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Preliminary FoodNet Data on the Incidence of Infection with Pathogens Transmitted Commonly Through Food — 10 States, 2007

The Foodborne Diseases Active Surveillance Network (FoodNet) of CDC's Emerging Infections Program collects data from 10 U.S. states* regarding diseases caused by pathogens commonly transmitted through food. FoodNet quantifies and monitors the incidence of these infections by conducting active, population-based surveillance for laboratory-confirmed infections (*1*). This report describes preliminary surveillance data for 2007 and compares them with data for previous years. In 2007, the estimated incidence of infections caused by *Campylobacter, Listeria*, Shiga toxin-producing *Escherichia coli* O157 (STEC O157), *Salmonella, Shigella, Vibrio,* and *Yersinia* did not change significantly, and *Cryptosporidium* infections increased compared with 2004–2006. Progress toward the targets for Healthy People 2010 national health objectives and targets (*2*) regarding the incidence of foodborne infections occurred before 2004; however, none of the targets were reached in 2007. *Salmonella* incidence was the furthest from its national health target, suggesting that reaching this target will require new approaches.

* Connecticut, Georgia, Maryland, Minnesota, New Mexico, Oregon, Tennessee, and selected counties in California, Colorado, and New York.

Surveillance Methods

In 1996, FoodNet began active, population-based surveillance for laboratory-confirmed cases of infection caused by *Campylobacter*, *Listeria*, *Salmonella*, STEC O157, *Shigella*, *Vibrio*, and *Yersinia*. FoodNet added surveillance for cases of *Cryptosporidium* and *Cyclospora* infection in 1997 and STEC non-O157 infection in 2000. In 2004, FoodNet began collecting data regarding which laboratory-confirmed infections were associated with outbreaks.

Infection with STEC O157 can cause hemolytic uremic syndrome (HUS), a complication in which the kidneys fail. HUS surveillance, which began in 2000, is conducted in nine states through a network of pediatric nephrologists and infection-control practitioners and validated through review of hospital discharge data. Because of the time required for review of hospital records, this report contains preliminary HUS data for 2006.

During 1996–2007, the FoodNet surveillance population increased from 14.3 million persons (5% of the U.S. population) in five states to 45.5 million persons (15% of the U.S. population) in 10 states. The preliminary incidence for 2007 was calculated by dividing the number of laboratory-confirmed infections by population estimates for 2006. Final incidence will be reported when population estimates for 2007 are available from the U.S. Census Bureau. In previous years, final incidence has been comparable to preliminary incidence.

Surveillance Data

In 2007, a total of 17,883 laboratory-confirmed cases of infection in FoodNet surveillance areas were identified. The number of cases and incidence per 100,000 population were reported as follows: *Salmonella* (6,790; 14.92), *Campylobacter* (5,818; 12.79), *Shigella* (2,848; 6.26), *Cryptosporidium* (1,216; 2.67), STEC O157 (545; 1.20), STEC non-O157 (260; 0.57), *Yersinia* (163; 0.36), *Listeria* (122; 0.27), *Vibrio* (108; 0.24), and *Cyclospora* (13; 0.03). Substantial variation occurred across surveillance sites (Table). The highest incidence per 100,000 population for *Salmonella* (62.11), *Shigella* (27.77), *Campylobacter* (24.01), and STEC O157 (3.66) infections was among children aged <5 years. In 2006, FoodNet identified 82 cases of

TABLE. Incidence* of laboratory-confirmed bacterial and parasitic infections in 2007 and postdiarrheal hemolytic uremic syndrome (HUS) in 2006, by site and pathogen, compared with national health objectives† — Foodborne Diseases Active Surveillance Network, United States

