. Implicated foods include ham, red and green peppers, vigcacha (an Andean rodent), eggplant, cucumbers, palm hearts, tomatoes, peaches, spinach, and a type of cheese with onions. It is not yet known what specific food may have caused the botulism in this outbreak but both men are bus drivers for the same company, Arriba Bus, Inc., and drive the same route and shift.

Persons who feel they or their relatives might have symptoms of botulism are asked to contact the Directorate of Epidemiology of the Argentine Ministry of Health at xxxx-xxxx .

*This is not the press release distributed by the Ministry of Health but was developed specifically for this exercise.

Question 4: Critique the press release. How might the press release impact the outbreak investigation?

Seven additional patients with neurologic signs consistent with botulism were identified. Five of the patients had sought medical attention and four were hospitalized. Working diagnoses for these patients at the time the initial two cases were discovered included myasthenia gravis (1), Guillain-Barré syndrome (2), stroke (1), and diabetic complications (1).

Botulinum toxin was identified in sera and/or stool from three patients, including one of the original cases reported on January 13.

All patients were drivers from the same bus company as the original cases and drove the same route. From initial reports, all had eaten at a home located at the terminal stop of the bus route where the drivers stopped during their breaks. Approximately 58 bus drivers worked this route; 27 in the morning shift, 16 in the afternoon shift, and 15 in the evening shift.

Question 5: Would you initiate any control measures at this time? What criteria would you consider in implementing control measures so early in an investigation?

PART II - DESCRIPTIVE EPIDEMIOLOGY AND HYPOTHESIS GENERATION

Staff from the local health department where the terminal stop of the bus route was located were invited to participate in the investigation.

Physicians attending the cases of botulism were asked to provide demographic and clinical information on their patients. (Table 1)

Table 1. Characteristics of cases of botulism, Buenos Aires, January 1998.

Patient No.	Age (years)	Gender	Work shift	Onset of neurologic symptoms	Symptoms
1	42	M*	Morning	January 6	blurred vision, double vision, drooping eyelids, upper and lower extremity weakness, respiratory difficulty, fatigue
2	31	M	Morning	January 5	blurred vision, double vision, drooping eyelids, upper and lower extremity weakness
3	23	M	Morning	January 9	blurred vision, drooping eyelids, upper extremity weakness, fatigue
4	46	M	Morning	January 8	drooping eyelids, difficulty speaking
5	54	M	Morning	January 5	blurred vision, double vision, drooping eyelids, difficulty speaking, respiratory difficulty
6	49	M	Morning	January 10	blurred vision, drooping eyelids, difficulty speaking
7	31	M	Morning	January 15	blurred vision, double vision, drooping eyelids, upper and lower extremity weakness, respiratory difficulty, fatigue
8	44	M	Morning	January 14	respiratory difficulty, fatigue, drooping eyelids,
9	24	M	Morning	January 12	drooping eyelids, fatigue

*M=male gender

Question 6A: Summarize the demographic and clinical information on these patients and draw an epidemic curve.

Question 6B: When was the most likely period of exposure among these cases?

In hypothesis-generating interviews with cases and other bus drivers, being a driver on the morning shift of the bus route and eating at the terminal home of the route were the only common exposures among cases. No cases of botulism occurred among bus drivers from the afternoon or evening shift of the route. Bus drivers from those shifts did not usually eat at the terminal home because it was only open for lunch.

The investigators hypothesized that the outbreak was limited to morning shift bus drivers and resulted from eating or drinking something at the home at the terminal stop of the particular bus route between January 3 and 7.

Question 7: What type(s) of study would you use to investigate this hypothesis? Why?

PART III - DESIGNING AN EPIDEMIOLOGIC STUDY TO TEST THE HYPOTHESIS

To identify the source of the outbreak, investigators undertook a retrospective cohort study among bus drivers who drove the morning shift of the bus route. Data were collected from January 15-19.

Investigators defined a confirmed case of botulism as a bus driver from the morning shift of the bus route with a serum or stool sample that demonstrated botulinum toxin or yielded *Clostridium botulinum* with onset of symptoms between January 5 and 15. A probable case was defined as acute cranial nerve dysfunction (e.g., blurred vision, double vision, drooping eyelids, problems swallowing) with no laboratory confirmation in this group of drivers during the same period. The comparison group consisted of all bus drivers from the morning shift of the implicated bus route who had no acute neurologic symptoms suggestive of botulism.

