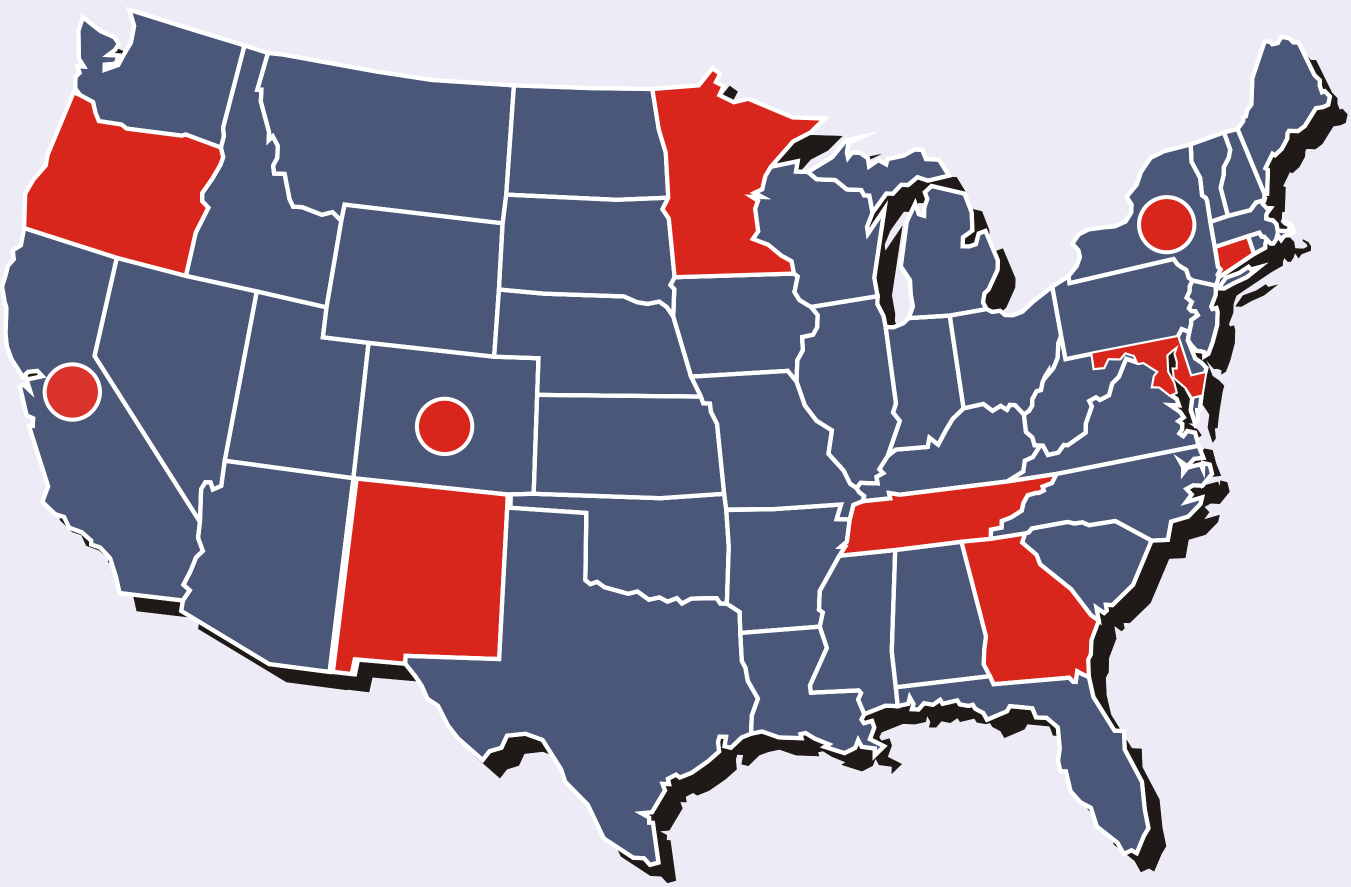
FoodNet Surveillance Report for 2004 (Final Report)



FoodNet
Foodborne Diseases Active Surveillance Network
CDC's Emerging Infections Program

Centers for Disease Control and Prevention
Division of Bacterial and Mycotic Diseases
Foodborne and Diarrheal Diseases Branch
June 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention

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Part I

Narrative Report

Executive Summary

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, state health departments in EIP sites, the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA), and the Center for Food Safety and Applied Nutrition (CFSAN) of the United States Food and Drug Administration (FDA). FoodNet is a sentinel network that is producing more stable and accurate national 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.

Between 1996 and 2004 there was a substantial decline in the incidence of infections caused by shiga toxin-producing *Escherichia coli* O157 (STEC O157). This decline, first noted in 2003, continued in 2004 and was consistent with the decline in STEC O157 contaminated ground beef reported by USDA-FSIS for 2003 and 2004. This was the first year that the incidence of STEC O157 infection reported by FoodNet was below the U.S. Department of Health and Human Services (DHHS) Healthy People 2010 objective (1.0 cases per 100,000 persons).

The incidence of infections caused by *Campylobacter, Listeria,Yersinia*, *Cyclospora*, and *Cryptosporidium* has also declined from 1996 to 2004. These declines indicate important progress toward achieving the Health People 2010 objectives of reducing the incidence of several foodborne diseases by the end of the decade.

The decline in overall *Salmonella* incidence was modest compared with other bacterial pathogens under surveillance. This observation may reflect the multifaceted sources of human *Salmonella* infections. Only one of the five most common *Salmonella* serotypes, *S*. Typhimurium, declined significantly. In contrast, there were marked increases in the incidence of *S*. Javiana and reports of S. I 4,[5]12:i:- infections. No substantial declines in the incidence of the other common *Salmonella* serotypes, *S*. Enteritidis, *S*. Newport, and *S*. Heidelberg, were observed.

The declines in the incidence of these infections are unlikely to be due to surveillance artifacts. FoodNet conducts several studies to monitor surveillance factors that can influence the incidence of laboratory-confirmed foodborne diseases. These factors include the frequency with which persons with gastrointestinal symptoms seek medical care, the frequency with which diagnostic stool specimens are submitted to clinical laboratories, and the frequency with which the laboratories routinely test stool specimens for various pathogens. We are unaware of any changes in these factors that might explain the magnitude of the declines observed in the reported infections.

Food animals are a major source of *Campylobacter, Salmonella*, STEC O157, and *Yersinia* infections. A contributing factor to the decline in foodborne infections caused by these pathogens was a change in the industry and regulatory approaches to meat and poultry safety. In 1997, the UDSA-FSIS implemented the Pathogen Reduction/Hazard Analysis Critical Control Point (PR/HACCP) systems regulations in meat and poultry slaughter and processing plants. The decline in the incidence of *Salmonella* Typhimurium infections in humans may be related to changes in meat processing as evidenced by a decline in the prevalence of *Salmonella* isolated from FSIS-regulated meat and poultry products reported by USDA.

