Contributing Factors in a Successful Foodborne Outbreak Investigation: an Analysis of Data Collected by the Foodborne Diseases Active Surveillance Network (FoodNet), 2003-2010.

Taryn Mecher  
Georgia State University

Christine E. Stauber  
Georgia State University

L. Hannah Gould  
Centers for Disease Control and Prevention

Follow this and additional works at: https://scholarworks.gsu.edu/iph_theses

Recommended Citation
https://scholarworks.gsu.edu/iph_theses/382

This Thesis is brought to you for free and open access by the School of Public Health at ScholarWorks @ Georgia State University. It has been accepted for inclusion in Public Health Theses by an authorized administrator of ScholarWorks @ Georgia State University. For more information, please contact scholarworks@gsu.edu.
Abstract

**Background.** Foodborne disease is estimated to cause 48 million illnesses annually in the US resulting in 3000 deaths [1]. Although most infections occur as sporadic cases, outbreak surveillance offers valuable insight about the foods and pathogens responsible for illnesses [2]. A total of 1632 foodborne disease outbreaks were reported during 2011-2012 [3] and recent data indicates an overall decrease in the number of outbreaks reported each year [4]. Understanding which factors contribute to the successful identification of a food vehicle in a foodborne outbreak investigation is crucial for improving outbreak response [5-10]. The purpose of this study was to describe outbreak characteristics and to determine which may be associated with the success of a foodborne outbreak investigation (i.e. one in which a food vehicle has been reported).

**Methods.** A foodborne disease outbreak was defined as the event in which two or more people acquired similar illnesses from consuming the same food or beverage. Outbreaks occurring in FoodNet sites during 2003 through 2010 were included in the analysis.

**Results.** Data were available for 1441(87%) of the 1655 foodborne disease outbreaks documented in FoodNet Outbreak Supplement Forms from 2003 through 2010. A food vehicle was identified in 692 of the 1441 (48%) outbreaks. Six outbreak characteristics remained statistically significant in both univariate and multivariate analyses: environmental and/or food culture collection, FDA or state agriculture involvement, outbreak size, case-control studies, and number of fecal specimens tested for norovirus.

**Conclusions.** Less than half of foodborne outbreaks examined here resulted in a food vehicle being identified. Having more robust resources available for outbreak detection and investigation may improve likelihood of a food vehicle being identified.
CONTRIBUTING FACTORS IN A SUCCESSFUL FOODBORNE OUTBREAK INVESTIGATION: AN ANALYSIS OF DATA COLLECTED BY THE FOODBORNE DISEASES ACTIVE SURVEILLANCE NETWORK (FOODNET), 2003-2010

By

TARYN MECHER

B.S., UNIVERSITY OF GEORGIA

A Thesis Submitted to the Graduate Faculty of Georgia State University in Partial Fulfillment of the Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA
30303
CONTRIBUTING FACTORS IN A SUCCESSFUL FOODBORNE OUTBREAK INVESTIGATION: AN ANALYSIS OF DATA COLLECTED BY THE FOODBORNE DISEASES ACTIVE SURVEILLANCE NETWORK (FOODNET), 2003-2010

By

TARYN MECHER

Approved:

[Signature]
Committee Chair

[Signature]
Committee Member

12/16/2014
Date
Acknowledgments

“That's the wonderful thing about man; he never gets so discouraged or disgusted that he gives up doing it all over again, because he knows very well it is important and WORTH the doing.”

~Ray Bradbury, Fahrenheit 451

I would like to recognize Dr. Christine Stauber and Dr. L. Hannah Gould for their patience and helpful advice in completing this thesis. I would like to express my gratitude to Dr. Carole Thurman for introducing me to the wonderful world of biostatistics. I would also like to thank my friends and family, especially Zach Gerth, whose support and encouragement means the world to me. I could not have done this without you!
In presenting this thesis as a partial fulfillment of the requirements for an advanced degree from Georgia State University, I agree that the Library of the University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote from, to copy from, or to publish this thesis may be granted by the author or, in his/her absence, by the professor under whose direction it was written, or in his/her absence, by the Associate Dean, College of Health and Human Sciences. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without written permission of the author.

Signature of Author
Notice to Borrowers Page

All theses deposited in the Georgia State University Library must be used in accordance with the stipulations prescribed by the author in the preceding statement.

The author of this thesis is:
Taryn Mecher
370 Hannaford Drive
Roswell, GA 30075

The Chair of the committee for this thesis is:
Christine Stauber, MS, PhD
School of Public Health
College of Health and Human Sciences
Georgia State University
P.O. Box 3995
Atlanta, Georgia, 30302-3995

Users of this thesis who not regularly enrolled as students at Georgia State University are required to attest acceptance of the preceding stipulation by signing below. Libraries borrowing this thesis for the use of their patrons are required to see that each user records here the information requested.

<table>
<thead>
<tr>
<th>NAME OF USER</th>
<th>ADDRESS</th>
<th>DATE</th>
<th>TYPE OF USE (EXAMINATION ONLY OR COPYING)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EDUCATION

Georgia State University, Atlanta, GA, December 2014 (Expected graduation)
Master of Public Health

University of Georgia, Athens, GA, May 2012
Bachelor of Science in Dietetics

PUBLIC HEALTH WORK EXPERIENCE

CDC Foundation, Atlanta, GA
Surveillance Epidemiologist, Healthy Swimming Program
October 2014—Present

CDC Foundation, Atlanta, GA
Enteric Diseases Epidemiology Branch Intern
January 2014—October 2014

Georgia State University, Atlanta, GA
Graduate Research Assistant
May 2013—May 2014

Athens Regional Medical Center, Athens, GA
Dietetics Intern
January 2011—May 2011

University of Georgia, Athens, GA
Undergraduate Research Assistant
August 2010—December 2011

Hospital Civil Dr. Luis F. Nachon, Xalapa, Veracruz, Mexico
University of Georgia Study Abroad Program
May 2010

TECHNICAL KNOWLEDGE

- Proficient in Microsoft PowerPoint and Word
- Competent in Microsoft Excel, Access, and Publisher
- Intermediate skill in SPSS and SAS Statistical Software for Windows
- Research literature searches using PubMed, Medscape, EBSCO, Medline databases

VOLUNTEER ACTIVITIES

HealthSTAT Program, Atlanta, Georgia
January 2013—June 2013

Steppin’ For Health Volunteer
# Table of Contents

Acknowledgments...........................................................................................................iii

List of Tables....................................................................................................................viii

List of Figures..................................................................................................................ix

Chapters

  Chapter I—Introduction.................................................................................................1
  Chapter II—Literature Review .......................................................................................4
  Chapter III—Manuscript ...............................................................................................13

References .....................................................................................................................36

Appendices

  A: Annotated Foodborne OB Supplement Form .........................................................38
  B: eFORS Reporting Form ..........................................................................................40
  C: Annotated NORS Reporting Form .........................................................................46
**List of Tables**

Table 1. Summary of descriptive statistics of foodborne disease outbreaks, FoodNet OB Supplement forms, 2003-2010 ..................................................................................................................31

Table 2. Univariate analysis of the year during which a foodborne disease outbreak occurred, FoodNet OB Supplement forms, 2003-2010 .................................................................32

Table 3. Univariate analysis of the state where a foodborne disease outbreak occurred, FoodNet OB Supplement forms, 2003-2010 ............................................................33

Table 4. Univariate analysis of outbreak characteristics, FoodNet OB Supplement forms, 2003-2010 ..................................................................................................................34

Table 5. Univariate analysis of types of etiologic agents identified for a specific foodborne disease outbreak, FoodNet OB Supplement forms, 2003-2010 ...............35

Table 6. Summary of stepwise selection for multivariate analysis of outbreak characteristics, FoodNet OB Supplement forms, 2003-2010 .........................................................36
List of Figures

Figure 1. Number of foodborne disease outbreaks by year, FoodNet OB Supplement forms, 2003-2010 ……………………………………………………………………………..24

Figure 2. Number of foodborne disease outbreaks by year, FDOSS, 2003-2010 ………25

Figure 3. Number of foodborne disease outbreaks by state, FoodNet OB Supplement forms, 2003-2010 ……………………………………………………………………………………26

Figure 4. Number of foodborne disease outbreaks by state and year, FoodNet OB Supplement forms, 2003-2010 ……………………………………………………………………………..27

Figure 5. Percentage of foodborne disease outbreaks with food vehicle(s) identified by year, FoodNet OB Supplement forms, 2003-2010 …………………………………………………………..28

Figure 6. Percentage of foodborne disease outbreaks with a single food vehicle identified by category, FoodNet OB Supplement forms, 2003-2010 ………………………………………………..29

Figure 7. Percentage of foodborne disease outbreaks with a single etiology identified by etiology group, FoodNet OB Supplement forms, 2003-2010 ……………………………………30
Chapter I—Introduction

The Centers for Disease Control and Prevention defines foodborne illness as a disease acquired “by consuming contaminated foods or beverages” [11]. Contamination may occur at any stage in food production—pre-harvest, harvest, processing, transport, food preparation, or food handling—and may affect one individual or may lead to a large-scale outbreak [12, 13]. Foodborne illness, according to the United States Economic Research Services, costs the US nearly 7 billion dollars annually. This estimate accounts for lost productivity, medical treatments for sick persons, outbreak mitigation efforts, and lost trade [12].