After consultation with the local health department where the terminal stop of the bus route was located and the bus company management, investigators developed a structured questionnaire for the epidemiologic study.

Question 8: What general types of information would you include in the questionnaire?

Question 9: What steps would you take to develop the questionnaire for this investigation.

Question 10: Using information on foods served at the terminal stop home from January 3-7 (Appendix 1), draft questions for food exposure for this study.

Investigators conducted interviews with each of the drivers of the morning shift of the bus route to complete the questionnaires.

Question 11: If the investigators had decided on self-administration of the questionnaire, what changes might need to be made to it?

PART IV - ANALYSIS AND INTERPRETATION OF EPIDEMIOLOGIC RESULTS

The following food exposure information was collected through the cohort study. On January 19, the information was tabulated by epidemiologists from the Argentine MOH. (Table 2)

Table 2. Foods eaten by ill and well bus drivers at the home at the terminal bus stop, January 3-7, 1998. (N=21)

Food item	Ate item		Did not eat item	
	Ill	Well	Ill	Well
Bologna	1	0	8	12
Hot dog	1	1	8	11
Matambre*	9	2	0	10
Mate**	4	4	5	3
Processed Ham	2	3	7	9
Sauce	7	2	2	10
Salami	1	1	8	11
Solid ham	2	3	7	9

*Matambre is a traditional meat roll in Argentina.
**Mate is green tea.

Question 12: Calculate the appropriate measures of association for these exposures.

Question 13: Interpret the results. What further data analysis/information might help?

PART V - ENVIRONMENTAL STUDIES AND FOOD INVESTIGATION

Matambre is a traditional Argentine dish prepared from meat, vegetables, spices, and eggs. In a traceback of the implicated matambre, the MOH discovered that it originated from a small scale producer located not far from the terminal stop of the bus route. The matambre was purchased at a local market on January 3 by the owners of the home that served the matambre. The MOH initiated an environmental health assessment of the matambre to identify production factors that could have contributed to the occurrence of botulism.

A complete environmental health assessment is not a cursory inspection of operations and sanitary conditions as is performed for the licensing of a food establishment, but focuses on the suspect food or meal and follows it from its raw ingredients to consumption by the customer. The objective of the environmental health assessment is to identify critical points where the implicated food could have become contaminated or microbial survival and growth in the food could have occurred, determine why these conditions existed, and identify appropriate interventions. The factors in Table 3, often found in these assessments, have been associated with an increased risk of foodborne disease.

Table 3. Factors that commonly contribute to outbreaks of foodborne diseases, from Bryan et al., 1987.

Contamination	Survival	Growth
raw foods that are contaminated infected foodhandler unclean equipment cross-contamination contaminated foods eaten raw or lightly cooked inappropriate container for food unsafe sources added poisonous chemicals natural toxicant poor dry-storage practices	inadequate cooking inadequate reheating inadequate acidification	inadequate refrigeration improper cooling inadequate hot-holding preparation too far in advance of serving use of leftover foods inadequate acidification high water content inadequate curing salt environment that provides favorable conditions for pathogen (e.g., anaerobic packaging)

Question 14: What types of activities do you think you would undertake as part of an environmental health assessment on the matambre? What equipment would you want to have?

Clostridium botulinum is a spore-forming obligate anaerobic bacterium (i.e., it cannot grow in the presence of oxygen). The spores are widespread in soil and dust worldwide. The toxin is produced in improperly canned, low-acid or alkaline foods and in pasteurized and lightly cured foods held without adequate refrigeration, especially in airtight containers. The toxin is destroyed by boiling; inactivation of spores requires much higher temperatures.

Food safety inspectors from the local health department initiated the environmental health assessment on January 20. The home at the terminal stop of the bus route was not formally licensed or equipped as a restaurant. Perishable foods, such as the matambre, were kept in two large refrigerators inside the home. Although the refrigerators were set at the coldest possible setting, temperatures measured inside the refrigerators were 9°C and 10°C (48°F and 50°F, respectively).

The home owner reported the most recent matambre served in the home weighed approximately 4 kg. The matambre was cut into about 15 slices and was served in sandwiches, usually with a spicy sauce; no other condiment or ingredient was added to the sandwiches. No matambre was available for testing.

The implicated matambre was bought at a local market where it had been stored in a refrigerator. The market had no temperature records or sales receipts; however, some customers reported that the matambre had recently been sold at reduced prices because of power outages.

