The Dietary Guidelines: Surveillance Issues and Research Needs

Keep Food Safe to Eat: Healthful Food Must Be Safe as Well as Nutritious

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ABSTRACT The inclusion of food safety in the 2000 edition of the Dietary Guidelines for Americans is an important step toward ensuring their continued relevance for health promotion and disease prevention. The inclusion of food safety is consistent with the original intent of the Guidelines and the increased focus on food safety today; it also better reflects current knowledge about diet and long-term health. A wide spectrum of surveillance methods can be used to monitor progress in reducing the incidence of foodborne illness, from surveys of food safety attitudes to epidemiologic data on foodborne illness. Surveillance data show that progress is being made, but that much work remains to be done. Strategies for reducing foodborne illness require a farm-to-table approach and the involvement of all those who have a responsibility for food safety, i.e., government, industry and the public. Federal agencies and others are finding it useful to use a risk analysis framework, i.e., risk assessment, risk management and risk communication, as a means of organizing available information, identifying data gaps, quantifying risks for specific pathogens and foods, and presenting strategies for improvement. Food safety education is a critical part of the overall strategy to reduce the incidence of foodborne illness and complements regulatory, research and other activities. J. Nutr. 131: 502S–509S, 2001.

KEY WORDS: • food safety • Dietary Guidelines for Americans • foodborne illness • risk analysis

Guidance of consumers toward nutritionally adequate diets must include research-based knowledge on food management procedures and preparation of foods for the table, to assure retention of both nutritional and eating qualities and to avoid foodborne illness (Senate Select Committee on Nutrition and Human Needs, United States Congress, 1977) (1).

The Nutrition and Your Health: Dietary Guidelines for Americans are important for two major reasons—first, they serve as a tool for educators, and second, they serve as a guide in setting food and nutrition policies. In these two roles, they have remained a success over the past 20 years because they are relevant and kept up to date by expert review. The inclusion of food safety in the 2000 edition is an important step toward ensuring their continued relevance for health promotion and disease prevention (2).

The incorporation of food safety into the Dietary Guidelines for Americans makes sense for four basic reasons. First, it is consistent with the both the original intent of the Dietary Guidelines as well as the growing focus on food safety we are seeing today. The report of the Senate Select Committee on Nutrition and Human Needs about the Dietary Goals for the United States, the predecessor document of the Dietary Guide-

lines, states that consumer guidance must “assure retention of both nutritional and eating qualities and...avoid foodborne illness” (1). The original Dietary Guidelines were designed to help Americans choose diets that will meet nutrient requirements, promote health, support active lives and reduce chronic health risks. Today, food safety is receiving more attention by government, the biomedical community and the public. The increased government focus is evidenced by a number of initiatives. In 1997, President Clinton announced his Food Safety Initiative, which provided needed funds for improvements in surveillance, inspection, research, risk assessment, outbreak response and education. In 1998 this was followed by the establishment of the President’s Council on Food Safety, which is charged with coordinating government-wide food safety activities. In addition, food safety has had a more explicit focus than ever before in Healthy People 2000 and 2010 Objectives (3). Healthy People is a government program that sets goals every 10 years for a variety of health concerns, including targets for the reduction of foodborne illness.

Second, by including food safety, the new Dietary Guidelines better reflect current knowledge about diet and long-term health. Much more is known now about the extent of foodborne illness and how severe it can be, not just in terms of acute illness, but also in terms of long-term chronic disease (4). The ability of foodborne illness to cause chronic complications is receiving new appreciation. In addition, there is a growing segment of the population, i.e., pregnant women, the elderly, the very young and individuals who are immunocom-

1 Published as a supplement to The Journal of Nutrition. The publication of this supplement was sponsored by the National Cancer Institute, National Institutes of Health, Bethesda, MD. The guest editor for this publication was Susan M. Krebs-Smith, NCI, NIH, Bethesda, MD.

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promised, that is particularly susceptible to foodborne illness (5). Vulnerable individuals become ill more readily and are likely to have more serious illnesses and complications.

