Table of Contents

Prologue

The *1997 Final FoodNet Surveillance Report* consists of two parts: Part I is the Narrative Report, and Part II is the summary tables and graphs. The Narrative Report is based on the report "1997 Surveillance Results", written for the Department of Health and Human Services in April 1998. The new document has two revisions from the earlier one. First, this report uses the 1997 postcensus population estimates which became available in August 1998. Second, the new report includes additional cases that were reported after publication of the initial report but before the closeout of the surveillance data. Therefore, tables 1A and 1B have been updated and incidence rates recalculated.

Further information concerning FoodNet can be obtained by contacting the Foodborne and Diarrheal Diseases Branch at telephone number 404.639.2206 or via the internet at http://www.cdc.gov/ncidod/dbmd/foodnet/foodnet.htm

Part I:

Narrative Report

Executive summary

Foodborne infections are an important public health challenge. The Centers for Disease Control and Prevention (CDC) is actively involved in preventing foodborne disease. CDC's principal role in the interagency national Food Safety Initiative launched this year has been to enhance surveillance for and investigation of infections that are foodborne. These efforts will provide crucial data to identify control points, focus future prevention strategies and decision making within food safety regulatory agencies, measure changes in the burden of disease, and improve the national early warning system for food safety emergencies.

One major project is the collaborative Foodborne Diseases Active Surveillance Network (FoodNet), which CDC conducts with states and other federal agencies. FoodNet is measuring the burden and sources of specific diseases that are usually foodborne in the United States through active surveillance and additional studies. FoodNet will track and interpret trends in these diseases over time and will conduct studies of causes of emerging foodborne diseases. Ongoing FoodNet surveillance will be used to document the effectiveness of new food safety control measures, such as the USDA Pathogen Reduction and Hazard Analysis and Critical Control Points (HACCP) Rule, in decreasing the number of cases of major foodborne diseases in the United States each year. FoodNet and other efforts at CDC augment, but do not replace, longstanding activities at CDC and in states to identify, control, and prevent foodborne disease hazards. FoodNet is a sentinel network that can respond rapidly to new and emerging foodborne pathogens. Enhanced surveillance and investigation are integral to developing and evaluating new prevention and control strategies that can improve the safety of our food and the public's health.

The following are key findings of CDC FoodNet surveillance activities during 1997:

- The overall burden of diarrheal disease is great. FoodNet estimates that 360 million cases of diarrheal illness occur per year, resulting in approximately 28 million medical consultations. Further studies will define the causes and impact of these illnesses and what proportion of them may be related to food.

- In 1997, FoodNet tracked infections caused by seven bacterial pathogens and began to track two parasitic pathogens. Among the agents under surveillance, *Campylobacter* was the most frequently diagnosed, even though outbreaks caused by this pathogen are rare. A study of *Campylobacter* infections that began in 1998 will identify control points and direct future

prevention strategies. Based on these surveillance findings, the USDA Agricultural Research Service is augmenting research into possible prevention strategies for *Campylobacter*.

- FoodNet showed that *Escherichia coli* O157:H7 infections were more common in northern states and that undercooked ground beef was the principal food source of *E. coli* O157:H7 infections. In contrast with the findings of previous investigations, hamburgers eaten at fast-food restaurants were not associated with infection, suggesting that recent changes in the meat industry may have reduced *E. coli* O157:H7 infections associated with consumption of hamburgers at fast-food restaurants. Expanded efforts to reduce contamination of meat and to promote thorough cooking of hamburgers can further reduce the number of these infections. A second study is planned to explore other potential control points.

- Hospitalization associated with foodborne diseases is an important public health problem. In FoodNet sites, *Listeria* infections had the highest hospitalization rate and caused nearly half of the reported deaths. Because of this, FoodNet will conduct additional studies of *Listeria* infections to identify food sources and potential control points.

- In the summer of 1997, an outbreak of *Vibrio parahaemolyticus* infections in the western United States was identified by FoodNet and state surveillance and was associated with consumption of raw oysters. As a result, public health officials closed oyster beds in Washington State and warned the public about the risk associated with those shellfish, thus preventing further human illness. In the future, surveillance of seafood-associated infections can be used to document the effect of FDA's seafood safety programs.

Background

FoodNet is the principal foodborne disease component of CDC's Emerging Infections Program (EIP). FoodNet is a collaborative project among CDC, the U.S. Department of Agriculture (USDA), the Food and Drug Administration (FDA), and the seven EIP sites. As of January 1, 1998, the total population of these sites is 20.3 million, or 7.5% of the U.S. population.