Pathogen	California	Colorado	Connecticut	Georgia	Maryland	Minnesota	New Mexico	New York	Oregon	Tennessee	Overall	National health objective
Bacteria												
Campylobacter	28.21	15.85	14.01	7.29	7.19	17.51	17.55	11.98	19.02	7.39	**12.79**	12.30
Listeria	0.25	0.34	0.34	0.33	0.27	0.14	0.20	0.26	0.24	0.26	**0.27**	0.24
Salmonella	14.29	11.99	12.27	21.78	15.33	13.74	14.38	12.09	8.65	14.13	**14.92**	6.80
Shigella	5.55	3.00	1.26	17.39	1.91	4.61	5.42	0.89	1.78	6.01	**6.26**	N/A§
STEC¶ O157	1.21	1.21	1.28	0.50	0.39	3.19	0.46	1.35	1.97	0.91	**1.20**	1.00
STEC non-O157	0.22	2.12	0.74	0.44	0.46	0.74	1.28	0.28	0.14	0.40	**0.57**	N/A
Vibrio	0.37	0.15	0.46	0.25	0.45	0.15	0.00	0.21	0.22	0.05	**0.24**	N/A
Yersinia	0.47	0.15	0.51	0.46	0.14	0.45	0.20	0.37	0.51	0.22	**0.36**	N/A
Parasites												
Cryptosporidium	1.24	3.87	1.20	2.45	0.57	5.81	6.14	2.07	3.51	2.19	**2.67**	N/A
Cyclospora	0.03	0.00	0.09	0.03	0.02	0.00	0.10	0.05	0.00	0.02	**0.03**	N/A
HUS**	2.36	2.50	1.48	1.00	0.81	2.32	—	0.43	2.60	5.02	**2.01**	0.90
Surveillance population (millions)	3.23	2.64	3.50	9.36	5.62	5.17	1.95	4.29	3.70	6.04	**45.50**	

* Per 100,000 population.
† Healthy People 2010 objective 10 targets for incidence of *Campylobacter, Salmonella*, and Shiga toxin-producing *Escherichia coli* O157 infections and HUS for 2010 and for incidence of *Listeria* infections for 2005 and 2010, as revised by midcourse review.
§ No national health objective exists for these pathogens.
¶ Shiga toxin-producing *Escherichia coli*.
** Incidence of postdiarrheal HUS in children aged <5 years; denominator is surveillance population aged <5 years in sites that conduct hospital discharge data review.

postdiarrheal HUS in persons aged <18 years (0.78 cases per 100,000 children); 58 (0.7%) cases occurred in children aged <5 years (2.01 cases per 100,000 children).

Of the 6,299 (92.8%) *Salmonella* isolates serotyped, seven serotypes accounted for 61.6% of infections: Enteritidis, 1,062 (16.9%); Typhimurium, 1,006 (16.0%); Newport, 656 (10.4%); I 4,[5],12:i:-, 358 (5.7%); Javiana, 347 (5.5%); Heidelberg, 243 (3.9%); and Montevideo, 211 (3.4%). Among 102 (94.4%) *Vibrio* isolates for which the species was identified, 59 (57.8%) were *parahaemolyticus,* 18 (17.7%) were *alginolyticus*, and 13 (12.8%) were *vulnificus*. Among 260 STEC non-O157 isolates tested for O antigen determination, 228 (87.7%) had an identifiable O antigen, primarily O26 (21.5%), O103 (20.6%), or O121 (19.3%).

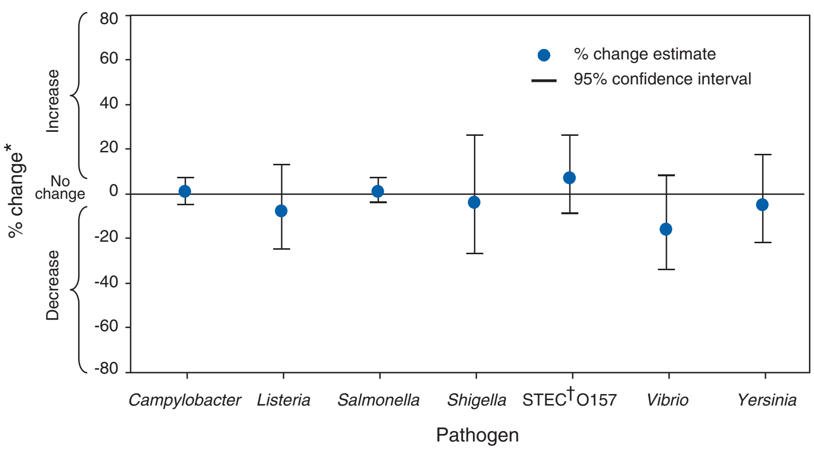
Comparison with Previous Years

A main-effects, log-linear Poisson regression model (negative binomial) was used to estimate statistically significant changes in incidence of infections in 2007 compared with previous years. This model accounts for the increase in the surveillance population and for variations in incidence among sites (*1*). The average annual incidence for 2004–2006 and for 1996–1998 (1997–1998 for *Cryptosporidium*), the first years of surveillance, were used for comparison. The estimated change in incidence (relative rate) between 2007 and the comparison periods was calculated, along with 95% confidence intervals (CIs). For HUS surveillance, 2000–2001, the first years of surveillance, was used as the comparison period. Changes over time have not been analyzed for non-O157 STEC, partly because changes in clinical laboratory practices might have affected incidence reporting (*3*).