Various public health regulations have emerged in order to encourage food safety and thereby lessen the burden of foodborne illness. While previous efforts focused primarily on enforcing hygienic conditions in the food service industry, current approaches involve monitoring pathogens at all stages of food production [12, 13]. The Food Safety Modernization Act (FSMA) in particular has been instrumental in reconstructing the US food safety system so that the focus is on prevention of foodborne outbreaks [14]. To improve compliance with food safety measures and response to food safety problems, this law grants the US Food and Drug Administration (FDA) several new authorities. These include: mandating preventive controls and safety standards at food establishments, creating regulations which protect against intentional contamination, ordering a mandatory recall if a voluntary one is unsuccessful, and establishing requirements for recordkeeping at facilities that handle high-risk foods [14]. Hazard Analysis Critical Control Points (HACCP) requires all food businesses to spot food
production stages at which potential hazards may occur and to propose methods for controlling these hazards [12]. The World Health Organization (WHO) and Food Agriculture Organization founded the Codex Alimentarius Commission, an international group responsible for developing food safety standards and guidelines. The WHO also provides health promotion materials to educate both food workers and consumers about the importance of practicing safe food handling and preparation behaviors [13].

Despite the existence of food safety laws and the continual effort to improve food safety, foodborne illness remains a prominent public health issue in the United States. Foodborne disease is estimated to cause 48 million illnesses annually in the US, resulting in 128,000 hospitalizations and 3000 deaths [1]. The 2012 data from FoodNet show that *Salmonella* and *Escherichia coli* infections collectively account for almost 90 percent of all foodborne outbreak-related cases [15]. Although most infections occur as sporadic cases, outbreak surveillance offers valuable insight about the foods and pathogens responsible for illnesses [2]. Preventing these illnesses poses a challenge due to limited resources and difficulty linking individual illnesses to a particular food vehicle. Understanding which factors contribute to the success of a foodborne outbreak investigation is crucial for attributing an illness to a food vehicle and for improving outbreak response [5-10].

This study focused on six different types of outbreak characteristics: agencies substantially involved in the investigation; items included in the investigation (i.e. case interviews, analytical epi investigation, environmental/food cultures, product traceback/recall); number of fecal specimens screened at a lab, public or private, via specified test methods; number of cases in the outbreak; type of etiologic agent identified
for a specific outbreak; and Interagency Food Safety Analytics Collaboration (IFSAC) category to which the food vehicle belongs. Data from FoodNet Outbreak Supplement Forms for the years 2003 through 2010 were included in the analysis. Odds ratios were calculated to estimate whether a specific outbreak characteristic—for example, food and/or environmental cultures attained in the investigation—increases the likelihood of a food vehicle being identified. The overall purpose of this study was to describe outbreak characteristics and to determine which may be associated with the success of a foodborne outbreak investigation (i.e. one in which a food vehicle has been identified and reported by the public health agency).
Chapter II—Literature review

Outbreak investigations involve a number of health agencies working to reduce the impact of foodborne illnesses. These agencies share a responsibility to ensure food safety by preventing, responding to, and controlling outbreaks. While some deem these efforts sufficient, others criticize their ability to lead an effective foodborne illness outbreak investigation.

The National Environmental Health Association (NEHA), in an assessment of food safety capacity at local and state health departments, identifies trends which may halt progress of an outbreak investigation [16]. Researchers found that lack of partnering between local and other agencies, decreased funding sources, inability to set long-term controls (i.e. product recall), inexperienced environmental health workers, inadequate training opportunities, and insufficient time for staff to investigate an outbreak may be responsible for reducing capacity of programs which address foodborne illness [16].

The Environmental Health Specialists Network (EHS-Net) oversaw a similar study using focus groups comprised of specialists from public health departments in eight states [10]. Discussion topics consisted of outbreak investigation procedures, methods for identifying factors associated with an outbreak, and challenges. Investigation practices varied widely by jurisdiction; in fact, nearly half of all participants noted minimal involvement except for routine restaurant inspections. Others recounted not only directing restaurant inspections but also interviewing customers and employees to find ill persons and suspected vehicle(s), requesting food or stool samples, and collaborating with epidemiologists and nurses. Instead of describing contributing factors, most
participants considered illness characteristics when determining a potential pathogen and managing a restaurant investigation. They cited the following as negatively affecting the investigation: uncooperative employees, difficulty contacting customers to complete a food history, poor epidemiologic assistance and management support, inadequate training in outbreak investigation, lack of cooperation among health agencies, insufficient staffing, physician noncompliance, and delayed outbreak notification. Shifting focus toward obtaining food and stool samples and identifying ill employees and unsafe food handling behaviors would likely increase pathogen detection and foodborne illness knowledge [10].

While both the NEHA and EHS-Net studies address issues faced by public health specialists, others examine consumer attitudes regarding foodborne illnesses. Arendt et al [17] convened focus groups to discover reasons for under-reporting. Feeling too ill, not knowing the cause or who to contact, and thinking that reporting would not benefit anyone kept consumers from reporting foodborne illnesses [17]. Healthcare professionals admitted that a lack of food safety knowledge prevented them from realizing the potential severity of foodborne illnesses and treating the patient appropriately. To better care for consumers, the authors recommended that healthcare professionals should receive training on detecting, preventing and managing foodborne illnesses [17].

Health and safety officials also shape consumer behaviors during an outbreak since they recommend which foods to avoid. Issuing warnings and food recalls requires determining which food may be responsible for an outbreak; however, incomplete and changing information makes it difficult for officials to provide advice to consumers. Arnade et al [9] learned that news about contamination of foods, rather than food safety,
piques consumer interest more often. This suggests that quickly identifying the suspected food vehicle(s) would facilitate better handling of food safety announcements and thus improve foodborne disease outbreak response.

Consumers, producers, supply chain managers, and governments all rely on news they receive during an outbreak to make decisions related to food production. A key component of recognizing when potential food-related hazards emerge is ability to link specific cases of illness to food vehicle(s) [18]. Attributing illnesses to food, however, proves difficult even for large outbreaks. Until recently, there existed no means by which foodborne illnesses could be categorized according to transmission mode [5]. Painter et al [19] devised a hierarchy of 17 commodities to help reporting agencies better describe foods causing outbreaks and to glean information regarding how different food commodities contribute to illness. Coupled with outbreak reports, this categorization scheme has been used to describe sources of illness at the point-of-consumption. In another study, Painter et al [7] reviewed data on foodborne disease outbreaks from 1998 to 2008 in order to estimate the number of foodborne illnesses, hospitalizations, and deaths for each of the 17 commodities. They attributed 22% of illnesses to leafy vegetables, 16% of hospitalizations to dairy products, and 19% of deaths to poultry. While these results may lend to prioritization of food safety interventions, one main limitation is that this analysis accounted for only those outbreaks with an implicated food vehicle and single etiologic agent. This represents only 37% of all foodborne disease outbreaks present in the database, suggesting that food attribution is an area of outbreak investigation that needs improvement.

Determining factors which lead to a successful foodborne outbreak investigation
may help with food attribution. Timeliness, according to Hedberg et al [20], plays a vital role in identifying those possibly exposed to the source of illness and in limiting case count for an outbreak. Jones et al [21] agrees that timely reporting—along with resource availability, health department priorities, specimens procured, health care sought by ill persons, and assistance from health care providers and lab workers—affects whether a food vehicle is established.

Tauxe et al [2] defines surveillance as “the systematic collection of reports of specific health events as they occur in a population”. It delineates the burden of diseases and mobilizes epidemiologic investigations and prevention initiatives. Foodborne illness surveillance serves these primary purposes: ascertaining a food vehicle, etiology, and location of exposure; and summarizing the results of an outbreak investigation [22]. Implementing HACCP-based plans in the food industry, detecting unfamiliar pathogens, generating awareness of current problems, observing changes in the prevalence of outbreaks by etiology, and evaluating the effectiveness of control and prevention efforts represent additional benefits [2, 6, 22]. Although the United States began surveillance activities in the 1800s, it was not until 2010 that foodborne disease outbreaks emerged as “a nationally notifiable condition” [22].

The Centers for Disease Control and Prevention (CDC) maintains several complementary surveillance systems, including the National Outbreak Reporting System (NORS) and the Foodborne Diseases Active Surveillance Network (FoodNet), that compile data on foodborne illness and outbreaks in the United States. NORS captures data on enteric and waterborne disease outbreaks reported by public health departments. By integrating the Waterborne Disease and Outbreak Surveillance System and Foodborne
Disease Outbreak Surveillance System, NORS has enhanced outbreak reporting [23]. FoodNet monitors lab-confirmed infections caused by nine pathogens commonly transmitted through food: *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC) O157 and non-O157, *Campylobacter*, *Listeria*, *Vibrio*, *Cryptosporidium*, *Cyclospora*, *Shigella*, and *Yersinia* [24-26]. Though initially comprised of five states—California, Connecticut, Georgia, Minnesota, and Oregon—the surveillance area soon covered 10 states and 15 percent of the US population. FoodNet releases an annual *National Report Card on Food Safety*, which compares changes in incidence of diseases during the past year to a baseline period. These aid regulatory agencies, healthcare workers, and consumer and industry groups in tailoring food safety strategies to meet national health objectives. A report showing a rise in *Escherichia coli* O157 infections due to ground beef consumption, for example, prompted USDA’s Food Safety and Inspection Service and the meat industry to launch a series of interventions which significantly reduced incidence of infection [24].

