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Prologue

This is the fifth in a series of annual reports. The FoodNet Surveillance Report for 2000 (Final Report) summarizes the data collected through FoodNet's active surveillance sites during 2000. It represents the continued efforts of numerous individuals, and the collaboration of multiple federal, state, and local public health agencies. The FoodNet Surveillance Report for 2000 (Final Report) consists of two parts: Part I, Narrative Report, and Part II, Summary Tables and Graphs. The FoodNet Surveillance Report for 2000 (Final Report) includes two main revisions to the FoodNet 2000 Preliminary Report, which was published in September 2001. First, the Final Report uses the 2000 census population counts, which became available in September 2001, as the denominator. Second, the Final Report includes a small number of additional cases reported since the publication of the preliminary report. Therefore, Tables 1A and 1B found in Part II, Summary Tables and Graphs of the Final Report are updated, with recalculated incidence rates. Furthermore, surveillance data for hemolytic uremic syndrome and deaths are provided in this Final Report.

Further information concerning FoodNet, including previous surveillance reports, MMWR articles, and other FoodNet publications, can be obtained by contacting the Foodborne and Diarrheal Diseases Branch at telephone number 404.371.5465 or via the Internet at http://www.cdc.gov/foodnet.

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 has been to enhance surveillance for and investigation of infections that are often 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 track trends in specific infections over time as prevention measures are implemented.

The Foodborne Diseases Active Surveillance Network (FoodNet) is the principal foodborne disease component of the Centers for Disease Control and Prevention's (CDC's) Emerging Infections Program (EIP). FoodNet is a collaborative project among CDC, the nine EIP state health department sites, the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA), and the United States Food and Drug Administration (FDA). FoodNet augments, but does not replace, longstanding activities at CDC, FSIS, FDA, and in states to identify, control, and prevent foodborne disease hazards.

FoodNet is a sentinel network that is producing more stable and accurate estimates of the burden and sources of specific foodborne diseases in the United States through active surveillance and additional studies. Enhanced surveillance and investigation are integral parts of developing and evaluating new prevention and control strategies that can improve the safety of our food and the public's health. Ongoing FoodNet surveillance is being used to document the effectiveness of new food safety control measures, such as the USDA, FSIS Pathogen Reduction and Hazard Analysis and Critical Control Point (HACCP) Systems, in decreasing the number of cases of foodborne diseases in the United States each year.

The following are key findings of FoodNet surveillance activities during 2000:

- A modest decline in incidence of *Campylobacter* and *Salmonella* infection indicates that further prevention efforts are needed to meet the Healthy People 2010 objectives for those pathogens.

- *Salmonella* serotype Enteritidis infections declined from 1996. Since the major source of *Salmonella* Enteritidis infections is eggs, this decline may be related to improvements in hygiene on egg-laying hen farms, improvements in keeping eggs refrigerated during transport and distribution, increased use of pasteurized eggs and egg products, and better cooking and handling of eggs in the kitchen.

- There was no substantial change in the rate of *E. coli* O157 infections. However, the absence of a large recognized outbreak highlights the importance of sporadic infections. Preventing *E. coli* O157 will not be a simple task because it can be transmitted through food, water, person-to-person contact, and direct animal exposure. FoodNet studies and recent outbreaks have shown that an important route of transmission is from direct contact with cattle or their environment. Strategies that reduce *E. coli* O157 on farms could decrease food contamination and direct contact infection, as well as entry into the water supply.

- The incidence of *Listeria* infections has decreased over the past twelve years. A previous surveillance system reported an annual *Listeria* infection rate of 1.6 per 100,000 persons in 1989 compared with the rate of 0.34 per 100,000 persons in FoodNet sites in 2000 (Tappero J, Schuchat A, Deavers K, et al. Reduction in the incidence of human listeriosis in the United States. JAMA 1995;273:1118-1122.) This decline over the past 12 years suggests that improvements by the food industry in sanitation have been effective. PulseNet, CDC's network of public health laboratories that subtype bacteria that can be transmitted by food, has led the way to improved outbreak identification in recent years (Information available at http://www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm). Investigation of these outbreaks, such as one due to deli turkey meat in 2000, indicates that production processes still need improvement to reach the Healthy People 2010 objective of 0.25 per 100,000 persons (CDC. Multistate outbreak of listeriosis - United States, 2000. MMWR 2000;49:1129-1130. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4950a1.htm).

- There are important regional variations in the rates of specific bacterial foodborne infections. For example, *Campylobacter* infections are five times more common in California than in Georgia, Tennessee, or Maryland sites. *E. coli* O157 infections are more common in the northern states of Connecticut, Minnesota, New York, and Oregon than in other sites. *Salmonella* shows less variation, being relatively common in all the FoodNet sites. Focused research into the reasons for these local differences may provide information about prevention that is of general use.

- The FoodNet surveillance system will be useful in measuring progress towards the US Department of Health and Human Services' Healthy People 2010 Objectives; these objectives are designed to measure and address preventable health threats to the nation (US Department of Health and Human Services. Healthy People 2010: Understanding and Improving Health. 2nd ed. Washington, D.C: US Government Printing Office, November 2000. Available at http://www.health.gov/healthypeople/Document/Word/uih/uih.doc). The year 2000 rates in FoodNet sites meet the Healthy People 2000 Objectives for each of the four infections, *Campylobacter jejuni, Salmonella, E.coli* O157:H7, and *Listeria monocytogenes*, specifically targeted by the Department of Health and Human Services. However, further prevention efforts are needed to reach the 2010 objectives.

Background

Foodborne infections are an important public health challenge. The Centers for Disease Control and Prevention (CDC) estimates that in 1997, foodborne infections caused 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths. CDC, the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA), the United States Food and Drug Administration (FDA), and the nine Emerging Infections Program (EIP) sites are actively involved in preventing foodborne diseases. In 1997, the interagency national Food Safety Initiative was established to meet the public health challenge of foodborne diseases. CDC's principal role in the Food Safety Initiative has been to enhance surveillance and investigation of infections that are usually foodborne. FoodNet has been instrumental in accomplishing this mission.

Objectives

The objectives of FoodNet are to determine the frequency and severity of foodborne diseases; determine the association of common foodborne diseases with 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 can document the effectiveness of new food safety initiatives, such as the USDA Hazard Analysis and Critical Control Points (HACCP) System, in decreasing the rate of foodborne diseases in the United States each year.

Methods

In 2000, FoodNet conducted population-based active surveillance for clinical laboratory isolations of *Campylobacter*, *Cryptosporidium*, *Cyclospora*, Shiga toxin-producing *E. coli*, including *E. coli* O157, *Listeria*, *Salmonella*, *Shigella*, *Vibrio*, and *Yersinia* infections in Connecticut, Georgia, Minnesota, and Oregon and selected counties in California, Maryland, New York, and Tennessee (total population 30.5 million)[1]. A case was defined as isolation (for bacteria) or identification (for parasites) of an organism from a clinical specimen. For simplicity, in this report, all isolations are referred to as infections, although not all strains of all pathogens have been proven to cause illness. To identify cases, FoodNet personnel contact each of the more than 450 clinical laboratories serving the catchment areas, either weekly or monthly, depending on the size of the clinical laboratory. FoodNet also conducts surveillance for foodborne disease outbreaks and hemolytic uremic syndrome (HUS), the latter principally through pediatric nephrologists.

Results

Cases reported

In 2000, a total of 12,930 laboratory confirmed infections caused by the pathogens under surveillance were identified in eight sites. Of these, 12,373 were bacterial, including 4,713 *Campylobacter* infections, 4330 *Salmonella* infections, 2355 *Shigella* infections, 626 *E. coli* O157 infections, 57 non-O157 Shiga toxin-producing *E. coli* (STEC), 133 *Yersinia* infections, 105 *Listeria* infections, and 54 *Vibrio* infections (Table 1A). Of the 3,964 *Salmonella*

1 A ninth site, selected counties in Colorado, was added in 2000 and will contribute active surveillance data in 2001.

isolates that were serotyped, the most commonly identified serotypes were Typhimurium (830 cases), Enteritidis (585), Newport (412), and Heidelberg (252). In addition, 557 cases of parasitic diseases were reported, including 535 cases of *Cryptosporidium* infection and 22 cases of *Cyclospora* infection (Table 1B).

