

Foodborne Disease in the United States

Food Safety in the 21st Century

Jessica Jensen

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Last school year at a local college, Mary asked her friend, Amy, if Amy would be willing to drive her to the emergency room in the middle of the night should she need to go. She explained that she had not been feeling well and had been experiencing abdominal pain and bloody diarrhea. At the time, Amy did not think that her friend could have possibly contracted *Escherichia coli* O157:H7. Then a few days later, she received an e-mail that Mary had been diagnosed with *E. coli* O157:H7. It was a little scary for Mary to know that a close friend she lived with contracted *E. coli* because everyone in the dorm consumed food from the same caterer. At the same time, there was an outbreak of *E. coli* O157:H7 in bagged spinach in the town neighboring the college campus. Unfortunately due to the fact that Mary did not eat beef, she was probably at an increased risk for contracting *E. coli* O157:H7 because on some nights salad was the only option for her to eat.

Foodborne Disease

Approximately 76 million cases of foodborne disease occur each year. As many as 325,000 people may be hospitalized for foodborne disease in a year, and 5,200 may die.¹ Although surveillance of foodborne disease has become better, it is estimated that only 40 to 45% of all foodborne disease cases are reported each year.² Hospitalization bills for foodborne illness are estimated at \$3 billion per year, and the economic impact of foodborne disease is thought to be as high as \$25 billion per year.³

Foodborne disease is caused by eating food or drinking beverages that are contaminated with harmful microbes or toxic chemicals. Over 250 different foodborne diseases have been documented, and most are caused by a variety of bacteria, viruses, or parasites that cause infection. The majority of foodborne disease is caused by bacteria, such as *Campylobacter*, *Salmonella*, and *Escherichia Coli* O157: H7, and viruses, such as the group of viruses known as calicivirus (Norwalk or Norwalk-like viruses),⁴ therefore this chapter will focus on bacterial and viral infections.

There are many issues that will make food safety increasing more difficult and more important in the coming years. These include emerging and reemerging pathogens, preparation and storage of food practices, global food supply, and groups that are at increased risk of contracting foodborne disease. This chapter will discuss these issues, and then it will talk about recent outbreaks of foodborne disease, what doctors and public health agencies can do in the event of a suspect case or outbreak of foodborne disease, what the Healthy People 2010 goals for food safety are, and where consumers can find additional information on foodborne disease and food safety.

Emerging and Reemerging Pathogens

Some of the most common pathogens associated with foodborne disease are *Campylobacter*, *Salmonella*, *Shigella*, and *E. coli* O157:H7, and some of the less common pathogens associated with food borne outbreaks are *Clotridium botulinum*, *Cryptosporidia*, *Cyclospora*, *Listeria*

monocytogenes, *Vibrio vulnificus*, and *Yersinia enterocolitica*⁵. Each of these common pathogens will be discussed along with their associated symptoms and diseases.

Campylobacter

The sources most associated with *Campylobacter* are chicken, unpasteurized milk, and water. The incubation period before symptoms are noticed is one to seven days. After this time, two-thirds of exposed people develop fever and one-half have bloody diarrhea; people can also develop cramps and abdominal pain. For most people, this disease normally lasts for 7-10 days, but it can have chronic effects in some people. These effects include Guillain-Barre syndrome and reactive arthritis. The 2005 incidence for *Campylobacter* was 12.72 per 100,000 people.⁶

Salmonella

Sources associated with *Salmonella* include animal foods (especially poultry), eggs, fruits, and vegetables. *Salmonella* disease (*Salmonellosis*) has an incubation time of 1-2 days, and usually lasts less than ten days. Symptoms of *Salmonellosis* are gastroenteritis with diarrhea and vomiting. While there is normally no treatment required for this disease, some cases can lead to a chronic condition, reactive arthritis. The 2005 incidence for *Salmonella* was 14.55 per 100,000 people.⁶

Shigella

This disease is associated with fruits, vegetables, and shellfish that have been contaminated with fecal matter. The incubation period of *Shigella* is 1-2 days, and the symptoms, including fever, strained bowel movements, nausea, abdominal cramps, can last for 5-7 days. *Shigella* can also cause dysentery, and the chronic condition that can result from *Shigella* is reactive arthritis. The 2005 incidence for *Shigella* was 4.67 per 100,000 people.⁶

E. coli O157:H7

Outbreaks of *E. coli* O157:H7 have been associated with alfalfa sprouts, hamburgers, salami, unpasteurized milk and juice, lettuce, and water. *E. coli* O157:H7 has created some of the largest outbreaks of foodborne disease, and estimated 200,000 cases occur annually with approximately 250 deaths per year.⁷ The common symptoms of *E. coli* O157:H7 are abdominal pain and bloody diarrhea. Hemolytic uremia syndrome is reported in 2-7 percent of all *E. coli* O157:H7 cases. The 2005 incidence for *E. coli* O157:H7 was 1.06 per 100,000 people.⁶

C. botulinum

Home-canned foods are commonly associated with *C. botulinum*. Twelve to seventy-two hours after exposure paralysis illness can present and lead to respiratory and musculoskeletal paralysis. Other symptoms are nausea, vomiting, diarrhea, and cramps.

Cryptosporidia

This is usually associated with water contaminated with fecal matter. The incubation period is 2-10 days, and symptoms are diarrhea, headache, cramping, nausea, vomiting and low grade fever that can last up to two weeks. Special filters have to be installed to keep the water supply safe from this organism because chlorine does not kill it. The 2005 incidence for *Cryptosporidia* was 2.95 per 100,000 people.⁶

Cyclospora

The associated sources of *Cyclospora* outbreaks are raspberries, lettuce, basil, and other foods that have been contaminated with fecal matter. The incubation period is 2-10 days, and symptoms that present are cramps, bloating, gas and diarrhea. These symptoms may last only a few days or up to a month. The 2005 incidence for *Cyclospora* was 0.15 per 100,000 people.⁶

L. monocytogenes

The foods associated with this organism are deli meats, soft cheeses, unpasteurized milk, and vegetables, and this organism is cold and heat tolerant. The incubation period is 1-2 days, and symptoms are upset stomach, fever, and diarrhea. This can also have chronic effects of encephalitis and neurological effects.

