

Beliefs about Meals Eaten Outside the Home as Sources of Gastrointestinal Illness

LAURA R. GREEN,^{1*} CAROL SELMAN,² ELAINE SCALLAN,³ TIMOTHY F. JONES,⁴ RUTHANNE MARCUS,⁵ AND THE EHS-NET POPULATION SURVEY WORKING GROUP^{2†}

¹RTI International, 4770 Buford Highway, MS F-28, Atlanta, Georgia 30341; ²National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Highway, Atlanta, Georgia 30341; ³National Center for Infectious Diseases, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, Georgia 30333; ⁴Communicable and Environmental Disease Services, Tennessee Department of Health, Fourth Floor, Cordell Hull Building, 425 Fifth Avenue, Nashville, Tennessee 37247; and ⁵Connecticut Emerging Infections Program, 1 Church Street, Seventh Floor, New Haven, Connecticut 06510, USA

MS 05-156: Received 18 April 2005/Accepted 18 May 2005

ABSTRACT

In a 2002 telephone survey of 16,435 randomly selected U.S. residents, respondents answered several questions about their beliefs concerning sources of gastrointestinal illness. Of those who had experienced vomiting or diarrhea in the month before their telephone interview, 22% believed the source of their gastrointestinal illness was a meal eaten outside the home. Ill respondents who had diarrhea but not vomiting and who did not miss work because of their illness were more likely to believe the illness resulted from a specific outside meal. Ill respondents attributed their illness to a specific outside meal for several reasons, including symptom timing (43%) and illness of their meal companions (6%). Eight percent of ill respondents reported their illness to a health department or the restaurant suspected of causing the illness. Those with vomiting and those who missed work or activities because of their illness were more likely to report their illness. Most respondents (54%) who attributed their illness to a specific outside meal said their illness symptoms began within a short time (5 h) of eating that meal. The foodborne illnesses for which this is a likely time frame typically are associated with vomiting, but respondents with vomiting did not report a shorter symptom onset than respondents without vomiting. These findings suggest that ill respondents may have the misconception that foodborne illness symptoms typically occur shortly after ingestion of contaminated food. Results suggest that education efforts should focus on the nature and timing of foodborne illness symptoms and the importance of reporting suspected foodborne illnesses.

Foodborne illnesses are common; an estimated 76 million foodborne illnesses occur annually in the United States (15). However, research suggests that many people lack knowledge about foodborne disease. For example, Fein et al. (6) found that most respondents did not know that fever is commonly associated with foodborne illness, and Altek-ruse et al. (1) found that most survey respondents were unaware of several foodborne pathogens, such as *Staphylococcus aureus* and *Listeria*.

Lack of knowledge about foodborne illness may cause people with gastrointestinal symptoms to ignore the potential of foodborne transmission. Consequently, ill persons may be unlikely to adopt safer food handling practices or report possible foodborne illness to a health department. Thus, increasing the general public's knowledge about foodborne illness is important to reducing its occurrence. To be effective, health education programs must incorporate information about program recipients' current knowledge and beliefs concerning food safety and foodborne illness (5, 7, 17); therefore, we conducted this study to increase understanding of the general public's beliefs about foodborne illness. Because foodborne illness is usually characterized by gastrointestinal symptoms, the study focused on

beliefs about these symptoms. Specifically, the study was conducted among respondents who had gastrointestinal symptoms in the month before the study to determine their beliefs about the source of their gastrointestinal illness, actions taken on the basis of those beliefs, and factors associated with those beliefs.

Recent studies have suggested that restaurants may be an important source of foodborne illness. Eating poultry prepared at a restaurant has been associated with sporadic *Campylobacter* (8, 13) and *Salmonella* Enteritidis (14) infections, and eating at a restaurant has been associated with sporadic *Salmonella* Enteritidis (18) and *Escherichia coli* O157 infections (12). Additionally, a substantial proportion of reported foodborne outbreaks have been associated with food prepared or served at restaurants (11, 16). Consequently, this study focused on people who believed the source of their gastrointestinal illness was a specific meal eaten outside the home.