Table 1A. Infections caused by specific bacterial pathogens, reported by FoodNet sites, 2000

Pathogen	CA	CT	GA	MD	MN	NY	OR	TN	Total
Campylobacter	1186	586	591	189	1079	343	558	181	4713
***Escherichia coli* O157**	46	84	42	16	216	74	114	34	626
Non-O157 STEC	0	13	12	0	28	0	3	1	57
Listeria	13	18	20	10	8	21	6	9	105
Salmonella	460	418	1491	379	612	254	293	423	4330
Shigella	577	69	319	82	903	22	118	265	2355
Vibrio	22	6	8	7	3	0	7	1	54
Yersinia	28	13	46	8	10	8	9	11	133
Total	2332	1207	2529	691	2859	722	1108	925	12373

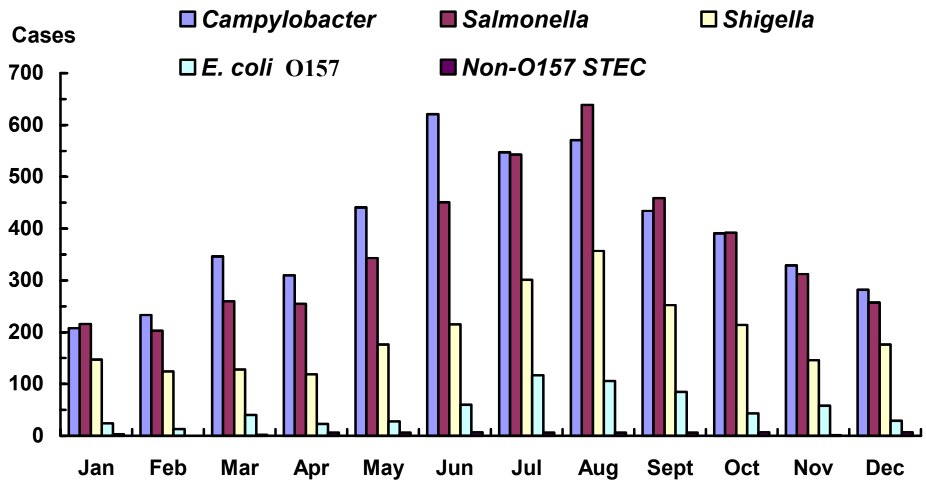
Table 1B. Infections caused by specific parasitic pathogens, reported by FoodNet sites, 2000

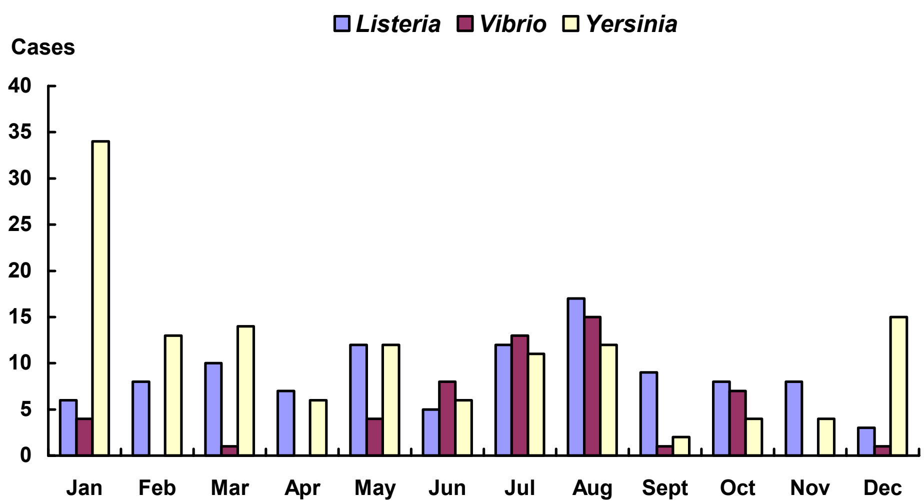
Pathogen	CA	CT	GA	MD	MN	NY	OR	TN	Total
Cryptosporidium	67	29	178	7	197	23	21	13	535
Cyclospora	6	2	13	0	0	1	0	0	22
Total	73	31	191	7	197	24	21	13	557

Seasonality

Isolation rates for pathogens showed seasonal variation; 45% of *E. coli* O157, 38% of *Salmonella*, 37% of *Campylobacter*, and 37% of *Shigella* were isolated during June through August (Figure 1). *Yersinia* infections were more likely to have occurred in winter months, with 47% of cases being reported during January, February, or December (Figure 1).

Figure 1. Cases of foodborne disease caused by specific pathogens, by month, FoodNet sites, 2000





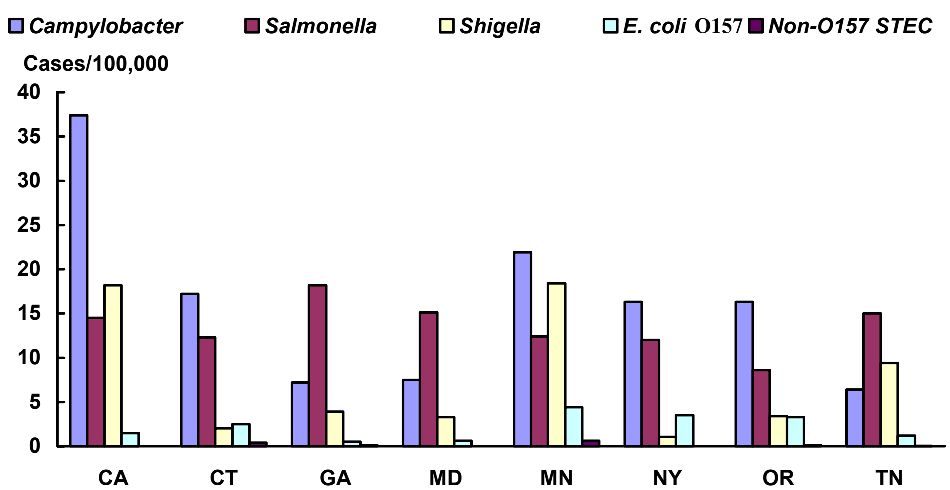
2000 Rates

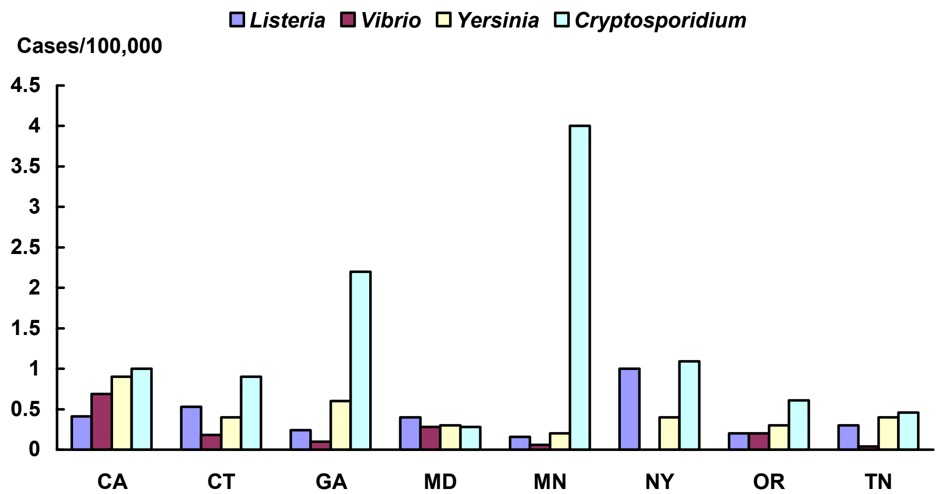
To compare the number of cases among sites with different populations, preliminary annual incidence rates were calculated. Incidence is the number of cases divided by the population. All 2000 rates reported here were calculated with 2000 census population counts. Overall incidence rates were highest for infections with *Campylobacter* (15.4/100,000 population), *Salmonella* (14.2/100,000), and *Shigella* (7.7/100,000). Lower overall incidence rates were reported for *E. coli* O157 (2.0/100,000), non-O157 STEC (0.19/100,000) *Cryptosporidium* (1.6/100,000), *Yersinia* (0.44/100,000), *Listeria* (0.34/100,000), *Vibrio* (0.18/100,000), and *Cyclospora* (0.06/100,000).