Third, nutrition and food safety are intertwined, and there are many examples of this association. Foodborne pathogens can affect nutritional status by reducing appetite and the absorption of nutrients from the gut. Short-term diarrheal diseases are associated with a sudden loss of some enzyme activity such as lactase, which is important to the digestion and absorption of lactose in dairy products. Conversely, dietary advice can have food safety implications. The “Eat 5 A Day for Better Health” Program (6) promotes the consumption of fruits and vegetables, but there are public health concerns about the safety of these products in terms of microbial contamination (7). For example, there are reports of increasing numbers of illnesses associated with the consumption of raw sprouts contaminated with Salmonella and Escherichia coli O157:H7 (8). Many other nutritious foods are associated with food safety problems. Even properly cooked meats, considered low-risk foods, can cause illness under certain circumstances, such as when food handlers allow raw meat juices to contaminate other foods. This does not mean that such foods should be avoided; the benefits outweigh the risks associated with their consumption. Rather, it means that nutrition and food safety education should go hand in hand when there are tangible steps consumers can take that will reduce the risk of foodborne illness.

The fourth reason food safety has a place in the Dietary Guidelines is that foodborne disease is partially preventable through public education; for that reason, government has an obligation to use this strategy to reduce foodborne illness. As the Dietary Guidelines Advisory Committee indicated in its report, the guideline on keeping food safe to eat is a “step in unifying and strengthening the focus of the Dietary Guidelines on actionable measures that can be taken by consumers and public health officials to keep Americans healthy” (9). Education is not a substitute for, but complements other government activities such as regulation and research.

**Challenges related to food safety education**

The development of food safety messages faces some of the same challenges faced by the development of nutrition messages in that they are subject to change based on new research and new developments. For example, new products in the marketplace, such as prepared salads and other deli items, are convenient for busy consumers; because they require more handling, however, both at federally inspected facilities and at retail locations, an increased opportunity exists for them to be contaminated with pathogens (10). The emergence of pathogens, such as *E. coli* O157:H7, and the reemergence of others, such as *Listeria monocytogenes*, require new regulatory approaches as well as new behaviors by susceptible populations.

The increasingly global nature of the food supply has led to the introduction of pathogens into the U.S. food supply that were not previously known here, such as *Cyclospora* in Guatemalan raspberries (11). In addition, the centralized nature of the food distribution system exposes a far larger number of people over a wider geographical area to contaminated products. New agricultural production methods also affect food safety. The upsurge in organic farming is good for the environment and helps reduce the contamination of food products with potentially harmful levels of chemical residues (12). However, there are public health concerns about the fact that pathogens such as *E. coli* O157:H7 can survive 30–60 days in composted manure used on crops (13), and some parasites persist even longer. New processing methods such as modified-atmosphere packaging also create food safety concerns because increased storage times permit *Listeria monocytogenes*, which thrives in cold temperatures, to grow while the product is refrigerated (10). The need to change food safety behavior based on these many factors is often difficult to convey to consumers who have never become ill from doing things the “old way.”

At the same time, calls to USDA’s Meat and Poultry Hotline 1–800-535–4555 show that consumers repeatedly are asking very basic questions about how to handle, prepare and store food (14). Although new food safety messages based on current developments may be needed and developed, they must go hand in hand with basic food safety information that is timeless. The importance of hand washing is a good example.

The development of food safety messages is further challenged by the fact that although our surveillance systems for foodborne illness are improving rapidly, the majority of cases of foodborne illness lack an identified etiology. The most recent and comprehensive data on foodborne illnesses in the United States (15) documents the large percentage of foodborne outbreaks reported to the Centers for Disease Control and Prevention (CDC) that are caused by pathogens and agents that have not yet been identified and thus cannot be diagnosed. The authors estimate that 62 million cases of gastrointestinal illness of unknown etiology are due to foodborne disease transmission each year. This may seem surprising until one considers that many of the pathogens of greatest concern today, such as *Campylobacter jejuni* and *Escherichia coli* O157:H7, were not recognized as causes of foodborne illness only 20 years ago (15).