The decline in the incidence of STEC O157 infections may also be attributed to enhanced food safety intervention efforts. In October 2002, FSIS notified manufactures of raw ground beef products that they must reassess their HACCP plans regarding this pathogen. Many beef processing plants began testing ground beef for STEC O157 and did not distribute production lots of ground beef unless such tests were negative.

In 2004, FoodNet began collecting international travel history for *Salmonella* and STEC O157 cases and information to discern whether *Salmonella* and STEC O157 cases were outbreak-associated. By identifying domestically-acquired *Salmonella* and STEC O157 cases that are not outbreak-associated, FoodNet will be able to better attribute infections to U.S. regulated food commodities.

The incidence of foodborne diseases remains high despite important declines in the incidence for several foodborne diseases. Additional measures are needed to further reduce the incidence of these diseases and are particularly needed for *Salmonella* and *Vibrio* to achieve the Healthy People 2010 objectives, and to protect the public health. Efforts to reduce the incidence of foodborne diseases should include steps to reduce the prevalence of these pathogens in their respective important animal reservoirs; e.g., cattle (STEC O157), egg-laying and broiler chickens (*Salmonella* Enteritidis), and seafood, particularly oysters (*Vibrio*). Implementation of nationwide, consistent on-farm preventive controls, for example, would reduce the risk of human illness from *Salmonella* Enteritidis contaminated eggs.

Background

Foodborne infections are an important public health challenge. The Centers for Disease Control and Prevention (CDC) has estimated that in 1997, foodborne infections caused 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths. CDC, the Emerging Infections Program (EIP) sites, the Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA), and the Center for Food Safety and Applied Nutrition (CFSAN) of the United States Food and Drug Administration (FDA) 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; monitor trends in foodborne diseases over time; and determine the association of common foodborne diseases with eating specific foods. To address these objectives, FoodNet uses active surveillance and conducts related epidemiologic studies. By monitoring the burden of foodborne diseases over time and attributing foodborne disease to sources, 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 burden of foodborne diseases in the United States.

Surveillance of Laboratory-Confirmed Infections

Methods

In 2004, FoodNet conducted population-based active surveillance for clinical laboratory isolations of *Campylobacter*, *Cryptosporidium*, *Cyclospora*, *Listeria*, *Salmonella*, Shiga toxin-producing *Escherichia coli* (STEC) including STEC O157, *Shigella*, *Vibrio*, and *Yersinia* infections in Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, and Tennessee, and selected counties in California, Colorado, and New York (total population 44.5 million). 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 in each case. To identify cases, FoodNet personnel contacted each of the 604 clinical laboratories serving the catchment area either weekly or monthly, depending on the size of the laboratory. FoodNet also conducts surveillance for foodborne disease outbreaks and hemolytic uremic syndrome (HUS), the latter principally through reports from pediatric nephrologists.

Cases reported in 2004

In 2004, a total of 16,015 laboratory-confirmed infections caused by the pathogens under surveillance were idenitified in 10 sites. Of these 15,363 were bacterial, including 6,498 *Salmonella* infections, 5,684 *Campylobacter* infections, 2,248 *Shigella* infections, 402 STEC O157 infections, 176 *Yersinia* infections, 123 *Vibrio* infections, 119 *Listeria* infections, 110 STEC non-O157 infections, and 3 STEC O antigen undetermined infections (Table 1A). There were 652 cases of parasitic diseases reported, including 637 *Cryptosporidium* infections and 15 *Cyclospora* infections (Table 1B).

Of the 6,053 (93%) *Salmonella* isolates that were serotyped, the most commonly identified serotypes were Typhimurium (1,190), Enteritidis (877), Newport (593), Javiana (419), and Heidelberg (308). Of the 114 (93%) *Vibrio* isolates speciated, the most commonly identified species were *parahaemolyticus* (59) and *vulnificus* (16).

FoodNet also collected data on 110 STEC non-O157 infections. Of the 90 (82%) STEC non-O157 isolates for which an O antigen was determined, the most commonly identified were O111 (41), O103 (15), and O26 (12).

Table 1A. Infections caused by specific bacterial pathogens, reported by FoodNet sites, 2004

Pathogen	CA	CO	CT	GA	MD	MN	NM	NY	OR	TN	Total
Campylobacter	920	501	585	575	290	896	343	493	643	438	5684
Listeria	15	9	18	15	18	5	2	16	5	16	119
Salmonella	481	324	462	1922	792	643	281	449	369	775	6498
Shigella	228	96	68	645	143	67	140	213	78	570	2248
STEC O157	25	21	31	23	22	110	7	54	61	48	402
STEC non-O157	0	1	24	6	10	16	10	38	1	4	110
STEC O Ant Undet*	0	0	0	1	0	0	1	0	0	1	3
Vibrio	26	11	10	24	28	3	2	1	9	9	123
Yersinia	25	8	19	42	8	22	1	10	15	26	176
Total	1720	971	1217	3253	1311	1762	787	1274	1181	1887	15363

*STEC O Antigen Undetermined

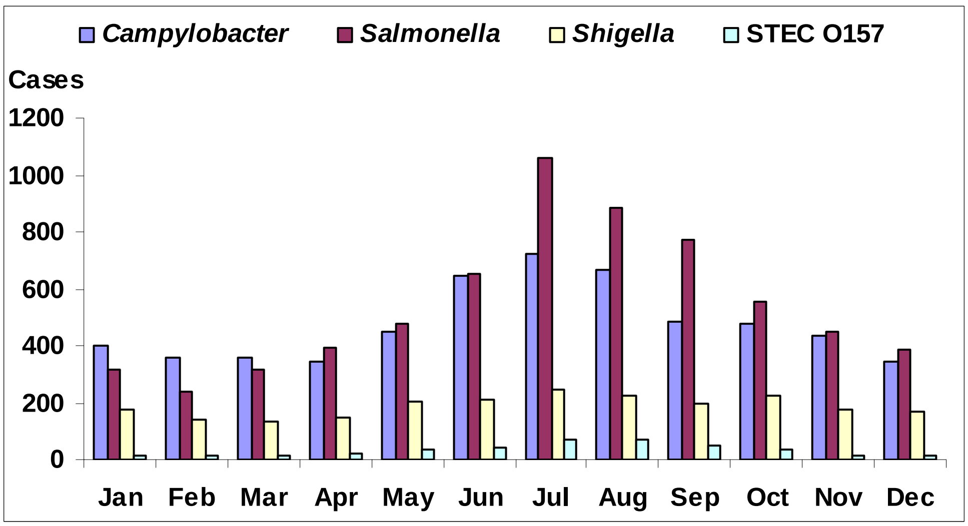
Table 1B. Infections caused by specific parastic pathogens, reported by FoodNet sites, 2004