V. vulnificus

This organism is associated with shellfish, and it is usually a result of the seafood being undercooked. Its incubation period is 1-4 days, and symptoms include vomiting, diarrhea, and abdominal pain. The 2005 incidence for *V. vulnificus* was 0.27 per 100,000 people.⁶

Y. enterocolitica

The common associated foods with *Y. enterocolitica* are raw pork, unpasteurized milk, and water. The incubation period is 4-7 days, and the common symptoms are fever, abdominal pain, and bloody diarrhea. The chronic effects from *Y. enterocolitica* are reactive arthritis and possibly Graves-Basedow thyroiditis. The 2005 incidence for *Y. enterocolitica* was 0.36 per 100,000 people.⁶

Preparation and Storage of Foods

Seventy-one percent of meals and 78 percent of snacks are prepared at home.⁸ Therefore it is increasingly important that consumers are well informed about proper food handling and storage techniques, and all consumers take precautions to keep themselves safe from foodborne disease. Prevention begins while shopping in the grocery store. Shoppers should be sure to pick up non-frozen/refrigerated products first. Cans and bottles should also be carefully checked to ensure that they are not dented or tampered. Items such as meat and poultry should be bagged separately in plastic bags to avoid contamination with other foods. When the shopper arrives home with the groceries, the perishable foods should be immediately placed in the refrigerator or freezer, and products should be stored at appropriate temperatures (refrigerator: 5 degrees C, freezer: -18 degrees C). Foods should also be dated and only kept for certain amounts of time. In Table 1, the storage period of various foods is given.

Product	Storage Period	
	Refrigerator	Freezer
Fresh Meat		
• Ground Beef	1-2 days	3-4 months
• Steaks and Roasts	3-5 days	5-12 months
Fresh Pork		
• Chops	3-5 days	4-6 months
• Ground	1-2 days	3-4 months
• Roast	3-5 days	4-6 months
Cured Meats		
• Lunch Meat	3-5 days	1-2 months
• Sausage	1-2 days	1-2 months

Fish			
	• Lean	1-2 days	6 months
	• Fatty	1-2 days	2-3 months
Chicken			
	• Whole	1-2 days	12 months
	• Parts	1-2 days	9 months
	• Giblets	1-2 days	3-4 months
Dairy			
	• Cheese	3-4 days	-
	• Milk	5 days	1 month
	• Ice Cream	-	2-4 months
Eggs			
	• Fresh	3 weeks	-
	• Hard Boiled	1 week	-

Table 1. List of common foods and their storage time in either the refrigerator or freezer.⁹

The five steps of precaution in preparing food are cook, separate, chill, clean, and report. First, foods such as meat, poultry, and eggs should always be cooked thoroughly to their proper temperatures to kill bacteria. Second, all foods should be kept separate while being prepared so that they will not cross-contaminate another food. Consumers should always make sure to wash hands and all cooking utensils are handling raw meat. Third, the consumer should always make sure everything is clean – the produce and his/her hands. Produce should be washed before it is cut and consumed; this will help avoid contamination for possible residue or dirt that is on the outside of the produce. A food preparer's hands should also be clean before handling any type of food product, and the food preparer should not be preparing food if he/she has diarrheal illness. Finally, any suspected cases of foodborne disease should be reported to the local health department. Multiple calls about a similar incidence are how an outbreak of foodborne disease is detected.^{10,11}

Global Issues

One of the biggest dangers of our increasingly global world is the food safety issue. Increasing amounts of food that is consumed in the United States originates from other countries. In 1995, it was estimated that one-third of produce consumed in the U.S. was produced in other countries; this estimate could be as high as seventy-five percent during winter months.¹²

Although the global food supply is an increasing concern, exporting meat, poultry or egg products into the United States is not easy. These products are only allowed to be imported from countries that have met strict criteria, and only 38 countries have met these criteria. The criteria include having laws on food produce that meet the standards of the United States and having random inspection visits from the Food Safety and Inspection Service (FSIS) to ensure that the country's system is equivalent. Once a country has been approved to export to the United States, the FSIS also does a random inspection of packages that are imported to the U.S. to ensure that the contents are what they are labeled as and to ensure that the food is of good quality. The FSIS, also, always makes sure to enforce bans on food, such as bans on poultry from locals where avian influenza has been detected.¹³

Another organization that works on an international level is the Codex Alimentarius Commission that was created in 1963 by the World Health Organization and the United Nations Food and Agriculture Organization. The Codex Alimentarius Commission responsibilities included developing guidelines and codes of practice for food safety, and its main purpose was to

ensure fair trade and protect public health. The guidelines formulated by this committee are not enforceable as law, but they are good practices to follow.¹³

At Risk Groups

For healthy populations, foodborne disease is short-lived and not life-threatening, but there are certain conditions/diseases that place people at an increased risk of severe effects of foodborne illness. More than 30 million people in the United States are at an increased risk of developing foodborne disease.¹⁴ These conditions/diseases that place people at increased risk include liver disease, hemochromatosis, diabetes, stomach problems, cancer, immune disorders, and long-term steroid use.¹⁵ There are also populations that are at an increased risk of severe effects of foodborne illness; these populations include pregnant women and the elderly.¹⁶

Recent Outbreaks

A couple of outbreaks from recent years have included the 2006 *E. coli* outbreak due to bagged spinach and the 2003-2004 norovirus outbreak due to frozen oyster meat. On September 14, 2006, the FDA and CDC issued a health warning not to eat bagged spinach, and the two agencies begin working together to determine the source of the outbreak. The recall warning associated with the spinach was a Class 1 recall, meaning food distributors had to account for all spinach that was in stock as well as distributed within one hour. On September 20, 2006, the source of the outbreak was located. The contaminated spinach was grown in California's Salinas Valley and packed by Natural Selection under the brand name Dole. By the time the source of the outbreak was located, three people had died and more than 200 people in 26 states became sick.¹⁷

Between November 2003 and January 2004, three outbreaks of norovirus occurred in Australia. Eighty-three people reported symptoms of gastroenteritis following the consumption of internationally distributed oysters. The outbreaks occurred in three different jurisdictions of the country, but through an epidemiological study, they were all traced back to the same batch of oysters.¹⁸

Diagnosis of Foodborne Disease

While there are no specific symptoms that foodborne disease presents, the majority of foodborne disease enters a person's body through the gastrointestinal tract and can cause symptoms such as vomiting, diarrhea, abdominal cramps, fever, headache, exhaustion, and blood/pus in stool.¹⁹

Physicians are encouraged to recognize:

- the possibility of foodborne disease in a patient's presenting symptoms;
- that many foodborne disease present as gastrointestinal problems but not all;
- that if they obtain stool samples if foodborne disease is suspected and know that additional test for diseases such as *E. coli* will need to be requested;
- they need to report suspected cases to the local public health officials;
- they should discuss ways to remain protected against a foodborne outbreak with patients;
- that if they see one case of a foodborne disease this could be the first case of an outbreak.