Foodborne disease outbreak surveillance systems like NORS and FoodNet provide valuable insight regarding the foods and pathogens responsible for illnesses [2]. CDC maintains NORS and FoodNet to collect data on foodborne disease outbreaks occurring in the United States and to ascertain the causes of these outbreaks. These systems serve as primary sources of information about illnesses, hospitalizations, deaths, food vehicle(s) and etiologic agents for foodborne disease outbreaks in the United States [15, 23].
References


8. Murphree R, Garman K, Phan Q, Everstine K, Gould LH, Jones TF. Characteristics of foodborne disease outbreak investigations conducted by Foodborne Diseases Active


Chapter III—Manuscript

Contributing factors in a successful foodborne outbreak investigation: an analysis of data collected by the Foodborne Diseases Active Surveillance Network (FoodNet), 2003-2010

Taryn R. Mecher
Christine Stauber, MS, PhD
L. Hannah Gould, MS, PhD

Send all correspondence to:
Taryn Mecher
370 Hannaford Drive
Roswell, GA 30075
Phone: 678-643-3834
Email: tmecher1@student.gsu

Abstract: 269 words
Text: 2032 words

Keywords: foodborne illness, foodborne disease, foodborne disease outbreaks, foodborne outbreak investigations
Abstract

**Background.** Foodborne disease is estimated to cause 48 million illnesses annually in the US resulting in 3000 deaths [1]. Although most infections occur as sporadic cases, outbreak surveillance offers valuable insight about the foods and pathogens responsible for illnesses [2]. A total of 1632 foodborne disease outbreaks were reported during 2011-2012 [3] and recent data indicates an overall decrease in the number of outbreaks reported each year [4]. Understanding which factors contribute to the successful identification of a food vehicle in a foodborne outbreak investigation is crucial for improving outbreak response [5-10]. The purpose of this study was to describe outbreak characteristics and to determine which may be associated with the success of a foodborne outbreak investigation (i.e. one in which a food vehicle has been reported).

**Methods.** A foodborne disease outbreak was defined as the event in which two or more people acquired similar illnesses from consuming the same food or beverage. Outbreaks occurring in FoodNet sites during 2003 through 2010 were included in the analysis.

**Results.** Data were available for 1441 (87%) of the 1655 foodborne disease outbreaks documented in FoodNet Outbreak Supplement Forms from 2003 through 2010. A food vehicle was identified in 692 of the 1441 (48%) outbreaks. Six outbreak characteristics remained statistically significant in both univariate and multivariate analyses: environmental and/or food culture collection, FDA or state agriculture involvement, outbreak size, case-control studies, and number of fecal specimens tested for norovirus.

**Conclusions.** Less than half of foodborne outbreaks examined here resulted in a food vehicle being identified. Having more robust resources available for outbreak detection and investigation may improve likelihood of a food vehicle being identified.
Foodborne disease is estimated to cause 48 million illnesses annually in the US resulting in 128,000 hospitalizations and 3000 deaths [1]. Although most infections occur as sporadic cases, outbreak surveillance offers valuable insight about the foods and pathogens responsible for illnesses [2]. An outbreak investigation may yield cause of illness, food vehicle(s), and exposure location; however, less than half of all foodborne disease outbreaks result in a food vehicle being identified [6].

Public health agencies in the United States voluntarily report foodborne disease outbreaks using the National Outbreak Reporting System (NORS). FoodNet enhances national surveillance of these outbreaks by monitoring 10 sites for lab-confirmed infections caused by nine pathogens commonly transmitted through food [11-13]. FoodNet data may provide information regarding how an outbreak investigation was conducted (i.e. agencies involved, studies conducted, specimens collected, outbreak size). Understanding which factors contribute to the success of a foodborne outbreak investigation is crucial for attributing an illness to a food vehicle and for improving outbreak response [3-8]. The purpose of this study was to describe outbreak characteristics and to determine which may be associated with the success of a foodborne outbreak investigation (i.e. one in which a food vehicle has been reported).

METHODS

Data on foodborne disease outbreaks occurring in FoodNet sites from 2003 through 2010 were included in the analysis. FoodNet monitors lab-confirmed infections caused by 9 pathogens commonly transmitted through food—Salmonella, Shiga toxin-producing Escherichia coli (STEC) O157 and non-O157, Campylobacter, Listeria,
Vibrio, Cryptosporidium, Cyclospora, Shigella, and Yersinia [11-13]. Though initially comprised of 5 states—California, Connecticut, Georgia, Minnesota, and Oregon—the surveillance area now covers 10 states and ≈15 percent of the US population. FoodNet also collects data on how outbreak investigations are conducted using FoodNet Outbreak Supplement Forms. These forms contain questions about who initially reported the outbreak; which agencies led the investigation, how they responded to the outbreak, and what challenges they encountered; what items the investigation included (i.e. case-control study, cohort study, environmental and/or food cultures); when and where contamination of foods occurred; and media coverage of the outbreak.

A foodborne disease outbreak was defined as an event in which two or more people acquired similar illnesses from consuming the same food or beverage. For each outbreak, we linked data from the FoodNet Outbreak Supplement Forms with corresponding reports in the Foodborne Disease Outbreak Surveillance System (FDOSS). These reporting systems included data regarding the mode of transmission, size of outbreak, etiologic agent, and implicated food. Only outbreaks occurring in a single state that could be linked to reports in NORS were included in the analysis.

We considered only one outcome—whether a food vehicle was identified for the specific outbreak—and defined a successful outbreak investigation as one in which a food vehicle was reported. In selecting variables, we removed those with cell counts of less than 5 for “yes” responses and greater than 50 percent missing. We chose these exclusion criteria since most variables had a large number of missing values and we wanted to be able to analyze as many variables as possible. Missing values were recategorized as “no” when appropriate. For each outbreak, we described the year of the
outbreak, the reporting state, the agencies involved, items included (i.e. case interviews, analytical epi investigation, environmental/food cultures, product traceback/recall), number of fecal specimens tested via specified methods (bacterial culture, norovirus), number of cases, type of etiologic agent, and food category.

We performed univariate analysis for each of the independent variables to determine which exposures were significantly associated with a successful outbreak investigation (FoodVehicleIdentified = “yes”). Odds ratios were calculated to estimate whether a specific outbreak characteristic—for example, food and/or environmental cultures attained in the investigation—increases the likelihood of a food vehicle being reported. Chi-square values were used for the year of the outbreak, the reporting state, and the type of etiologic agent since these variables contained more than 2 categories. We then used forward stepwise selection to build a logistic model comprised of variables significantly affecting the outcome of an investigation. We conducted statistical analyses using SAS software version 9.3 (SAS Institute), and Excel and Access software, version 2013 (Microsoft). We submitted an Application for Designation of Not Human Subjects Research to Georgia State University’s Institutional Review Board and earned permission to use data from FoodNet Outbreak Supplement Forms.

**RESULTS**

We included data for 1441 (87%) of the 1655 foodborne disease outbreaks documented in the FoodNet Outbreak Supplement Forms from 2003 through 2010. Excluded outbreaks represented those for which no record existed in FDOSS, data did not support a foodborne outbreak (i.e. other mode of transmission), or exposure occurred in
multiple states. A mean of 180 foodborne disease outbreaks were reported annually (range, 105-251) (Figure 1), and variability in the number and rate of outbreaks reported was observed among sites (Figures 3 and 4). Both year ($\chi^2 = 14.7$) (Table 2) and reporting state ($\chi^2 = 535.4$) (Table 3) were significantly associated with a successful outbreak investigation, but neither of these factors significantly affected the outcome of a foodborne investigation when all other factors were considered.

A food vehicle was identified in 692 (48%) of the 1441 outbreaks (Table 1). During 2003 through 2010, the percentage of outbreaks with a food vehicle identified ranged from 37% in 2007 to 55% in 2004 (Figure 5). Approximately 23% of these outbreaks were attributed to multiple food categories and 25% were attributed to a single food category. Of the foodborne disease outbreaks in which the food vehicle could be classified into a single category, meat-poultry and produce were the most common (Figure 6).

An etiologic agent was identified in 1218 (85%) of the 1441 outbreaks (Table 1). Only a small percentage of outbreaks were attributed to multiple etiologies. Of the foodborne disease outbreaks in which the etiologic agent could be classified as a single etiology, viral and bacterial were the most common (Figure 7). Etiology was significantly associated with a successful outbreak investigation ($\chi^2 = 101.7$) (Table 5), but this factor did not significantly affect the outcome of a foodborne investigation when all other factors were considered.

The agencies most often involved in an outbreak investigation were local and/or regional health departments (n=1227; 85%) or 1 or more state health departments (n=925; 64%) (Table 4). Outbreak investigations that involved FDA (OR, 13.6; 95% CI,
4.2-44.5), USDA (OR, 8.8; 95% CI, 2.0, 38.6), state agriculture (OR, 4.7; 95% CI, 2.7-8.3), CDC (OR, 3.1; 95% CI, 1.5-6.5), or 1 or more state health departments (OR, 1.4; 95% CI, 1.1-1.7) were found to be significantly associated with a successful outbreak investigation (Table 4). When all other factors were considered, FDA ($\chi^2=22.6$) and state agriculture ($\chi^2=18.7$) were the only agencies whose involvement significantly affected the outcome of a foodborne investigation (Table 6).

The items most commonly included in an outbreak investigation were case interviews (n=674; 47%) or EHS inspection and/or EHSNET evaluation (n=636; 44%) (Table 4). Outbreak investigations in which environmental and/or food cultures were collected (OR, 3.8; 95% CI, 2.4-5.9), state agriculture was contacted (OR, 4.2; 95% CI, 2.3-7.6), conference calls were held (OR, 5.4; 95% CI, 2.5-11.6), case-control studies were conducted (OR, 1.4; 95% CI, 1.04-1.8), or product traceback was done (OR, 1.8; 95% CI, 1.001-3.1) were found to be significantly associated with a successful outbreak investigation (Table 4). Collecting environmental and/or food cultures, conducting case interviews, and conducting case-control studies were the only items whose inclusion significantly affected the outcome of a foodborne outbreak investigation when all other factors were considered (Table 6).