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 6.4/100,000 in Tennessee to 37.4/100,000 in California, and for *Shigella* infections from 1.04/100,000 in New York to 18.4/100,000 in Minnesota. Incidence rates for aggregate *Salmonella* infection also varied among the sites, from 8.6/100,000 in Oregon to 18.2/100,000 in Georgia. Among the two most common serotypes of *Salmonella*, *S.* Typhimurium ranged from 2.1/100,000 in Oregon to 3.6/100,000 in Tennessee and *S.* Enteritidis ranged from 1.0/100,000 in Tennessee and Georgia to 5.0/100,000 in Maryland. Incidence rates for *E. coli* O157 infection varied from 0.51/100,000 in Georgia to 4.4/100,000 in Minnesota. FoodNet began collecting information on non-O157 STEC in 2000; the majority of these cases were reported in Connecticut and Minnesota. Infection caused by *Yersinia* varied from 0.2/100,000 in Minnesota to 0.88/100,000 in California. Incidence rates of *Cryptosporidium* infection ranged from 0.28/100,000 in Maryland to 4.0/100,000 in Minnesota. Listeriosis ranged from 0.16/100,000 in Minnesota to 1.0/100,000 in New York, and *Vibrio* infections ranged from no detected cases in New York to 0.69/100,000 in California. Reasons for these regional differences in incidence rates are being investigated; for example, most laboratories do not test specimens routinely for all pathogens. However, regional differences in *E. coli* O157 incidence are only partially accounted for by differences in laboratory practices.

Figure 2. Cases per 100,000 population of foodborne disease caused by specific pathogens, FoodNet sites, 2000

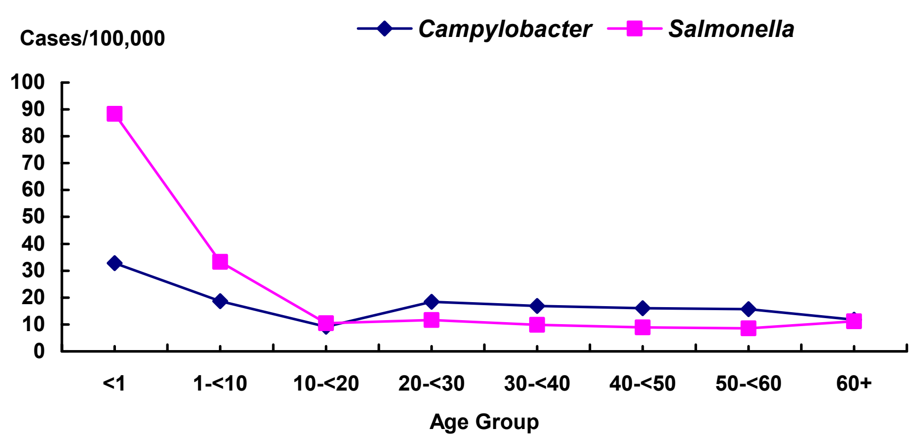




Rates by age

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 88.4/100,000 and the rate of *Campylobacter* infection was 32.8/100,000, rates substantially higher than for other age groups.

Figure 3. Incidence of *Campylobacter* and *Salmonella* infections by age group, FoodNet sites, 2000



Rates by sex

Incidence rates also varied by sex (Table 2). Overall, males were more likely than females to be infected with every pathogen except *Cyclospora*, *E. coli* O157 and *Listeria*. Rates of *Cryptosporidium* infection were 64% higher among males, rates of *Campylobacter* infection were 26% higher among males, and rates of *Shigella* were 20% higher among males.

Table 2. Sex-specific incidence rates per 100,000 population, by pathogen, FoodNet sites, 2000

Pathogen	**Male**	**Female**
Campylobacter	17.1	13.6
Cryptosporidium	1.96	1.19
Cyclospora	0.04	0.09
***E. coli* O157**	1.85	2.23
Listeria	0.30	0.39
Salmonella	14.1	13.9
Shigella	8.3	6.9
Vibrio	0.27	0.08
Yersinia	0.47	0.39

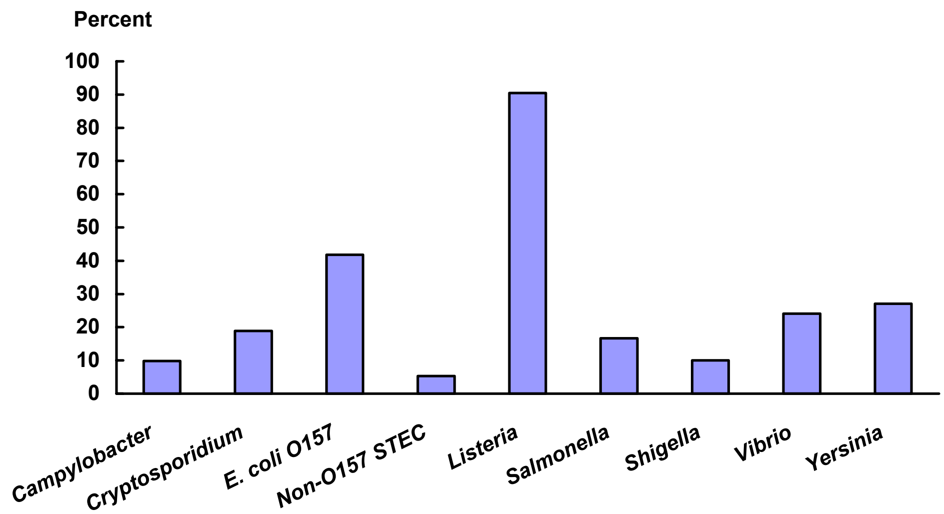
Rates by age and sex

The incidence rate of *Campylobacter* infection was higher for males than for females in all age groups, except for persons aged 20-29 years. Among persons more than 20 years of age, the incidence rate of *Salmonella* infection was higher among women than among men.

Hospitalizations

Overall, 14.9% of persons with culture-confirmed infection were hospitalized; hospitalization rates differed markedly by pathogen (Figure 4). The percentage of hospitalizations was highest for persons infected with *Listeria* (90.5% of reported cases) followed by those infected with *E. coli* O157 (41.8%), *Yersinia* (27.1%), *Vibrio* (24.1%), *Cryptosporidium* (18.9%), *Salmonella* (16.7%), *Shigella* (10%), *Campylobacter* (9.8%), and non-O157 STEC (5.3%).

Figure 4. Percentage of persons hospitalized with infections caused by specific pathogens, FoodNet sites, 2000



Deaths

Fifty-eight persons died; of those, 22 were infected with *Listeria*, 13 with *Salmonella*, nine with *Cryptosporidium,* seven with *E. coli* O157, four with *Campylobacter*, two with *Shigella*, and one with *Vibrio*. The pathogen with the highest case-fatality rate was *Listeria*; 21% of persons infected with *Listeria* died.

HUS

Hemolytic uremic syndrome (HUS) is a life-threatening illness characterized by acute hemolytic anemia, thrombocytopenia, and acute renal failure. Most cases of HUS in the United States are preceded by diarrhea caused by infection with Shiga toxin-producing *Escherichia coli* (STEC). *E. coli* O157:H7 is the most easily and frequently isolated STEC, but other serotypes also cause HUS. Active surveillance for pediatric HUS cases was established in 1997 in five FoodNet sites (California, Connecticut, Georgia, Minnesota, and Oregon). Surveillance was expanded to include areas of Maryland and New York in 1999 and Tennessee in 2000. As a pilot site, Colorado began HUS surveillance in 2000. This data was included, but considered as outside the catchment area. Active surveillance is accomplished through pediatric nephrologists, who report all cases of HUS, including those from outside the FoodNet catchment area. Data on HUS cases in adults are also collected, but surveillance is passive and often incomplete. The primary objectives of HUS surveillance are to 1) determine the incidence of HUS, 2) monitor long-term trends in STEC infection using HUS as a marker, and 3) identify and monitor STEC strains causing HUS over time. A total of 240 cases of HUS were reported between 1997 and 2000 (Table 3A). Sixty percent of reported cases occurred in females. The median

age was 4 years and the median length of hospitalization was 12 days. In 2000, 94 HUS cases were reported, and deaths occurred in six (7%). Among children, 74 HUS cases were reported and 4 deaths occurred. Consistent with the temporal distribution of 2000 *E. coli* O157:H7 infections, 41 (44%) of the 2000 HUS cases were diagnosed between June and August (Figure 5).
The overall rate of HUS among children under 15 years of age in the eight sites from 1997 to 2000 was 0.7/100,000, and among children under 5 years of age was 1.6/100,000 (Table 3B). *E. coli* O157:H7 was isolated from 62% of stools that were specifically tested for this pathogen (Table 3C). Six patients had stool samples that tested positive for Shiga toxin, but stool cultures did not yield *E. coli* O157:H7. Only one other STEC was identified, but it is unclear how rigorously they were sought. A total of 14 cases had STEC serology done to identify anti- O157, O111 or O126 antibodies; 9 cases (64%) had detectable antibody to O157. No antibody against non-O157 STEC serotypes was detected among these cases.