Once it has been determined that a patient has foodborne disease, a few of the pieces of information needed to determine the etiology of disease are the incubation period, the duration of illness, the clinical symptoms, and other people that were exposed to the contaminated food.²⁰

Clinical Symptoms	Potential Bacterium, Viruses, or Toxins to Consider
Gastroenteritis	Viral gastroenteritis
Noninflammatory diarrhea	Enterotoxigenic <i>E. coli</i>

	<i>Giardia</i> <i>Vibrio cholerae</i> Enteric viruses <i>Cryptosporidium</i> <i>Cyclospora cayetanensis</i>
Inflammatory Diarrhea	<i>Shigella</i> species <i>Campylobacter</i> species <i>Salmonella</i> species Enteroinvasive <i>E. coli</i> Enterohemorrhagic <i>E. coli</i> <i>E. coli</i> O157:H7 <i>Vibrio parahaemolyticus</i> <i>Yersinia enterocolitica</i> <i>Entamoeba histolytica</i>
Persistent diarrhea	<i>Cyclospora cayetanensis</i> <i>Cryptosporidium</i> <i>Entamoeba histolytica</i> <i>Giardia lamblia</i>
Neurologic manifestations	<i>Clostridium botulinum</i> toxin Organophosphate pesticides Thallium poisoning Scorpaenoid fish poisoning Ciguatera fish poisoning Tetraodon fish poisoning Neurotoxic fish poisoning Paralytic fish poisoning Amnesic shellfish poisoning Mushroom poisoning Guillain-Berre syndrome (<i>Campylobacter jejuni</i>)
Systemic illness	<i>Listeria monocytogenes</i> <i>Brucella</i> species <i>Trichinella spiralis</i> <i>Toxoplasma gondii</i> <i>Vibrio vulnificus</i> Hepatitis A virus Hepatitis E virus <i>Salmonella</i> Typhi <i>Salmonella</i> Paratyphi Amebic liver abscess

Table 2. Common clinical presentations and possible causes of disease to consider.²¹

Outbreak Investigations

Outbreak investigations are extremely important in the event of a foodborne disease outbreak because they help to identify the source of contamination to the food supply and thus prevent future cases of foodborne disease. The sentinel case of an outbreak comes to public health officials in various ways – either through physician recognition of foodborne disease or from a consumer calling the health agency and reporting a suspected foodborne disease. One reason for investigating foodborne outbreaks is that they may be ongoing, and therefore more than one cases of foodborne disease would be reported.²² In this section, the ten steps of an outbreak investigation will be explained, and then the reader will be walked through a case-study of an outbreak of *E. coli* O157:H7.

Before these ten steps can be completed in an outbreak investigation, the outbreak has to be detected. Cases can be detected either by a person with a suspected foodborne illness calling a health department or a medical professional reporting a suspected case or outbreak to a health department.²² The report can be made by using a form similar to the form in Appendix 1. Once a case or suspected outbreak has been reported to a health agency, the agency has to make sure

that the report is a valid report. This can be done through confirming the source of the information through medical screening.

There are ten essential steps to performing an outbreak investigation. The first step in performing an outbreak investigation is creating a case definition and exclusion criteria need to be formulated. This is a critical stage in the investigation because the case definition needs to be strict for the investigation to be as successful as possible. Some case definitions are straight forward and cases can be confirmed through laboratory testing. Other case definitions are clinical due to the fact that outbreak investigations happen quickly. If a clinical definition, such as diarrhea and headache, is used, then the definition should be as strict as possible, including a timeframe of when the disease should have occurred and what all of the symptoms are.²²

Second, it needs to be confirmed that reported cases are actually cases according to definition. Cases should be scrutinized closely to make sure that they match the case definition of the disease and that the clinical and laboratory results are in agreement. If a clinical sign or symptom does not match a laboratory result, the results need to be reviewed to see if there was possibly a laboratory error or a misclassification of clinical symptoms.²²

Third, the normally expected rate of disease needs to be established and all cases should be located to show that the cases being seen are an abnormal number, indicating an outbreak. The normally expected rate of disease must be established before the findings can be considered abnormal. If one-hundred students from the same university reported to a local emergency room complaining of a similar gastrointestinal illness, a doctor would have a right to suspect that an outbreak was occurring because he/she knows that this is an unexpected rate of illness occurrence. If a doctor only saw one or two students complaining of gastrointestinal problems, it would probably not be unusual.²²

Fourth, the public health worker should examine the epidemiological features of the cases by gathering data on activities, locals, and food eaten during time of outbreak. Identified cases need to be questioned extensively about all of their activities and foods they have eaten over the past 72 hours or if organism has been identified in the outbreak, then that organism's incubation period should be used. The more cases that can identify where they have eaten and what activities they have participated in, the easier it will be to trace the possible food source of the outbreak.²²

Fifth, once it is decided that there is an outbreak, the scope of the outbreak must be defined geographically and temporally so suspected foods can be identified. Once the information is obtained from cases, the window of exposure and location can be narrowed. If the cases are in a similar geographic region, the places where most of the cases consumed food would be the first places to identify as possible locals for the source of the outbreak.²²

Sixth, the public health worker must now generate a hypothesis. Once the information is collected, the public health worker must select a location and/or food for testing a hypothesis.²²

Seventh, he/she should now test the hypothesis. Once the public health worker has formulated the hypothesis, he/she must go out into the field to test that hypothesis. This could require trips to the dining facility identified or a search for contaminated food products at grocery stores. If the outbreak seemed to be coming from one location, such as a particular restaurant, the public health worker would also want to interview the employees and see if there was any possibility that they could have been a carrier of the disease.²²

Eighth, collect and test samples from hypothesized contaminated foods to determine the source of the outbreak. Once specific foods have been identified as a possibly contaminated

food, a sample should be gathered for analysis. These samples would be sent to a lab to be analyzed for infectious agents.²²

Ninth, once source of outbreak is identified, measures should be implemented to control quality of food or facility so additional outbreaks do not occur. If the outbreak was due to a food worker, proper precautions should be taken to educate the worker on how to properly handle food. If the outbreak was due to a contaminated food item, the proper steps should be undergone to ensure that the food item is destroyed and the contaminant is kept away from future crops.²²

Finally, the public health worker should correspond with the media so that the public knows their food is safe again. Public health workers need to inform the community about the status of the ongoing investigation, but they need to be particularly vocal when the outbreak is over so citizens feel safe consuming from the restaurant or food supply again. The public health worker also needs to report the outbreak to the CDC using a form such as the one in Appendix 2.²²

E. coli O157:H7 Outbreak

In June 1997, the Michigan Department of Community Health (MDCH) noticed that 34 more cases of *E. coli* O157:H7 were reported than in the previous month. The first epidemiological look into the data did not seem to show any occurrences out of the ordinary, and the increase in cases was not perceived to be a real increase (an increase due to an outbreak). At this time, the MDCH looked into the numbers to see if laboratory results were coming back incorrect or if diagnosis had changed to see from where this change in numbers was resulting.²³