Despite the challenges, decades of experience with consumer messages and professional education about food safety can demonstrate their importance in the overall strategy to reduce the incidence of foodborne illness. This experience has made educators smarter in terms of knowing how best to develop and target the educational activities to have the greatest effect. Food safety education cannot be a substitute for needed regulatory and research activities. But all three must go hand in hand as part of a farm-to-table, comprehensive strategy to reduce the incidence of foodborne illness.

**Methods of assessment**

A wide spectrum of surveillance methods can be used to monitor progress in reducing the incidence of foodborne illness. At one end of the spectrum, methods to assess knowledge and attitudes about food safety are helpful in determining whether basic information about how to handle, prepare and store food has reached consumers and other food handlers. But as health professionals well know, knowledge does not necessarily translate into action; that is why it is also necessary to evaluate food safety behavior.

On the more objective end of the spectrum, data on pathogens in foods provide valuable information on the exposure of individuals to certain foodborne pathogens, although other variables such as preparation and food handling can alter the link between levels of pathogens in a product and subsequent illness. The ultimate measure of progress in reducing food-
borne illness is public health outcome data that can be obtained through surveillance systems.

None of these four methods of assessment, i.e., knowledge and attitudes, food safety behavior, levels of pathogens in foods and foodborne illness data, is perfect. For example, surveys asking questions about food safety knowledge, attitudes and behaviors suffer from the reporting biases common to all such self-reported data. In the area of pathogen levels on foods, data are lacking for foods other than meat and poultry products, and information on levels for specific pathogens such as Campylobacter are lacking due to difficulties in analytic methodologies. Linking levels of pathogens in specific foods to the likelihood of illness is difficult because of the lack of dose-response studies and ethical constraints on conducting such studies. The newest data estimating the annual incidence of foodborne illness from the CDC indicate that a large proportion of diarrheal illnesses have no identified etiology (15). Despite these limitations, useful data have been obtained using all four methods of assessment.

**Surveillance**

**Knowledge and attitudes.** Surveys of the public's knowledge and attitudes demonstrate that progress has been made over the years, but that much work remains to be done. Interestingly, in light of the attention food safety has received in the media in recent years, many surveys show a high public awareness about food safety, but knowledge remains fair to poor. In a survey conducted by the Food Marketing Institute (FMI) in January 2000 on consumer attitudes and behaviors and the supermarket, researchers found that 91% of the participants rated food safety as very or somewhat important. Of the 2000 consumers interviewed by telephone, 27% thought that mishandling or poor sanitation was the most common cause of foodborne illness (16).

A 1998 Food Safety Survey conducted by the Food and Drug Administration (FDA) and the Food Safety and Inspection Service (FSIS) compared consumer knowledge in the years 1988, 1993 and 1998 and found that, in general, food safety knowledge increased (17). The most dramatic change was in consumers' knowledge about microbes. In 1993, 36% of those surveyed thought that microbes are a serious food safety problem, compared with 55% in 1998. In 1993, 84% of consumers surveyed knew about Salmonella, and by 1998, that had increased to 93%. There also was an increase in consumers' understanding of risks of leaving perishable foods at room temperature. In 1988, 21% of those surveyed thought meat left at room temperature for >2 h was safe; in 1998, only 8% made that mistake.

Food safety behaviors are somewhat more difficult to evaluate because they often are self-reported, and such reporting is often associated with biases (18). In the FMI survey, consumers were asked what they do to be sure the food they prepare at home is safe from germs. Sixty percentage of consumers said they wash their hands and food preparation surfaces often; 17% said they cook properly; 13% said they refrigerate foods; and 6% said they separate foods. The FDA-FSIS survey illustrates how repeated consumer behaviors changed over a period of 5 y, between 1993 and 1998. The number of consumers who did not wash cutting boards, did not wash hands and abused food temperature precautions decreased over that time. The reported consumption of raw eggs, raw oysters and raw hamburger, all considered to be high-risk behaviors, also decreased.