Table 3A. HUS cases by site* and year, 1997-2000

State	**1997**		**1998**		**1999**		**2000**	
	Age <15 years	Age ≥15 years	Age <15 years	Age ≥15 years	Age <15 years	Age ≥15 years	Age <15 years	Age ≥15 years
California	10	0	8	0	5	0	15	0
Colorado	n/a	n/a	n/a	n/a	n/a	n/a	8	0
Connecticut	1	0	0	0	8	2	11	5
Georgia	6	0	13	0	4	0	9	2
Maryland	n/a	n/a	n/a	n/a	2	0	2	0
Minnesota	9	3	17	3	9	4	12	1
New York	n/a	n/a	n/a	n/a	15	5	2	2
Oregon	6	3	6	1	3	3	5	3
Tennessee	n/a	n/a	n/a	n/a	n/a	n/a	10	7
Total	**32**	**6**	**44**	**4**	**46**	**14**	**74**	**20**

**Includes cases among persons residing outside the formal catchment area.*

Table 3B. Pediatric HUS cases, by site* and age, 1997-2000

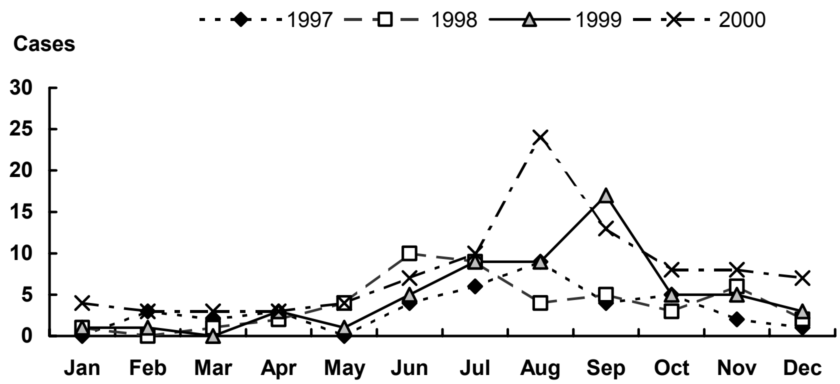
State	Age < 5 years		Age < 15 years	
	Cases	Rate per 100,000	Cases	Rate per 100,000
California	6	1.0	8	0.4
Connecticut	12	1.5	19	0.7
Georgia	18	1.4	22	0.4
Maryland**	1	0.3	2	0.2
Minnesota	33	2.6	47	1.1
New York**	10	3.8	13	1.5
Oregon	16	1.8	18	0.7
Tennessee[†]	4	2.1	6	1.0
Total	**100**	**1.6**	**135**	**0.7**

**Includes cases among persons residing within catchment area only*
***Based only on 1999-2000 data*
[†]*Based only on 2000 data*

Table 3C. Results of microbiologic testing for STEC infection among HUS cases, 1997-2000

Diarrhea in 3 weeks before HUS diagnosis/ Total patients	227/240 (95%)
Stool specimen obtained/ Total patients with information available	224/240 (93%)
Stool cultured for *E. coli* O157:H7/ Patients with stool specimen obtained	221/224 (99%)
E. coli O157:H7 isolated from stool/ Patients with stool cultured for *E. coli* O157:H7	136/221 (62%)
Stool tested for Shiga toxin/ Patients with stool obtained and information available	65/219 (30%)
Stool Shiga toxin positive/ Patients with stool tested for Shiga toxin and information available	46/64 (72%)
Non-O157 STEC isolated from stool/ Patients with stool tested for Shiga toxin	1/65 (2%)
Stool yielding *E. coli* O157:H7, non-O157 STEC and/or Shiga toxin/ total patients with information available	143/221 (65%)

Figure 5. Total Cases of HUS, by year and month, 1997-2000



Foodborne Outbreaks A foodborne outbreak is defined as the occurrence of two or more cases of a similar illness resulting from the ingestion of a common food in the United States. As of January 22, 2002, the overall rate of reported foodborne outbreaks in FoodNet sites in which 10 or more persons become ill was 3.3 outbreaks per million population, ranging from 1.5 outbreaks per million in Connecticut to 5.5 outbreaks per million in Minnesota (Table 4A). These numbers are subject to change as FoodNet sites finalize outbreak investigations. The variation in rates may be in part explained by variation in resources and disease-surveillance activities of state and local public health agencies. Almost half of reported foodborne outbreaks were viral in etiology and slightly more than a quarter had unknown etiologies (Table 4B). Six multistate and 6 multicounty outbreaks that included data from areas outside the FoodNet catchment were excluded.

Table 4A: Outbreaks with 10 or more persons ill by FoodNet site*, 2000

	Number of Outbreaks	**Outbreak Rate / 1,000,000 persons**	**Median # Ill**	**Known Etiology** # (%)
California	10	3.2	21	4 (40)
Connecticut	5	1.5	13	3 (60)
Georgia	26	3.2	36	13 (50)
Maryland	9	3.6	19	3 (33)
Minnesota	27	5.5	24	22 (81)
New York	9	4.3	18	5 (56)
Oregon	8	2.3	24	3 (38)
Tennessee	6	2.1	73	5 (83)
Total	**100**	**3.3**	**25**	**58 (58)**

**Outbreaks reported as of January 22, 2002. Does not include multistate or multicounty outbreaks as all involved sites were not in FoodNet catchment area. FoodNet sites were involved in a total of 6 multistate outbreaks and 6 multicounty outbreaks.*

Table 4B: Reported outbreaks with 10 or more persons ill, by pathogen, FoodNet Sites*, 2000

Etiology	Number of Outbreaks	Median # Ill
Bacillus cereus	1	10
Campylobacter	1	13
Clostridium perfringens	2	53
Cyclospora	1	29
***E. coli* O157**	4	40
Hepatitis A Virus	1	38
Norwalk-like Virus	34	26
Salmonella	8	14
Scombroid toxin	1	11
Shigella	1	24
Staphylococcus	4	95
Unknown, viral profile**	7	18
Unknown, other	35	24
Total	**100**	**25**

** Outbreaks reported as of January 22, 2002. Does not include multistate or multicounty outbreaks as all involved sites were not in FoodNet catchment area. FoodNet sites were involved in a total of 6 multistate outbreaks and 6 multicounty outbreaks.*
***Unconfirmed viral etiology largely based on symptoms*

1996-2000 Rates

Because the population under surveillance expanded substantially from 1996 to 2000 (Figures 6, 7), examining the data only from the original five sites provides consistency (Table 5A). Comparing years 1996 to 2000, the incidence of laboratory-diagnosed campylobacteriosis declined in the original five sites combined, and in four of the five original sites considered individually (Figure 8A). The magnitude and pattern of decrease varied by site. The incidence of diagnosed salmonellosis declined in all five sites combined and in each of the five original sites (Figure 8B). Comparing 1996 to 2000, the incidence of infection with the most common serotypes of *Salmonella* also declined, from 2.5 to 1.8 for *Salmonella* Enteriditis, from 3.9 to 2.7 for *Salmonella* Typhimurium, and from 0.78 to 0.49 for *Salmonella* Newport (Table 5B). The incidence of listeriosis declined overall and in each of the sites (Figure 8C). In contrast, the overall incidence of shigellosis varied substantially from year to year and from site to site; the incidence increased in all sites combined and in two of the five individual sites; large increases occurred in California and Minnesota during 2000 (Figure 8D). The overall incidence of diagnosed *E. coli* O157 infections varied from year to year in the combined five sites. There was also marked year-to-year fluctuation in the rates of *E. coli* O157 infections in individual sites, and marked variation from site to site (Figure 8E). *Vibrio* rates increased slightly in the combined five sites and were consistently higher in California than in the other four FoodNet sites (Figure 8F). *Yersinia* rates in FoodNet decreased from 1996-2000, Georgia generally reported higher rates than the other four FoodNet sites (Figure 8G). The incidence of cryptosporidiosis and cyclosporiasis also declined after surveillance began in 1997.