Fecal specimens were tested for bacterial culture in 553 (38%) and for norovirus in 340 (24%) of the 1441 foodborne disease outbreaks (Table 4). Testing more than two fecal specimens via bacterial culture increased the odds of identifying a food vehicle by 30 percent (OR, 1.3; 95% CI, 1.4-1.6). When all other factors were considered, the number of fecal specimens tested for norovirus significantly affected the outcome of a foodborne outbreak investigation (Table 6).
In 688 (48%) of the 1441 foodborne disease outbreaks, more than 10 individuals became ill (Table 4). Outbreaks affecting more than 10 cases contributed to a 30% higher likelihood of identifying a food vehicle as compared with those with 10 or fewer cases (OR, 1.3; 95% CI, 1.0-1.6) (Table 4). When all other factors were considered, outbreak size significantly affected the outcome of a foodborne outbreak investigation (Table 6).

**DISCUSSION**

Our findings describe the outbreak characteristics associated with a food vehicle being identified and have a few important implications. Foodborne disease outbreak investigations were found to be most successful when environmental and/or food cultures were collected, FDA or state agriculture was involved, and case-control studies were conducted.

During 2003 through 2010, the number of foodborne disease outbreaks reported to FDOSS varied both by year and by reporting state. These variations may be attributed to differences in the resources available—laboratory testing, funding sources, skilled health workers, training opportunities— as well as regional variations in foodborne illnesses. Further research is needed to understand how these factors affect outbreak investigations at the individual state level.

We determined that several of the exposures were significantly associated with a successful outbreak investigation. Having 1 or more regulatory agencies (FDA, USDA, state agriculture) involved in an investigation substantially improved the likelihood of a food vehicle being identified. This is not surprising since state agriculture, FDA or USDA are sometimes not brought into an investigation until there is greater likelihood of
identifying a specific food [14]. The likelihood also increased when either CDC or 1 or more state health departments was involved in the outbreak investigation. These results were consistent with the studies conducted by the National Environmental Health Association (NEHA) [15] and the Environmental Health Specialists Network (EHS-Net) [10], both of which reported that lack of cooperation among health agencies and inavailability of resources may halt progress of an outbreak investigation. To better understand the roles of regional and local health departments, it would be helpful to consider whether the state has a home rule system (i.e. one in which a local or regional health department receives the initial report and relays this information to the state health department) or a centralized system (i.e. one in which a state health department handles the outbreak investigation). We found that investigations which included conference calls, contact with state agriculture, and environmental and/or food cultures were associated with a substantial increase in the odds of a food vehicle being identified. Case-control studies and product traceback were also found to increase these odds. These results are not surprising since doing a product traceback gives the investigators a good idea of which food is responsible for an outbreak [14]. Testing >2 fecal specimens for bacterial culture also proved to be a critical component of a successful outbreak investigation, but testing >3 fecal specimens for norovirus was not associated with an increased likelihood of a food vehicle being identified. These results are somewhat surprising since we would expect that testing more fecal specimens for norovirus would have increased the odds of a food vehicle being identified. There exist no standard methods for identifying a viral agent in foods, which may explain why so few of the outbreaks that tested more than 3 fecal specimens for norovirus resulted in a food vehicle being identified [8]. We were
also surprised to learn that neither case interviews nor product recall was associated with an increased likelihood of a food vehicle being identified. Some research [10, 14] suggested that shifting focus toward obtaining food, environmental and stool samples would likely improve the likelihood that a pathogen and food vehicle are identified.

We found that outbreaks affecting more than 10 individuals contributed to a sizable increase in the odds of a food vehicle being identified as compared with those with 10 or fewer cases. Investigations for larger outbreaks also tend to have the resources necessary to conduct epidemiological studies and to collect laboratory specimens [16]. Although attributing illnesses to food may prove difficult even for large outbreaks [16], outbreak size is important because outbreaks with a high number of ill persons are more likely to be detected, reported and investigated [8].

While these results offer insight regarding the characteristics of a successful foodborne outbreak investigation, a major limitation was that the data obtained from the FoodNet Outbreak Supplement Forms may have been incomplete or inaccurate. During 2003-2010, the format of these forms changed and not all questions were asked each year. Most of the variables chosen had a large number of missing values, which we recategorized as “no” when appropriate, so this might have affected our results. Another limitation was that these reports are done voluntarily, so not all outbreaks may be captured. Since we evaluated outbreak characteristics at the 10 sites which participate in the FoodNet active surveillance, our results may not be generalizable to the US population. The number of reported foodborne disease outbreaks at FoodNet sites was similar in pattern of frequency when compared with national data (Figures 1 and 2), which implies that examining outbreaks in FoodNet may provide insight regarding how
outbreak investigations can be improved. Less than half of foodborne disease outbreaks examined here resulted in a food vehicle being identified. The results of this study suggest that having more robust resources available for outbreak detection and investigation would improve likelihood of a food vehicle being identified.
**Figure 1.** Number\(^a\) of foodborne disease outbreaks by year. FoodNet OB Supplement forms, 2003-2010.

\(^a\)N=1,441
Figure 2. Number* of foodborne disease outbreaks by year, FDOSS, 2003-2010.

*N=8,311
Figure 3. Number\textsuperscript{*} of foodborne disease outbreaks by state\textsuperscript{**}, FoodNet OB Supplement forms, 2003-2010.

\textsuperscript{*}N=1,441

\textsuperscript{**}New York, California, and Colorado only include selected counties in the states in FoodNet, which is why a large state like California has so few outbreaks included in this study.
*N=1,441

**New York, California, and Colorado only include selected counties in the states in FoodNet, which is why a large state like California has so few outbreaks included in this study. The reporting rate for New Mexico is consistently lower than the other states, which helps to explain why this state has so few outbreaks included in this study.
Figure 5. Percentage of foodborne disease outbreaks with food vehicle(s) identified* by year, FoodNet OB Supplement forms, 2003-2010

*n=692 (48.0%) of the total 1,441 foodborne disease outbreaks reported in the supplement forms
Figure 6. Percentage of foodborne disease outbreaks with a single food vehicle identified* by category, FoodNet OB Supplement forms, 2003-2010.

*N=322
Figure 7. Percentage of foodborne disease outbreaks with a single etiology identified* by etiology group, FoodNet OB Supplement forms, 2003-2010.

*N=1215

<table>
<thead>
<tr>
<th>Description</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of foodborne disease outbreaks</td>
<td>1441</td>
</tr>
<tr>
<td>Outbreaks in which a food vehicle was identified</td>
<td>692 (48.0)</td>
</tr>
<tr>
<td>Outbreaks in which an etiologic agent was identified</td>
<td>1218 (84.5)</td>
</tr>
<tr>
<td>Outbreaks in which case interviews were included</td>
<td>674 (46.8)</td>
</tr>
<tr>
<td>Outbreaks in which case-control studies were included</td>
<td>228 (15.8)</td>
</tr>
<tr>
<td>Outbreaks in which food/environmental samples were collected</td>
<td>113 (7.8)</td>
</tr>
<tr>
<td>Outbreaks in which product traceback and/or recall were included</td>
<td>66 (4.6)</td>
</tr>
</tbody>
</table>
Table 2. Univariate analysis of the year during which a foodborne disease outbreak occurred, FoodNet OB Supplement forms, 2003-2010.

<table>
<thead>
<tr>
<th>Year of Outbreak</th>
<th>Food Vehicle Identified, No. (%)</th>
<th>Chi-Square</th>
<th>Significance (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Chi-Square</td>
</tr>
<tr>
<td>2003</td>
<td>95 (6.7)</td>
<td>118 (8.2)</td>
<td>14.7</td>
</tr>
<tr>
<td>2004</td>
<td>121 (8.4)</td>
<td>100 (6.9)</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>94 (6.5)</td>
<td>86 (6.0)</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>119 (8.3)</td>
<td>132 (9.2)</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>44 (3.1)</td>
<td>75 (5.2)</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>100 (6.9)</td>
<td>106 (7.4)</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>56 (3.9)</td>
<td>49 (3.4)</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>63 (4.4)</td>
<td>83 (5.8)</td>
<td></td>
</tr>
</tbody>
</table>

*This variable was significant at alpha=0.05.
Table 3. Univariate analysis of the state where a foodborne disease outbreak occurred, FoodNet OB Supplement forms, 2003-2010.

<table>
<thead>
<tr>
<th>Reporting State</th>
<th>Food Vehicle Identified, No. (%)</th>
<th>Chi-Square</th>
<th>Significance (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
<td>No (%)</td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>22 (1.5)</td>
<td>27 (1.9)</td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>63 (4.4)</td>
<td>74 (5.1)</td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>59 (4.1)</td>
<td>31 (2.2)</td>
<td></td>
</tr>
<tr>
<td>Georgia</td>
<td>72 (5.0)</td>
<td>98 (6.8)</td>
<td></td>
</tr>
<tr>
<td>Maryland</td>
<td>82 (5.7)</td>
<td>83 (5.8)</td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>195 (13.5)</td>
<td>170 (11.8)</td>
<td>535.4, &lt;0.0001*</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2 (0.1)</td>
<td>11 (0.8)</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>58 (4.0)</td>
<td>32 (2.2)</td>
<td></td>
</tr>
<tr>
<td>Oregon</td>
<td>71 (4.9)</td>
<td>145 (10.1)</td>
<td></td>
</tr>
<tr>
<td>Tennessee</td>
<td>68 (4.7)</td>
<td>78 (5.4)</td>
<td></td>
</tr>
</tbody>
</table>

*This variable was significant at alpha=0.05.
Table 4. Univariate analysis of outbreak characteristics, FoodNet OB Supplement forms, 2003-2010.