MATERIALS AND METHODS

Data source. This study was conducted by the Environmental Health Specialists Network (EHS-Net), a collaborative project of the Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA), the U.S. Food and Drug Administration (FDA), and eight states, focused on the investigation of environmental antecedents of foodborne illness. To collect data for this study, EHS-Net collaborated with the Foodborne Diseases

* Author for correspondence. Tel: 770-488-4332; Fax: 770-488-7310; E-mail: lrg0@cdc.gov.

† Members of this group are listed in the "Acknowledgments" section.

Active Surveillance Network (FoodNet), also a collaborative project of CDC, USDA, FDA, and 10 states (eight of which are also EHS-Net states), but focused on active surveillance and epidemiologic investigation of foodborne diseases. FoodNet periodically conducts a population-based telephone survey (FoodNet Population Survey) on foodborne illness topics, which includes questions on eating outside the home, experiences with gastrointestinal illness in the month before the telephone interview, and demographic characteristics (9, 10). These questions were the basis for this study, along with a set of questions developed by EHS-Net and added to the FoodNet Population Survey concerning survey respondents' beliefs about and experiences with gastrointestinal illness.

Sample. The FoodNet Population Survey was conducted in the nine 2002 FoodNet sites (all or parts of California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New York, Oregon, and Tennessee) from March 2002 through February 2003 using methods similar to those of the CDC's Behavioral Risk Factor Surveillance System survey (2). The sample was selected from households with telephones using a single-stage, random-digit dialing technique. One respondent was randomly selected from each household contacted. Interviews were conducted in English or Spanish, depending on the respondents' primary language.

Survey questions. Respondents were asked about their demographic characteristics (e.g., age, sex, and education) and if in the past 7 days they had eaten food from a sit-down restaurant, a deli or cafeteria, a fast food chain, a grocery store, a street food vendor, or a convenience store. They were also asked if they had experienced vomiting or diarrhea in the month before the interview. Those who reported vomiting or diarrhea were asked how many days they had experienced diarrhea or vomiting symptoms; whether they had missed any time from work because of their illness (if they worked); whether the illness had kept them from engaging in activities, such as recreational activities or working around the home; and whether they had any long-lasting or chronic condition in which diarrhea or vomiting was a major symptom, such as irritable bowel syndrome, ulcerative colitis, or problems of the stomach or esophagus.

Respondents who reported diarrhea or vomiting in the month before their interview were asked, "Do you think your illness resulted from eating a specific meal outside the home, for example, at a restaurant, cafeteria, lunchroom, catered event, or street vendor?" Respondents who answered "yes" to this question were then asked how long after this meal they first experienced diarrhea or vomiting, what led them to believe they had gotten sick from the specific meal eaten outside their home, whether they had notified the food service facility of their illness, and whether they had notified a health department that they had an illness they believed resulted from eating at a food service facility.

Data analysis. To compensate for unequal probabilities of selection, the data were weighted by the number of eligible respondents and telephone lines in each household. The data were also weighted to the 2000 U.S. population by age, sex, and FoodNet site. Thus, the weighted results from this survey can be generalized to the population of the FoodNet sites, a population of 37.4 million at the time of the study (13% of the U.S. population) (3).

Descriptive statistics and the significance test values of bivariate analyses (*t* tests for proportions, chi-square tests) were obtained with the SUDAAN, version 8.1 software package (RTI International, Research Triangle Park, N.C.) to account for the complex survey sampling design. Data from participants who respond-

ed "don't know" or "not sure" to a question or who refused to answer a question were excluded from analysis of that question.

The Council of American Survey Research Organizations upper bound response rate was calculated for this survey. The calculation of this response rate included information on people who completed or refused the interview or who terminated the interview before completion but not people we were unable to contact.

RESULTS

A total of 16,435 respondents were interviewed during the 12-month survey period. The Council of American Survey Research Organizations upper bound response rate for the survey was 47.4%. After excluding respondents younger than 18 years and those who reported a chronic illness in which vomiting or diarrhea was a major symptom, 13,157 respondents were included in the analysis. Of these respondents, 1,508 had experienced vomiting or diarrhea in the month before the interview; this corresponds to a weighted population estimate of 11.3% (95% confidence interval [CI], 10.6 to 12.0%). Of these ill respondents, 307 believed their illness was caused by a specific meal eaten outside the home; this corresponds to a weighted population estimate of 21.8% (95% CI, 18.9 to 24.6%).

