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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 USDA-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 manufacturers 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.



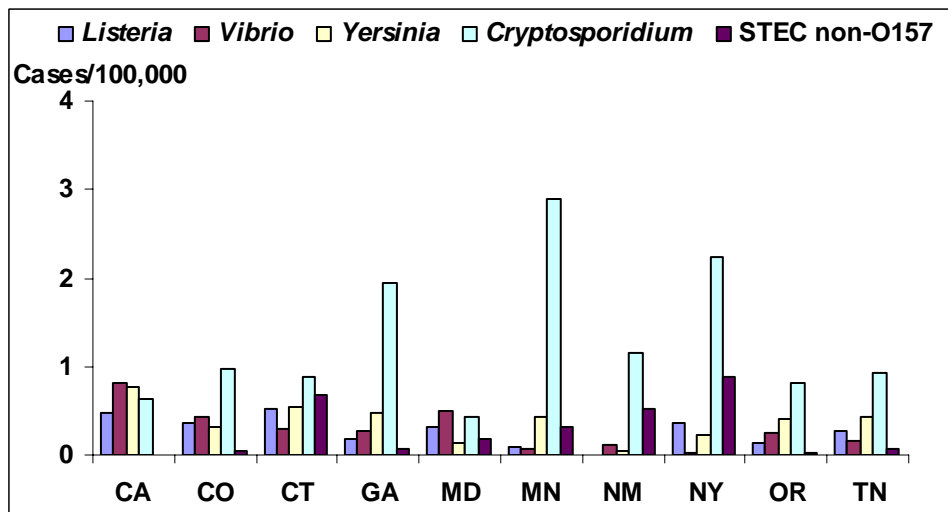
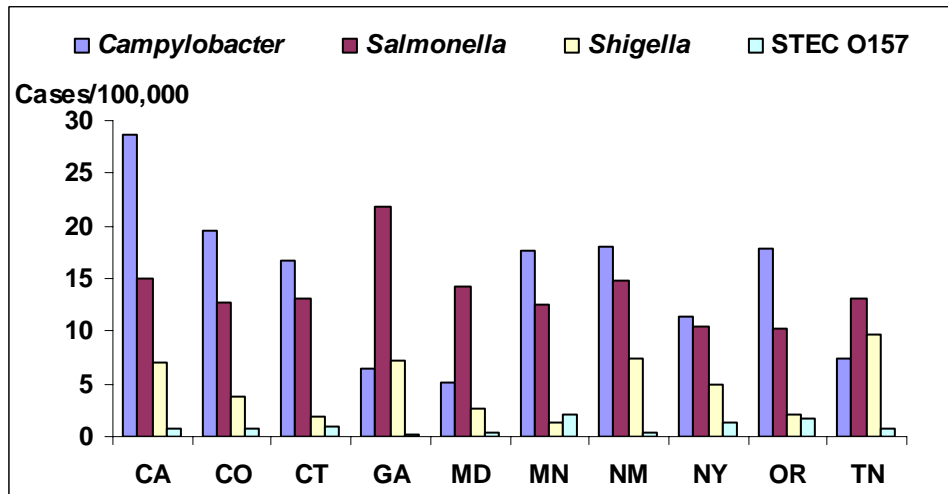




**Incidence in 2004**

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**







***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.

***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) 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*, *S. Heidelberg*, and *S. Newport*.

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

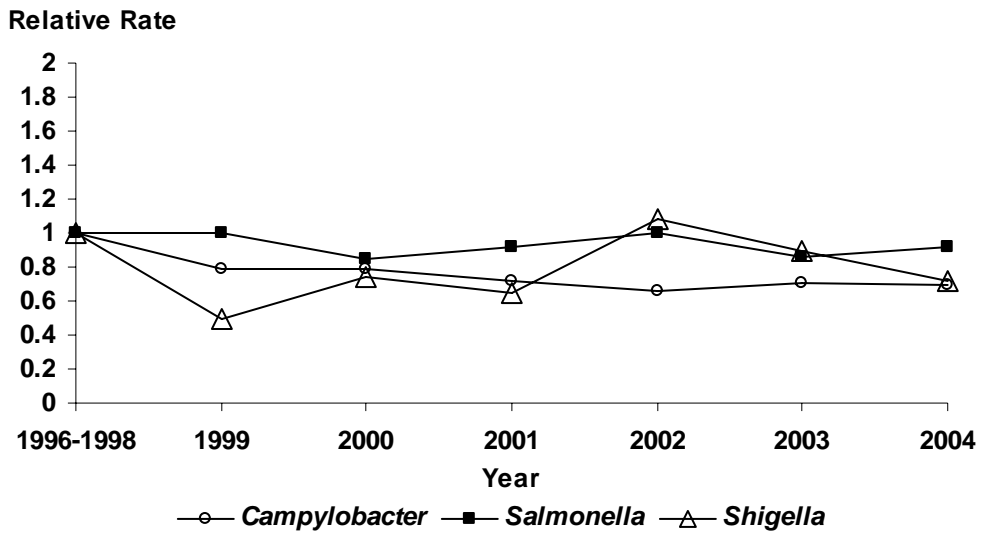
**Table 3. Population under surveillance in FoodNet sites, 1996-2004**