<table>
<thead>
<tr>
<th>Outbreak Characteristic</th>
<th>Food Vehicle Identified, No. (%)</th>
<th>Odds ratio (95% CI)</th>
<th>Significance (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agencies substantially involved in investigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local &amp;/or regional health depts.</td>
<td>Yes 580 (40.3) No 112 (7.8)</td>
<td>0.82 (0.61, 1.1)</td>
<td>0.1710</td>
</tr>
<tr>
<td>1 or more state health depts.</td>
<td>Yes 471 (32.7) No 221 (15.3)</td>
<td>1.4 (1.1, 1.7)</td>
<td>0.0032**</td>
</tr>
<tr>
<td>FoodNet group</td>
<td>Yes 58 (4.0) No 634 (44.0)</td>
<td>1.5 (0.98, 2.2)</td>
<td>0.0638</td>
</tr>
<tr>
<td>CDC</td>
<td>Yes 28 (1.9) No 664 (46.1)</td>
<td>3.1 (1.5, 6.5)</td>
<td>0.0013**</td>
</tr>
<tr>
<td>FDA</td>
<td>Yes 36 (2.5) No 654 (45.5)</td>
<td>13.6 (4.2, 44.5)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>USDA</td>
<td>Yes 16 (1.1) No 676 (46.9)</td>
<td>8.8 (2.0, 38.6)</td>
<td>0.0005**</td>
</tr>
<tr>
<td>State agriculture</td>
<td>Yes 65 (4.5) No 627 (43.5)</td>
<td>4.7 (2.7, 8.3)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>Active case finding</td>
<td>Yes 122 (8.5) No 570 (39.5)</td>
<td>1.2 (0.90, 1.6)</td>
<td>0.2168</td>
</tr>
<tr>
<td>Case interviews</td>
<td>Yes 307 (21.3) No 385 (26.7)</td>
<td>0.83 (0.67, 1.02)</td>
<td>0.0781</td>
</tr>
<tr>
<td>Chart or record review</td>
<td>Yes 9 (0.6) No 683 (47.4)</td>
<td>0.81 (0.34, 1.9)</td>
<td>0.6332</td>
</tr>
<tr>
<td>Case-control study</td>
<td>Yes 125 (8.7) No 567 (39.4)</td>
<td>1.4 (1.04, 1.8)</td>
<td>0.0250**</td>
</tr>
<tr>
<td>Cohort study</td>
<td>Yes 122 (8.5) No 570 (39.5)</td>
<td>1.1 (0.83, 1.4)</td>
<td>0.5419</td>
</tr>
<tr>
<td>EHS inspection &amp;/or EHSNET evaluation</td>
<td>Yes 296 (20.5) No 396 (27.5)</td>
<td>0.90 (0.73, 1.1)</td>
<td>0.3171</td>
</tr>
<tr>
<td>Environmental &amp;/or food cultures</td>
<td>Yes 86 (6.0) No 606 (42.0)</td>
<td>3.8 (2.4, 5.9)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>Product traceback</td>
<td>Yes 32 (2.2) No 660 (45.8)</td>
<td>1.8 (1.001, 3.1)</td>
<td>0.0469**</td>
</tr>
<tr>
<td>Product recall</td>
<td>Yes 6 (0.4) No 686 (47.6)</td>
<td>0.81 (0.28, 2.3)</td>
<td>0.6975</td>
</tr>
<tr>
<td>Contact with state agriculture</td>
<td>Yes 51 (3.5) No 641 (44.5)</td>
<td>4.2 (2.3, 7.6)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>Conference calls</td>
<td>Yes 38 (2.6) No 654 (45.4)</td>
<td>5.4 (2.5, 11.6)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>No. fecal specimens tested via specified methods*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacterial culture</td>
<td>&gt;2 287 (19.9) ≤2 405 (28.1)</td>
<td>1.3 (1.04, 1.6)</td>
<td>0.0201**</td>
</tr>
<tr>
<td>Norovirus</td>
<td>&gt;3 143 (9.9) ≤3 549 (38.1)</td>
<td>0.73 (0.57, 0.93)</td>
<td>0.0118**</td>
</tr>
<tr>
<td>No. cases in outbreak*</td>
<td>Greater than 10 352 (24.4)</td>
<td>1.3 (1.03, 1.6)</td>
<td>0.0226**</td>
</tr>
<tr>
<td></td>
<td>Less than or equal to 10 340 (23.6)</td>
<td>413 (28.7)</td>
<td></td>
</tr>
</tbody>
</table>

*Since the distribution of these variables was very positively skewed and each of them had so many different values, the median values were used as cut-off points for these analyses.

**These variables were significant at alpha=0.05.
Table 5. Univariate analysis of types of etiologic agents identified for a specific foodborne disease outbreak, FoodNet OB Supplement forms, 2003-2010.

<table>
<thead>
<tr>
<th>Type of etiologic agent</th>
<th>Food Vehicle Identified, No. (%)</th>
<th>Chi-Square</th>
<th>Significance (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
<td></td>
</tr>
<tr>
<td>Viral</td>
<td>278 (19.3)</td>
<td>439 (30.5)</td>
<td>101.7</td>
</tr>
<tr>
<td>Unknown</td>
<td>88 (6.1)</td>
<td>135 (9.4)</td>
<td></td>
</tr>
<tr>
<td>Parasitic</td>
<td>8 (0.6)</td>
<td>3 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td>44 (3.1)</td>
<td>5 (0.4)</td>
<td></td>
</tr>
<tr>
<td>Bacterial</td>
<td>271 (18.9)</td>
<td>167 (11.6)</td>
<td></td>
</tr>
</tbody>
</table>

*This variable was significant at alpha=0.05.

<table>
<thead>
<tr>
<th>Outbreak Characteristic</th>
<th>Entered</th>
<th>Removed</th>
<th>Odds ratio (95% CI)</th>
<th>DF</th>
<th>Score Chi-Square</th>
<th>Wald Chi-Square</th>
<th>Pr &gt; ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental &amp;/or Food Cultures</td>
<td></td>
<td></td>
<td>3.8 (2.4, 5.9)</td>
<td>1</td>
<td>38.7</td>
<td>&lt;0.0001**</td>
<td></td>
</tr>
<tr>
<td>FDA</td>
<td></td>
<td></td>
<td>13.6 (4.2, 44.5)</td>
<td>1</td>
<td>22.6</td>
<td>&lt;0.0001**</td>
<td></td>
</tr>
<tr>
<td>State Agriculture</td>
<td></td>
<td></td>
<td>4.7 (2.7, 8.3)</td>
<td>1</td>
<td>18.7</td>
<td>&lt;0.0001**</td>
<td></td>
</tr>
<tr>
<td>Case Interviews</td>
<td></td>
<td></td>
<td>0.83 (0.67, 1.02)</td>
<td>1</td>
<td>12.8</td>
<td>0.0004**</td>
<td></td>
</tr>
<tr>
<td>Outbreak Size Group (&gt;10, ≤ 10 cases)</td>
<td></td>
<td></td>
<td>1.3 (1.03, 1.6)</td>
<td>1</td>
<td>6.4</td>
<td>0.0116**</td>
<td></td>
</tr>
<tr>
<td>Case-Control Study</td>
<td></td>
<td></td>
<td>1.4 (1.04, 1.8)</td>
<td>1</td>
<td>4.3</td>
<td>0.0386**</td>
<td></td>
</tr>
<tr>
<td>No. Fecal Specimens Tested for Norovirus (&gt;3, ≤ 3)</td>
<td></td>
<td></td>
<td>0.73 (0.57, 0.93)</td>
<td>1</td>
<td>4.2</td>
<td>0.0400**</td>
<td></td>
</tr>
<tr>
<td>No. Fecal Specimens Tested via Bacterial Culture (&gt;2, ≤ 2)</td>
<td></td>
<td></td>
<td>1.3 (1.04, 1.6)</td>
<td>1</td>
<td>3.5</td>
<td>0.0630</td>
<td></td>
</tr>
<tr>
<td>No. Fecal Specimens Tested via Bacterial Culture (&gt;2, ≤ 2)</td>
<td></td>
<td></td>
<td>1.3 (1.04, 1.6)</td>
<td>1</td>
<td>3.5</td>
<td>0.0632</td>
<td></td>
</tr>
</tbody>
</table>

*Chi-square value for model: $\chi^2_{HF}$ (df=7) = 1.59; Prob $\chi^2_{HF} = 0.9789$.