Demographic, illness, and dining-out characteristics. Table 1 compares the demographic, illness, and dining-out characteristics of those who believed the source of their illness was a specific outside meal. The *t* tests revealed that respondents who believed the source of their illness was a specific outside meal were significantly more likely to be younger than the median age of 33 years than older than the median age; more likely to have had some college education than to have had no college education; more likely to have had diarrhea (with no vomiting) than vomiting (with or without diarrhea); less likely to have missed work because of the illness than not to have missed work; and more likely to have dined out in the week before their interview than to not have dined out. There were no significant differences in beliefs by sex, duration of illness, or whether or not the illness prevented activities (e.g., recreational, working around the home).

Symptom onset. Most respondents (53.8%) who believed the source of their illness was a specific outside meal said their illness symptoms began within 5 h of eating that meal (Table 2). The average and median times from eating the outside meal to symptom onset reported by respondents who believed the source of their illness was a specific outside meal were 7.9 and 3.8 h, respectively. Because foodborne illnesses with short incubation periods are often characterized by vomiting, we conducted *t* tests to test for significant differences in symptom onset by symptom type. Respondents with vomiting were not significantly more likely than those without vomiting to have symptom onset of 5 h or less ($P > 0.08$) or to have a shorter average time from eating the outside meal to symptom onset ($P > 0.64$).

Reasons for belief that an outside meal caused illness. When asked to give the reason that led them to believe they got sick from a specific meal eaten outside the home, 42.5% (95% CI, 34.7 to 50.3%) of respondents said

TABLE 1. Differences in respondents' beliefs that the source of illness was a specific outside meal by demographic, illness, and dining-out characteristics, 2002 FoodNet Population Survey

Characteristics	Ill respondents who believed source of illness was outside meal, weighted % (95% CI) ^a	P value ^b
Age (y) (n = 1,508)		
<33	26.4 (21.0–31.8)	0.01
≥33	18.5 (15.6–21.4)	
Education (n = 1,492)		
No college education	16.7 (12.0–21.5)	0.01
Some college education	24.0 (20.5–27.5)	
Sex (n = 1,508)		
Male	24.6 (19.6–29.7)	0.12
Female	19.8 (16.5–23.1)	
Symptoms (n = 1,457)		
Vomiting, with or without diarrhea	16.9 (12.7–17.1)	0.009
Diarrhea, no vomiting	24.3 (19.6–29.7)	
Duration (n = 1,508)		
≤2 days of vomiting or diarrhea	23.1 (19.6–26.5)	0.12
>2 days of vomiting or diarrhea	18.3 (13.4–23.1)	
Missed work (n = 971)		
Yes	16.8 (10.6–23.1)	0.003
No	28.4 (23.9–32.8)	
Missed activities (n = 1,506)		
Yes	19.9 (15.5–24.3)	0.33
No	22.8 (19.1–26.4)	
Ate out in previous week (n = 1,508)		
Yes	23.0 (19.9–26.0)	0.0001
No	10.5 (5.2–15.8)	

^a CI, confidence interval.

^b The tests were two-tailed. Test with *P* values of 0.05 or lower are considered statistically significant.

the timing of their illness following the meal was the reason. Other reasons included the suspected meal either looked or tasted bad or uncooked (15.6%; 95% CI, 9.5 to 21.7%); the meal had some property, such as greasiness or spiciness, that typically makes them ill (10.7%; 95% CI, 5.9 to 15.6%); others who ate with them (meal companions) also got sick (6.2%; 95% CI, 2.8 to 9.6%); the suspected meal contained food they usually did not eat, was from a restaurant in which they usually did not eat, or was eaten in a foreign country (3.1%; 95% CI, 1.1 to 5.2%); and the restaurant, kitchen, or food workers did not look clean (2.0%; 95% CI, 0.1 to 3.9%). Twenty percent (95% CI, 14.1 to 25.3%) of responses were classified as miscellaneous responses and included responses such as “It [the food] had germs in it” and “It’s a guess.”