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	<b>3,272,563</b>	<b>3,282,031</b>	<b>3,411,956</b>	<b>3,434,602</b>	<b>3,460,503</b>	<b>3,483,375</b>	<b>3,503,604</b>
Georgia	2,720,443	3,632,206	3,744,022	<b>7,788,240</b>	<b>8,234,373</b>	<b>8,405,677</b>	<b>8,560,310</b>	<b>8,684,715</b>	<b>8,829,383</b>
Maryland	-	-	2,441,279	2,450,566	2,516,889	4,253,665	<b>5,458,137</b>	<b>5,508,909</b>	<b>5,558,058</b>
Minnesota	<b>4,647,723</b>	<b>4,687,726</b>	<b>4,726,411</b>	<b>4,775,508</b>	<b>4,934,248</b>	<b>4,984,535</b>	<b>5,019,720</b>	<b>5,059,375</b>	<b>5,100,958</b>
New Mexico	-	-	-	-	-	-	-	-	<b>1,903,289</b>
New York	-	-	1,105,062	2,084,453	2,111,143	2,115,056	3,330,456	3,972,809	4,315,310
Oregon	<b>3,195,087</b>	<b>3,243,254</b>	<b>3,282,055</b>	<b>3,316,154</b>	<b>3,431,137</b>	<b>3,473,441</b>	<b>3,521,515</b>	<b>3,559,596</b>	<b>3,594,586</b>
Tennessee	-	-	-	-	2,825,539	2,848,426	2,874,846	<b>5,841,748</b>	<b>5,900,962</b>
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

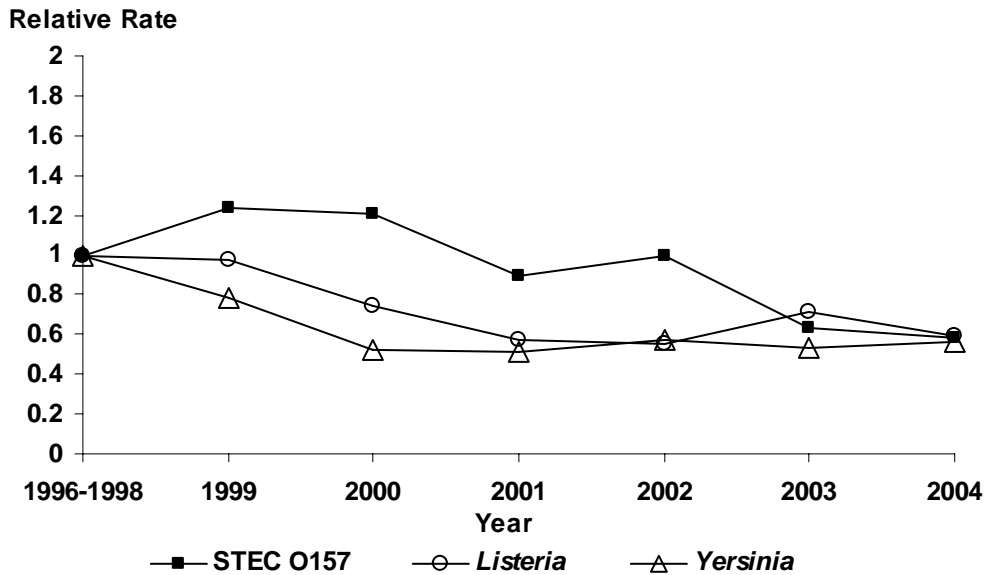
**Bolded** indicates active surveillance was conducted statewide, including all counties within a state; otherwise surveillance was conducted in select counties.