Objectives

The objectives of FoodNet are to determine the frequency and severity of foodborne diseases; determine the proportion of common foodborne diseases that results from eating specific foods; and describe the epidemiology of new and emerging bacterial, parasitic, and viral foodborne pathogens. To address these objectives, FoodNet uses active surveillance and conducts related epidemiologic studies. By monitoring the burden of foodborne diseases over time, FoodNet will document the effectiveness of new food safety initiatives, such as the USDA Pathogen Reduction and Hazard Analysis and Critical Control Points (HACCP) Rule, in decreasing the number of cases of foodborne diseases in the United States each year.

Methods

In 1997, FoodNet conducted population-based active surveillance for confirmed cases of *Campylobacter*, *Escherichia coli* O157, *Listeria*, *Salmonella*, *Shigella*, *Vibrio*, and *Yersinia* infections in Minnesota, Oregon, and selected counties in California, Connecticut, and Georgia (total population: 16.1 million). Active surveillance data from Maryland and New York will be included in 1998. To identify cases, FoodNet personnel contact each of the nearly 300 clinical laboratories within the catchment areas, either weekly or monthly, depending on the size of the clinical laboratory.

Results

In 1997, a total of 8576 confirmed cases of infections caused by the pathogens under surveillance were identified in the five sites. Of these, 8059 were bacterial; 3974 *Campylobacter* infections, 2205 *Salmonella* infections, 1273 *Shigella* infections, 340 *E. coli* O157 infections, 139 *Yersinia* infections, 77 *Listeria* infections, and 51 *Vibrio* infections (Table 1A). The most commonly identified *Salmonella* serotypes were Typhimurium (646 cases), Enteritidis (361), Heidelberg (141), Newport (77), and Montevideo (67). In addition, 517 cases of parasitic disease were reported from four sites; 468 cases of *Cryptosporidium* and 49 of *Cyclospora* (Table 1B).

Table 1A. Infections caused by specific bacterial pathogens, reported by FoodNet sites, 1997

Pathogen	CA	CT	GA	MN	OR	Total
Campylobacter	1036	527	499	1175	737	3974
E. coli O157	19	34	8	199	80	340
Listeria	14	12	20	18	13	77
Salmonella	370	417	470	619	329	2205
Shigella	293	78	586	138	177	1273
Vibrio	31	4	2	2	12	51
Yersinia	35	15	43	31	15	139
Total	1798	1088	1628	2182	1363	8059

**Table 1B. Infections caused by specific parasitic pathogens, reported by FoodNet sites, 1997**

Pathogen	CA	CT	GA	MN	OR*	Total
Cryptosporidium	157	42	-	243	26	468
Cyclospora	16	29	-	3	1	49
Total	173	71	-	246	27	517

*Oregon began surveillance for parasitic disease on July 1, 1997

Seasonality

Isolation rates for several pathogens showed wide seasonal variation; 66% of *Vibrio*, 52% of *E. coli* O157, 35% of *Campylobacter*, and 32% of *Salmonella* were isolated during June through August (Figure 1).

Figure 1. Cases of foodborne disease caused by specific pathogens, by month, FoodNet Sites, 1997
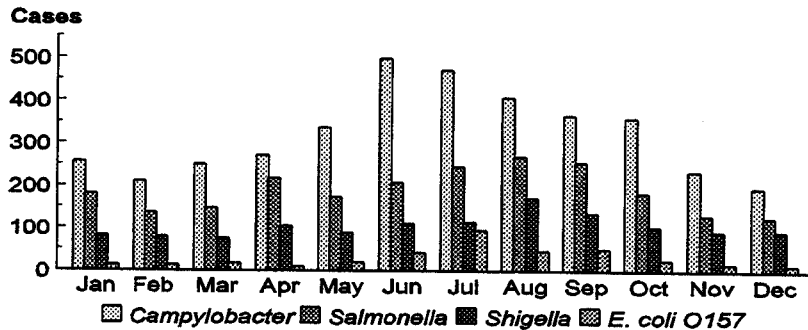
1997 Rates

To compare the number of cases among sites with different populations, annual incidence rates were calculated. Incidence is the number of reported culture-confirmed cases divided by the 1997 postcensus estimates of the population. Overall incidence rates were higher for infections with *Campylobacter* (24.7/100,000 population), *Salmonella* (13.7/100,000), and *Shigella* (7.9/100,000). Lower overall incidence rates were reported for *E. coli* O157 infection (2.1/100,000), *Yersinia* (0.9/100,000), *Listeria* (0.5/100,000), and *Vibrio* (0.3/100,000).