The estimated incidence of *Campylobacter*, *Listeria*, *Salmonella*, *Shigella*, STEC O157, *Vibrio,* and *Yersinia* infections (Figure 1) did not change significantly in 2007 compared with 2004–2006, but the estimated incidence of *Cryptosporidium* infections increased 44% (CI = 8%–91%). Among the seven most common *Salmonella* serotypes, the incidence of Typhimurium and Heidelberg decreased, I 4,[5],12:i- and Newport increased, and the others did not change significantly.

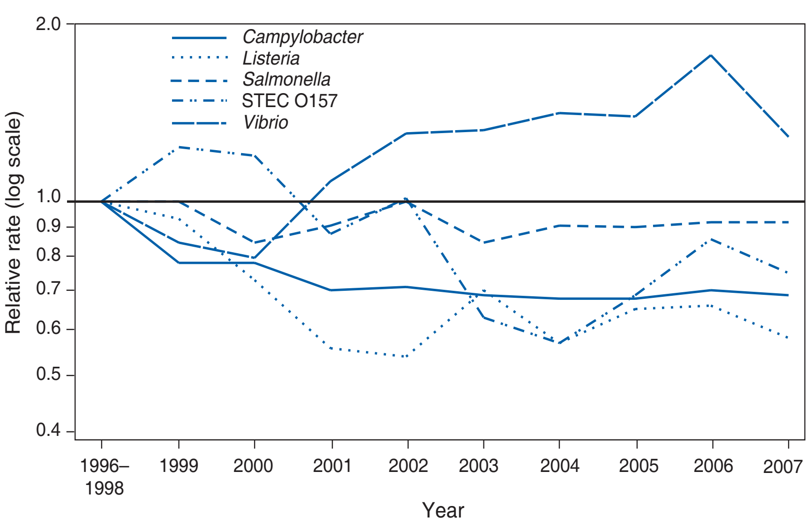
In comparison with 1996–1998, relative rates of *Yersinia* decreased 49% (CI = 36%–59%), *Listeria* decreased 42% (CI = 28%–54%), *Shigella* decreased 36% (CI = 9%–55%), *Campylobacter* decreased 31% (CI = 25%–36%), STEC O157 decreased 25% (CI = 9%–38%), and *Salmonella* decreased 8% (CI = 1%–14%) in 2007 (Figure 2). The estimated incidence of infection with *Cryptosporidium* and *Vibrio* did not change significantly. The incidence of

FIGURE 1. Percentage change in incidence of laboratory-confirmed bacterial infections in 2007 compared with 2004–2006, by pathogen — Foodborne Diseases Active Surveillance Network, United States



* *No significant change* = 95% confidence interval is both above and below the no change line; *significant increase* = estimate and entire 95% confidence interval are above the no change line; *significant decrease* = estimate and entire 95% confidence interval are below the no change line.
† Shiga toxin-producing *Escherichia coli*.

FIGURE 2. Relative rates of laboratory-confirmed infections with *Campylobacter*, STEC* O157, *Listeria*, *Salmonella*, and *Vibrio* compared with 1996–1998 rates, by year — Foodborne Diseases Active Surveillance Network, United States, 1996–2007†



* Shiga toxin-producing *Escherichia coli*.
† The position of each line indicates the relative change in the incidence of that pathogen compared with 1996–1998. The actual incidences of these infections can differ.

postdiarrheal HUS has paralleled that of STEC O157, declining in 2003 and 2004, followed by increases the next 2 years. The estimated incidence of postdiarrheal HUS in children aged <5 years in 2006 did not change significantly compared with 2000–2001.

Outbreak-Associated Cases of Infection

In 2007, outbreak-associated infections accounted for 86 (15.8%) of STEC O157 cases and 364 (5.4%) of *Salmonella* cases ascertained, similar to proportions in previous years. Four large multistate outbreaks of *Salmonella* infections that included FoodNet sites were investigated in 2007: an outbreak of *S.* Tennessee infections caused by contaminated peanut butter (*4*), an outbreak of *S.* I 4,[5],12:i:- infections caused by contaminated frozen pot pies, an outbreak of *S.* Wandsworth and *S.* Typhimurium infections attributed to a puffed vegetable snack, and an outbreak of *S.* Paratyphi B var. Java associated with exposure to turtles (*5*).