After the cases kept increasing throughout July, the department began an outbreak investigation. The case definition was a resident of Michigan who had diarrhea (more than three bowel movements a day) and/or abdominal cramps, onset occurred between June 15-July 15, and stool culture yielded *E. coli* O157:H7. From these defined cases, hypothesis generating interviews were undertaken with a few cases. In these interviews, detailed information was obtained about activities and food consumption. From the information, it was determined that the cases did not attend any of the same functions together, so the outbreak appeared to be widespread in the food supply. The number of cases was skewed toward females of middle age. Outbreaks of *Salmonella* have been seen in a similar demographic population due to lettuce or sprouts. Therefore, it was hypothesized that possibly lettuce or sprouts was the cause of the outbreak.²³

A case-control study was undertaken to determine the source of the outbreak. Case-control studies work well for this type of investigation because they are relatively inexpensive and can be conducted quickly. Cases food history should have been collected for the incubation time period of *E. coli* O157:H7, which is 3-8 days preceding illness. Food history should be gathered for the controls to match the dates that information is gathered from cases. The study found that 56% of cases ate alfalfa sprouts in the seven days preceding illness, but only six percent report eating lettuce. Therefore, alfalfa sprouts seem to be the implicated food in this study. Once this is identified, the public health workers would need to perform a traceback study to try and determine which sprouts were the causes of the outbreak so they can be removed from the shelf.²³ For a reference on how to traceback fruits and vegetables that have been implicated in an outbreak, visit the FDA's website for this:

http://www.fda.gov/ora/inspect_ref/igs/epigde/epigde.html.

Goals for Food Safety

One of the Healthy People 2000 goals was met – reducing foodborne disease due to four key pathogens (*Salmonella*, *Campylobacter*, *E. coli* O157:H7, and *L. monocytogenes*). Two of the goals showed solid progress, these were reducing the *Salmonella* serotype Enteritidis and state agency adoption and review of the *Food Code* for restaurants.²⁴

The overall goal for Healthy People 2010 is to reduce foodborne illnesses. The specific, measurable goals of this program are:

- reduce infections caused by key foodborne pathogens (*Campylobacter*, *E. coli* O157: H7, *L. monocytogenes*, *Salmonella*, *Cyclospora*, and congenital *Toxoplasma gondii*) by 50 percent compared to 1997 baseline data
- reduce outbreaks of infections caused by key foodborne bacteria (*E. coli* O157:H7 and *Salmonella* serotype Enteritidis) by 50 percent compared to 1997 baseline data
- prevent an increase in the proportion of isolated of *Salmonella* from humans and slaughter animals that are resistant to antimicrobial drugs
- reduce deaths due to anaphylaxis from food allergies
- increase the proportion of consumers who follow key food safety practices to 79 percent of the population
- improve food service workers behaviors and food preparation techniques used in restaurants that directly relate to foodborne illnesses
- reduce human exposure to organophosphate pesticides from food.²⁴

Food Safety, Inspection, and Consumer Information

The Food Safety Initiative began with President Bill Clinton’s administration, and the mission of this initiative was to strengthen the nation’s food safety infrastructure. One of this initiative’s major programs was the Food Outbreak Response Coordinating Group. This group was composed of the Department of Health and Human Services (which includes the Food and Drug Administration and the Centers for Disease Control), the U.S. Department of Agriculture, and the Environmental Protection Agency, and the purpose of this group was to increase communication among the food safety agencies at local, state, and national level, work together to coordinate expertise during a foodborne outbreak, and plan for new threats to the U.S. food supply, including threats of bioterrorism.²⁵

The inspection of foods is a necessary role in protecting the safety of food. There are numerous departments and agencies that work to ensure the safety of the United States food supply, and these are listed in Table 3. More information on the inspection process can be found in the website listed by the agency/department listings. The two main inspection agencies are the U.S. Food Safety and Inspection Service and U.S. Food and Drug Administration. More information about their specific websites can be found below.

Agency/Department	Responsibility to Food Supply
U.S. Department of Health and Human Services (http://www.hhs.gov/) <ul style="list-style-type: none"> • Food and Drug Administration (http://www.fda.gov/) • Centers for Disease Control and Prevention (http://www.cdc.gov/) 	<ul style="list-style-type: none"> • Domestic and imported food sold in interstate commerce (except meat and poultry) • Bottled Water • Wine Beverages (< 7 percent alcohol) • All foods
U.S. Department of Agriculture	

http://www.usda.gov/wps/portal/usdahome <ul style="list-style-type: none"> • Food Safety and Inspection Service (http://www.fsis.usda.gov/) • Cooperative State Research, Education, and Extension Service (http://www.csrees.usda.gov/) • National Agricultural Library - USDA/FDA Foodborne Illness Education Information Center (http://www.nal.usda.gov/foodborne/) 	<ul style="list-style-type: none"> • Domestic and imported meat and poultry or meat and poultry containing products • Processed egg products • All domestic food • All foods
U.S. Environmental Protection Agency (http://www.epa.gov/)	<ul style="list-style-type: none"> • Drinking water • Produce
U.S. Department of Commerce (http://www.commerce.gov/)	<ul style="list-style-type: none"> • Fish and seafood products
U.S. Department of the Treasury (http://www.ustreas.gov/) <ul style="list-style-type: none"> • Bureau of Alcohol, Tobacco, and Firearms (http://www.atf.treas.gov/) • U.S. Customs Service (http://www.customs.ustreas.gov/) 	<ul style="list-style-type: none"> • Alcoholic beverages • Imported Foods
U.S. Department of Justice (http://www.usdoj.gov/)	<ul style="list-style-type: none"> • All foods
Federal Trade Commission (http://www.ftc.gov/)	<ul style="list-style-type: none"> • All foods
State and Local Governments (http://www.odh.state.oh.us/)	<ul style="list-style-type: none"> • All foods within jurisdiction

Table 3. Agencies and Departments that work to ensure food safety; foods that are under each agency/department's jurisdiction are listed as well - these are the foods that they have a responsibility to keep safe.²⁶

In addition to the websites listed above, these are a few of the most comprehensive websites that should be visited by the reader for more information:

- **Centers for Disease Control and Prevention** (<http://www.cdc.gov/foodsafety/>). This website provides information on diseases, environmental hazards, outbreaks, surveillance, and recent articles. This is the best resource if a reader would like more information about bacterial and viral infectious disease. It also provides many excellent links to other websites that are useful sources for more information. Each of the categories of information that is on the page can be easily navigated through by using the "Program Contents" menu found on the left side of the web page.
- **U.S. Food and Drug Administration** (<http://www.cfsan.fda.gov/>). This website is overwhelming. The best places to start searching for information are in the "Recent News" section, which will update the reader with the latest food safety news. Also, under "Program Areas" there is a section called "Foodborne Illness" and "Inspections, Compliance, Enforcements, and Recalls" that the reader is recommended to look through. There are also numerous links on the page to other websites with information about food safety issues.
- **U.S. Food Safety and Inspection Service** (<http://www.fsis.usda.gov/>). This website is very user friendly. In the upper right corner, there is a menu of frequently asked questions that a reader might be asking about food safety. The main part of the page has current news stories and information about them. There is also a menu to find more

information on food safety education, science, regulations & policies, recalls, and food defense & emergency response.