Timing of illness as reason for belief. We compared symptom onset for respondents who gave timing of their illness as the reason for their belief that the source of their illness was a specific outside meal and for those who gave other reasons. The *t* tests revealed that those who gave timing as the reason for their belief were not significantly more likely to report symptom onset of 5 h or less than those who gave other reasons for their belief (61.2% [95% CI, 48.0 to 74.5%] versus 52.1% [95% CI, 42.7 to 61.5%], *P*

> 0.26). However, respondents who gave timing of the illness as the reason for their belief reported a shorter *average* symptom onset than did those who gave other reasons (6.6 h [95% CI, 4.7 to 8.4 h] versus 9.1 h [95% CI, 7.3 to 11.0 h], *P* < 0.05).

Reporting behavior. Eight percent (8.4%; 95% CI, 4.4 to 12.4%) of ill respondents who believed the source of their illness was a specific outside meal said they had notified either the suspected food service facility (7.2%; 95% CI, 3.4 to 11.0%) or a health department (2.3%; 95% CI, 0.3 to 4.3%) of their belief that the food prepared at the food service facility had made them sick. We compared demographic, illness, and dining-out characteristics of those who reported their illness to a food service facility or health department (Table 3). The *t* tests revealed that respondents who reported their illness were significantly less likely to have had diarrhea than vomiting and significantly more likely to have missed work or activities because of their illness than not to have missed work or activities. No significant differences in reporting occurred by age, sex, education, duration of symptoms, or dining-out behavior.

Although we also wished to examine the relationship between respondents' reasons for attributing illness to an

TABLE 2. Symptom onset data for ill respondents who believed the source of their illness was a specific outside meal, 2002 FoodNet Population Survey

Onset	Weighted % (95% CI) ^a		
	All ill respondents (n = 307)	Ill respondents with diarrhea, no vomiting (n = 200)	Ill respondents with vomiting, with or without diarrhea (n = 98)
Onset in 1 to 5 h	53.8 (46.4–61.2)	60.0 (51.7–68.3)	46.8 (33.5–60.1)
Onset in 6 to 10 h	22.5 (16.1–29.0)	19.6 (12.7–26.6)	23.9 (13.2–34.5)
Onset in 11 to 15 h	11.5 (6.3–16.7)	7.6 (3.8–11.5)	16.6 (3.9–39.2)
Onset in >15 h	12.2 (7.6–16.7)	12.7 (11.5–17.8)	12.8 (2.9–22.7)
Hours from eating to onset ^b	7.9 (6.7–9.1)	7.7 (6.1–9.2)	8.3 (6.2–10.4)
Hours from eating to onset ^c	3.8 (2.8–5.0)	2.8 (1.9–4.4)	5.4 (3.4–7.8)

^a CI, confidence interval.

^b These values are weighted means.

^c These values are weighted medians.

outside meal and reporting behavior, the small number of respondents in most of the reason categories (<40 respondents per reason category) precluded any weighted analysis that would allow generalization of results to the population. However, we conducted significance tests on the non-weighted data in a preliminary exploration of this issue. The chi-square tests revealed that respondents who reported their illness did not differ in the reasons they gave for their belief that a specific outside meal was the source of their

illness (reason was or was not timing, 4.6 versus 10.2%, $P > 0.09$; reason was or was not meal was bad or uncooked, 14.6 versus 6.7%, $P > 0.08$; reason was or was not meal had an illness-causing property, 6.9 versus 7.9%, $P > 0.85$; reason was or was not meal companions also got sick, 19.0 versus 6.8%, $P > 0.09$; reason was or was not unfamiliar food or place, 9.1 versus 7.7%, $P > 0.86$; reason was or was not unclean restaurant, 0.0 versus 7.1%, $P > 0.47$).