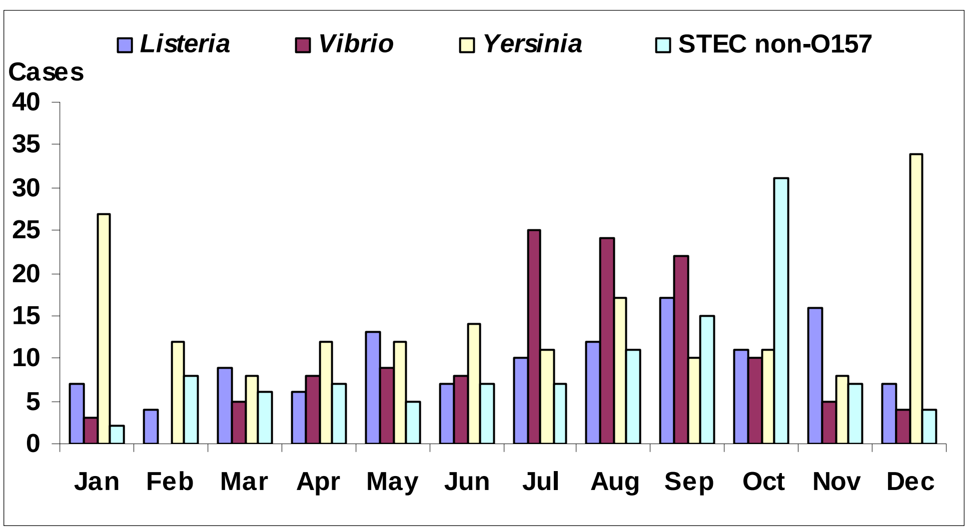
Pathogen	CA	CO	CT	GA	MD	MN	NM	NY	OR	TN	Total
Cryptosporidium	36	25	31	171	24	147	22	97	29	55	637
Cyclospora	0	3	7	2	2	0	0	1	0	0	15
Total	36	28	38	173	26	147	22	98	29	55	652

Seasonality in 2004

Laboratory-confirmed infections showed seasonal variation: 36% of *Campylobacter* and 30% of *Shigella* cases were isolated between June and August; 58% of *Vibrio*, 48% of STEC O157 and 42% of *Salmonella* cases were isolated between July and September; and 52% of STEC non-O157 cases were isolated between August and October (Figure 1). *Yersinia* infections were most common in winter months, with 35% of cases reported during December and January (Figure 1).

Figure 1. Cases of foodborne disease caused by specific pathogens, by month, FoodNet sites, 2004

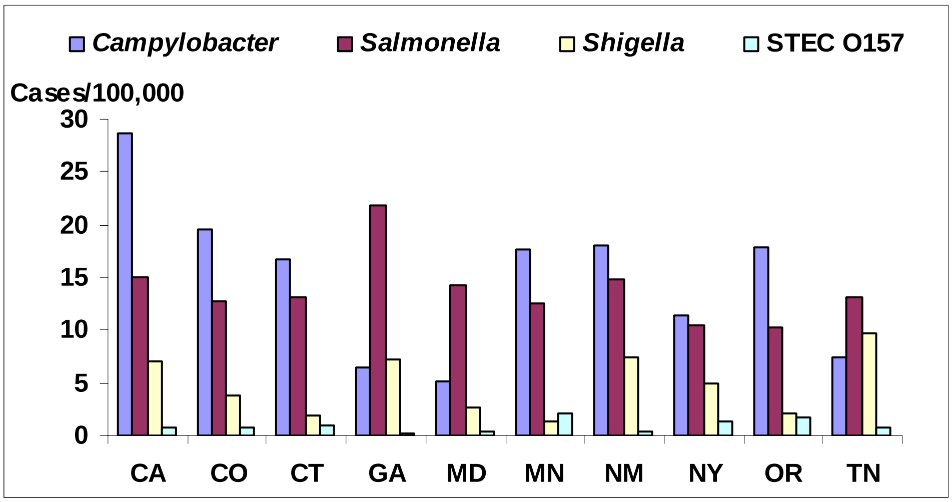


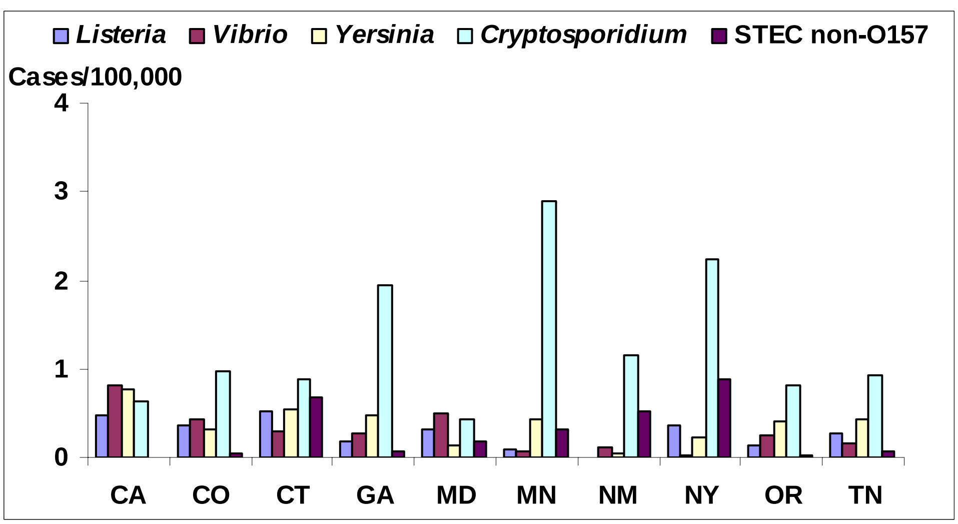


Incidence in 2004

To compare the number of laboratory-confirmed cases among sites with different populations, incidence was calculated (incidence is the number of laboratory-confirmed cases divided by the population). The incidence reported here was calculated using the 2004 census population counts. The incidence for infections in 2004, ranked from highest to lowest, is *Salmonella* (14.61/100,000), *Campylobacter* (12.78/100,000), *Shigella* (5.06/100,000), *Cryptosporidium* (1.43/100,000), STEC O157 (0.90/100,000), *Yersinia* (0.40/100,000), *Vibrio* (0.28/100,000), *Listeria* (0.27/100,000), STEC non-O157 (0.25/100,000), and *Cyclospora* (0.03/100,000). The 2004 incidences of foodborne diseases caused by specific pathogens, by FoodNet site, are shown in Figure 2.