- **Environmental Protection Agency** (<http://www.epa.gov/oecaagct/tfsy.html>). The most information on this page can be found by scrolling down to the section titled “Food Safety Topics”. This website provides much useful information on bioterrorism and pesticide use. While this was not the focus of this paper, it is an important topic and should not be discounted. This website also has a section for fish food advisories.
- **World Health Organization** (<http://www.who.int/mediacentre/factsheets/fs237/en/>). This website gives a brief overview of what the magnitude of the foodborne disease is and what some of the challenges and accomplishments of the WHO have been in dealing with food safety. While there are no links directly off of the page for more information, information is given on how to contact the WHO for more information. Also, for a useful reference on general foodborne disease education reference *Foodborne diseases: a focus for health education* by the World Health Organization, Geneva (2000).

¹ Mead PS, Slutsker L, Dietz V, McCaig LF, Bresee JS, Shapiro C, Griffin PM, Tauxe RV. 1999. Food related illness and death in the United States. *Emerging Infectious Disease* 5(5): 607-625.

² Centers for Disease Control and Prevention. Diagnosis and management of foodborne illness. *MMWR* 2001; 50(RR02):1-69.

³ Food and Drug Administration, U.S. Department of Agriculture, and U.S. Environmental Protection Agency. *Food Safety From Farm to Table: A National Food Safety Initiative. Report to the President, May 1997.* Washington DC: FDA, USDA, EPA. 1997.

⁴ Centers for Disease Control and Prevention. Frequently Asked Questions. Foodborne Illness. Jan. 10, 2005.

⁵ Taeye, Alan J. The new American diet and the changing face of foodborne illness. *Cleveland Clinic Journal of Medicine* 2002; 69(5): 419-424.

⁶ Angulo, Fredrick J. Activities, Achievements, and Lessons Learned during the First 10 years of the Foodborne Diseases Active Surveillance Network: 1996-2005.

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<http://vm.cfsan.fda.gov/~lrd/foodteam.html>.

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APPENDIX 1. Foodborne Outbreak Complaint Form.

North Carolina Public Health Department FOODBORNE ILLNESS COMPLAINT WORKSHEET

Questions? Call

Date: ___/___/___

Gen Comm Disease Control 919-733-3419
DENR- Food/Inst. Sanitation 919-733-2905
State Lab of Public Health 919-733-7367

PERSON TAKING CALL

Name: _____ Phone: (____) _____ - _____
 Agency: _____ Fax: (____) _____ - _____ Email: _____

Complainant Information:

Name:	
Caller name (if different):	Age:
Address:	
Phone:	Occupation:
Work Phone:	
Where were suspect foods eaten? (name, address)	Date: Time:
Foods/beverages consumed:	
Please list any available remaining foods:	

Others in your party/household who are sick:

Name	Address/Town	Phone	Age (yrs)	Occupation	Med Provider
1					
2					
3					
4					

Symptoms:

Intoxications <input type="checkbox"/> Nausea <input type="checkbox"/> Vomiting <input type="checkbox"/> Bloating <input type="checkbox"/> Burning sensation (mouth) <input type="checkbox"/> Metallic taste in mouth <input type="checkbox"/> Thirst <input type="checkbox"/> Flushing <input type="checkbox"/> Excessive sweating Other symptoms:	Enteric <input type="checkbox"/> Abdominal cramps <input type="checkbox"/> Diarrhea <input type="checkbox"/> Bloody diarrhea <input type="checkbox"/> Fever ____°F <input type="checkbox"/> Chills	Generalized <input type="checkbox"/> Cough <input type="checkbox"/> Dehydration <input type="checkbox"/> Swelling <input type="checkbox"/> Headache <input type="checkbox"/> Jaundice <input type="checkbox"/> Rash <input type="checkbox"/> Weakness	Neurological <input type="checkbox"/> Blurred vision <input type="checkbox"/> Difficulty speaking <input type="checkbox"/> Difficulty swallowing <input type="checkbox"/> Dizziness <input type="checkbox"/> Double vision <input type="checkbox"/> Numbness <input type="checkbox"/> Paralysis <input type="checkbox"/> Tingling
Date symptoms began:		Time:	
Date symptoms ended:		Time:	
Was medical attention received?		If yes, Dr/Clinic name:	
Were specimens (stool, urine, blood) taken?		If yes, results:	

General Information:

Have you traveled recently? If so, location/date:
Have you been exposed to any animals/reptiles recently? If so, what type/when?

FOOD HISTORY

Obtain history back 72 hours prior to symptoms, **OR**, if organism is identified - use average incubation period
 If > 2 ill, follow above time frame for **common meals** (food) only

Date/Time ¹	# Exp ²	Foods consumed	Restaurant/store where purchased (name/town)	Placed consumed
__ B __ L __ D				__ Same as left __ Home __ Other (specify):
__ B __ L __ D				__ Same as left __ Home __ Other (specify):
__ B __ L __ D				__ Same as left __ Home __ Other (specify):
__ B __ L __ D				__ Same as left __ Home __ Other (specify):
__ B __ L __ D				__ Same as left __ Home __ Other (specify):
__ B __ L __ D				__ Same as left __ Home __ Other (specify):

1 Always record Time if possible; otherwise, choose B= breakfast, L= lunch, D= Dinner

2 Total # person (both ill and well) who consumed indicated food(s)

Investigated by: _____ **Date:** _____

Notes

Food Testing

Food(s) available for testing? __ Yes __ No __ Unkn Send to SLPH? __ Yes __ No __ Unkn

If Yes, specify food(s) & source:

Product and Manufacturer Information for Commercially-Processed Food(s)