TABLE 3. Differences in respondents' reporting to a health department or restaurant by demographic, illness, and dining-out characteristics, 2002 FoodNet Population Survey

Characteristics	Ill respondents reporting, weighted % (95% CI) ^a	<i>P</i> value ^b
Age (y) (n = 307)		
<33	9.0 (2.6–15.3)	0.28
≥33	7.8 (3.0–12.7)	
Education (n = 303)		
No college education	14.6 (4.5–24.8)	0.11
Some college education	6.5 (2.3–10.6)	
Sex (n = 307)		
Male	8.4 (2.2–14.7)	0.97
Female	8.3 (3.3–13.3)	
Symptoms (n = 298)		
Vomiting, with or without diarrhea	17.3 (8.3–26.4)	0.007
Diarrhea, no vomiting	3.8 (0.2–7.7)	
Duration (n = 307)		
≤2 days of vomiting or diarrhea	8.5 (3.9–13.2)	0.87
>2 days of vomiting or diarrhea	7.9 (0.6–15.3)	
Missed work (n = 222)		
Yes	24.9 (7.5–42.3)	0.05
No	6.8 (1.9–11.6)	
Missed activities (n = 307)		
Yes	18.4 (8.6–28.0)	0.005
No	3.6 (0.4–6.8)	
Ate out in previous week (n = 307)		
Yes	8.6 (3.5–9.7)	0.49
No	4.9 (4.6–14.4)	

^a CI, confidence interval.

^b The tests were two-tailed. Tests with probability values of 0.05 or lower are considered statistically significant.

DISCUSSION

Almost 22% of respondents who had experienced vomiting or diarrhea in the month before their interview believed their illness resulted from a specific meal eaten outside the home. Younger people, those with some college education, and those who had eaten out in the week before the interview were more likely to believe the source of their illness was a meal eaten outside the home than older people, those with no college education, and those who had not eaten out in the week before the interview. These findings may reflect the fact that younger people, those with some college education, and those who have eaten out recently eat out more in general and, thus, may be more likely to attribute a suspected foodborne illness to an outside meal because they are more likely to have eaten an outside meal around the time of their illness.

Respondents who did not experience vomiting and who did not miss work because of their illness were more likely than those who did experience vomiting and who did miss work to believe their illness was caused by an outside meal, suggesting that those who experienced a milder illness were more likely to believe the source of their illness was a meal eaten outside the home. These findings are consistent with the finding of Fein et al. that the public perceives foodborne illness as a minor sickness obtained from eating restaurant food (6).

Respondents reported relying on several sources of information when making attributions about the cause of their illness, including the timing of their illness symptoms, the look or taste of the food, and the fact that their meal companions also got sick. If used correctly, these sources of information can help determine the cause of gastrointestinal illness; epidemiologists use some of them in their foodborne illness investigations.

Fifty-four percent of respondents who believed a specific outside meal had made them ill said their symptoms began within 5 h of eating the outside meal. Although some foodborne pathogens, such as *S. aureus*, have incubation periods of 5 h or less, many of the more common foodborne pathogens have longer incubation periods (4, 15). For example, *Campylobacter jejuni* and *Salmonella* have typical incubation periods of 2 to 5 days and 1 to 3 days, respectively (4). It is possible that respondents who reported shorter symptom onsets experienced foodborne illnesses with shorter incubation periods. The pathogens that cause foodborne illnesses with shorter symptom onsets are typically associated with vomiting; however, we found that respondents who experienced vomiting were no more likely than those who did not experience vomiting to report shorter symptom onsets. Taken together, these findings suggest that our respondents may have the misconception that foodborne illness symptoms typically occur shortly after ingestion of contaminated food. This conclusion is supported by the finding that those who gave timing as the reason for their belief that the source of their illness was an outside meal were more likely to report a shorter average symptom onset than those who did not give timing as their reason.

If respondents have misconceptions about the incuba-

tion periods of foodborne illness, they are likely to have inaccurate beliefs about the specific meal that caused their illness. However, the findings from this study are not based on epidemiologic or laboratory data, as are findings from other studies that link restaurants and meals eaten outside the home to foodborne illness (8, 12–14, 18); this study only examined people's *beliefs* about the cause of their illness. Thus, the findings reported herein do not contradict findings from other studies that indicate that restaurants are an important source of foodborne illness; instead, they simply suggest that the general public may not be very good at identifying the specific meal that caused their gastrointestinal illness. Additional studies to assess patient knowledge and beliefs about sources of exposure and symptom timing in cases of illness caused by a documented pathogen and source of exposure are needed to further understand these issues.