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Editorial Note: Although significant declines in the incidence of certain foodborne pathogens have occurred since 1996, these declines all occurred before 2004. Comparing 2007 with 2004–2006, the estimated incidence of infections caused by *Campylobacter, Listeria*, *Salmonella, Shigella,* STEC O157, *Vibrio,* and *Yersinia* did not decline significantly, and the incidence of *Cryptosporidium* infections increased. The incidence of *Salmonella* infections in 2007 (14.92 cases per 100,000) was the furthest from the national target for 2010 (6.80 cases), and only infections caused by *Salmonella* serotypes Typhimurium and Heidelberg declined significantly.

Salmonella organisms live in the intestines of most food animals. Transmission of *Salmonella* to humans can occur by many routes, including consumption of food animal products or raw produce contaminated with animal waste, contact with animals and their environment, and contaminated water. Outbreaks caused by contaminated peanut butter, frozen pot pies, and a puffed vegetable snack in 2007 underscore the need to prevent contamination of commercially produced products. The outbreak associated with turtle exposure highlights the importance of animals as a nonfood source of human infections. To reduce the incidence of *Salmonella* infections, concerted efforts are needed throughout the food supply chain, from farm to processing plant to kitchen. Recognizing the need to prevent *Salmonella* contamination of poultry products and other meats, the U.S. Department of Agriculture's Food Safety and Inspection Service (USDA FSIS) launched a *Salmonella* initiative in 2006, with enhancements in 2008 (*5*). A USDA FSIS testing program reported recent declines in the percentage of broiler chicken carcasses that yielded *Salmonella*, from 16.3% in 2005 to 11.4% in 2006 and 8.5% in 2007 (*7*).

Declines in the incidence of STEC O157 infections in 2003 and 2004 have not been maintained. Although the USDA FSIS and the beef processing industry have implemented interventions to reduce ground beef contamination, 21 beef product recalls for possible contamination with STEC O157 were issued in 2007, of which 10 were illness associated, an increase compared with previous years. USDA FSIS launched an STEC O157 initiative in fall 2007 and hosted a public meeting in spring 2008 to explore solutions to the challenges this pathogen presents.[†] Additional efforts are needed to control STEC O157 in cattle and to prevent its spread to other food animals and food products, such as produce.

The increase in reported *Cryptosporidium* infections compared with 2004–2006 might reflect an increase in diagnostic testing stimulated by licensing of a new treatment (nitazoxanide). The incidence of *Campylobacter*, *Salmonella*, *Shigella*, and STEC O157 infections remains highest among children aged <5 years, highlighting the need for targeted interventions. Identified risk factors for bacterial enteric illness in young children include riding in a shopping cart next to raw meat or poultry, attendance at day care, visiting or living on a farm, and living in a home with a reptile (*8,9*). Recent *Salmonella* outbreaks associated with exposure to small turtles (carapace lengths of <4 inches) highlight the importance of enforcing a 1975 prohibition on their sale and distribution in the United States (*5*).

The findings in this report are subject to at least four limitations. First, FoodNet relies on laboratory diagnoses, and changing laboratory practices might affect the reported incidence for some pathogens, especially STEC. Second, many foodborne illnesses (e.g., norovirus) are not reported to FoodNet. Third, differences in health-care seeking behaviors might contribute to a higher incidence of reported illnesses in certain age groups (e.g., young children). Finally, although the FoodNet population is similar to the U.S. population, the findings might not be generalizable (*1*).

Enhanced measures are needed to understand the complex ecologies that link pathogens to animals and plants; to control or eliminate pathogens in food sources; to reduce or prevent contamination during food growing, harvesting, and processing; and to educate restaurant workers and consumers about infection risks and prevention measures. Such measures can be more focused when the sources of human infections are known. More outbreaks can be recognized through more rapid and complete subtyping of pathogens and interviewing of ill persons and controls when clusters of illness are recognized.

Consumers can reduce their risk for foodborne illness by following safe food-handling and preparation recommendations and avoiding unsafe foods. Information on food safety practices is available at http://www.foodsafety.gov, http://www.fightbac.org, and http://www.cdc.gov/healthypets.