**These variables were significant at alpha=0.05.
References


Appendix A: Annotated Foodborne OB Supplement Form

<table>
<thead>
<tr>
<th>Foodborne OB Supplement</th>
<th>State</th>
<th>State</th>
<th>County</th>
<th>County</th>
<th>eCRS ID #</th>
<th>D</th>
<th>State Outbreak ID</th>
<th>StateoutbreakID</th>
</tr>
</thead>
</table>

**What was the source of the initial outbreak report to the public health system in your state?**
- [ ] private citizen report
- [ ] reportable disease surveillance blip
- [ ] syndromic surveillance blip
- [ ] nursing home/ALC staff report
- [ ] PFGE match
- [ ] other

**Date of second outbreak case illness onset?**
- [ ] date
- [ ] m/d/y
- [ ] date

**Which agencies were substantially involved in the investigation? (check all that apply)**
- [ ] MSKD
- [ ] CDC
- [ ] FDA
- [ ] MD
- [ ] USDA
- [ ] SHD
- [ ] state Ag
- [ ] SAG
- [ ] InvOth

**Who designed the investigation?**
- [ ] CaseInt
- [ ] ChrRev
- [ ] CaCoSt
- [ ] GehoSt
- [ ] ProdTrac
- [ ] Envi
- [ ] FoodCo
- [ ] ProdRec
- [ ] FoodCol
- [ ] ContUSDA
- [ ] ContC DC
- [ ] ContFDA
- [ ] ContConfDA
- [ ] ContC Eng
- [ ] ContC
- [ ] ContC SHD
- [ ] ContC MD
- [ ] ContC USDA

**How many foods were implicated?**
- [ ] none
- [ ] no food available
- [ ] no food implicated

**How many food workers were tested?**
- [ ] none
- [ ] no food workers
- [ ] no food workers tested

**On what date was a vehicle for this outbreak identified with reasonable certainty?**
- [ ] date
- [ ] m/d/y

**What was the contamination of the vehicle in this outbreak?**
- [ ] no idea
- [ ] other

**What type of intervention was conducted as a response to this outbreak?**
- [ ] close
- [ ] fooddisc
- [ ] foodreac
- [ ] inabsc
- [ ] othdisc
- [ ] othreac
- [ ] other

**On what date did the first intervention begin?**
- [ ] date
- [ ] m/d/y

**Completed by**
- [ ] agency
- [ ] date

*January 1, 2009*
### Foodborne OB Supplement

**What problems significantly affected the success of this investigation? (check all that apply)**

- too few cases
- too few controls available
- inadequate case finding
- everybody ate everything syndrome
- lack of cooperation from cases
- lack of cooperation from local HD
- delayed notification of local HD
- delayed notification from local HD to state
- weekend/overtime staffing limits
- inadequate study design/sampling
- methodology/bad questionnaire
- no trained HD staff available
- DELLHD
- DELSHD
- FERWC
- INACFIND
- EVERYATE
- BADQUEST
- HDISAFF
- INAQSSTD
- NACCD
- NCOOP
- NSCOOP
- PROB

**Was there any media coverage of this outbreak investigation?**

- yes
- no
- unknown

**If yes, was the media coverage initiated by the investigating agency?**

- yes
- no
- unknown

**If the media coverage was initiated by the investigating agency, what was the intent of the coverage?**

- to find additional cases
- to alert the public to potential contamination of a commercial product
- other

**If the media coverage was not initiated by the investigating agency, how did the media find out about the outbreak?**

- from an outbreak case
- from unusual occurrence of the outbreak that was leaked
- other

**Did the media coverage hinder the investigation?**

- yes (explain how)
- no
- unknown

**Was an after-action review, involving more than one agency or investigational group, conducted after this outbreak?**

- yes
- no
- unknown

**Comments**

---

Completed by: [Name]

Agency: [Agency]

Date: January 1, 2009
## Appendix B: eFORS Reporting Form

### Part 1: Basic Information

1. **Report Type**
   - Please check if this is a final report
   - Please check if data does not support a FOODBORNE outbreak

2. **Number of Cases**
   - Lab-confirmed cases (A) including secondary cases
   - Probable cases (B) including secondary cases
   - Estimated total ill

3. **Dates**
   - First case became ill
   - Last case became ill
   - First known exposure
   - Last known exposure

4. **Location of Exposure**
   - Reporting state
   - If multiple states involved:
     - Exposures occurred in multiple states
     - Exposures occurred in single state, but cases resident in multiple states
     - Other states
   - Reporting county
   - If multiple counties involved:
     - Exposures occurred in multiple counties
     - Exposures occurred in one county, but cases resident in multiple counties
     - Other counties

5. **Approximate Percentage of Cases in Each Age Group**
   - <1 year
   - 1-4 yrs
   - 5-19 yrs
   - ≥20 yrs
   - Unknown

6. **Sex**
   - (Estimated percent of the total cases)
   - Male
   - Female

7. **Investigation Methods** (Check all that apply)
   - Interviews of only cases
   - Case-control study
   - Food preparation review
   - Cohort study
   - Investigation at facility or production plant
   - Investigation at original source (farm, marina, etc.)
   - Food product traceback
   - Environment/food sample cultures

### Part 2: Implicated Food(s)

<table>
<thead>
<tr>
<th>Name of Food</th>
<th>Main Ingredient(s)</th>
<th>Contaminated Ingredient(s)</th>
<th>Reason(s) Suspected</th>
<th>Method of Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g., Lasagna</td>
<td>e.g., Pasta, sauce, beef</td>
<td>e.g., Eggs</td>
<td>e.g., 4</td>
<td>e.g., MI</td>
</tr>
<tr>
<td>1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Food vehicle underinvestigated*

**Reason Suspected (List above all that apply)**
1. Statistical evidence from epidemiological investigation
2. Other data (e.g., same type pathogen found in farm that supplied eggs)
3. Laboratory evidence (e.g., identification of pathogen in food)
4. Specific evidence lacking, but prior experience makes it likely source
5. Compelling supportive information

---

Public reporting burden of this collection of information is estimated to average 20 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. To report a problem regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, contact CDC/TSOR Reports Clearance Officer, 1600 Clifton Road NE, MS D74, Atlanta, Georgia 30333, ATTN: prA (0920-0004).
9. Etiology: (Name the bacteria, virus, parasite, or toxin. If available, include the serotype and other characteristics such as plagues type, virulence factors, and metabolic profile. Confirmation criteria available at [https://www.cdc.gov/foodborneoutbreaks/results, fit.html](https://www.cdc.gov/foodborneoutbreaks/results, fit.html) or MMWR/3095/5 Vol. 35/5 2004) 

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Serotype</th>
<th>Other Characteristics (e.g., plague type)</th>
<th>Detected In (check one and below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Etiology undetermined

Detected In (List above all that apply):
1. Patient specimen(s)
2. Food specimen(s)
3. Environment specimen(s)
4. Food Worker specimen(s)

10. Isolate Subtype

<table>
<thead>
<tr>
<th>State Lab ID</th>
<th>PFGE (PulseNet designation)</th>
<th>PFGE (PulseNet designation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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)
- NA

Proliferation/Amplification Factor (bacterial outbreaks only)
- cP1
- cP2
- cP3
- cP4
- cP5
- cP6
- cP7
- cP8
- cP9
- cP10
- cP11
- cP12 (describe in Comments)
- NA

Survival Factor (microbial outbreaks only)
- cS1
- cS2
- cS3
- cS4
- cS5 (describe in Comments)
- NA

Was food-worker implicated as the source of contamination? □ Yes □ No
If yes, please check only one of following:
- laboratory and epidemiologic evidence
- evidence of lab contamination
- lab evidence (w/o epidemiologic evidence)
- prior experience makes this the likely source (please explain in Comments)

CDC 52.13 revised November, 2004
### Part 2: Additional Information

#### 12. Symptoms, Signs and Outcomes

<table>
<thead>
<tr>
<th>Feature</th>
<th>Cases with symptoms/feature</th>
<th>Total cases for whom you have information available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthcare provider visit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloody stools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUS or TTP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 13. Incubation Period

(Circle appropriate units)
- Shortest: _____ (Hours, Days)
- Longest: _____ (Hours, Days)
- Median: _____ (Hours, Days)

*Unknown

#### 14. Duration of Illness

(Among those who recovered)
(Circle appropriate units)
- Shortest: _____ (Hours, Days)
- Longest: _____ (Hours, Days)
- Median: _____ (Hours, Days)

*Unknown

#### 15. If Cohort Investigation Conducted:

\[
\text{Attack rate}^* = \frac{\text{Exposed and ill}}{\text{Exposed and ill} \times 100} = \%.
\]

* 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, and the denominator is the total number of persons exposed in 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)
- Restaurant or deli
- Nursing home
- Day care center
- Prison, jail
- School
- Private home
- Office setting
- Workplace, not cafeteria
- Workplace cafeteria
- Wedding reception
- Banquet facility
- Church, temple, etc.
- Picnic
- Camp
- Cruise
- Contaminated food imported into U.S.
- Grocery Store
- Hospital
- Fair, festival, temporary/ mobile services
- Commercial product, served without further preparation
- Unknown or undetermined
- Other (Describe)

#### 17. Location of Exposure or Where Food Was Eaten

(Check all that apply)
- Restaurant or deli
- Nursing Home
- Day care center
- Prison, jail
- School
- Private home
- Office Setting
- Workplace, not cafeteria
- Workplace cafeteria
- Wedding Reception
- Banquet Facility
- Church, temple, etc.
- Picnic
- Camp
- Grocery Store
- Hospital
- Fair, festival, temporary/ mobile service
- Unknown or undetermined
- Other (Describe)

#### 11. Trace back

- Please check if trace back conducted

<table>
<thead>
<tr>
<th>Source (e.g., Chicken farm, Tomato processing plant)</th>
<th>Location of Source</th>
<th>Country</th>
<th>Comments</th>
</tr>
</thead>
</table>

CDC 52.13 revised November, 2004
19. Recall
- Please check if any food product recalled
   Recall Comments
   
20. Available Reports (Please attach)
- Unpublished agency report
- Title Add report
- Publication (please reference if not attached)
   
21. Agency reporting this outbreak
   Contact person:
   Name
   Title
   Phone
   Fax
   E-mail
   
22. Remarks
   Briefly describe important aspects of the outbreak not covered above
   (e.g., massout closure, immunoglobulin administration, economic impact, etc)
   
Part 3: School Questions

1. Did the outbreak involve a single or multiple schools?
   - Single
   - Multiple (\(\text{\# of \# of schools}\))

2. School characteristics: (for all involved students in all involved schools)
   a. Total approximate enrollment
      (number of students)
      - Unknown or Undetermined
   b. Grade level(s) (Please check all grades affected)
      - Preschool
      - Grade school (grades K-12)
      - College/University/Technical School
      - Unknown or Undetermined
   c. Primary funding of involved school(s)
      - Public
      - Private
      - Unknown or Undetermined

3. Describe the preparation of the implicated item:
   - Heat and serve (served mostly prepared or cooked off-site, reheated on-site)
   - Served à la carte
   - Served only (prepared or served cold)
   - Cooked on-site using primary ingredients
   - Provided by a food service management company
   - Provided by a fast food vendor
   - Provided by a prep-cook company
   - Sold at a school fundraising event
   - Served in the classroom
   - Brought by student/teacher/parent
   - Other
   - Unknown or Undetermined

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?*
   - Once
   - Twice
   - More than two times
   - Not inspected
   - Unknown or Undetermined

5. Does the school have a HACCP plan in place for the school feeding program?*
   - Yes
   - No
   - Unknown or Undetermined

*If there are multiple schools involved, please answer according to the most affected school

CDC 52.15 revised November, 2004
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:  
   - UIDA 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

1. Mode of Transmission (for E. coli O157:H7 or Salmonella Enteritidis only)
   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 uncooked?
   - Pooling?