Product Name: _____ Code/lot # _____

Expiration date: ____/____/____ Package size/type: _____

Manufacturer: _____ Phone # () _____-

Address _____

City: _____ State: _____ Zip _____

Incubation Periods for Selected Organisms

	Min	Max		Min	Max		Min	Max
<i>B. cereus</i> (short)	1hr	6hrs	<i>E. coli</i> 0157:H7	3 days	8days	<i>Staph aureus</i>	30 min	8hrs
<i>B. cereus</i> (long)	6hrs	24hr	Hepatitis A	15 days	50 days	<i>Shigella</i>	12 hrs	96 hrs
<i>Campylobacter</i>	1 day	10 days	<i>Salmonella</i> (non typhi)	6hrs	72hrs	<i>Vibrio cholerae</i>	few hrs	5days
<i>Cyclospora</i>	1day	14 days	<i>Salmonella typhi</i>	1 wk	3wks	Viral GI	12hrs	48 hrs
<i>C. perfringens</i>	6hrs	24 hrs	Shellfish poisoning	min	few hrs	<i>Yersinia</i>	3 days	7 days

9. Etiology: (Name the bacteria, virus, parasite, or toxin. If available, include the serotype and other characteristics such as phage type, virulence factors, and metabolic profile. Confirmation criteria available at <http://www.cdc.gov/ncidod/dbmd/outbreak/> or MMWR2000/Vol. 49/SS-1/App. B)

Etiology	Serotype	Other Characteristics (e.g., phage type)	Detected In (See codes just below)
1)	<input type="checkbox"/> Confirmed		
2)	<input type="checkbox"/> Confirmed		
3)	<input type="checkbox"/> Confirmed		

Etiology undetermined

Detected In (List above all that apply)

1 - Patient Specimen(s) 3 - Environment specimen(s)
 2 - Food Specimen(s) 4 - Food Worker specimen(s)

10. Isolate Subtype

State Lab ID	PFGE (PulseNet designation)	PFGE (PulseNet designation)
1)		
2)		
3)		

11. Contributing Factors (Check all that apply. See attached codes and explanations)

Contributing factors unknown

Contamination Factor
 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 C11 C12 C13 C14 C15 (describe in Comments) N/A

Proliferation/Amplification Factor (bacterial outbreaks only)
 P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 (describe in Comments) N/A

Survival Factor (microbial outbreaks only)
 S1 S2 S3 S4 S5 (describe in Comments) N/A

Was food-worker implicated as the source of contamination? Yes No
 If yes, please check only one of following

- laboratory and epidemiologic evidence
- epidemiologic evidence (w/o lab confirmation)
- lab evidence (w/o epidemiologic evidence)
- prior experience makes this the likely source (please explain in Comments)

Part 2: Additional Information

12. Symptoms, Signs and Outcomes			13. Incubation Period (Circle appropriate units)		14. Duration of Illness (Among those who recovered) (Circle appropriate units)																												
Feature	Cases with outcome/feature	Total cases for whom you have information available	Shortest _____(Hours, Days)		Shortest _____(Hours, Days)																												
Healthcare provider visit			Longest _____(Hours, Days)		Longest _____(Hours, Days)																												
Hospitalization			Median _____(Hours, Days)		Median _____(Hours, Days)																												
Death			<input type="checkbox"/> Unknown		<input type="checkbox"/> Unknown																												
Vomiting			* Use the following terms, if appropriate, to describe other common characteristics of cases <table style="width:100%; margin-top: 10px;"> <tr> <td>Anaphylaxis</td> <td>Headache</td> <td>Tachycardia</td> </tr> <tr> <td>Arthralgia</td> <td>Hypotension</td> <td>Temperature reversal</td> </tr> <tr> <td>Bradycardia</td> <td>Itching</td> <td>Thrombocytopenia</td> </tr> <tr> <td>Bullous skin lesions</td> <td>Jaundice</td> <td>Urticaria</td> </tr> <tr> <td>Coma</td> <td>Lethargy</td> <td>Wheezing</td> </tr> <tr> <td>Cough</td> <td>Myalgia</td> <td></td> </tr> <tr> <td>Descending paralysis</td> <td>Paresthesia</td> <td></td> </tr> <tr> <td>Diplopia</td> <td>Septicemia</td> <td></td> </tr> <tr> <td>Flushing</td> <td>Sore throat</td> <td></td> </tr> </table>				Anaphylaxis	Headache	Tachycardia	Arthralgia	Hypotension	Temperature reversal	Bradycardia	Itching	Thrombocytopenia	Bullous skin lesions	Jaundice	Urticaria	Coma	Lethargy	Wheezing	Cough	Myalgia		Descending paralysis	Paresthesia		Diplopia	Septicemia		Flushing	Sore throat	
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Bloody stools																																	
Fever																																	
Abdominal cramps																																	
HUS or TTP																																	
Asymptomatic																																	
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15. If Cohort Investigation Conducted:	
Attack rate* = $\frac{\text{Exposed and ill}}{\text{Total number exposed for whom you have illness information}} \times 100 = \text{_____} \%$	
* The attack rate is applied to persons in a cohort who were exposed to the implicated vehicle. The numerator is the number of persons who were exposed and became ill; the denominator is the total number of persons exposed to the implicated vehicle. If the vehicle is unknown, then the attack rate should not be calculated.	