1996 Rates

Incidence rates in 1996, calculated using the 1996 postcensus population, were similar to those in 1997. Overall incidence rates in 1996 were higher for infections with, *Salmonella* (14.5/100,000), *E. coli* O157 (2.7/100,000) and *Shigella* (8.9/100,000), and lower for infections with *Campylobacter* (23.5/100,000 population), *Yersinia* (1.0/100,000), *Listeria* (0.5/100,000), and *Vibrio* (0.1/100,000). It is too soon to determine whether differences between 1996 and 1997 rates reflect year-to-year variation or longer-term trends. The increase in *Vibrio* infections in 1997 was a result of an outbreak of *V. parahemolyticus* infections associated with oysters from the Northwest coast.

Rates by site   Incidence rates for many of these pathogens varied substantially among the sites
(Figure 2). The incidence rates for *Campylobacter* infection varied from
14/100,000 in Georgia to 49/100,000 in California, and for *Shigella* varied from
3/100,000 in Minnesota to 16/100,000 in Georgia. Although incidence rates for
Salmonella infection were similar among the sites, the rates for *Salmonella*
serotype Enteritidis infection varied dramatically, from 0.6/100,000 in Georgia to
5.8/100,000 in Connecticut. Incidence rates for *E. coli* O157 infection varied from
0.2/100,000 in Georgia to 4/100,000 in Minnesota, and for *Yersinia* infection
varied from 0.5/100,000 in Oregon to 1.7/100,000 in California. Reasons for
these regional differences in incidence rates are being investigated; for example,
some laboratories do not test specimens routinely for all pathogens.

**Figure 2. Cases of foodborne disease caused by specific pathogens per 100,000
population, FoodNet sites, 1997**
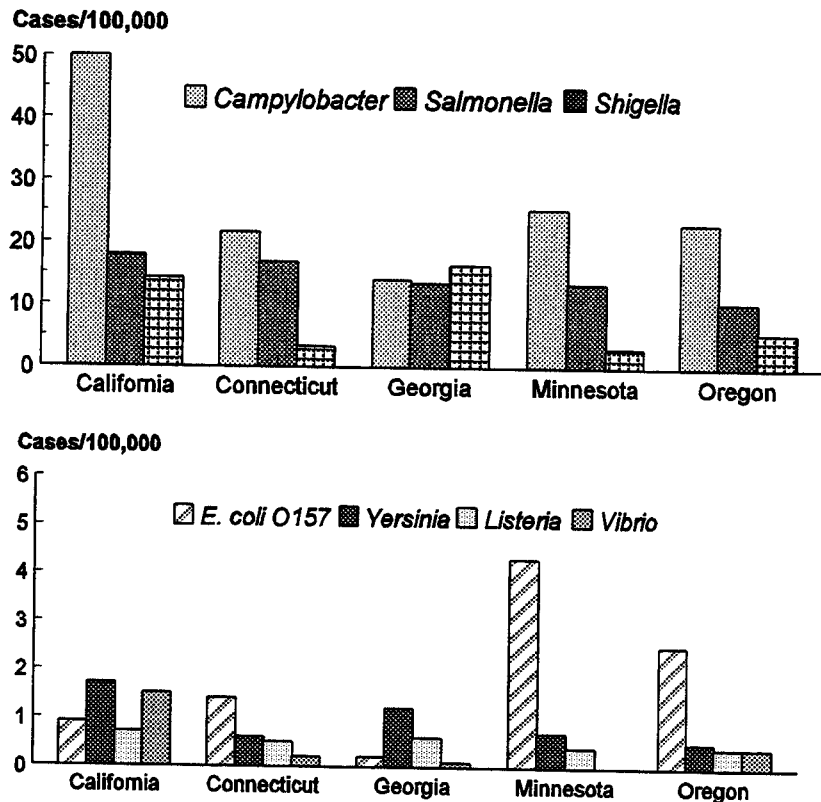
Rates by age   Annual incidence rates of foodborne illness varied by age, especially for

Campylobacter and *Salmonella* infections (Figure 3). For children <1 year of age,

the rate of *Salmonella* infection was 111/100,000, and the rate of *Campylobacter*

infection was 56/100,000, rates substantially higher than for other age groups.