Figure 2. Cases per 100,000 population of foodborne disease caused by specific pathogens, FoodNet sites, 2004

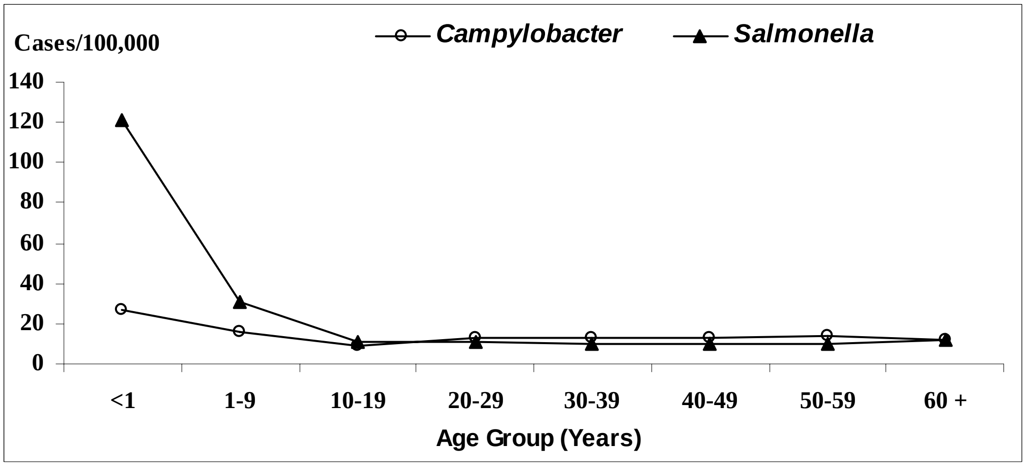




Incidence by age in 2004

The incidence of foodborne illness varied by age in 2004, especially for *Salmonella* and *Campylobacter* infections (Figure 3). For children <1 year of age, the incidence of *Salmonella* infection was 121.57/100,000 and the incidence of *Campylobacter* infection was 26.98/100,000, substantially higher than for other age groups.

Figure 3. Incidence of *Campylobacter* and *Salmonella* infections by age group, FoodNet sites, 2004



Incidence by sex

The incidence also varied by sex in 2004 (Table 2). Among males, the incidence of *Vibrio* was 178% higher than females, *Listeria* was 47% higher, *Cryptosporidium* was 46% higher, and *Campylobacter* was 24% higher. Among females, the incidence of *Cyclospora* was 45% higher than males, *Yersinia* was 12% higher, *Salmonella* was 7% higher, and STEC O157 was 7% higher.

Table 2. Sex-specific incidence (per 100,000 population), by pathogen, FoodNet sites, 2004

Pathogen	Male	Female
Campylobacter	14.15	11.40
Cryptosporidium	1.70	1.17
Cyclospora	0.03	0.04
Listeria	0.32	0.22
Salmonella	14.06	15.07
Shigella	5.14	4.89
STEC O157	0.87	0.93
Vibrio	0.41	0.15
Yersinia	0.37	0.42

Hospitalizations in 2004

Hospitalization status was ascertained for 80% (12,864) of the FoodNet cases in 2004. Overall, 22% of persons with laboratory-confirmed infection were hospitalized; hospitalization rates differed markedly by pathogen. The percentage of persons hospitalized was highest for *Listeria* (97% of reported cases), followed by STEC O157 (42%), *Vibrio* (32%), *Cryptosporidium* (27%), *Yersinia* (27%), *Salmonella* (26%), STEC non-O157 (21%), *Shigella* (18%), and *Campylobacter* (15%). No persons with laboratory-confirmed *Cyclospora* infections were hospitalized.

Deaths in 2004

Eighty-four persons with laboratory-confirmed infections in 2004 died; of those, 38 were infected with *Salmonella*, 19 with *Listeria*, nine with *Campylobacter*, five with *Cryptosporidium*, five with *Vibrio*, four with STEC O157, three with *Shigella*, and one with *Yersinia*. Listeria had the highest case-fatality rate; 16% of persons infected with *Listeria* died.

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Outbreaks In 2004

In 2004, FoodNet cases were part of 251 nationally reported foodborne disease outbreaks (defined as two or more illnesses from a common source); an etiology was confirmed in 173 (69%) outbreaks. The most common etiologies were norovirus (52%) and *Salmonella* (23%). Of the outbreaks reported, 140 (56%) were associated with restaurants. Cases associated with outbreaks influenced the incidence of laboratory-diagnosed infections. For example, the incidence of *S*. Javiana cases increased substantially in 2004, in part because of a multistate outbreak associated with Roma tomatoes that included 42 laboratory-diagnosed cases in Maryland (CDC, unpublished data, 2005).

Of the 6,498 *Salmonella* cases ascertained, 352 (5%) were identified as being outbreak related. Of the outbreak-associated *Salmonella* cases, 78% were food-related, 20% were not food-related, and for 2% the mode of transmission was unknown. Of the 402 STEC O157 cases ascertained, 36 (9%) were identified as being outbreak related. Of these outbreak-associated STEC O157 cases, 58% were food-related, 39% were not food related, and for 3% the mode of transmission was unknown.

International Travel In 2004

Information on international travel in the 7 days before illness onset was obtained from 4,060 (62%) persons with laboratory-confirmed *Salmonella* and 359 (89%) persons with laboratory-confirmed STEC O157 infections. Ten percent of *Salmonella* cases and 3% of the STEC O157 cases reported international travel in the 7 days before illness onset.

Incidence, 2004 to 1996-1998

The number of FoodNet sites has doubled and the population under surveillance has more than tripled since FoodNet began in 1996 (Table 3). Because of substantial variation in incidence among the sites, adding new sites influences overall incidence. To account for the increase in the number of FoodNet sites and populations under surveillance since 1996 and for variation in the incidence of infections among sites, a main-effects, log-linear Poisson regression model (negative binomial) was used to estimate statistically significant changes in the incidence of pathogens (1). To create a baseline period, an average annual incidence for the first 3 years (2 years for *Cryptosporidium*) of FoodNet surveillance, 1996--1998, was calculated. The estimated change in incidence (relative rate) between the baseline period and 2004 was calculated, along with a 95% confidence interval (CI). The 3-year baseline, which differs from the 1996 baseline used in previous reports, resulted in more stable and precise relative rate estimates (Figures 4A to 4D). The relative change in incidence between 3-year baseline and 2004 was estimated and confidence intervals for those changes were calculated (Tables 4A to 4B).

Comparing 2004 with baseline (Table 4A), the estimated incidence of *Yersinia* decreased 44% (95% CI=55% to 32% decrease), STEC O157 decreased 42% (95% CI=54% to 28% decrease), *Listeria* decreased 41% (95% CI=52% to 26% decrease), *Campylobacter* decreased 31% (95% CI =36% to 25% decrease), and *Salmonella* decreased 8% (95% CI =15% to 1% decrease). Comparing 2004 with the 1996--1998 baseline (Table 4B), *S.* Typhimurium decreased 41% (95% CI=48% to 33% decrease), *S.* Newport increased 40% (95% CI=4% to 87% increase), and *S*. Javiana increased 219% (95% CI=98% to 414% increase). There was no statistical difference between the 2004 incidence and baseline for *S.* Enteritidis and *S.* Heidelberg.