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

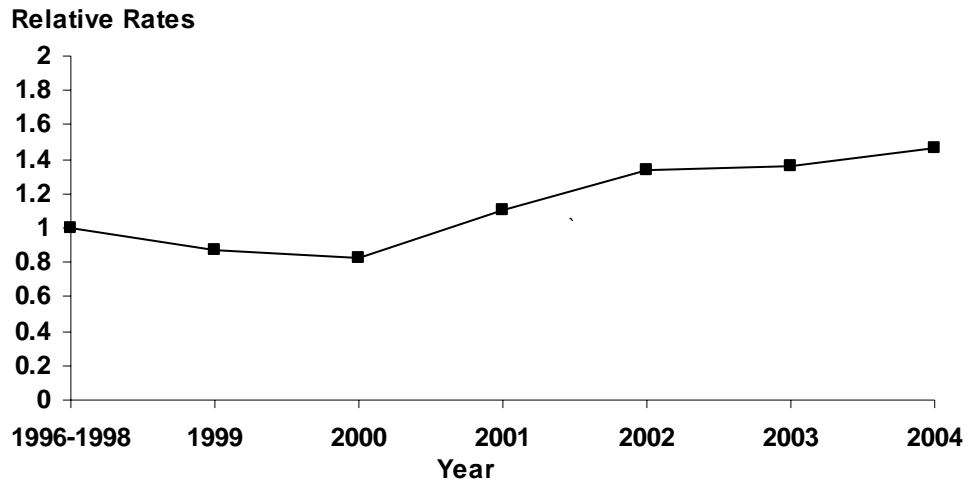
**Figure 4A. Relative rates of laboratory-confirmed cases of *Campylobacter*, *Salmonella*, and *Shigella*, by year, 2004 to 1996-1998**



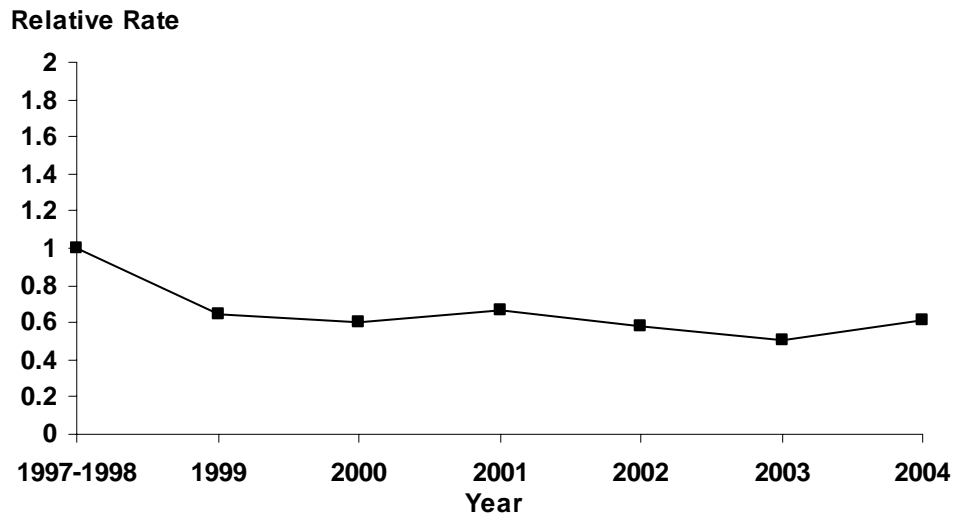
**Figure 4B. Relative rates of laboratory-confirmed cases of STEC O157, *Listeria*, and *Yersinia*, by year, 2004 to 1996-1998**



**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**

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

\*Cases per 100,000 population

<b>Parasitic Pathogen</b>	<b>Percent Change*</b>	<b>95% Confidence Interval</b>
<i>Cryptosporidium</i>	-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**

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

\*Cases per 100,000 population

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

<b>Pathogen</b>	<b>Incidence<sup>†</sup></b>	
	<b>2004 Actual</b>	<b>Objective</b>
<i>Campylobacter</i>	12.8	12.3*
<i>Listeria</i>	0.27	0.25**
<i>Salmonella</i>	14.6	6.8*
STEC O157	0.9	1.0*

<sup>†</sup>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 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**

State	Age < 5 years		Age 5–14 years	
	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.

3 US Department of Agriculture, Food Safety and Inspection Service. 9 CFR Part 430. Control of *Listeria monocytogenes* in ready-to-eat meat and poultry products; final rule. Federal Register 2003;68:34,208--54.

4 Allos BM, Moore MR, Griffin PM, Tauxe RV. Surveillance for sporadic foodborne disease in the 21st century: the FoodNet perspective. Clin Infect Dis 2004;38(Suppl 3):S115--20.

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.

9 CDC. Compendium of measures to prevent disease associated with animals in public settings, 2005: National Association of State Public Health Veterinarians, Inc. (NASPHV). *MMWR* 2005;54(No. RR-4).