2. If eggs traced back to farm, was Salmonella Enteritidis found on the farm?
   - Yes  
   - No  
   - Unknown or Undetermined

Comment: ____________________________________________

CDC 52.13 revised November, 2004
Contamination Factors:  
1. Toxic substance part of tissue (e.g., cigaretes)  
2. Poisonous substance intentionally added (e.g., cyanide or phenolphthalein added to cause illness)  
3. Poisonous or physical substance accidentally/incorrectly added (e.g., sanitizer or cleaning compound)  
4. Addition of excessive quantities of ingredients that are toxic under these situations (e.g., sodium polystyrene in bread)  
5. Toxic container or pipelines (e.g., galvanized containers with acid food, copper pipe with contaminated beverages)  
6. Raw product ingredient contaminated by pathogens from animal or environment (e.g., Salmonella Enteritidis in egg, Norwalk in shellfish, E. coli in sprouts)  
7. Ingestion of contaminated raw products (e.g., raw shellfish, produce, eggs)  
8. Obtaining food from polluted sources (e.g., shellfish)  
9. Cross-contamination from raw ingredient of animal origin (e.g., raw poultry or the cutting board)  
10. Bare-hand contact by handler/worker/preparer (e.g., with ready-to-eat food)  
11. Glove-handled contact by handler/worker/preparer (e.g., with ready-to-eat food)  
12. Handling by an infected person or carrier of pathogen (e.g., Staphylococcus, Salmonella, Norwalk agent)  
13. Inadequate cleaning of processing/preparation equipment/utensils leads to contamination of vehicle (e.g., cutting boards)  
14. Storage in contaminated environment leads to contamination of vehicle (e.g., store room, refrigerator)  
15. Other source of contamination (please describe in Comments)

Proliferation/Amplication Factors:  
1. P1 - Allowing foods to remain at warm outdoor temperature for several hours (e.g., during preparation or holding for service)  
2. P2 - Slow cooling (e.g., deep containers or large roasts)  
3. P3 - Inadequate cold-holding temperature (e.g., refrigerator inadequate/not working, left holding inadequate)  
4. P4 - Preparing foods a half day or more before serving (e.g., banquet preparation a day in advance)  
5. P5 - Protracted cold storage for several weeks (e.g., permits slow growth of psychotrophic pathogens)  
6. P6 - Insufficient time and/or temperature during hot holding (e.g., malfunctioning equipment, too large a mass of food)  
7. P7 - Insufficient acidification (e.g., home canned foods)  
8. P8 - Insufficiently low water activity (e.g., smoked/salted fish)  
9. P9 - Inadequate thawing of frozen products (e.g., room thawing)  
10. P10 - Anaerobic packaging/Modified atmosphere (e.g., vacuum-packed fish, salad in gas flushed bag)  
11. P11 - Inadequate fermentation (e.g., processed meat, cheese)  
12. P12 - Other situations that promote or allow microbial growth or toxin 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)  
2. S2 - Insufficient time and/or temperature during reheating (e.g., soups, roasts)  
3. S3 - Inadequate acidification (e.g., mayonnaise, tomatoes canned)  
4. S4 - Inadequate thawing, followed by insufficient cooking (e.g., frozen turkey)  
5. S5 - Other process failures that permit the agent to survive (please describe in Comments)

Method of Preparation:  
1. M1 - Food eaten raw or lightly cooked (e.g., hard shell clams, sunny side up eggs)  
2. M2 - Solid masses of potentially hazardous foods (e.g., casseroles, lasagna, stuffing)  
3. M3 - Multiple foods (e.g., smorgasbord, buffet)  
4. M4 - Cooked foods (e.g., steak, fish fillet)  
5. M5 - Natural toxinant (e.g., poisonous mushroom, paralytic shellfish poisoning)  
6. M6 - Roasted meat/poultry (e.g., roast beef, roast turkey)  
7. M7 - Salads prepared with one or more cooked ingredients (e.g., macaroni, potato, tuna)  
8. M8 - Liquid or semi-solid mixtures of potentially hazardous foods (e.g., gravy, chili sauce)  
9. M9 - Chemical contamination (e.g., heavy metal, pesticide)  
10. M10 - Baked goods (e.g., pies, éclairs)  
11. M11 - Commercially processed foods (e.g., canned foods and vegetables, ice cream)  
12. M12 - Sandwiches (e.g., hot dog, hamburger, Monte Cristo)  
13. M13 - Beverages (e.g., carbonated and non-carbonated, milk)  
14. M14 - Salads with raw ingredients (e.g., green salad, fruit salad)  
15. M15 - Other, does not fit into above categories (please describe in Comments)  
16. M16 - Unknown, vehicle was not identified

Appendix C: Annotated NORS Reporting Form

### National Outbreak Reporting System

**Foodborne Disease Transmission, Person-to-Person Disease Transmission, Animal Contact**

This form is used to report specific foodborne, person-to-person, and animal contact-related disease outbreak investigations. This form has five sections: General, Laboratory, Reporting, Person-to-Person, Animal Contact, and Food, as indicated by tabs at the top of each page. Complete the General and Laboratory tabs for all modes of transmission and complete additional sections as indicated by the mode of transmission. Please complete as much of all sections as possible.

#### General Section

**Primary Mode of Transmission (check one)**

- [ ] Food (complete General, Lab, and Food tabs)
- [ ] Water (complete CDC 52.12)
- [ ] Animal contact (complete General, Lab, and Animal Contact tabs)

#### Investigation Methods (check all that apply)

- [ ] Interviews only of ill persons
- [ ] Case-control study
- [ ] Cohort study
- [ ] Food preparation review
- [ ] Water system assessment: Drinking water
- [ ] Water system assessment: Nonpotable water

**Comments**

---

#### Dates (mm/dd/yyyy)

- Date first case became ill (required) __/__/____
- Date last case became ill __/__/____
- Date of initial exposure __/__/____
- Date of last exposure __/__/____
- Date of report to CDC (other than this form) __/__/____
- Date of notification to State/Territory or Local Tribal Health Authorities __/__/____

#### Geographic Location

- Reporting state: __/__/____
- Exposure occurred in multiple states: __/__/____
- Exposure occurred in a single state, but cases resided in multiple states: __/__/____
- Other states: __/__/____
- Reporting county: __/__/____
- Exposure occurred in multiple counties in reporting state: __/__/____
- Exposure occurred in a single county, but cases resided in multiple counties in reporting state: __/__/____
- Other counties: __/__/____
- City/Town/Place of exposure: __/__/____

#### Primary Cases

<table>
<thead>
<tr>
<th>Number of primary cases</th>
<th>Sex (number or percent of the primary cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab-confirmed primary cases</td>
<td>Male # G24 # G27 %</td>
</tr>
<tr>
<td>Probable primary cases</td>
<td>Female # G25 # G28 %</td>
</tr>
<tr>
<td>Estimated total primary cases</td>
<td>Unknown # G26 # G29 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cases</th>
<th>Total # of cases for whom info is available</th>
<th>Age (number or percent of the primary cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>G30 # G34</td>
<td>&lt;1 year G38 # G46 % 20-49 years G42 # G50 %</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>G31 # G35</td>
<td>1-4 years G39 # G47 % 50-74 years G43 # G51 %</td>
</tr>
<tr>
<td>Visited Emergency Room</td>
<td>G32 # G36</td>
<td>5-9 years G40 # G48 % ≥ 75 years G44 # G52 %</td>
</tr>
<tr>
<td>Visited health care provider (excluding ER visits)</td>
<td>G33 # G37</td>
<td>10-19 years G41 # G49 % Unknown G45 # G53 %</td>
</tr>
</tbody>
</table>
### Incubation Period, Duration of Illness, Signs or Symptoms for Primary Cases Only

<table>
<thead>
<tr>
<th>Incubation Period (circle appropriate units)</th>
<th>Duration of Illness (among recovered cases-circle appropriate units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortest (G54 Min, Hours, Days)</td>
<td>Shortest (G62 Min, Hours, Days)</td>
</tr>
<tr>
<td>Median (G55 Min, Days)</td>
<td>Median (G64 Min, Days)</td>
</tr>
<tr>
<td>Longest (G56 Min, Days)</td>
<td>Longest (G66 Min, Days)</td>
</tr>
<tr>
<td>Total # of cases for whom info is available (G57 Days)</td>
<td>Total # of cases for whom info is available (G68 Days)</td>
</tr>
<tr>
<td>Unknown incubation period (G58)</td>
<td>Unknown duration of illness (G69)</td>
</tr>
</tbody>
</table>

### Signs or Symptoms (Refer to items from appendices, if appropriate, to describe other common characteristics of cases.)