16. Location Where Food Was Prepared (Check all that apply) <table style="width:100%; margin-top: 5px;"> <tr> <td><input type="checkbox"/> Restaurant or deli</td> <td><input type="checkbox"/> Nursing home</td> </tr> <tr> <td><input type="checkbox"/> Day care center</td> <td><input type="checkbox"/> Prison, jail</td> </tr> <tr> <td><input type="checkbox"/> School</td> <td><input type="checkbox"/> Private home</td> </tr> <tr> <td><input type="checkbox"/> Office setting</td> <td><input type="checkbox"/> Workplace, not cafeteria</td> </tr> <tr> <td><input type="checkbox"/> Workplace cafeteria</td> <td><input type="checkbox"/> Wedding reception</td> </tr> <tr> <td><input type="checkbox"/> Banquet Facility</td> <td><input type="checkbox"/> Church, temple, etc</td> </tr> <tr> <td><input type="checkbox"/> Picnic</td> <td><input type="checkbox"/> Camp</td> </tr> <tr> <td><input type="checkbox"/> Caterer</td> <td><input type="checkbox"/> Contaminated food imported into U.S.</td> </tr> <tr> <td><input type="checkbox"/> Grocery Store</td> <td><input type="checkbox"/> Hospital</td> </tr> <tr> <td><input type="checkbox"/> Fair, festival, other temporary/ mobile services</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Commercial product, served without further preparation</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Unknown or undetermined</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Other (Describe) _____</td> <td></td> </tr> </table>	<input type="checkbox"/> Restaurant or deli	<input type="checkbox"/> Nursing home	<input type="checkbox"/> Day care center	<input type="checkbox"/> Prison, jail	<input type="checkbox"/> School	<input type="checkbox"/> Private home	<input type="checkbox"/> Office setting	<input type="checkbox"/> Workplace, not cafeteria	<input type="checkbox"/> Workplace cafeteria	<input type="checkbox"/> Wedding reception	<input type="checkbox"/> Banquet Facility	<input type="checkbox"/> Church, temple, etc	<input type="checkbox"/> Picnic	<input type="checkbox"/> Camp	<input type="checkbox"/> Caterer	<input type="checkbox"/> Contaminated food imported into U.S.	<input type="checkbox"/> Grocery Store	<input type="checkbox"/> Hospital	<input type="checkbox"/> Fair, festival, other temporary/ mobile services		<input type="checkbox"/> Commercial product, served without further preparation		<input type="checkbox"/> Unknown or undetermined		<input type="checkbox"/> Other (Describe) _____		17. Location of Exposure or Where Food Was Eaten (Check all that apply) <table style="width:100%; margin-top: 5px;"> <tr> <td><input type="checkbox"/> Restaurant or deli</td> <td><input type="checkbox"/> Nursing Home</td> </tr> <tr> <td><input type="checkbox"/> Day care center</td> <td><input type="checkbox"/> Prison, jail</td> </tr> <tr> <td><input type="checkbox"/> School</td> <td><input type="checkbox"/> Private home</td> </tr> <tr> <td><input type="checkbox"/> Office Setting</td> <td><input type="checkbox"/> Workplace, not cafeteria</td> </tr> <tr> <td><input type="checkbox"/> Workplace cafeteria</td> <td><input type="checkbox"/> Wedding Reception</td> </tr> <tr> <td><input type="checkbox"/> Banquet Facility</td> <td><input type="checkbox"/> Church, temple, etc.</td> </tr> <tr> <td><input type="checkbox"/> Picnic</td> <td><input type="checkbox"/> Camp</td> </tr> <tr> <td><input type="checkbox"/> Grocery Store</td> <td><input type="checkbox"/> Hospital</td> </tr> <tr> <td><input type="checkbox"/> Fair, festival, temporary/ mobile service</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Unknown or undetermined</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Other (Describe) _____</td> <td></td> </tr> </table>	<input type="checkbox"/> Restaurant or deli	<input type="checkbox"/> Nursing Home	<input type="checkbox"/> Day care center	<input type="checkbox"/> Prison, jail	<input type="checkbox"/> School	<input type="checkbox"/> Private home	<input type="checkbox"/> Office Setting	<input type="checkbox"/> Workplace, not cafeteria	<input type="checkbox"/> Workplace cafeteria	<input type="checkbox"/> Wedding Reception	<input type="checkbox"/> Banquet Facility	<input type="checkbox"/> Church, temple, etc.	<input type="checkbox"/> Picnic	<input type="checkbox"/> Camp	<input type="checkbox"/> Grocery Store	<input type="checkbox"/> Hospital	<input type="checkbox"/> Fair, festival, temporary/ mobile service		<input type="checkbox"/> Unknown or undetermined		<input type="checkbox"/> Other (Describe) _____	
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18. Trace back		
<input type="checkbox"/> Please check if trace back conducted		
Source to which trace back led:		
Source (e.g., Chicken farm, Tomato processing plant)	Location of Source	Comments
	State	Country

<p>19. Recall</p> <p><input type="checkbox"/> Please check if any food product recalled</p> <p>Recall Comments</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>20. Available Reports (Please attach)</p> <p><input type="checkbox"/> Unpublished agency report</p> <p><input type="checkbox"/> Epi-Aid report</p> <p><input type="checkbox"/> Publication (please reference if not attached)</p> <p>_____</p> <p>_____</p>
<p>21. Agency reporting this outbreak</p> <p>_____</p> <p>Contact person:</p> <p>Name _____</p> <p>Title _____</p> <p>Phone _____</p> <p>Fax _____</p> <p>E-mail _____</p>	<p>22. Remarks</p> <p>Briefly describe important aspects of the outbreak not covered above (e.g., restaurant closure, immunoglobulin administration, economic impact, etc)</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>

Part 3: School Questions

<p>1. Did the outbreak involve a single or multiple schools?</p> <p><input type="checkbox"/> Single</p> <p><input type="checkbox"/> Multiple (If yes, number of schools _____)</p>	
<p>2. School characteristics (for all involved students in all involved schools)</p> <p>a. Total approximate enrollment _____ (number of students)</p> <p><input type="checkbox"/> Unknown or Undetermined</p> <p>b. Grade level(s) (Please check all grades affected)</p> <p><input type="checkbox"/> Preschool</p> <p><input type="checkbox"/> Grade School (grades K-12)</p> <p> Please check all grades affected: <input type="checkbox"/> K <input type="checkbox"/> 1st <input type="checkbox"/> 2nd <input type="checkbox"/> 3rd <input type="checkbox"/> 4th <input type="checkbox"/> 5th <input type="checkbox"/> 6th <input type="checkbox"/> 7th <input type="checkbox"/> 8th <input type="checkbox"/> 9th <input type="checkbox"/> 10th <input type="checkbox"/> 11th <input type="checkbox"/> 12th</p> <p><input type="checkbox"/> College/University/Technical School</p> <p><input type="checkbox"/> Unknown or Undetermined</p> <p>c. Primary funding of involved school(s)</p> <p><input type="checkbox"/> Public <input type="checkbox"/> Private <input type="checkbox"/> Unknown or Undetermined</p>	
<p>3. Describe the preparation of the implicated item:</p> <p><input type="checkbox"/> Heat and serve (item mostly prepared or cooked off-site, reheated on-site)</p> <p><input type="checkbox"/> Served a-la-carte</p> <p><input type="checkbox"/> Serve only (preheated or served cold)</p> <p><input type="checkbox"/> Cooked on site using primary ingredients</p> <p><input type="checkbox"/> Provided by a food service management company</p> <p><input type="checkbox"/> Provided by a fast food vendor</p> <p><input type="checkbox"/> Provided by a pre-plate company</p> <p><input type="checkbox"/> Part of a club/ fundraising event</p> <p><input type="checkbox"/> Made in the classroom</p> <p><input type="checkbox"/> Brought by a student/teacher/parent</p> <p><input type="checkbox"/> Other _____</p> <p><input type="checkbox"/> Unknown or Undetermined</p>	<p>4. How many times has the state, county or local health department inspected this school cafeteria or kitchen in the 12 months before the outbreak?*</p> <p><input type="checkbox"/> Once</p> <p><input type="checkbox"/> Twice</p> <p><input type="checkbox"/> More than two times</p> <p><input type="checkbox"/> Not inspected</p> <p><input type="checkbox"/> Unknown or Undetermined</p> <p>5. Does the school have a HACCP plan in place for the school feeding program?*</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p><input type="checkbox"/> Unknown or Undetermined</p> <p>*If there are multiple schools involved, please answer according to the most affected school</p>