## *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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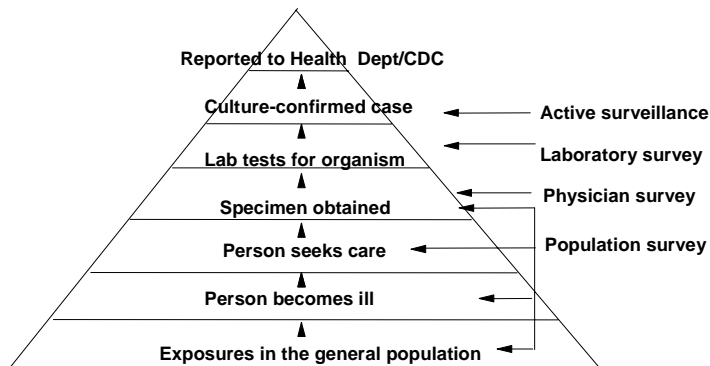
## Other FoodNet Data Sources

### 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>

### ***Publications***

1. Allos BM, Moore MR, Griffin PM, Tauxe RV. Surveillance for sporadic foodborne disease in the 21st century: the FoodNet perspective. *Clinical Infectious Diseases* 2004;38(Suppl 3):S115-120.
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#### **Abstracts**

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2. Ailes EC, Vugia DJ, Segler SD, Hurd S, Megginson M, Stenzel SA, Hidalgo C, Ingram LA, Moore MR; Emerging Infections Program FoodNet Working Group; Rates of hospitalization for specific foodborne pathogens, FoodNet, 1996-2001. Presented at the International Conference on Emerging Infectious Diseases, Atlanta, GA, 2004.
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7. Hurd S, Scheftel J, Snider CJ, Shin S, Hatch J, Thomas SM, Gerber DE, Smith G, Burnite S, Holtry RS, Strockbine N, Moore MR; Emerging Infections Program FoodNet Working Group. Clinical laboratory practices for the identification of shiga toxin-producing *Escherichia coli* in FoodNet sites. Presented at the International Conference on Emerging Infectious Diseases, Atlanta, GA, 2004.
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**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.  
CDC. 1999 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 2000.  
CDC. 2000 Final FoodNet Surveillance Report. Atlanta: Centers for Disease Control and Prevention; 2002.  
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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.  
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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/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm)  
<http://www.cdc.gov/health/diseases.htm>

## ***FoodNet Working Group, 2004***

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James Howgate  
Matthew Johns  
Susan Lance  
Alicia McDonald  
May Park  
Christina Payne  
Lynette Poventud  
Laura Rainer  
Susan Ray  
Jody Schweitzer

Suzanne Segler  
Tami Stigger  
Stepy Thomas  
Melissa Tobin-D'Angelo

### **Maryland**

David Blythe  
Patricia Ryan  
Melanie Megginson  
Dale Rohn  
Leslie Edwards  
Jack DeBoy  
Robert Myers  
Ken Wilde  
J. Glenn Morris, Jr.  
Karen T. Cuenco  
Jonigene Ruark  
Mary Warren  
Kim Holmes  
Jackie Hunter  
Julie Kiehlbauch  
Kirsten Larson  
Amber Starn

### **Minnesota**

April Bogard  
Candace Fuller  
Kirk Smith  
Ellen Swanson Laine  
Carlota Medus  
Joni Scheftel  
Jeff Luedeman  
Brian Lee  
Stephanie Wedel  
John Besser  
Dawn Kaehler  
Stephen Swanson  
Theresa Weber

### **New Mexico**

Joan Baumbach  
Karen Edge  
Karla Thornton  
Lisa Butler  
Karen Johnson  
Joanne Keefe  
Kathy Villa

### **New York**

Bridget Anderson  
Robyn Atkinson  
Hwa-Gan Chang  
Nellie Dumas  
Dina Hoefler

Dale Morse  
David Nicholas  
Candace Noonan-Toly  
Tim Root  
Dianna Schoonmaker-Bopp  
Glenda Smith  
Perry Smith  
Nancy Spina  
Shelley Zansky

### **Oregon**

Paul Cieslak  
Emilio DeBess  
Debbie Bergquist  
Julie Hatch  
Bill Keene  
James Mack  
Melissa Plantenga  
Beletshachew Shiferaw  
John Townes  
Molly Wagner  
Rob Vega

### **Tennessee**

Effie Boothe  
Allen Craig  
Diane Eigsti Gerber  
Samir Hanna  
Henrietta Hardin  
Amanda Ingram  
Timothy Jones  
Leonard Lindsay  
Ryan Mason  
Marcy McMillian

### **USDA-FSIS**

Michael Cooper  
David Goldman  
Jane Harman  
Kristin Holt  
Fred Ramsey  
Columb Rigney  
Carl Schroeder

### **FDA-CFSAN**

Jack Guzewich  
Eileen Parish  
Patrick McCarthy  
Clifford Purdy

### **FDA-CVM**

David White