Despite their belief that food from a food service facility had made them ill, respondents reported that they did not often contact the facility or the health department about their concerns. Local public health authorities' ability to accurately identify, investigate, and prevent foodborne illnesses and outbreaks depends, at least in part, on public reporting of suspected foodborne illnesses. Our findings suggest that the public's awareness of the importance of reporting suspected foodborne illnesses may need to be improved. However, some foodborne illness complaints to public health authorities can be more useful in identifying and investigating foodborne illness outbreaks than others; for example, complaints based on the illness of meal companions may be more useful than other types of complaints. Only 19% of respondents who attributed their illness to an outside meal because their meal companions also got sick reported their illness. These findings suggest that efforts to improve reporting of suspected foodborne illnesses should focus on the importance of reporting complaints in certain situations, such as those in which multiple meal companions become sick.

It would be useful to determine the factors associated with whether people report their suspected foodborne illness to food service facilities or health departments. Results from this study indicate that the type and severity of illness symptoms are related to reporting behavior: those who experienced vomiting were more likely than those who did not experience vomiting to report their illness, and those who missed work or other activities as a result of their illness were more likely than those who did not miss work or other activities to report their illness. This study found no significant relationships between reasons for the belief that a specific outside meal caused foodborne illness and reporting behavior; however, given the small number of respondents included in any given reason category, more research with larger samples is needed before definitive conclusions can be drawn.

The design of this study allows generalization of inferences to the survey population. However, the cross-sectional design of this study does not allow us to make causal inferences about the relationships among variables. Additionally, this study focuses only on respondents who be-

lied the source of their illness was an outside meal; investigating the experiences and beliefs of ill persons who have other beliefs about the source of their illness would be useful.

This study increases our understanding of the population's beliefs about foodborne illness. Findings suggest that education should be improved in the areas of the nature and timing of foodborne illness symptoms and the importance of reporting suspected foodborne illnesses when multiple meal companions are ill.

ACKNOWLEDGMENTS

The members of the EHS-Net Population Survey Working Group include Alicia Cronquist (Colorado Department of Public Health), Glenda Lewis (Center for Food Safety and Nutrition, FDA), Patrick McCarthy (Center for Food Safety and Nutrition, FDA), Carlota Medus (Minnesota Department of Health), and Melissa Tobin-D'Angelo (Georgia Division of Public Health). The authors thank the EHS-Net Working Group (National Center for Environmental Health, CDC) for its assistance with survey development; the FoodNet Working Group (National Center for Infectious Diseases, CDC) for administering the EHS-Net survey questions in the FoodNet Population Survey; Anyana Banerjee (National Center for Infectious Diseases, CDC) and Curtis Blanton (National Center for Environmental Health, CDC) for their assistance with data analysis; and Frederick Angulo (National Center for Infectious Diseases, CDC), Robert Tauxe (National Center for Infectious Diseases, CDC), and Craig Hedberg (School of Public Health, University of Minnesota) for their helpful comments on the paper.