6. Was implicated food item provided to the school through the National School Lunch/Breakfast Program?

- Yes
- No
- Unknown or Undetermined

If Yes, Was the implicated food item donated/purchased by :

- USDA through the Commodity Distribution Program
- Purchased commercially by the state/school authority
- Other _____
- Unknown or Undetermined

Part 4: Ground Beef

1. What percentage of ill persons (for whom information is available) ate ground beef raw or undercooked? ____ %

2. Was ground beef case ready? (Ground beef that comes from a manufacturer packaged for sale and not altered or repackaged by the retailer)

- Yes
- No
- Unknown or Undetermined

3. Was the beef ground or reground by the retailer?

- Yes
- No
- Unknown or Undetermined

If yes, was anything added to the beef during grinding (e.g., shop trim or any product to alter the fat content) _____

Part 5: Mode of Transmission

(Enterohemorrhagic *E. coli* or *Salmonella* Enteritidis only)

1. Mode of Transmission (for greater than 50% of cases)

Select one:

- Food
- Person to person
- Swimming or recreational water
- Drinking water
- Contact with animals or their environment
- Unknown or Undetermined

Part 6: Additional Egg Questions

1. Were Eggs: (Check all that apply)

- in-shell, un-pasteurized?
- in-shell, pasteurized?
- liquid or dry egg product?
- stored with inadequate refrigeration during or after sale?
- consumed raw?
- consumed undercooked?
- pooled?

2. If eggs traced back to farm, was *Salmonella* Enteritidis found on the farm?

- Yes
- No
- Unknown or Undetermined

Comment: _____

Contamination Factors:¹

C1 - Toxic substance part of tissue (e.g., ciguatera)

- C2 - Poisonous substance intentionally added (e.g., cyanide or phenolphthalein added to cause illness)
- C3 - Poisonous or physical substance accidentally/incidentally added (e.g., sanitizer or cleaning compound)
- C4 - Addition of excessive quantities of ingredients that are toxic under these situations (e.g., niacin poisoning in bread)
- C5 - Toxic container or pipelines (e.g., galvanized containers with acid food, copper pipe with carbonated beverages)
- C6 - Raw product/ingredient contaminated by pathogens from animal or environment (e.g., *Salmonella enteritidis* in egg, Norwalk in shellfish, *E. coli* in sprouts)
- C7 - Ingestion of contaminated raw products (e.g., raw shellfish, produce, eggs)
- C8 - Obtaining foods from polluted sources (e.g., shellfish)
- C9 - Cross-contamination from raw ingredient of animal origin (e.g., raw poultry on the cutting board)
- C10 - Bare-handed contact by handler/worker/preparer (e.g., with ready-to-eat food)
- C11 - Glove-handed contact by handler/worker/preparer (e.g., with ready-to-eat food)
- C12 - Handling by an infected person or carrier of pathogen (e.g., *Staphylococcus*, *Salmonella*, Norwalk agent)
- C13 - Inadequate cleaning of processing/preparation equipment/utensils B leads to contamination of vehicle (e.g., cutting boards)
- C14 - Storage in contaminated environment B leads to contamination of vehicle (e.g., store room, refrigerator)
- C15 - Other source of contamination (please describe in Comments)

Proliferation/Amplification Factors:¹

- P1 - Allowing foods to remain at room or warm outdoor temperature for several hours (e.g., during preparation or holding for service)
- P2 - Slow cooling (e.g., deep containers or large roasts)
- P3 - Inadequate cold-holding temperatures (e.g., refrigerator inadequate/not working, iced holding inadequate)
- P4 - Preparing foods a half day or more before serving (e.g., banquet preparation a day in advance)
- P5 - Prolonged cold storage for several weeks (e.g., permits slow growth of psychrophilic pathogens)
- P6 - Insufficient time and/or temperature during hot holding (e.g., malfunctioning equipment, too large a mass of food)
- P7 - Insufficient acidification (e.g., home canned foods)
- P8 - Insufficiently low water activity (e.g., smoked/salted fish)
- P9 - Inadequate thawing of frozen products (e.g., room thawing)
- P10 - Anaerobic packaging/Modified atmosphere (e.g., vacuum packed fish, salad in gas flushed bag)
- P11 - Inadequate fermentation (e.g., processed meat, cheese)
- P12 - Other situations that promote or allow microbial growth or toxic production (please describe in Comments)

Survival Factors:¹

- S1 - Insufficient time and/or temperature during initial cooking/heat processing (e.g., roasted meats/poultry, canned foods, pasteurization)
- S2 - Insufficient time and/or temperature during reheating (e.g., sauces, roasts)
- S3 - Inadequate acidification (e.g., mayonnaise, tomatoes canned)
- S4 - Insufficient thawing, followed by insufficient cooking (e.g., frozen turkey)
- S5 - Other process failures that permit the agent to survive (please describe in Comments)

Method of Preparation:²

- M1 - Foods eaten raw or lightly cooked (e.g., hard shell clams, sunny side up eggs)
- M2 - Solid masses of potentially hazardous foods (e.g., casseroles, lasagna, stuffing)
- M3 - Multiple foods (e.g., smorgasbord, buffet)
- M4 - Cook/serve foods (e.g., steak, fish fillet)
- M5 - Natural toxicant (e.g., poisonous mushrooms, paralytic shellfish poisoning)
- M6 - Roasted meat/poultry (e.g., roast beef, roast turkey)
- M7 - Salads prepared with one or more cooked ingredients (e.g., macaroni, potato, tuna)
- M8 - Liquid or semi-solid mixtures of potentially hazardous foods (e.g., gravy, chili, sauce)
- M9 - Chemical contamination (e.g., heavy metal, pesticide)
- M10 - Baked goods (e.g., pies, eclairs)
- M11 - Commercially processed foods (e.g., canned fruits and vegetables, ice cream)
- M12 - Sandwiches (e.g., hot dog, hamburger, Monte Cristo)
- M13 - Beverages (e.g., carbonated and non-carbonated, milk)
- M14 - Salads with raw ingredients (e.g., green salad, fruit salad)
- M15 - Other, does not fit into above categories (please describe in Comments)
- M16 - Unknown, vehicle was not identified

¹ Frank L. Bryan, John J. Guzewich, and Ewen C. D. Todd. Surveillance of Foodborne Disease III. Summary and Presentation of Data on Vehicles and Contributory Factors; Their Value and Limitations. *Journal of Food Protection*, 60; 6:701-714, 1997.

² Weingold, S. E., Guzewich JJ, and Fudala JK. Use of foodborne disease data for HACCP risk assessment. *Journal of Food Protection*, 57; 9:820-830, 1994.