The incidence of *Shigella* infections showed considerable variation by year and site with no statistical difference between the 2004 incidence and baseline. The incidence of *Vibrio* infections was 96% higher in 1997 than it was in 1996, reflecting the emergence of *Vibrio parahaemolyticus* O3:K6. When comparing 2004 with 1996--1998, *Vibrio* increases 46% (95% CI=6% to 100% increase). This increase was less than that reported previously because of the use of the combined 3-year baseline.

Surveillance for the parasitic pathogens *Cryptosporidium* and *Cyclospora* began in 1997. Comparing 2004 with 1997-1998, the incidence of *Cryptosporidium* infections decreased 39% (95% CI=51% to 24% decrease) (Figure 4D). Although the incidence of *Cyclospora* has decreased since 1997, the statistical model could not be applied to *Cyclospora* because of the rarity of cases (200 cases between 1997 and 2004).

Healthy People 2010 objectives have been established for four pathogens under FoodNet surveillance; the Healthy People 2010 objective for *Listeria* was subsequently accelerated to a 2005 objective. In 2004, the incidences of *Campylobacter*, STEC O157, and *Listeria* were approaching their targets of 12.3, 1.0, and 0.25 cases per 100,000 respectively. The incidence of *Salmonella* infections in 2004, however, remained much higher than the goal of 6.8 cases per 100,000 (Table 5).

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1 Hardnett FP, Hoekstra RM, Kennedy M, Charles L, Angulo FJ; Emerging Infections Program FoodNet Working Group. Epidemiologic issues in study design and data analysis related to FoodNet activities. Clin Infect Dis 2004;38(Suppl 3):S121--6

Table 3. Population under surveillance in FoodNet sites, 1996-2004

Site	1996	1997	1998	1999	2000	2001	2002	2003	2004
California	2,087,032	2,113,195	2,142,806	2,162,359	3,181,686	3,230,038	3,228,717	3,213,848	3,208,609
Colorado	-	-	-	-	-	2,155,324	2,507,484	2,526,245	2,555,636
Connecticut	1,622,809	2,453,483	**3,272,563**	**3,282,031**	**3,411,956**	**3,434,602**	**3,460,503**	**3,483,375**	**3,503,604**
Georgia	2,720,443	3,632,206	3,744,022	**7,788,240**	**8,234,373**	**8,405,677**	**8,560,310**	**8,684,715**	**8,829,383**
Maryland	-	-	2,441,279	2,450,566	2,516,889	4,253,665	**5,458,137**	**5,508,909**	**5,558,058**
Minnesota	**4,647,723**	**4,687,726**	**4,726,411**	**4,775,508**	**4,934,248**	**4,984,535**	**5,019,720**	**5,059,375**	**5,100,958**
New Mexico	-	-	-	-	-	-	-	-	**1,903,289**
New York	-	-	1,105,062	2,084,453	2,111,143	2,115,056	3,330,456	3,972,809	4,315,310
Oregon	**3,195,087**	**3,243,254**	**3,282,055**	**3,316,154**	**3,431,137**	**3,473,441**	**3,521,515**	**3,559,596**	**3,594,586**
Tennessee	-	-	-	-	2,825,539	2,848,426	2,874,846	**5,841,748**	**5,900,962**
TOTAL	14,273,094	16,129,864	20,714,198	25,859,311	30,646,971	34,900,764	37,961,688	41,850,620	44,470,395
FoodNet population as % of U.S. population	5.4	6	7.7	9.5	10.9	12.2	13.2	14.4	15.1

Bolded indicates active surveillance was conducted statewide, including all counties within a state; otherwise surveillance was conducted in select counties.

"-" Indicates state was not a FoodNet site during indicated year.

Figure 4A. Relative rates of laboratory-confirmed cases of *Campylobacter, Salmonella*, and *Shigella*, by year, 2004 to 1996-1998

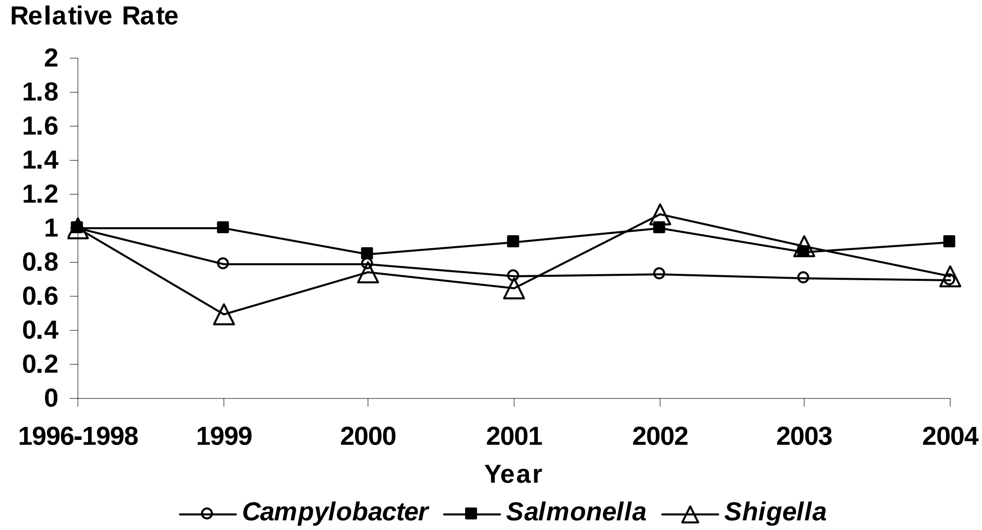

Figure 4B. Relative rates of laboratory- confirmed cases of STEC O157, *Listeria*, and *Yersinia*, by year, 2004 to 1996-1998

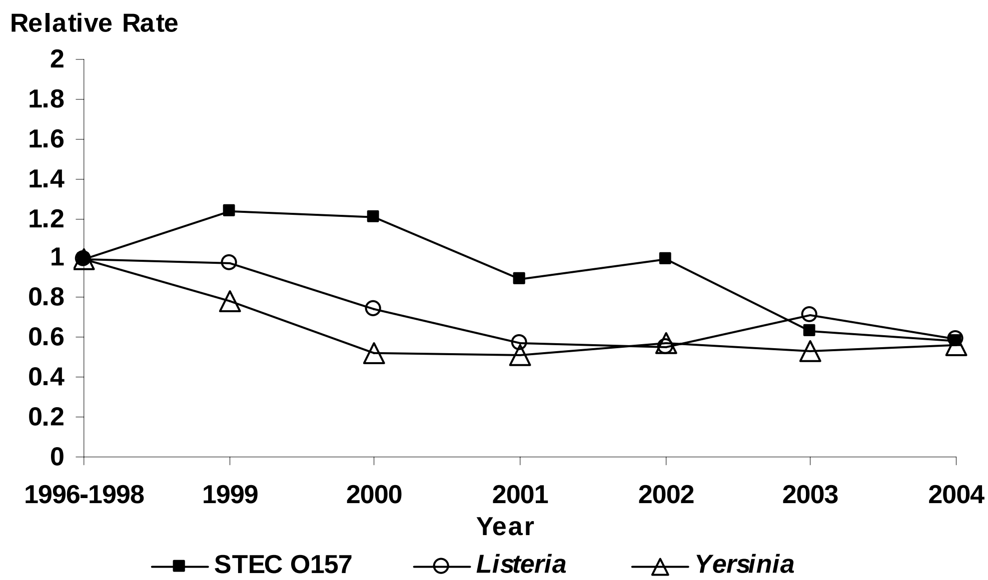

Figure 4C. Relative rates of laboratory- confirmed cases of *Vibrio*, by year, 2004 to 1996-1998