Figure 6. 1996 FoodNet surveillance area (Sites indicated by black areas) (total population=14, 281,096)

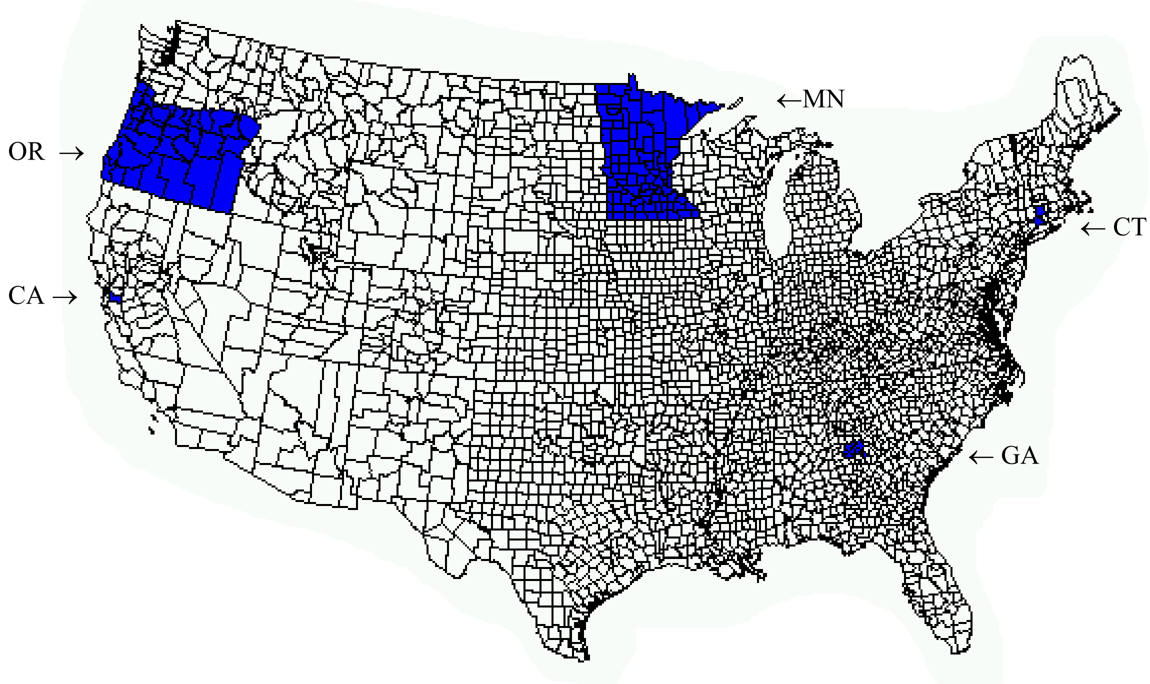


Figure 7. 2000 FoodNet surveillance area (Sites indicated by black areas)

(total population=30, 543,022)

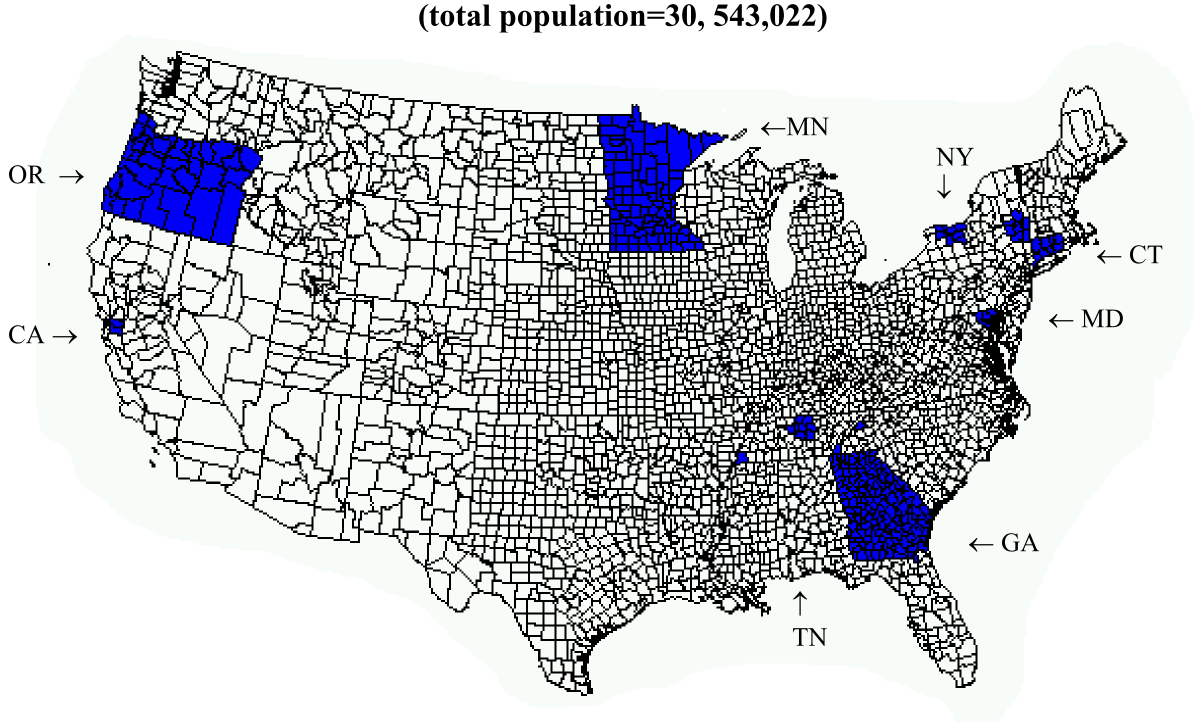


Table 5A. Rate* of selected pathogens detected by FoodNet at the five original sites and the 2000 sites, by year and pathogen, 1996-2000

	Original Five Sites					2000 Sites
Pathogen	**1996**	**1997**	**1998**	**1999**[¶]	**2000**[¶]	**2000**
Campylobacter	23.5	25.3	21.4	17.5	19.6	15.4
Cryptosporidium	NR[α]	3.7**	2.9**	1.8**	1.9**	1.6
Cyclospora	NR[α]	0.40**	0.06**	0.05**	0.06**	0.065
***E. coli* O157**	2.7	2.3	2.8	2.1	2.7	2.0
Listeria	0.46	0.49	0.57	0.53	0.31	0.34
Salmonella	14.5	13.6	12.3	13.6	11.6	14.2
Shigella	8.9	7.5	8.5	5.0	11.3	7.7
Vibrio	0.15	0.33	0.25	0.20	0.23	0.18
Yersinia	1.04	0.92	1.01	0.83	0.53	0.44

* Per 100,000 population

[ι] In 1996, active surveillance began for laboratory-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. In 1997, active surveillance began for laboratory-confirmed cases of *Cryptosporidium* and *Cyclospora* infections in Connecticut, Minnesota, and Oregon, and selected counties in California.

[¶] Urine isolates excluded, because urine isolates were not reported before 1999.

[α] Not Reported

**Rates from 1997-2000 for *Cryptosporidium* and *Cyclospora* were calculated using the 1997 catchment area. Connecticut, Minnesota and selected counties in California began data collection at the beginning of 1997; Oregon and other selected counties in California began this process mid-year. Only full-year data (CA, CT, MN) are included in these rates.

