

OREGON PUBLIC HEALTH DIVISION • OREGON HEALTH AUTHORITY

FOODBORNE ILLNESS: HOW BIG A PROBLEM?

Foodborne illness is an important public health issue, and the health care cost for foodborne illness is enormous. Data from population surveys suggest that about 0.6 episodes of “diarrhea” (three or more loose stools in a 24 hour period) occur per person each year in the U. S.<sup>1</sup> Although we think that much acute gastrointestinal illness is foodborne, person-to-person transmission and acquisition of pathogens from environmental sources, e.g., farm animals, certainly play a big role. Ascertaining the source of infection for sporadic cases is difficult to impossible. Moreover, not every person with foodborne illness presents for medical care, submits a specimen and gets a diagnosis. For this reason, extensive efforts have been made to estimate the number of foodborne illnesses that occur each year.

Since 1999, the official U.S. point estimates for the annual burden of foodborne disease have been 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths.<sup>2</sup> The long-awaited\* revisit of these figures was published in January 2011 in two papers authored by CDC.<sup>3,4</sup> They were derived using methods different from those employed in 1999.<sup>†</sup> The new estimates also include “credible intervals” (CrI) to give us some idea of the uncertainty about them. The punch line: it is now estimated that about 48 million cases of illness are caused annually by consumption of food within the U.S. (Table 1).

**KNOWN PATHOGENS**

Laboratory-based national data were available from various surveillance systems for 25 of the 31 pathogens. Multipliers derived

from comparing active to passive reporting systems were applied to account for underreporting. Pathogen-specific multipliers, estimated based on surveys of acute gastroenteritis, care-seeking behavior and diagnostic practices were applied to adjust for underdiagnosis. Alternative approaches were used for non-reportable illnesses.<sup>3</sup> Hospitalizations, deaths and cases associated with foreign travel were estimated by extrapolating rates derived from surveillance data.

The investigators estimated that each year in the United States, 31 recognized pathogens caused (by any route of transmission) 37.2 million illnesses, of which 36.4 million were domestically acquired; of these, 9.4 million (90% CrI 6.6–12.7 million) were transmitted by the foodborne route. They estimated that 5.5 million (59%) of the foodborne illnesses were caused by viruses, 3.6 million (39%) by bacteria, and 200,000 (2%) by parasites. Norovirus — that bane of nursing homes, restaurants and potluck dinners — was estimated to cause a whopping 58% (5.5 million) of all cases of foodborne illness of known etiology. Next were nontyphoidal *Salmonella* spp. (1.0 million), *Clostridium perfringens* (1.0 million), and *Campylobacter* spp. (0.8 million). Estimates for 27 of the pathogens, along with Oregon guesstimates, are shown in Table 2, *verso*.

These 31 pathogens caused an estimated 228,744 hospitalizations annually, of which 55,961 were caused by contaminated food eaten in the United States (Table 1). Some pathogens cause foodborne illness less often, but when they do, they are more likely

to put their victims in the hospital. Estimated leading causes of hospitalization were nontyphoidal *Salmonella* spp. (35%), norovirus (26%), *Campylobacter* spp. (15%), and *Toxoplasma gondii* (8%). The 31 pathogens caused an estimated 2,612 deaths, of which 1,351 were foodborne. The leading foodborne causes of death were nontyphoidal *Salmonella* spp. (28%), *T. gondii* (24%), *Listeria monocytogenes* (19%), and norovirus (11%).

**UNSPECIFIED AGENTS**

The cause of most episodes of gastroenteritis is never identified — even in studies that bring all the modern diagnostic methods to bear.<sup>5</sup> In their second paper, therefore, the CDC investigators tried to estimate episodes of illness caused by unspecified agents, including known agents not yet recognized as causing foodborne illness, substances that are known to be in food but are of unproven pathogenicity, and yet-to-be-discovered agents.<sup>4</sup> They approached this daunting challenge by first estimating numbers of acute gastrointestinal illnesses, hospitalizations, and deaths from surveys, hospital records and death certificates; and then subtracting the estimates of illness caused by the 24 pathogens known typically to cause diarrhea or vomiting. Then they used the same proportions of domestically acquired and foodborne from the 24 known pathogens and applied it to the estimates of unspecified illnesses.