Few direct observations of food safety behaviors exist in the published literature. However, a 1997 audit of consumer food handling practices by Audits International was reported in the February 1998 issue of Food Technology (19). Auditors observed food behaviors in 106 households located in 81 cities across the United States and Canada. This was a biased sample in that the individuals were highly educated, i.e., 73% had college degrees. Auditors used a critical control point approach similar to that conducted in restaurants. Even under a watchful eye, however, <1% of the households met minimum criteria for acceptable performance. Critical violations observed included cross-contamination, sick/symptomatic food handlers, hand washing neglected and improper cooling of leftovers. At least one critical violation was observed in 96% of households. This indicates that poor food safety practices are common, even among better-educated individuals. A follow-up 1999 survey conducted in different households showed some improvement, but critical violations were observed in 69% of the households. (20). Audits International plans to conduct a home food safety survey each year to monitor trends.

Research on knowledge and behaviors of foodservice workers in institutional settings, restaurants and retail food stores is surprisingly limited, but this is a major area of concern for a number of reasons. These include rapid turnover of employees and the difficulty this poses in terms of training, and the fact that food safety mistakes in large-scale feeding operations can have major ramifications, particularly for those patients in hospitals and nursing homes who are more susceptible to foodborne illness. In addition, epidemiologic data show that cross-contamination in retail operations has been responsible for outbreaks. In a study of outbreaks of E. coli O157:H7 at four chain steak and salad bar restaurants in Oregon and Washington, it was determined that cross-contamination from beef within the restaurant kitchens, where meats and multiple salad bar items were prepared, was the likely source of these outbreaks (21).

In September 2000, the FDA released a report of its retail food program database of foodborne illness risk factors. The report, which covered 900 institutional foodservice establishments, restaurants and retail food stores, showed that the risk factors in need of greatest attention were improper holding times and temperatures, contaminated equipment/cross-contamination and poor personal hygiene. The report established a baseline with which to measure how effective industry and regulatory efforts are in changing behaviors and practices that relate directly to foodborne illness in the retail food industry against which future follow-up studies can be compared. (22).

Knowledge and attitudes related to food safety also are critical among health care professionals who have direct contact with patients. This is particularly important for those health care professionals providing care to that segment of the population most susceptible to foodborne illness. For example, healthy people do not often develop noticeable listeriosis symptoms after eating food containing Listeria monocytogenes. However, some people are very susceptible to the disease. During pregnancy, the illness can be transmitted to the fetus, causing spontaneous abortion or serious illness in newborns. Others most at risk include the elderly and patients with immune systems compromised by cancer, AIDS, immunosuppressive medications and chronic diseases. Although data are limited regarding the food safety knowledge of health care professionals, what little is available is not very encouraging. In a qualitative research project conducted by the International Food Information Council, for example, knowledge about listeriosis among obstetricians and gynecologists was very limited. Few physicians indicated that they discuss the need for safe food handling with their patients (23).

In the spring of 2000, eight sites of the Foodborne Disease...
TABLE 1

Prevalence of Salmonella in products

<table>
<thead>
<tr>
<th>Product</th>
<th>Performance standard</th>
<th>Large plant prevalence</th>
<th>Large plant prevalence</th>
<th>Small plant prevalence</th>
<th>Small plant prevalence</th>
<th>Combined prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>first year</td>
<td>past year</td>
<td>first year</td>
<td>past year</td>
<td>(large and small)</td>
</tr>
<tr>
<td>Broilers</td>
<td>20.0</td>
<td>(5697) 10.9</td>
<td>(6171) 8.0</td>
<td>(2193) 16.3</td>
<td>(3060) 13.2</td>
<td>(9231) 9.9</td>
</tr>
<tr>
<td>Hogs</td>
<td>8.7</td>
<td>(1532) 6.5</td>
<td>(2200) 3.7</td>
<td>(825) 18.2</td>
<td>(1485) 13.5</td>
<td>(3685) 7.7</td>
</tr>
<tr>
<td>Cows/bulls</td>
<td>2.7</td>
<td>(58) 0</td>
<td>(58) 0</td>
<td>(1276) 2.3</td>
<td>(1392) 1.7</td>
<td>(1450) 1.6</td>
</tr>
<tr>
<td>Steers/heifers</td>
<td>1.0</td>
<td>(222) 0</td>
<td>(328) 0.3</td>
<td>(591) 0.2</td>
<td>(574) 0.2</td>
<td>(902) 0.2</td>
</tr>
<tr>
<td>Ground beef</td>
<td>7.5</td>
<td>(1184) 4.8</td>
<td>(583) 9.1</td>
<td>(14,522) 4.3</td>
<td>(8427) 4.7</td>
<td>(9010) 5.0</td>
</tr>
<tr>
<td>Ground chicken</td>
<td>44.6</td>
<td>(23) 4.4</td>
<td>(159) 8.8</td>
<td>(318) 18.9</td>
<td>(265) 17.7</td>
<td>(424) 14.4</td>
</tr>
<tr>
<td>Ground turkey</td>
<td>49.9</td>
<td>(748) 36.4</td>
<td>(583) 9.8</td>
<td>(363) 27</td>
<td>(318) 30.2</td>
<td>(901) 30.0</td>
</tr>
</tbody>
</table>