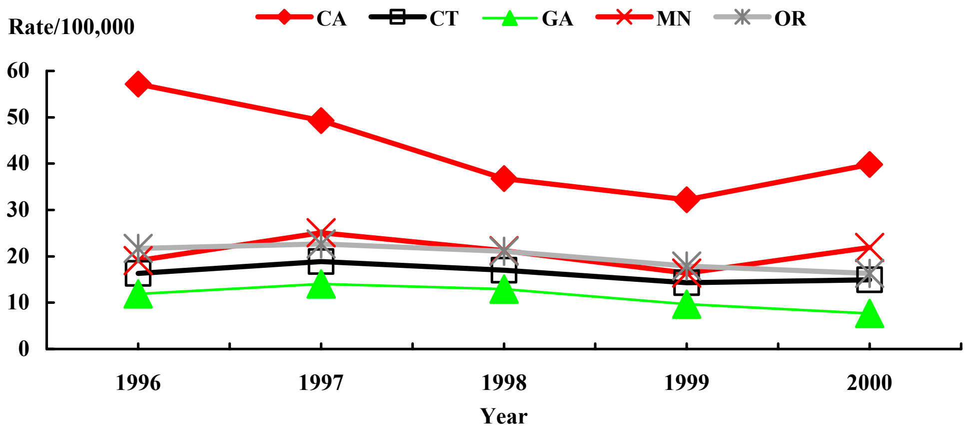
Table 5B. Rate* of *S.* Enteritidis, *S.* Typhimurium, and *S.* Newport detected by FoodNet at the five original sites, by year and serotype, 1996-2000

Pathogen	1996	1997	1998	1999	2000
***Salmonella* Enteritidis**	**2.5**	**2.3**	**1.4**	**1.3**	**1.8**
***Salmonella* Typhimurium**	**3.9**	**3.9**	**3.7**	**3.5**	**2.7**
***Salmonella* Newport**	**0.78**	**0.49**	**0.39**	**0.66**	**0.49**

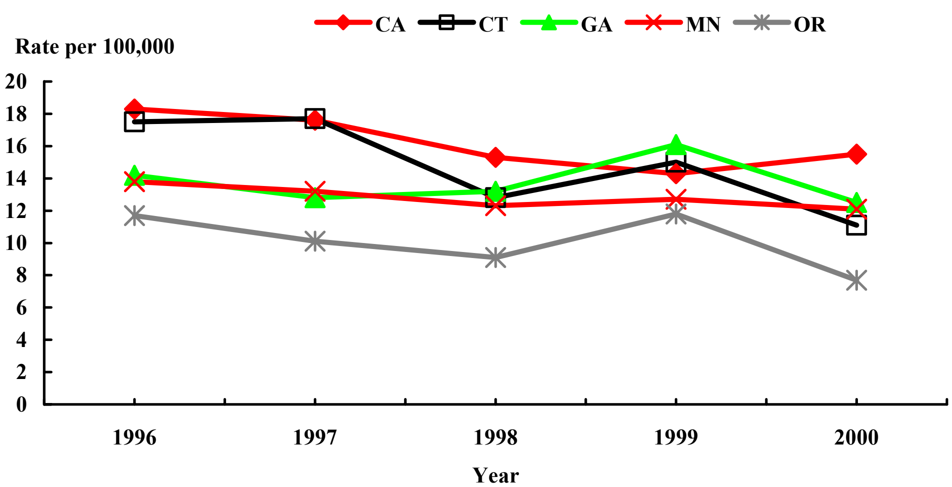
* Per 100,000 population.

Figure 8. Incidence of diagnosed infections for pathogens under surveillance in FoodNet at the five original sites, by year and organism – United States, 1996-2000