**Figure 3. Incidence of *Campylobacter* and *Salmonella* infections
by age group, FoodNet sites, 1997**
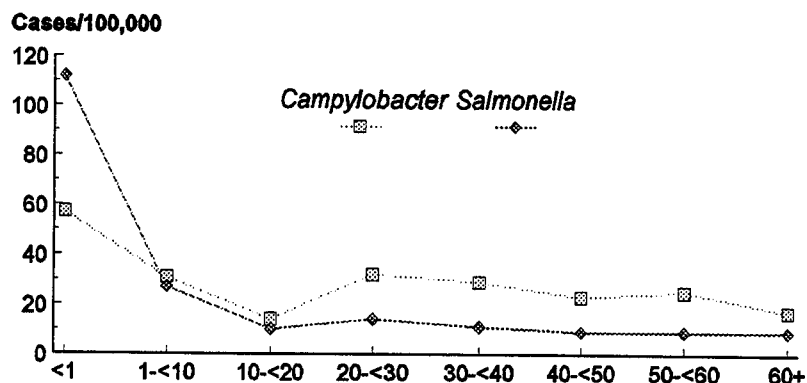
Rates by sex   There were significant differences in sex-specific incidence rates (Table 2). Overall, males

were more likely than females to be infected with one of these pathogens. In particular,

rates of *Vibrio* infection were 100% higher among males than females, and rates of

*Campylobacter* infection were 27% higher among males than females.

**Table 2. Sex-specific incidence rates per 100,000 population,
by pathogen, FoodNet sites, 1997**

Isolate	Male	Female	Overall
Campylobacter	27.6	21.7	24.7
E. coli **O157**	2.0	2.2	2.1
Listeria	0.5	0.4	0.5
Salmonella	14.0	13.3	13.7
Shigella	8.3	7.5	7.9
Vibrio	0.4	0.2	0.3
Yersinia	0.8	0.9	0.9
Total	53.6	46.2	50.1

11

Rates by age and sex   Compared with females, the incidence rate of *Campylobacter* infection was higher for males in all age groups except infants (<1 year of age); rates for infants were similar for males and females. In contrast, rates of *Salmonella* infection were higher for male infants and children aged 1-10 years compared with females.

Hospitalizations   Overall, 15% of infected persons were hospitalized; there were significant differences in hospitalization rates by pathogen (Figure 4). The rate of hospitalization was highest for persons infected with *Listeria* (88%) followed by those infected with *E. coli* O157 (29%), *Salmonella* (21%), *Yersinia* (15%), *Shigella* (13%), *Campylobacter* (10%), and *Vibrio* (10%).

Figure 4. Percentage of persons hospitalized with infections caused by specific pathogens, FoodNet sites, 1997
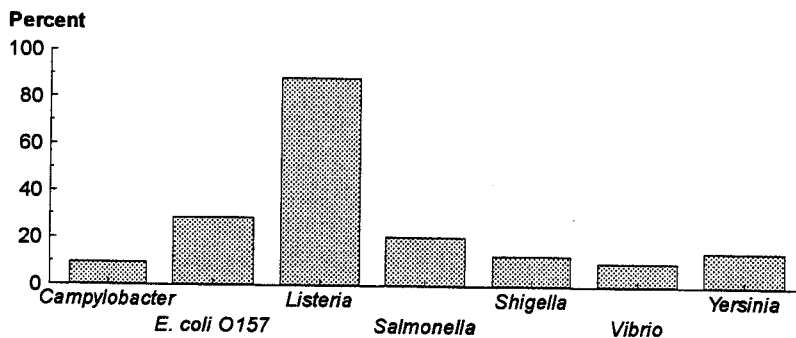

Deaths   Thirty-three persons died; of those, 15 were infected with *Listeria*, 12 with *Salmonella*, four with *E. coli* O157, one with *Shigella*, and one with *Campylobacter*. The pathogen with the highest case-fatality rate was *Listeria*; 20% of persons infected with *Listeria* died.

Additional Studies

Burden of illness   Cases reported through active surveillance represent a fraction of the number of cases in the community. To better estimate the number of cases of foodborne disease in the community, we conducted surveys of laboratories, physicians, and the general population in the FoodNet sites (Figure 5).

Figure 5. Burden of illness pyramid
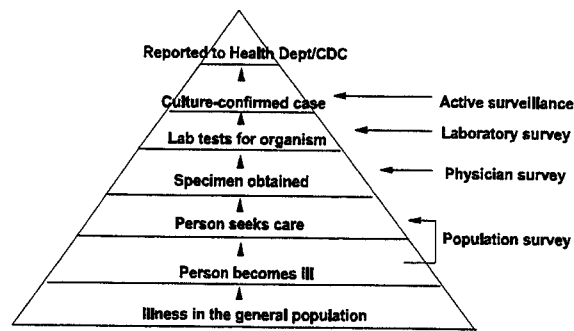
- **Laboratory survey**

  All microbiology laboratories in the FoodNet sites routinely test all stools submitted for culture for *Campylobacter, Salmonella,* and *Shigella*; however, only 50% routinely test for *E. coli* O157, 30% for *Yersinia*, and 19% for *Vibrio*.