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Malnutrition and Micronutrient Deficiencies Among Bhutanese Refugee Children — Nepal, 2007

Acute and chronic malnutrition and micronutrient deficiencies have been found in refugee camp populations (*1*). In southeastern Nepal, despite consistent access by refugees to general rations,* certain micronutrient deficiencies have posed a substantial health burden to the approximately 100,000 Bhutanese residing in seven refugee camps (*2*). Limited food diversity, frequent illness, and poor feeding practices have been cited as underlying causes of poor nutritional status in this population. Annual surveys to assess levels of acute malnutrition (i.e., wasting) and chronic malnutrition (i.e., stunting) have been conducted in these camps by the Association of Medical Doctors of Asia (AMDA) and United Nations High Commissioner for Refugees (UNHCR); however, the capacity to reliably evaluate micronutrient deficiencies has not existed locally in the camps (*3*). In January 2007, AMDA and CDC, at the request of UNHCR and the World Food Programme (WFP), conducted a nutritional survey of children aged 6–59 months, assessing 1) the prevalence of acute malnutrition, chronic malnutrition, underweight, anemia, and angular stomatitis (i.e., riboflavin deficiency); 2) the cumulative incidence of diarrhea and acute respiratory illness (ARI); and 3) the feeding practices of the children's mothers. This report describes the results of that survey, which indicated that, although acute malnutrition was found in only 4.2% of the children, chronic malnutrition was found in 26.9% and anemia in 43.3%. These findings underscore the importance of monitoring both malnutrition and micronutrient deficiencies and addressing the underlying causes of nutritional deficits.

In 1991, approximately 100,000 Bhutanese mostly of Nepali origin began fleeing ethnic persecution in Bhutan and now live in seven refugee camps in southeastern Nepal. This refugee population has been stable since 1993 but remains dependent on food assistance. During January 28–February 6, 2007, a cross-sectional survey was conducted in the Bhutanese refugee camps. The number of households selected in each camp was proportional to the size of the camp; individual households were selected using a systematic random sampling method. Information was collected regarding all children aged 6–59 months in each household by interviewing their mothers. Questions were asked regarding foods eaten by their children within the preceding 24 hours, incidence of diarrhea (i.e., three or more episodes within the preceding 24 hours) or ARI (i.e., fever plus either cough or difficulty breathing) in children within the preceding 14 days, and beliefs regarding their practices for feeding their children. In addition, the children's weight and height measurements, hemoglobin levels, and presence of clinical signs of angular stomatitis were assessed.

Weight was measured using digital scales, and height (or recumbent length for children aged <2 years) was measured using a Shorr Infant-Child Height Board (*4*). Acute malnutrition was defined as a weight-for-height z-score <-2 or the presence of edema; severe acute malnutrition was defined as a weight-for-height z-score <-3 or edema (*5*). Chronic malnutrition was defined as a height-for-age z-score <-2; severe chronic malnutrition was defined as a height-for-age z-score <-3. Underweight was defined as a weight-for-age z-score <-2; severe underweight was defined as a weight-for-age z-score <-3. Hemoglobin was measured using a Hemocue B-Hemoglobin Photometer (*6*). Anemia was defined as hemoglobin ≤11.0 g/dL for children and pregnant women and ≤12.0 g/dL for nonpregnant women.

The survey sample included 497 children and their 413 mothers. Twenty-one (4.2%) of the children aged 6–59 months had acute malnutrition, and one (0.2%) had severe acute malnutrition (Table). The prevalence of acute malnutrition was greatest (6.0%) among children aged 12–23 months. Chronic malnutrition was identified in 134 (26.9%) children, and severe chronic malnutrition was identified in 21 (4.2%) children. A total of 125 (25.1%) children were underweight, and 24 (4.8%) were severely underweight. Both chronic malnutrition and underweight increased with age (chi square for both trends: p = 0.001).

Among the children, 215 (43.3%) had anemia; prevalence of anemia decreased with age (Figure), from 78.8% among infants aged 6–11 months to 20.1% among children aged 48–59 months (chi square for trend: p<0.001).

* A daily general ration in Bhutanese refugee camps in Nepal consists of parboiled rice, 400 g; whole grain, 20 g; lentils, 40 g; vegetable oil, 25 g; sugar, 20 g; wheat soya blend, 35 g; salt, 7.5 g; fresh vegetables, 260 g (rotated each month and including cauliflower, potato, pumpkin, squash, and radish).