REFERENCES

- Altekruse, A., D. Street, S., Fein, and A. Levy. 1995. Consumer knowledge of foodborne microbial hazards and food-handling practices. *J. Food Prot.* 59:287–294.
- Centers for Disease Control and Prevention. 1998. *Behavioral Risk Factor Surveillance System user's guide*. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta.
- Centers for Disease Control and Prevention. 2002. Preliminary FoodNet data on the incidence of foodborne illnesses—selected sites, United States, 2002. *Morb. Mortal. Wkly. Rep.* 52:340–343.
- Centers for Disease Control and Prevention. 2004. Diagnosis and management of foodborne illnesses: a primer for physicians and other health care professionals. *Morb. Mortal. Wkly. Rep.* 53:RR-4.
- Ehiri, J., and G. Morris. 1996. Hygiene training and education of food handlers: does it work? *Eco. Food Nutr.* 35:243–251.
- Fein, S., T. Lin, and A. Levy. 1995. Foodborne illness: perceptions, experience, and preventative behaviors in the United States. *J. Food Prot.* 58:1405–1411.
- Foster, G., and F. Kaferstein. 1985. Food safety and the behavioural sciences. *Soc. Sci. Med.* 21:1273–1277.
- Friedman, C., R. Hoekstra, M. Samuel, R. Marcus, J. Bender, B. Shiferaw, S. Reddy, S. Ahuja, D. Helfrick, F. Hardnett, M. Carter, B. Anderson, and R. Tauxe, for the Emerging Infections Program FoodNet Working Group. 2004. Risk factors for sporadic *Campylobacter* infection in the United States: a case-control study in FoodNet sites. *Clin. Infect. Dis.* 38:S285–S296.
- Herikstad, H., S. Yang, T. Van Gilder, D. Vugia, J. Hadler, P. Blake, V. Deneen, B. Shiferaw, F. Angulo, and the FoodNet Working Group. 2002. A population-based estimate of the burden of diarrheal illness in the United States: FoodNet, 1996–1997. *Epidemiol. Infect.* 129:9–17.
- Imhoff, B., D. Morse, B. Shiferaw, M. Hawkins, D. Vugia, S. Lance-Parker, J. Hadler, C. Medus, M. Kennedy, M. Moore, and T. Van Gilder. 2004. Burden of self-reported acute diarrheal illness in FoodNet surveillance areas, 1998–1999. *Clin. Infect. Dis.* 38:219–226.
- Jones, T., B. Imhoff, M. Samuel, P. Mshar, K., McCombs, M. Hawkins, V. Deneen, M. Cambridge, and S. Olsen, for the Emerging Infections Program FoodNet Working Group. 2004. Limitations to successful investigation and reporting of foodborne outbreaks: an analysis of foodborne disease outbreaks in FoodNet catchment areas, 1998–99. *Clin. Infect. Dis.* 38:S297–S302.
- Kassenborg, H., C. Hedberg, M. Hoekstra, M. Evans, A. Chin, R. Marcus, D. Vugia, K. Smith, S. Ahuja, L. Slutsker, and P. Griffin, for the Emerging Infections Program FoodNet Working Group. 2004. Farm visits and undercooked hamburgers as major risk factors for sporadic *Escherichia coli* O157:H7 infection: data from a case-control study in 5 FoodNet sites. *Clin. Infect. Dis.* 38:S271–S278.
- Kassenborg, H., K. Smith, D. Vugia, T. Rabatsky-Ehr, M. Bates, M. Carter, N. Dumas, M. Cassidy, N. Marano, R. Tauxe, and F. Angulo, for the Emerging Infections Program FoodNet Working Group. 2004. Fluoroquinolone-resistant *Campylobacter* infections: eating poultry outside of the home and foreign travel are risk factors. *Clin. Infect. Dis.* 38:S279–S284.
- Kimura, A., V. Reddy, R. Marcus, P. Cieslak, J. Mohle-Boetani, H. Kassenborg, S. Segler, F. Hardnett, T. Barrett, and D. Swerdlow, for the Emerging Infections Program FoodNet Working Group. 2004. Chicken consumption is a newly identified risk factor for sporadic *Salmonella enterica* serotype Enteritidis infections in the United States: a case-control study in FoodNet sites. *Clin. Infect. Dis.* 38: S244–S252.
- Mead, P., L., Slutsker, A. Dietz, L. McCaig, J. Bresee, C. Shapiro, P. Griffin, and R. Tauxe. 1999. Food-related illness and death in the United States. *Emerg. Infect. Dis.* 5:607–625.
- Olsen, S., L. MacKinon, J. Goulding, N. Bean, and L. Slutsker. 2000. Surveillance for foodborne disease outbreaks—United States, 1993–1997. *Morb. Mortal. Wkly. Rep.* 49:1–51.
- Rennie, D. 1995. Health education models and food hygiene education. *J. R. Soc. Health.* 115:75–78.
- Sobel, J., A. Hirshfeld, K. McTigue, C. Burnett, S. Altekruse, F. Brenner, G. Malcolm, S. Mottice, C. Nichols, and D. Swerdlow. 2000. The pandemic of *Salmonella* Enteritidis phage type 4 reaches Utah: a complex investigation confirms the need for continuing rigorous control measures. *Epidemiol. Infect.* 125:1–8.