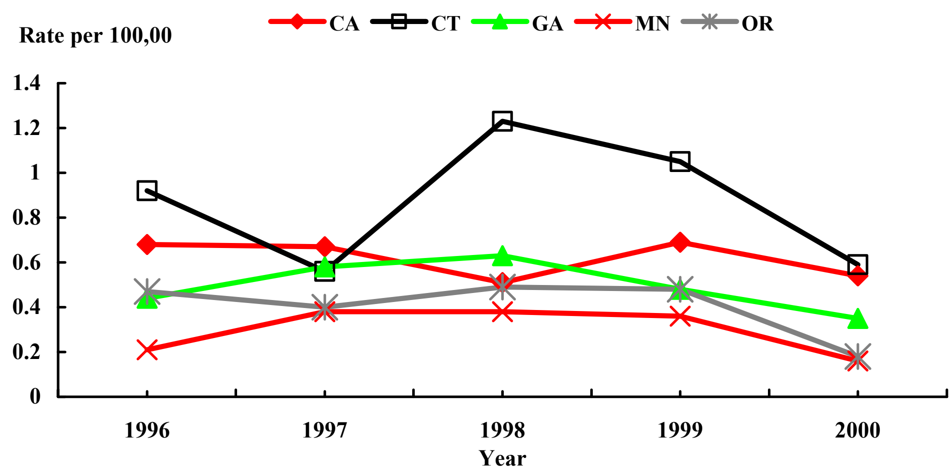
8A) *Campylobacter* infections



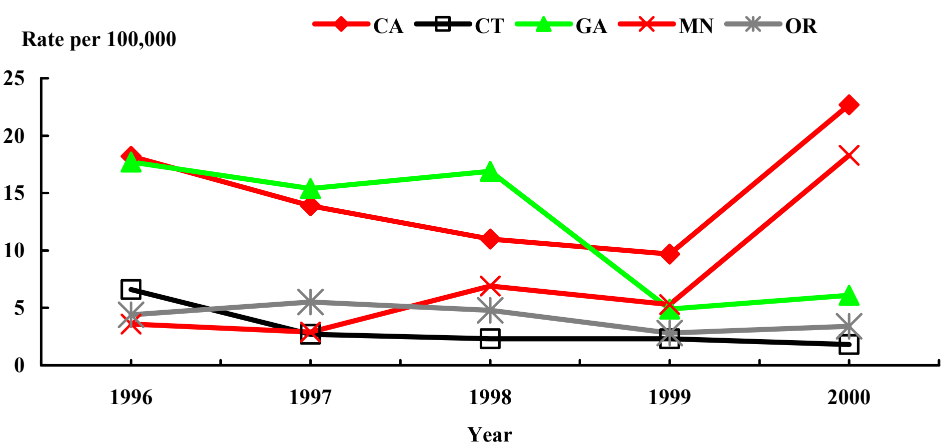
8B) *Salmonella* infections



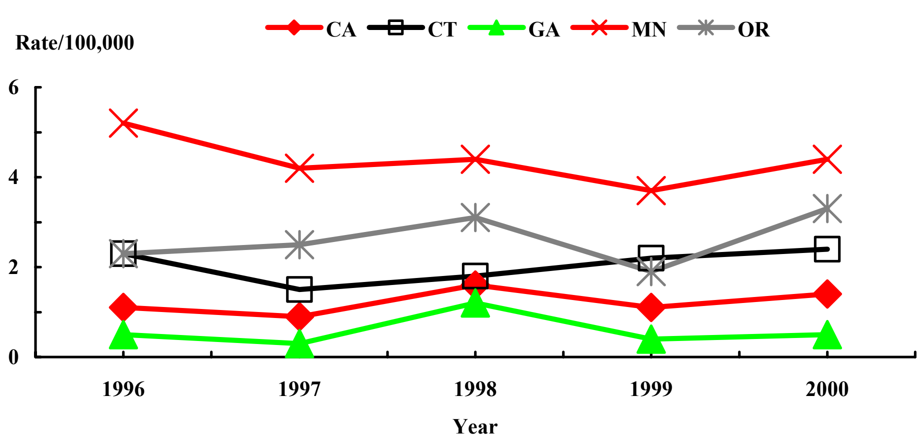
8C) *Listeria* Infections



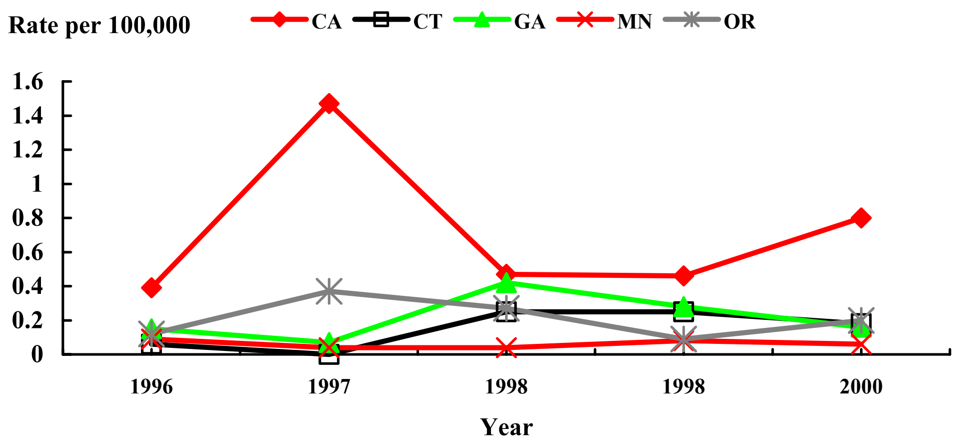
8D) *Shigella* Infections



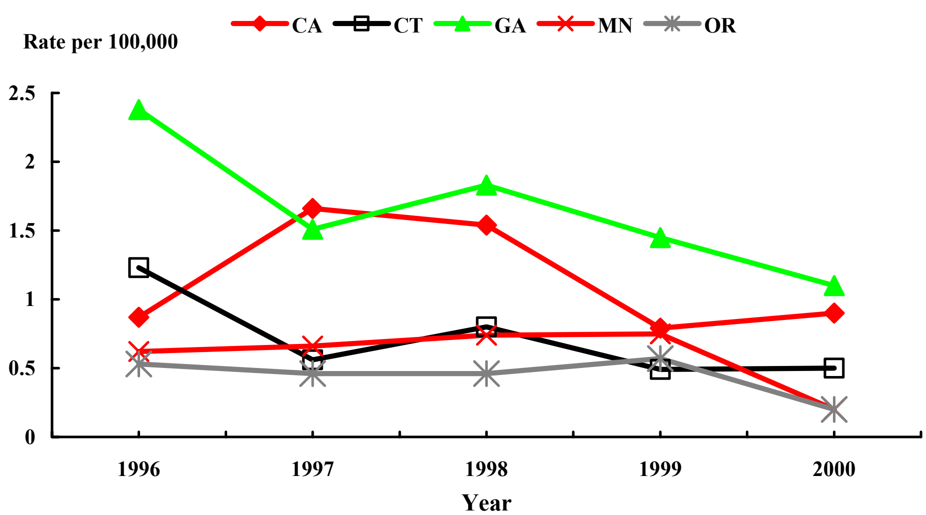
8E) *E. coli* O157 infections



8F) *Vibrio* Infections



8G) *Yersinia* Infections



Comments

In all years, *Campylobacter* was the most frequently diagnosed pathogen, followed by *Salmonella, Shigella*, and *E. coli* O157; however, there was substantial regional and year-to-year variation. Differences in calendar year 2000 rates between the expanded and original (Table 5A) populations reflect regional differences in pathogen isolation rates. However, the rank order of isolation of pathogens is the same. Despite the year-to-year variation and regional fluctuations, the general magnitude of incidence and the relative order of pathogens has remained the same. This indicates that this expanded system will be useful for measuring progress towards the Healthy People 2010 Objectives for infections with *Campylobacter* (for which the 2010 objective is 12.3 per 100,000), *E. coli* O157 (2010 objective is 1.0 per 100,000), *Salmonella* (2010 objective is 6.8 per 100,000) and *Listeria* (2010 objective is 0.25 per 100,000) (Table 6) and for assessing attainment of the Healthy People 2000 Objectives. FoodNet data indicate a need to increase prevention efforts to reach the 2010 objectives.

Table 6. Comparing 2000 incidence with the Healthy People 2000 and 2010 Objectives

Pathogen	2000 Incidence*	2000 Objective*	2010 Objective*
Campylobacter	15.4	25.0	12.3
Escherichia coli O157	2.0	4.0	1.0
Salmonella	14.2	16.0	6.8
Listeria	0.34	0.50	0.25

*Per 100,000 population

The incidence of listeriosis (0.34 per 100,000 population in all sites combined) in 2000 was lower than in earlier reports from a previous surveillance system (1.6 per 100,000 in 1989) (Tappero J, Schuchat A, Deavers K, et al. Reduction in the incidence of human listeriosis in the United States. JAMA 1995;273:1118-1122.). The decline in *Listeria* infection over the past 12 years suggests that improvements by the food industry in sanitation have been effective. The 2000 decline may indicate further improvements resulting from PulseNet's contribution to outbreak identification and investigation. As PulseNet identifies outbreaks, particularly multistate outbreaks at a greater rate, public health officials are more quickly able to identify, respond, and contain outbreaks (http://www.cdc.gov/ncidod/dbmd/pulsenet/pulsenet.htm). The recent national *Listeria* outbreak due to deli turkey meat indicates the need for further improvements in the production process (CDC. Multistate outbreak of listeriosis - United States, 2000. MMWR 2000;49:1129-1130. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4950a1.htm).

The incidence of laboratory-diagnosed *Salmonella* and *Campylobacter* infections declined from 1996 to 2000. This decline occurs in the setting of improvements in slaughter plant monitoring and inspection, by implementation of Hazard Analysis Critical Control Points (HAACP). Other factors, including food safety education, on farm pathogen reduction, and improved restaurant practices may also be part of this decline. The year-to-year variations make overall trends difficult to measure with precision. However, *Salmonella* Enteritidis and *Salmonella* Typhimurium infections have modestly declined since 1996 (Table 5B). The major source of *Salmonella* Enteritidis infections is eggs; the continued decline in *Salmonella* Enteritidis infections may be related to improvements in hygiene on egg-laying farms, improvements in keeping eggs refrigerated during transport and distribution, increased use of pasteurized eggs and egg products, and better cooking and handling of eggs in the kitchen.

Although the incidence increased from 1999 to 2000 in the original five sites, a longer term trend in the incidence of diagnosed *E.coli* O157 cannot be discerned. The continued problem of *E. coli* O157 indicates that despite the absence of large, recognized outbreaks, this remains an important pathogen. Preventing *E. coli* O157 will not be a simple task because it can be transmitted through food, water, person-to-person contact, and direct animal exposure. FoodNet studies and recent outbreaks have shown that a growing part of the problem results from direct animal exposure, i.e., children visiting petting farms. Control of transmission through the food chain will not prevent these infections; strategies that reduce *E. coli* O157 on farms will alleviate both food contamination and direct contact infection.

The substantial overall increase in shigellosis (mainly caused by *Shigella sonnei*) was driven primarily by large increases in Minnesota and California. An estimated 80% of shigellosis is transmitted by non-foodborne routes (Mead PS, Slutsker L, Dietz V, et al. Food-related illness and death in the United States. Emerging Infectious Disease 1999;5:607-25. Available at http://www.cdc.gov/ncidod/eid/vol5no5/mead.htm). The increase in Minnesota appears to be the result of several community outbreaks, especially in day-care centers and elementary schools, and California's increase was primarily caused by two outbreaks, a multistate foodborne outbreak associated with a commercially prepared bean dip (CDC. Public health dispatch-outbreak of *Shigella sonnei* infections associated with eating a nationally distributed dip – California, Oregon, and Washington, January 2000. MMWR 2000;49:60-1. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm4903a4.htm), and a non-foodborne outbreak in San Francisco among men who have sex with men (CDC. Surveillance for Foodborne Disease Outbreaks –United States, 1993-1997. MMWR CDC Surveillance Summaries 2000;49(SS-1):1-51. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml/ss4901a1.htm).

Overall, the marked regional variability in the incidence of some laboratory-confirmed infections may indicate the need for prevention measures targeted to high-incidence locations. A low incidence in one area may provide information on how to decrease the incidence in other areas.

The findings in this report are subject to several limitations. First, although

FoodNet surveillance encompassed just over 10% of the U.S. population in 2000, these data are subject to substantial local variation and may not be a nationally representative sample, particularly in analyses restricted to the five original sites. Second, FoodNet data are limited to laboratory-confirmed illnesses, and most foodborne illnesses are neither laboratory confirmed nor reported to state health departments. CDC estimates that for every Salmonella infection confirmed, a number more occur that are not diagnosed or reported. Although clinical laboratories in FoodNet sites routinely test stool specimens for *Salmonella* and *Shigella,* and almost always for *Campylobacter,* only about 50% routinely test for *E. coli* O157, and fewer test routinely for other pathogens; variations in testing for pathogens could account for some of the variations in incidence. Third, some laboratory-confirmed illnesses reported to FoodNet can be acquired through non-foodborne routes, e.g., through contaminated water, person-to-person contact, and direct animal exposure; therefore, the reported rates do not represent foodborne sources exclusively. Further surveillance and comparison on the expanded geographic base is necessary to determine which changes represent year-to-year variation and which are definitive trends.