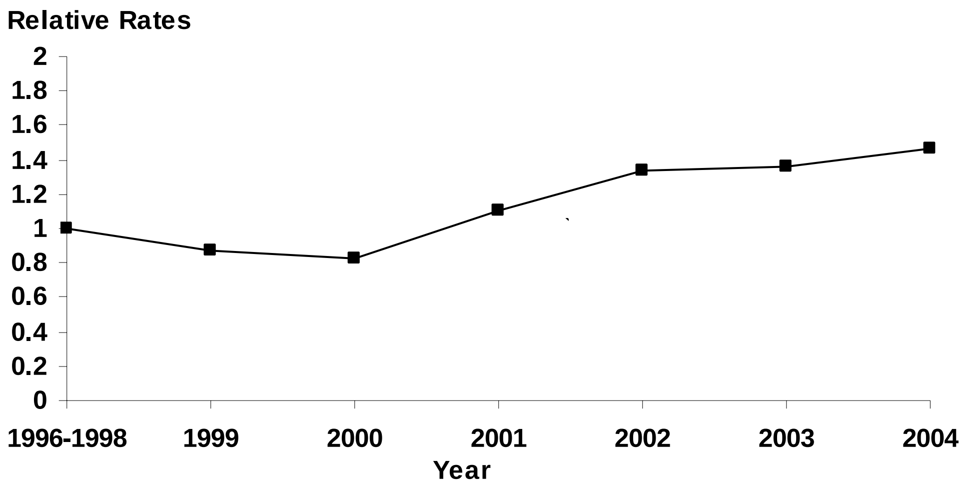

Figure 4D. Relative rates of laboratory- confirmed cases of *Cryptosporidium*, by year, 2004 to 1997-1998

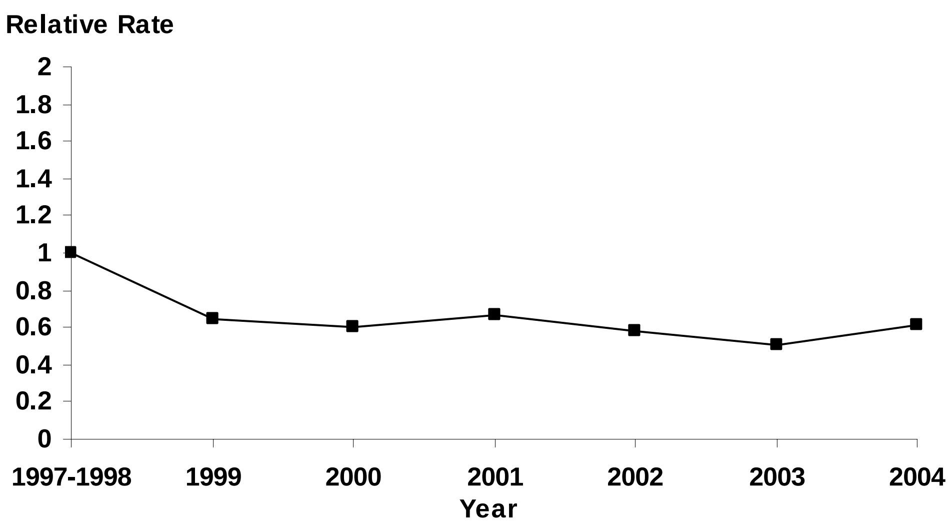

Table 4A. Percent change in incidence* of diagnosed infections for pathogens under surveillance in FoodNet, by pathogen, 2004 to 1996-1998

Bacterial Pathogen	Percent Change	95% Confidence Interval
Campylobacter	-31	36% to 25% decrease
Listeria	-41	52% to 26% decrease
Salmonella	-8	15% to 1% decrease
Shigella	-28	51% decrease to 5% increase
STEC O157	-42	54% to 28% decrease
Vibrio	46	6% to 100% increase
Yersinia	-44	55% to 32% decrease

*Cases per 100,000 population

Parasitic Pathogen	Percent Change*	95% Confidence Interval
Cryptosporidium	-39	51% to 24% decrease

*2004 to 1997-1998

Table 4B. Percent change in incidence* of diagnosed infections for the five most common *Salmonella* serotypes, by serotype, 2004 to 1996-1998

Pathogen	Percent Change	95% Confidence Interval
Salmonella Typhimurium	-41	48% to 33% decrease
Salmonella Enteritidis	0	20% decrease to 26% increase
Salmonella Heidelberg	3	16% decrease to 26% increase
Salmonella Newport	40	4% to 87% increase
Salmonella Javiana	219	98% to 414% increase

*Cases per 100,000 population

Table 5. Comparison of 2004 incidence with the National Health objectives

	Incidence[†]	
Pathogen	**2004 Actual**	**Objective**
Campylobacter	12.8	12.3[*]
Listeria	0.27	0.25[**]
Salmonella	14.6	6.8[*]
STEC O157	0.9	1.0[*]

[†]Cases per 100,000 population
[*]2010 Healthy People objective
[**]2005 objective

Surveillance of Hemolytic Uremic Syndrome

Background

Hemolytic uremic syndrome (HUS) is a life-threatening illness characterized by 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). STEC O157 is the most easily and frequently isolated STEC, but other serotypes can also cause HUS.

Methods

In 2003, HUS surveillance was conducted in Connecticut, Georgia, Maryland, Minnesota, Oregon, Tennessee and select counties in California, New York, and Colorado. Active surveillance was accomplished in all 9 sites through a network of pediatric nephrologists and infection control practitioners, who reported all cases of HUS. Data on adult HUS cases were collected in 8 of the 9 sites, but surveillance was passive and incomplete. In 8 sites hospital discharge data were reviewed to identify any HUS cases that may not have been reported through the networks or passive surveillance.

Cases reported in 2003

In 2003, 97 HUS cases were reported (Table 6A) and 4 (4%) died. Among children less than 15 years of age, 73 HUS cases were reported and 2 (3%) died. Fifty-three percent of HUS cases were diagnosed between June and September.