<table>
<thead>
<tr>
<th>Feature</th>
<th># Cases with signs or symptoms</th>
<th>Total # of cases for whom info is available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomiting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td>G70</td>
<td>G72</td>
</tr>
<tr>
<td>Bloody stools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>G71</td>
<td>G72</td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asymptomatic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Secondary Cases

#### Mode of secondary transmission (check all that apply)

- Food (G72)
- Water
- Animal contact
- Person-to-person
- Environmental contamination other than food/water
- Indeterminate/Other/Unknown

#### Number of secondary cases

- Lab-confirmed secondary cases (G74)
- Probable secondary cases (G75)
- Estimated total secondary cases (G76)
- Estimated total cases (Primary + Secondary) (G77)

### Environmental Health Specialists Network (if applicable)

EHS-Net Evaluation ID: 1) G78 2) G79 3) G80 G81

### Traceback (for food and bottled water only, not public water)

- Please check if traceback conducted (G82)

#### Source name (if publicly available)

- G83

#### Source type (e.g., poultry farm, tomato processing plant, bottled water factory)

- G84

#### Location of source

- State
- Country
- G85 G86

#### Traceback Comments

- G87

### Recall

- Please check if any food or bottled water product was recalled (G88)

#### Type of item recalled: G89

#### Comments: G90

### Reporting Agency

- Agency name: G91
- Contact name: G92
- Contact title: G93
- E-mail: G94
- Phone no.: G95
- Fax no.: G96

### General Remarks

Briefly describe important aspects of the outbreak not covered above. Please indicate if any adverse outcomes occurred in special populations (e.g., pregnant women, immunocompromised persons.)

- G97
### Laboratory Section

**Etiology Known?**
- Yes
- No

**Etiology is unknown, were patient specimens collected?**
- Yes
- No
- Unknown

**What were they tested for? (check all that apply)**
- Bacteria
- Chemicals/Toxins
- Viruses
- Parasites

**Etiology**
*(Name the bacterium, chemical/toxin, virus, or parasite. If available, include the serotype and other characteristics such as phase type, virulence factors, and metabolic profiles. Confirmation criteria available at [https://www.cdc.gov/outbreaknet/references/resources/guide-confirming-diagnosis.html](https://www.cdc.gov/outbreaknet/references/resources/guide-confirming-diagnosis.html) or [MMWR2009/06.49SS1/App. B]*

**Genus**
- GL8

**Species**
- GL9

**Serotype/Genotype**
- GL10

**Confirmed outbreak etiology**
- GL11

**Other characteristics**
- GL12

**Detected in**
- GL13

**# Of Lab-Confirmed cases**
- GL14

*Detected in (choose all that apply): 1 - patient specimen 2 - food specimen 3 - environment specimen 4 - food worker specimen*

### Person-to-Person Section

**Major setting of exposure (choose one)**
- Camp
- Child day care
- Community-wide
- Hospital
- Hotel
- Nursing home
- Prison or detention facility
- Religious facility
- Private setting (residential home)
- Ship
- Restaurant
- Workplace

**Estimated exposed in major setting**
- P2

**Estimated ill in major setting**
- P4

**Crude attack rate ([estimated ill / estimated exposed] x 100)**
- P6

*(e.g., number of persons on ship, number of residents in nursing home or affected ward)*

### Animal Contact Section

**Setting of exposure**
- P1

**Type of animal**
- A1

**Animal Contact Remarks**
- A2

- A3
<table>
<thead>
<tr>
<th>Food Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Food vehicle undetermined</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of food (excluding any preparation)</td>
<td>F2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingredient(s) (enter all that apply)</td>
<td>F3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated ingredient(s) (enter all that apply)</td>
<td>F4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total # of cases exposed to implicated food</td>
<td>F5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason(s) suspected (enter all that apply from list in appendix)</td>
<td>F6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of processing (enter all that apply from list in appendix)</td>
<td>F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method of preparation (select one from list in appendix)</td>
<td>F8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level of preparation (select one from list in appendix)</td>
<td>F9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contaminated food imported to US?</td>
<td>F10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, Country</td>
<td>Yes, Unknown</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Yes, Unknown</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was product both produced under domestic regulatory oversight and sold?</td>
<td>F12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Unknown</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location where food was prepared (check all that apply)</th>
<th>Location of exposure (where food was eaten) (check all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restaurant – ‘Fast-food’ (drive up service or pay at counter)</td>
<td>Restaurant – ‘Fast-food’ (drive up service or pay at counter)</td>
</tr>
<tr>
<td>Restaurant – Sit-down dining</td>
<td>Hospital</td>
</tr>
<tr>
<td>Restaurant – Other or unknown type</td>
<td>Child day care center</td>
</tr>
<tr>
<td>Private home</td>
<td>School</td>
</tr>
<tr>
<td>Banquet Facility (food prepared and served on-site)</td>
<td>Prison, jail</td>
</tr>
<tr>
<td>Caterer (food prepared off-site from where served)</td>
<td>Church, temple, religious location</td>
</tr>
<tr>
<td>Fair, festival, other temporary or mobile services</td>
<td>Camp</td>
</tr>
<tr>
<td>Grocery store</td>
<td>Picnic</td>
</tr>
<tr>
<td>Workplace, not cafeteria</td>
<td>Other (describe in Where Prepared Remarks)</td>
</tr>
<tr>
<td>Workplace cafeteria</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Where Prepared Remarks: F15
Where Eaten Remarks: F16
### Contributing Factors (check all that contributed to this outbreak)
- Contributing factors unknown [F17]
- Contamination Factor
  - C1
  - C2
  - C3
  - C4
  - C5
  - C6
  - C7
  - C8
  - C9
  - C10
  - C11
  - C12
  - C13
  - C14
  - C15
  - C-N/A
- Proliferation/Amplification Factor (bacterial outbreaks only)
  - P1
  - P2
  - P3
  - P4
  - P5
  - P6
  - P7
  - P8
  - P9
  - P10
  - P11
  - P12
  - P-N/A
- Survival Factor
  - S1
  - S2
  - S3
  - S4
  - S5
  - S-N/A
- The date of contamination (check one)
  - Before preparation [F20]
  - Preparation [F21]
  - Pre-Harvest [F22]
  - Processing [F23]
  - Unknown [F24]
- Reason suspected (check all that apply)
  - Environmental evidence [F25]
  - Laboratory evidence [F26]
  - Epidemiologic evidence [F27]
  - Prior experience makes this a likely source [F28]
- Was food-worker implicated as the source of contamination? [F29]
  - Yes
  - No

### School Questions
(Complete this section only if "school" is checked in either sections "Location where food was prepared" or "Location of exposure (where food was eaten)")

1. Did the outbreak involve a single or multiple schools? [F31]
   - Single
   - Multiple (number of schools) [F32]

2. School characteristics (for all involved students in all involved schools)
   - Total approximate enrollment [F33]
     - Number of students
     - Unknown or undetermined [F34]
   - Grade level [F35]
     - Preschool
     - Grade school (grades K-12)
       - Please check all grades affected:
         - K
         - 1st
         - 2nd
         - 3rd
         - 4th
         - 5th
         - 6th
         - 7th
         - 8th
         - 9th
         - 10th
         - 11th
         - 12th
   - College/University/Technical school
     - Unknown or Undetermined
   - Primary funding of involved schools [F36]
     - Public
     - Private
     - Unknown

3. Describe the preparation of the implicated item (check all that apply) [F37]
   - Heat and serve (item mostly prepared or cooked off-site, reheated on-site)
   - Serve a-la-carte
   - Serve only (reheated or served cold)
   - Cooked on-site using primary ingredients
   - Provided by a food service management company
   - Provided by a fast-food vendor
   - Provided by a pre-plate company
   - Part of a club or fundraising event
   - Made in the classroom
   - Brought by a student/teacher/parent
   - Other (describe in General Remarks)
   - Unknown or Undetermined

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? [F38]
   - Once
   - Twice
   - More than two times
   - Not inspected
   - Unknown or Undetermined
   - If multiple schools are involved, please answer according to the most affected school.

5. Does the school have a HACCP plan in place for the school feeding program? [F39]
   - Yes
   - No
   - Unknown or Undetermined
   - If multiple schools are involved, please answer according to the most affected school.
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  
- The state/school authority  
- Other (describe in General Remarks)  
- Unknown or Undetermined  

**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?  
   - Yes  
   - No  
   - Unknown  

(Case-ready ground beef is meat that comes from a manufacturer packaged for sale that is not altered or repackaged by the retailer.)

3. Was the beef ground or reground by the retailer?  
   - Yes  
   - No  
   - Unknown  

If yes, was anything added to the beef during grinding (such as shop trim or any product to alter the fat content)?  

**Additional Salmonella Questions**  
(Complete this section for Salmonella outbreaks)

1. Phage type(s) of patient isolates:  
   - RDNC* then include  
   - RDNC* then include  
   - RDNC* then include  
   - RDNC* then include  

* Reacts, Does Not Conform  

**Eggs**

1. Were eggs (check all that apply)  
   - in shell, unpasteurized?  
   - in shell, pasteurized?  
   - packaged liquid or dry?  
   - stored with inadequate refrigeration during or after sale?  
   - consumed raw?  
   - consumed undercooked?  
   - pooled?  

2. Was Salmonella enteritidis found on the farm?  
   - Yes  
   - No  
   - Unknown  

**Egg Comment** (e.g., eggs and patients isolates matched by phage type):  