CDC estimated that 38.4 million (90% CrI 19.8–61.3 million) episodes of domestically acquired foodborne gastroenteritis were caused by unspecified agents. They also estimated that 71,878 hospitalizations (90% CrI

**Table 1. Annual burden of illness of domestically consumed food, United States**

	Known pathogens <sup>3</sup>	Unspecified agents <sup>4</sup>	Total
Illnesses	9.4 (CrI: 6.6–12.7) million	38.4 (CrI: 19.8–61.3) million	47.8 million
Hospitalizations	55,961 (CrI: 39,534–75,741)	71,878 (CrI 9,924-157,340)	127,839
Deaths	1,351 (CrI: 712–2,268)	1, 686 (CrI 369–3,338)	3,037

\* by some of us, anyway

† Wherefore shalt thou not compare the estimates, nor shalt thou infer a trend. Saying that foodborne illness “declined” is Right Out.

CrI: 90% credible interval



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9,924–157,340), and 1,686 deaths (90% CrI 369–3,338) are caused by domestically acquired unspecified agents that were transmitted by food in the U.S.

Combining these two estimates, i.e., domestically acquired foodborne diseases caused by specified and unspecified agents, gives a total estimate of 47.8 million illnesses, 127,839 hospitalizations, and 3,037 deaths.

**PREVENTION**

Almost all domestically acquired foodborne illness should be preventable by proper food handler hygiene, avoidance of uncooked foods of animal origin (e.g., oysters, milk, meat, eggs), and keeping hot foods hot and cold foods cold. Regulatory agencies play an important role in keeping food safe. Disease transmitted by fresh vegetables may be a bit tougher to prevent: washing may help, but because it isn't a "kill step," it only gets you so far. The recently enacted Food Safety Modernization Act might help prevent contaminated food from reaching the supermarket.<sup>6</sup> Radiation — safe, effective, and often enhancing of shelf life — may be the way to go.<sup>7</sup> Dare we mention reducing the amount of food consumed? That would help to prevent other health problems as well.

Until foodborne illness goes the way of smallpox, advise your patients — especially pregnant women, immunocompromised persons and parents of young children — to avoid those foods known to be particularly risky: raw shellfish and sprouts; unpasteurized milk and juice; *queso fresco* made from unpasteurized

milk; and undercooked meat. Keep foodborne illness in your differential diagnosis, especially for patients with vomiting or diarrhea. Test for the usual pathogens as the clinical picture warrants, and report suspicious clusters of illness to your local public health authority.

**ADDITIONAL RESOURCES**

The two CDC papers<sup>3-4</sup> that are the focus of this issue are available online at [wwwnc.cdc.gov/eid/content/17/1/contents.htm](http://wwwnc.cdc.gov/eid/content/17/1/contents.htm). Check out the Oregon FoodNet site at <http://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/Pages/foodnet.aspx>. Or e-mail our FoodNet Epidemiologist: [beletshachew.shiferaw@state.or.us](mailto:beletshachew.shiferaw@state.or.us).

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**Table 2. Estimated annual cases of domestically acquired foodborne illness, by pathogen**

Pathogen	United States <sup>3</sup>	Oregon
<b>Bacteria</b>		
<i>Bacillus cereus</i>	63,400	802
<i>Brucella</i> spp.	839	56*
<i>Campylobacter</i> spp.	845,024	16,592*
<i>Clostridium botulinum</i>	55	2*
<i>Clostridium perfringens</i>	965,958	12,225
<i>E. coli</i> O157	63,153	1,261*
<i>E. coli</i> non-O157 Shiga-toxigenic	112,752	1,427
<i>E. coli</i> , enterotoxigenic	17,894	228
<i>E. coli</i> , other diarrheagenic	11,892	152
<i>Listeria</i>	1,591	24*
<i>Salmonella</i> spp., nontyphoidal	1,027,561	10,280*
<i>S. enterica</i> serotype Typhi	1,821	21*
<i>Shigella</i> spp.	131,254	608*
<i>Staphylococcus aureus</i>	241,148	3,052
<i>Streptococcus</i> spp. group A	11,217	142
<i>Vibrio parahaemolyticus</i>	34,664	1,819*
<i>Yersinia enterocolitica</i>	17,564	1,439*
<b>Parasites</b>		
<i>Cryptosporidium</i> spp.	57,616	1,072*
<i>Cyclospora cayetanensis</i>	11,407	95*
<i>Giardia intestinalis</i>	76,840	1,748*
<i>Toxoplasma gondii</i>	86,686	1,097
<i>Trichinella</i> spp.	156	2
<b>Viruses</b>		
Astrovirus	15,433	195
Hepatitis A virus	1,566	12*
Norovirus	5,461,731	69,123
Rotavirus	15,433	195
Sapovirus	15,433	195

\*indicates Oregon estimate derived using 2006–2010 Oregon case counts and CDC multipliers. Other Oregon numbers are population-based extrapolations from national estimates. We omitted *Mycobacterium bovis* and non-*parahaemolyticus* vibrios.