1 Source: (41)
3 First year prevalence for Large and Small establishments was calculated by using results from all samples collected for sets initiated and completed that year. Number in parentheses is number of samples.
foodborne disease in the United States. Overall, these data indicate that foodborne diseases appear to cause more illnesses, but fewer deaths than reported previously. According to the new data, diseases caused by food may cause an estimated 325,000 serious illnesses resulting in hospitalizations, 76 million cases of gastrointestinal illnesses and 5000 deaths each year. These estimates include mild cases of foodborne illness that may not result in a physician visit and thus would not be reported through the health care system. Three pathogens, i.e., Salmonella, Listeria, and Toxoplasma, are responsible for 1500 deaths each year, >75% of those caused by known pathogens (Table 2).

These data represent a baseline against which future efforts to improve food safety can be measured. They cannot be compared with previous data because the new estimates are the result of better information and new analyses. In addition, they include some diseases that were not included in previous estimates. Thus, the data cannot be used to say the problem of foodborne illness is getting better or worse, but they may allow such statements to be made in the future. The data support

<table>
<thead>
<tr>
<th>Disease or agent</th>
<th>Total</th>
<th>Foodborne</th>
<th>% of total foodborne</th>
<th>Illnesses</th>
<th>Hospitalizations</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacterial</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>27,360</td>
<td>27,360</td>
<td>0.2</td>
<td>8</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Bacillus, foodborne</td>
<td>58</td>
<td>58</td>
<td>0.0</td>
<td>46</td>
<td>46</td>
<td>4</td>
</tr>
<tr>
<td>Brucella spp.</td>
<td>1554</td>
<td>777</td>
<td>0.0</td>
<td>122</td>
<td>61</td>
<td>11</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>2,453,926</td>
<td>1,963,141</td>
<td>14.2</td>
<td>13,174</td>
<td>10,539</td>
<td>124</td>
</tr>
<tr>
<td>Closstridium</td>
<td>248,520</td>
<td>248,520</td>
<td>1.8</td>
<td>41</td>
<td>41</td>
<td>7</td>
</tr>
<tr>
<td>perfringens</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escherichia coli O157:H7</td>
<td>73,480</td>
<td>62,458</td>
<td>0.5</td>
<td>2168</td>
<td>1843</td>
<td>61</td>
</tr>
<tr>
<td>E. coli, non-O157 STEC</td>
<td>36,740</td>
<td>31,229</td>
<td>0.2</td>
<td>1084</td>
<td>921</td>
<td>30</td>
</tr>
<tr>
<td>E. coli, enterotoxigenic</td>
<td>79,420</td>
<td>55,594</td>
<td>0.4</td>
<td>21</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>E. coli, other diarrheogenic</td>
<td>79,420</td>
<td>23,826</td>
<td>0.2</td>
<td>21</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>2518</td>
<td>2493</td>
<td>0.0</td>
<td>2322</td>
<td>2298</td>
<td>504</td>
</tr>
<tr>
<td>Salmonella typhi</td>
<td>824</td>
<td>659</td>
<td>0.0</td>
<td>618</td>
<td>484</td>
<td>3</td>
</tr>
<tr>
<td>Salmonella, nontyphoidal</td>
<td>1,412,498</td>
<td>1,341,873</td>
<td>9.7</td>
<td>16,430</td>
<td>15,608</td>
<td>582</td>
</tr>
<tr>
<td>Shigella spp.</td>
<td>448,240</td>
<td>89,648</td>
<td>0.6</td>
<td>6231</td>
<td>1246</td>
<td>70</td>
</tr>
<tr>
<td>Staphylococcus food poisoning</td>
<td>185,060</td>
<td>185,060</td>
<td>1.3</td>
<td>1753</td>
<td>1753</td>
<td>2</td>
</tr>
<tr>
<td>Streptococcus, foodborne</td>
<td>50,920</td>
<td>50,920</td>
<td>0.4</td>
<td>358</td>
<td>358</td>
<td>0</td>
</tr>
<tr>