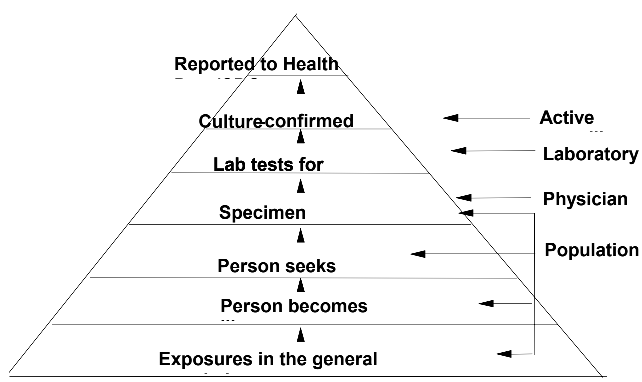
Other Ongoing Projects

Burden of Illness

Cases reported through active surveillance represent only a fraction of the number of cases in the community. To estimate better the number of cases of foodborne disease in the community, FoodNet conducts surveys of laboratories, physicians, and the general population in the participating EIP sites (Figure 9). Using these data, we can determine the proportion of people in the general population with a diarrheal illness and from among those, the number who seek medical care for the illness. We can estimate the proportion of physicians who ordered a bacterial stool culture for patients with diarrhea, and we can evaluate how variations in laboratory testing for bacterial pathogens influence the number of culture-confirmed cases. Using FoodNet and other data, CDC estimates that 76 million foodborne illnesses, 325,000 hospitalizations, and 5,000 deaths occurred in 1997 in the United States (Mead P, Slutsker L, Dietz V, et al. Food-related illness and death in the United States. Emerging Infectious Disease 1999;5:607-25. Available at http://www.cdc.gov/ncidod/eid/vol5no5/mead.htm).

This model can be used for developing estimates of the burden of illness caused by each foodborne pathogen. For example, data from this model suggest that in 1997 there were 1,400,000 *Salmonella* infections, resulting in 113,000 physician office visits and 37,200 culture-confirmed cases in this country. Laboratory-confirmed cases alone resulted in an estimated 8500 hospitalizations and 300 deaths; additional hospitalizations and deaths occur among persons whose illness is not laboratory-confirmed.

Figure 9. Burden of Illness



Routes of Transmission Of Foodborne Pathogens

FoodNet conducts case-control studies to determine the proportion of foodborne diseases that are caused by specific foods or food preparation and handling practices. To date, FoodNet has conducted case-control studies of *E. coli* O157, of *Salmonella* serotypes Enteritidis, Heidelberg, and Typhimurium DT104, of infant salmonellosis, and of *Campylobacter*. A

Cryptosporidium case-control study and 2nd *E. coli* O157 case-control study are ongoing. A *Listeria* case-control study was begun in 2000 and is anticipated to continue for three years. By determining this proportion of foodborne diseases caused by specific foods or food preparation and handling practices, prevention efforts can be made more specific and their effectiveness documented.

Other FoodNet Activities

- A complete analysis of the third survey of clinical laboratories in FoodNet sites was conducted in 2000 to determine changes in laboratory practices is ongoing.
- The population under active surveillance was expanded by including additional counties in Tennessee in 2000.
- The third cycle of the FoodNet population survey began in February 2000 in the 8 FoodNet sites and will run for 12 months. The purpose of the survey is to estimate more precisely the burden of acute diarrheal illness in the United States. FoodNet population survey data help determine the prevalence and severity of self-reported diarrheal illness, common symptoms associated with diarrhea, the proportion of persons with diarrhea who seek care, and exposures that may be associated with foodborne illness.
- A physician survey was conducted to assess food safety education practices.
- Enrollment was continued for the second *E. coli* O157 case-control study.
- Enrollment was continued for the *Cryptosporidium* case-control study.
- FoodNet collaborated with environmental health specialists to form the Environmental Health Specialists Network (EHS-Net) to strengthen relationships between epidemiology, laboratory and food protection programs and to better identify factors contributing to foodborne illness and foodborne disease outbreaks, particularly in retail establishments.

Future activities

- Continue population-based surveillance for *Campylobacter*, *Cryptosporidium*, *Cyclospora*, *Salmonella*, *Shigella*, Shiga toxin-producing *Escherichia coli* including *E. coli* O157, *Listeria*, *Yersinia*, and *Vibrio* infections and for hemolytic uremic syndrome.
- Conduct the fourth cycle of the FoodNet population survey. Scheduled to begin in 2002 in the 9 FoodNet sites, it will run for 12 months.
- Conduct surveillance for foodborne disease outbreaks of any cause that occur within the FoodNet sites and pilot electronic reporting of outbreaks.
- Expand the population under active surveillance by including additional counties in Colorado for participation starting 2001.
- Five counties in Colorado and Prince George's County and Montgomery County in Maryland will be added in 2001.
- Conduct analysis of the *E. coli* O157 case-control study.
- Continue the *Cryptosporidium* case-control study.
- Continue the *Listeria* case-control study.
- Continue the physician survey on food safety education practices.
- Conduct retrospective study of infant illness within FoodNet sites.
- Continue collaboration with EHS-Net to better identify factors contributing to foodborne illness and foodborne disease outbreaks, particularly in retail establishments.
- Conduct pilot surveillance of reactive arthritis and pilot case-control studies to estimate the proportion of enteric infections that progress to reactive arthritis.

Materials Available on On-Line

The following reports are available at the FoodNet web site:

http://www.cdc.gov/foodnet

CDC. 1996 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 1998.

CDC. 1997 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 1998.

CDC. FoodNet Surveillance Report for 1998: Final Report. Atlanta: Centers for Disease Control and Prevention; 1998.

CDC. FoodNet Surveillance Report for 1999: Final Report. Atlanta: Centers for Disease Control and Prevention; 2000.

The following MMWR articles about FoodNet are available at this web site:

http://www.cdc.gov/epo/mmwr/mmwr.html

CDC. The Foodborne Diseases Active Surveillance Network**,** 1996. Morbidity and Mortality Weekly Report. 1997; 46:258-61.

CDC. Incidence of foodborne illness-FoodNet**,** 1997. Morbidity and Mortality Weekly Report. 1998; 47:782 -86.

CDC. Incidence of foodborne illness: Preliminary data from the Foodborne Diseases Active Surveillance Network (FoodNet) – United States**,** 1998. Morbidity and Mortality Weekly Report. 1999; 48:189-94.

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 1999. Morbidity and Mortality Weekly Report. 2000; 49: 201-5.

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 2000. Morbidity and Mortality Weekly Report. 2001; 50: 241-46.

The following FoodNet News newsletters are available at the FoodNet web site:

http://www.cdc.gov/foodnet

FoodNet News. Volume 1, No. 1, Fall 1998
FoodNet News. Volume 1, No. 3, Fall 1999
FoodNet News. Volume 1, No. 2, Winter 1999
FoodNet News. Volume 3, No. 1, Spring 2000
FoodNet News. Volume 3, No. 2, Winter 2000

A list of FoodNet publications and presentations is available at the following FoodNet web site:

http://www.cdc.gov/foodnet/pub.htm

Additional information about the pathogens under FoodNet surveillance is available at the following web sites:

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm
http://www.cdc.gov/health/diseases.htm

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www.cdc.gov/foodnet

Part II
Summary Tables and Graphs

Part II:
Listing of Summary tables and graphs

Tables

Graphs

Rates per 100,000 by pathogen per month

Campylobacter
Cryptosporidium
Cyclospora
Escherichia coli O157 and other Shiga toxin-producing *E. coli*
Listeria
Salmonella
Salmonella Enteritidis
Salmonella Typhimurium
Salmonella Heidelberg
Salmonella Newport
Salmonella Montevideo
Salmonella Agona
Shigella
Shigella sonnei
Shigella flexneri
Shigella dysentariae
Vibrio
Yersinia

Age-specific rates per 100,000 distribution by pathogen for all sites

Campylobacter
Cryptosporidium
Cyclospora
Escherichia coli O157
Listeria
Salmonella
Shigella
Vibrio
Yersinia