The market purchased matambre from a small scale commercial producer who made matambre and processed hams in his home. To make matambre, the producer placed a slab of raw beef (1- to 3-cm thick) on a stainless steel table. Ingredients included raw sliced carrots, hard-boiled eggs, salt, red pepper flakes, dried oregano, and commercial potato flour. The meat was rolled up around the vegetables and eggs to make an approximately 10 x 30 cm cylinder. The meat roll was placed into a rectangular stainless steel pan to keep ingredients inside during cooking. Between 10 and 15 matambre in individual steel pans were immersed together in water heated to 70 to 80°C (158 to 176°F) and cooked approximately 4 hours. The matambre was never brought to a boil. After cooking, the water was drained and the temperature was checked to ensure an internal temperature of about 68°C (154°F). The producer placed each warm matambre in plastic wrap, squeezed out the air, and sealed the plastic with heat. The plastic wrapped matambre were allowed to cool, placed in a walk-in refrigerator, and were stored for up to 2 weeks before being sold to either supermarkets or directly to consumers.

Question 15: Identify the foodhandling practices for the matambre which were most likely to contribute to the development of botulism.

The producer reported making matambre every 2 weeks in batches of 15-20 each time. The last batch produced before the outbreak was made in early December. No matambre were available from that batch.

Question 16: What control measures would you initiate at this time? What difficulties might you encounter?

PART VI - CONTROL

After inspection by local food safety officials, the facility producing the matambre was closed. The producer was unable to provide receipts or a distribution list with locations where his products were sold. He reported that most of his clients distributed his products in the western greater Buenos Aires area. The producer's matambre was not labeled in any way to indicate the source or date of production, so a recall of any remaining matambre was not deemed feasible.

Based on data maintained by the MOH, botulism is not an uncommon occurrence in Argentina. During the years 1979-97, 277 cases of botulism were reported; for most, the source of the exposure was undetermined. In 1997, 23 patients with suspected botulism were reported (of which 13 [57%] died); about the same number of laboratory-confirmed cases were identified in the United States, which has 10 times the population of Argentina.

Question 17: Given the scope of the problem, what longer term interventions might help decrease the number of botulism cases in Argentina?

Because of the relatively high incidence and case fatality ratio for botulism in Argentina, the MOH and Centers for Disease Control and Prevention (CDC) collaborated to establish a botulism surveillance and antitoxin release system in Argentina. The system components included: 1) the establishment of a local stock of antitoxin, 2) a mechanism for antitoxin distribution within the country, 3) emergency notification and response for suspect cases (including urgent epidemiologic investigation of the possible food source), and 4) laboratory confirmation of suspect cases.

Question 18: What is the rationale behind the components of this control effort?

Question 19: How might you monitor the Argentine botulism surveillance and antitoxin release system over time to determine if it is effective?

EPILOGUE

Although consumption of matambre is an established tradition in Argentina, it is usually consumed fresh and is not generally intended for pickling or long-term preservation. Matambre produced by licensed, commercial facilities use nitrites, acidifiers, or other preservatives to prevent bacterial growth; the implicated matambre lacked these. Insufficient cooking, vacuum packing in heat-shrinked wrap, and inadequate refrigeration may have provided conditions for live spores to germinate and produce toxin.

The matambre that is believed to be the cause of the outbreak was cooked at relatively low temperatures (78-80°C or 158-176°F) over a time period of approximately 240 minutes, too short to kill all *C. botulinum* spores. These spores are difficult to destroy using conventional cooking techniques. In fact, nonkilling heat shock and the lack of preservatives or acidifiers may even enhance germination and toxin elaboration.

To safely prepare foods for canning or long-term storage, the U.S. Department of Agriculture recommends that all low-acid foods (i.e., foods with a pH > 4.6, including meats, seafood, poultry, milk, and fresh vegetables) be sterilized at temperatures of 116 to 121°C (240-250°F) in pressure canners operated at 0.66 to 0.97 atm (10-15 lb/in^2). At these temperatures, the time needed to destroy bacteria in low-acid canned food ranges from 20-100 minutes. The exact time depends on the kind of food being canned, the way it is packed, and the amount of food being cooked.

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APPENDIX 1

Foods served to bus drivers in home at terminal stop of bus route in the first week of January:

Bologna
Hot dogs
Matambre*
Mate**
Processed ham
Sauce
Salami
Solid ham

*Matambre is a traditional meat roll in Argentina. At the terminal stop it was sliced and served in sandwiches, usually with a spicy sauce.
**Mate is green tea.