<td>Vibrio cholerae, toxigenic</td>
<td>54</td>
<td>49</td>
<td>0.0</td>
<td>18</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>V. vulnificus</td>
<td>94</td>
<td>47</td>
<td>0.0</td>
<td>86</td>
<td>43</td>
<td>37</td>
</tr>
<tr>
<td>Vibrio, other</td>
<td>7880</td>
<td>5122</td>
<td>0.0</td>
<td>99</td>
<td>65</td>
<td>20</td>
</tr>
<tr>
<td>Yersinia enterocolitica</td>
<td>96,368</td>
<td>86,731</td>
<td>0.6</td>
<td>1228</td>
<td>1105</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>5,204,934</td>
<td>4,175,565</td>
<td>30.2</td>
<td>45,826</td>
<td>36,466</td>
<td>1458</td>
</tr>
<tr>
<td><strong>Parasitic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryptosporidium parvum</td>
<td>300,000</td>
<td>300,000</td>
<td>0.2</td>
<td>1989</td>
<td>199</td>
<td>66</td>
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<tr>
<td>Cyclospora</td>
<td>16,264</td>
<td>14,638</td>
<td>0.1</td>
<td>17</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>cayetanensis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giardia lamblia</td>
<td>2,000,000</td>
<td>200,000</td>
<td>1.4</td>
<td>5000</td>
<td>5000</td>
<td>10</td>
</tr>
<tr>
<td>Toxoplasma gondii</td>
<td>225,000</td>
<td>112,500</td>
<td>0.8</td>
<td>5000</td>
<td>2500</td>
<td>750</td>
</tr>
<tr>
<td>Trichinella spiralis</td>
<td>52</td>
<td>52</td>
<td>0.0</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>2,541,316</td>
<td>357,190</td>
<td>2.6</td>
<td>12,010</td>
<td>3219</td>
<td>827</td>
</tr>
<tr>
<td><strong>Viral</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Norwalk-like virus</td>
<td>23,000,000</td>
<td>9,200,000</td>
<td>66.6</td>
<td>50,000</td>
<td>20,000</td>
<td>310</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>3,900,000</td>
<td>39,000</td>
<td>0.3</td>
<td>50,000</td>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td>Astrovirus</td>
<td>3,900,000</td>
<td>39,000</td>
<td>0.3</td>
<td>12,500</td>
<td>125</td>
<td>10</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>83,391</td>
<td>4,170</td>
<td>0.0</td>
<td>10,841</td>
<td>90</td>
<td>83</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>30,833,391</td>
<td>9,282,170</td>
<td>67.2</td>
<td>123,341</td>
<td>21,167</td>
<td>433</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>38,629,641</td>
<td>13,814,924</td>
<td>100.0</td>
<td>181,177</td>
<td>60,854</td>
<td>2718</td>
</tr>
</tbody>
</table>

1 Source: Mead (15).
what has been known all along, i.e., that the burden of foodborne illness is substantial.

Because scientists are better able to quantify the effect of foodborne diseases on health, they also are learning more about the nature of that effect. For example, experts used to think foodborne illness was limited to an acute illness. But it is now known that infections can cause chronic complications as well. It is estimated that chronic sequelae may occur in 2–3% of foodborne disease cases and that the long-term consequences may be more detrimental than the acute disease (4). Examples of such associations are E. coli O157:H7 with hemolytic uremic syndrome, Campylobacter with Guillain-Barré syndrome and Salmonella with reactive arthritis. FoodNet conducts surveillance for hemolytic uremic syndrome through pediatric nephrologists, and in 1998 reported a total of 52 cases from FoodNet sites (28). In addition, FoodNet plans to collect data on chronic conditions such as Guillain-Barré syndrome and arthritis, to increase our understanding of the extent of chronic complications associated with foodborne illness (personal communication, Tamar Lasky, FSIS, 2000).