Incidence, 1997-2003

A total of 628 cases of HUS were reported between 1997 and 2003 (Table 6A). Fifty-eight percent were female. The median age was 5 years and the median length of hospitalization was 12 days. FoodNet identified 462 cases of HUS in children 0 to 14 years of age (rate of 1.06 per 100,000 children); 311 (67%) of these cases of occurred in children under five years of age (rate of 2.21 per 100,000 children, Table 6B). STEC O157 was isolated from 54% of stools that were specifically tested for this pathogen (Table 6C), and Shiga toxin was detected in 66% of stools specifically tested for it. Only four STEC non-O157 were isolated, but it is unknown how rigorously they were sought. Serum samples from 47 cases were tested for antibodies to O157, O111, or O26 lipopolysaccharide (LPS); 26 cases (55%) had antibodies to O157 LPS and two cases (4%) had antibodies to O111 LPS.

Table 6A. HUS cases by site and year, 1997-2003*

State	1997		1998		1999		2000		2001		2002		2003		Total
	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	Age<15 years	Age≥15 years	
CA	10	0	10	0	5	1	18	6	10	2	8	3	11	3	87
CO	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	15	0	11	1	10	1	38
CT	1	0	0	0	8	2	11	5	3	1	7	2	2	1	43
GA	6	0	13	0	4	0	15	15	10	7	11	10	5	1	97
MD	n/a	n/a	n/a	n/a	3	0	4	3	11	5	4	5	5	7	47
MN	9	3	16	4	9	5	16	4	20	5	11	1	8	5	116
NY	n/a	n/a	n/a	n/a	15	6	5	3	2	3	4	3	10	1	52
OR	6	4	6	0	3	3	6	5	12	1	22	3	8	2	81
TN	n/a	n/a	n/a	n/a	n/a	n/a	10	6	12	7	7	3	14	3	62
Total	32	7	45	4	47	17	85	47	95	31	85	31	73	24	623

*5 HUS cases were missing both data of birth and diagnosis date

Table 6B. Pediatric HUS cases, by site and age, 1997–2003

	Age < 5 years		Age 5–14 years	
State	**Cases**	**Rate per 100,000**	**Cases**	**Rate per 100,000**
California	45	3.71	27	1.11
Colorado***	24	4.51	12	1.18
Connecticut	20	1.35	12	0.37
Georgia	44	1.20	20	0.28
Maryland*	13	0.86	14	0.43
Minnesota	60	2.67	29	0.58
New York*	26	2.93	10	0.49
Oregon	52	3.35	11	0.33
Tennessee**	27	2.77	16	0.81
Total	311	2.21	151	0.51

*Based only on 1999-2003 data
**Based only on 2000-2003 data
***Based only on 2001-2003 data

Table 6C. Results of microbiologic testing for STEC infection among HUS cases, 1997–2003

Diarrhea in three weeks before HUS diagnosis/ Total patients	549/628	87%
Stool specimen obtained/ Total patients	536/628	85%
Stool cultured for STEC O157/ Patients with stool specimen obtained	501/536	93%
STEC O157 isolated from stool/ Patients with stool cultured for STEC O157	272/501	54%
Stool tested for Shiga toxin/ Patients with stool specimen obtained	199/536	37%
Stool Shiga toxin-positive/ Patients with stool tested for Shiga toxin	131/199	66%
STEC non-O157 isolated from stool/ Patients with stool tested for Shiga toxin	4/199	2%
Stool yielding STEC O157, STEC non-O157 and/or Shiga toxin/ Total patients with stool cultured for STEC O157	287/501	57%

Comments

From 1996-2004, substantial declines occurred in the estimated incidence of infections with *Campylobacter*, *Cryptosporidium*, *Listeria*, *S.* Typhimurium, STEC O157, and *Yersinia*. The 2004 incidence of STEC O157 infections declined below the 2010 national target of 1.0 case per 100,000 persons in FoodNet overall and in seven of the 10 surveillance sites. In addition, the decline in *Campylobacter* incidence represents progress toward the national health objective of 12.3 cases per 100,000 persons (2); the renewed decline in *Listeria* incidence, to 0.27 cases per 100,000 population in 2004, suggests that the revised national objective to reduce foodborne listeriosis to 0.25 cases per 100,000 population by 2005 might be achievable with continued efforts (3).

The declines described in this report have occurred concurrently with several important food safety initiatives and education efforts (4). The substantial decline of STEC O157 infections first noted in 2003 and sustained in 2004 is consistent with declines in STEC O157 contamination of ground beef reported by the USDA-FSIS for 2003 (5) and 2004. Multiple interventions might have contributed to this decline, including industry response to the FSIS 2002 notice to manufacturers to reassess control strategies for STEC O157 in the production of ground beef and enhanced strategies for reduction of pathogens in live cattle and during slaughter (4). The overall decline in *Campylobacter* incidence from the baseline period to 2004, most of which occurred before 2001, might reflect efforts to reduce contamination of poultry and educate consumers about safe food-handling practices. Although the incidence of *Listeria* infections decreased from the period 1996--1998 through 2004, the incidence in 2004 was comparable to 2002, after an increase in 2003; efforts must continue to prevent foodborne listeriosis.

The decline in *Salmonella* incidence was modest compared with those of other foodborne bacterial pathogens. Only one of the five most common *Salmonella* serotypes, *S.* Typhimurium, declined significantly. To achieve the national health objective of reducing the number of cases to 6.8 per 100,000 persons, greater efforts are needed to understand the complex epidemiology of *Salmonella* and to identify effective pathogen-reduction strategies. The multistate tomato-associated *S.* Javiana outbreak that occurred in the summer of 2004 emphasizes the need to better understand *Salmonella* reservoirs and contamination of produce during production and harvest (6). The Food and

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2 US Department of Health and Human Services. Healthy people 2010 (conference ed, in 2 vols). Washington, DC: US Department of Health and Human Services; 2000.

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5 Naugle AL, Holt KG, Levine P, Eckel R. 2005. Food Safety and Inspection Service regulatory testing program for *Escherichia coli* O157:H7 in raw ground beef. J Food Prot 2005;68:462--8.

6 CDC. Outbreaks of *Salmonella* infections associated with eating Roma tomatoes---United States and Canada, 2004. MMWR 2005;54:325--8.

Drug Administration recently developed a plan to decrease foodborne illness associated with fresh produce (7). Moreover, multidrug resistance is an emerging problem among *Salmonella* serotypes, particularly *S*. Newport; large multistate outbreaks associated with ground beef are cause for increased concern (8).