- **Physician survey**

  Physicians who practice in the FoodNet sites reported that they were more likely to request stool specimens for culture from patients with any of the following features: bloody diarrhea, AIDS, duration of illness greater than 3 days, history of travel to a developing country, and fever.

- **Population survey**

  Of the 10,000 residents of the FoodNet sites we surveyed, 11% reported a diarrheal illness during the previous month or 1.4 episodes of diarrhea per person per year. Of those who were ill, only 8% sought medical care. Of those seeking medical care, 20% reported submitting a stool specimen for culture.

Causes of foodborne   As a part of FoodNet, case-control studies are conducted to determine the
disease   proportion of foodborne diseases that are caused by specific foods or food
preparation practices. By determining this proportion, specific prevention efforts
can be developed and their effectiveness documented.

- *E. coli* **O157:H7 case-control study**
  A case-control study of *E. coli* O157:H7 infections conducted at FoodNet
  sites included interviews with 200 patients or their parents and 380 healthy
  controls. Undercooked ground beef was determined to be the principal
  food source of these infections. Based on these findings, efforts to reduce
  contamination of ground beef and to promote thorough cooking could
  reduce the incidence of this infection. A follow-up case-control study will
  further define other potential control measures for the prevention of *E. coli*
  O157:H7 infections.

- *Salmonella* **case-control study**
  Salmonella of many different serotypes are the second most commonly
  diagnosed bacterial cause of diarrheal illness. Two serotypes, Enteritidis
  and Typhimurium, account for half of all cases of salmonellosis. FoodNet
  case-control studies of these two types are nearing completion and will help
  define the sources and points of control for these infections.

- *Campylobacter* **case-control study**
  Campylobacter is the most commonly diagnosed bacterial cause of
  diarrheal illness. FoodNet case-control studies to determine the sources
  and risk factors for this infection began in 1998.

Conclusion

Through active surveillance and additional studies, FoodNet is providing better estimates of the burden of foodborne illness and is tracking trends in these diseases over time. In 1997, surveillance of the seven pathogens studied showed that 50 cases of these infections were diagnosed per 100,000 population, representing a total of 130,000 culture-confirmed cases in the entire U.S. population. Additional FoodNet surveys showed that these cases represent a fraction of the burden of foodborne illness. Based on these surveys, at least 60 more of these infections may have occurred for each one that was diagnosed, suggesting that approximately 8 million cases of these bacterial infections occurred in 1997 in the United States.

In addition, FoodNet is a sentinel network that can rapidly respond to new and emerging bacterial, parasitic, and viral foodborne pathogens. Many diarrheal illnesses are not diagnosed because their causative organisms are not detected by routine laboratory tests. Determining the infectious causes and the food source or other sources of these infections is critical to developing methods to prevent them in the future. Beginning in 1998, studies of mild and severe diarrheal illnesses will help define the full spectrum of microbes that cause diarrheal illness in the United States.

Future activities

- Continue active laboratory-based surveillance for *Campylobacter, Salmonella, Shigella, Escherichia coli* O157:H7, *Listeria, Yersinia,* and *Vibrio* infections and active surveillance for hemolytic uremic syndrome (HUS).

- Expand the population under active surveillance with the inclusion of additional counties in Connecticut, Georgia, New York, and Maryland. In 1998, the population within the catchment areas will include 20.3 million persons or 7.5% of the U.S. population. An eighth site will be identified in 1998 for further expansion of FoodNet in 1999.

- Conduct a prospective case-control study of sporadic *Campylobacter* infections in the seven EIP sites.

- Conduct a prospective case-control study of sporadic *Shigella* infections in the California site.

- Begin prospective case-control studies of *Cryptosporidium* and *Listeria* infections.

- Conduct a follow-up prospective case-control study of *E. coli* O157:H7 infections, which will include pulsed-field gel electrophoresis subtyping of isolates.

- Begin rapid reporting of foodborne outbreaks in FoodNet sites.

- Conduct a study of patients hospitalized with acute severe gastroenteritis of unknown etiology in New York, Oregon, and Connecticut.

For additional information about FoodNet, visit our website at
http://www.cdc.gov/ncidod/dbmd/foodnet/foodnet.htm.

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