Enhanced efforts are needed across the farm-to-table continuum to understand and control pathogens in animals and plants, to reduce or prevent contamination during processing, and to educate consumers about risks and prevention measures. Such efforts can be particularly focused when an animal reservoir species and transmission route for a pathogen are known. For example, many *Vibrio* infections are related to consumption of raw molluscan shellfish harvested from waters where *Vibrio* are present; ultra-high hydrostatic pressure treatment of oysters will likely prevent *Vibrio* infections. Other effective prevention measures, such as pasteurization of in-shell eggs and irradiation of ground meat and raw poultry, should be used more widely, particularly for foods eaten by persons at high risk. Consumers should follow safe food-handling recommendations and not consume raw or undercooked shellfish, eggs, ground beef, or poultry. In addition, efforts are needed to prevent transmission by nonfoodborne routes (e.g., via water, person-to-person, and exposure to animals or their environments). Guidelines to prevent disease associated with direct contact with animals or their environments in public settings (e.g., fairs and petting zoos) have recently been published (9).

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7 Food and Drug Administration. Produce safety from production to consumption: 2004 action plan to minimize foodborne illness associated with fresh produce consumption. Rockville, MD: US Department of Health and Human Services, Food and Drug Administration; 2004. Available at http://www.cfsan.fda.gov/~dms/prodpla2.html.

8 CDC. Outbreak of multidrug-resistant *Salmonella* Newport---United States, January--April 2002. MMWR 2002;51:545--8.

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Limitations

The findings in this report are subject to at least four limitations. First, FoodNet relies on laboratory diagnoses, and many foodborne illnesses are not laboratory diagnosed. For example, infections such as norovirus are not identified routinely in clinical laboratories. Second, protocols for isolation of enteric pathogens (e.g., STEC non-O157) in clinical laboratories vary and are not implemented uniformly within FoodNet sites (10). Third, reported illnesses might have been acquired through nonfoodborne sources; reported incidence rates do not represent foodborne sources exclusively. Fourth, although the FoodNet population is similar to the U.S. population (11), the findings might not be generalizable to the entire population of the United States.

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10 Voetsch AC, Angulo FJ, Rabatsky-Ehr T, et al. 2004. Laboratory practices for stool-specimen culture for bacterial pathogens, including *Escherichia coli* O157:H7, in the FoodNet sites, 1995--2000. Clin Infect Dis 2004;38(Suppl 3):S190--7.

11 Hardnett FP, Hoekstra RM, Kennedy M, Charles L, Angulo FJ; Emerging Infections Program FoodNet Working Group. Epidemiologic issues in study design and data analysis related to FoodNet activities. Clin Infect Dis 2004;38(Suppl 3):S121--6.

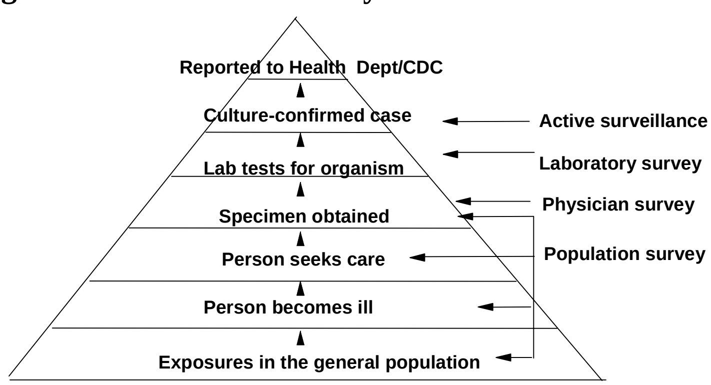
Other FoodNet Data Sources

Burden of Illness

Cases reported through active surveillance represent only a fraction of the number of cases in the community. To better estimate 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 5). 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 estimated that 76 million foodborne illnesses, 325,000 hospitalizations, and 5,000 deaths occurred in 1997 in the United States (12).

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 8,500 hospitalizations and 300 deaths; additional hospitalizations and deaths occur among persons whose illness is not laboratory diagnosed.

Figure 5. Burden of Illness Pyramid



12 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

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 STEC O157; *Salmonella* serotypes Enteritidis, Heidelberg, Newport, and Typhimurium; infant salmonellosis; *Campylobacter*; *Cryptosporidium*; and *Listeria*. Case-control studies of infant *Salmonella* and *Campylobacter* infections were launched in 2002. By determining the contribution to these foodborne diseases made by specific foods or food preparation and handling practices, prevention efforts can be made more specific and their effectiveness documented.

Other FoodNet Activities in 2004

- Analysis of the *Listeria* case-control study, which enrolled 174 cases and 378 controls, was completed.
- Analysis for the *Salmonella* Newport and *Salmonella* Enteritidis case-control studies was completed. The *S*. Newport study was designed to identify behavioral, dietary, and medical risk factors for and medical consequences of *S*. Newport infections, including multidrug-resistant strains of *S*. Newport. This study enrolled 215 cases and 1154 controls. The *S*. Enteritidis study was designed to identify behavioral, dietary, and medical risk factors for and medical consequences of *S*. Enteritidis infections. This study enrolled 223 cases and 742 controls.
- Analysis for the infant salmonellosis and campylobacteriosis case-control studies, enrolling 566 cases and 928 controls, was completed. These studies were designed to identify behavioral, dietary, and medical risk factors for infections of infants with *Salmonella* or *Campylobacter*.
- Data analysis began on a retrospective cohort study to evaluate the impact that reduced susceptibility to fluoroquinolones has on clinical outcomes of *Salmonella* Typhi infection.

Publications and Abstracts, 2004

A list of FoodNet publications and presentations is also available at the following FoodNet Web site:
http://www.cdc.gov/foodnet/pub.htm

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25. Voetsch AC, Vugia DJ, Klontz KC, Megginson M, Scheftel J, Ingram LA, Hurd S, Thomas SM, Burnite S, Anderson BJ, Moore MR; Emerging Infections Program FoodNet Working Group. Trends in sporadic *Vibrio* infections in Foodborne Diseases Active Surveillance Network (FoodNet) sites, 1996-2002. Presented at the International Conference on Emerging Infectious Diseases, Atlanta, GA, 2004.

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 (404) 639-3680.

Materials Available On-Line

The following reports are available on the FoodNet Web site:

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

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. 1998 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 1998.
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CDC. 2001 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 2002.
CDC. 2002 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 2003.
CDC. 2003 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 2004

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

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

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.

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 2001. Morbidity and Mortality Weekly Report. 2002; 51: 325-29.

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 2002. Morbidity and Mortality Weekly Report. 2003; 52: 340-43.

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 2003. Morbidity and Mortality Weekly Report. 2004; 53: 338-343

CDC. Preliminary FoodNet data on the incidence of foodborne illnesses – selected sites, United States, 2004. Morbidity and Mortality Weekly Report. 2005; 54: 352-356

The following *FoodNet News* newsletters are available at the FoodNet Web site:

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

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
FoodNet News. Volume 4, No. 1, Fall 2002
FoodNet News. Volume 4, No. 2, Spring 2003
FoodNet News. Volume 5, No. 1, Fall/Winter 2003
FoodNet News. Volume 5, No. 1, Spring 2005

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

http://www.cdc.gov/foodnet/publications.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/node.do/id/0900f3ec8000e035

FoodNet Working Group, 2004

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