New technologies such as pulsed-field gel electrophoresis (PFGE), also known as DNA “fingerprinting,” allow us to gather more data on the specific etiology of foodborne illness cases. PulseNet is a national network of public health laboratories that perform DNA fingerprinting on bacteria that may be foodborne. The network permits rapid comparisons of these fingerprint patterns through an electronic database at CDC (28). This enables public health experts to link specific food products to specific human illnesses and to link what appear to be sporadic cases to a common source. Such associations have been made in a number of recent foodborne illness outbreaks, enabling public health officials to intervene more rapidly to limit the scope of the outbreak.

Although surveillance efforts discussed so far address microbial contamination, which is considered the most significant hazard associated with food, systems also are in place to monitor the safety of food from chemical contaminants. For example, the FDA approves new animal drugs for use in food-producing animals and monitors their use through surveillance and compliance programs (29). In addition, the FDA and FSIS share the responsibility for monitoring the food supply for chemical contaminants (30). Occasionally, special studies are conducted by Federal agencies to address a specific problem, such as recent studies conducted to determine levels of dioxin in foods.

Strategies for improvement

Strategies for improvement require the involvement of everyone with a responsibility for food safety, i.e., government, industry and the public. The surveillance systems discussed above will continue to guide public health agencies in terms of what new prevention and control strategies are required and will help to document the effectiveness of food safety strategies already in place.

Risk analysis framework. Federal agencies and others involved in food safety are finding it very useful to use a risk analysis framework as a means of organizing available information, identifying data gaps, quantifying food safety problems and presenting strategies for improvement. The risk analysis framework is composed of three parts, i.e., risk assessment, risk management and risk communication (Fig. 1). Risk assessment is a structured process for determining the risks associated with any type of hazard, biological, chemical or physical, in a food. Risk management is the process of weighing policy alternatives in light of the results of risk assessment and selecting and implementing appropriate control options. Risk communication is the exchange of information and opinions on risk among risk assessors, risk managers and other interested parties, including the general public. It is a way in which managers can communicate with the public about the nature of actions they have taken and provide information on how to reduce illnesses. In fact, this framework was used to develop the strategic plan for Federal food safety activities that is being developed through the President’s Council on Food Safety (31).

Risk assessment. One challenge of conducting risk assessments for microbial pathogens is that unlike chemical, environmental or toxicological contaminants, bacteria can multiply and produce toxins as conditions change. In addition to this technical difficulty, many data gaps exist. For example, little information is available to estimate accurately the relationship between the quantity of a microbial pathogens and subsequent illness. Despite these challenges, researchers are developing predictive models to estimate risk for certain pathogens and certain foods.

In 1998, FSIS, in cooperation with other Federal agencies and academia, completed a farm-to-table, microbial risk assessment for Salmonella Enteritidis (SE) to quantify the risks associated with eggs and egg products. Epidemiologic data from the CDC showed that there was an increasing problem with infections of SE associated with these products. This was the first farm-to-table, quantitative risk assessment ever conducted for a microbial pathogen (32).

As a result of the risk assessment, public health officials know more about the incidence of illness attributed to SE in shell eggs and egg products. Although a very small percentage of eggs, 1 in 20,000, are contaminated, the implications for human health are quite significant in terms of illnesses. A contributing factor is the practice of pooling eggs for quantity food production, which increases exposure to an SE-contaminated egg.

A risk assessment is currently underway for E. coli O157:H7 in ground beef (33), and a risk ranking is underway for Listeria monocytogenes in ready-to-eat products (34).

Risk management. Once a risk assessment is completed, risk managers are better able to determine what steps are required to address the problem. On the basis of the risk
have already been established, and many food safety resources
partnerships to improve food safety knowledge and behavior
President’s Council on Food Safety have identified profes-
sions of the food processing industry, retail food service
includes producers, growers, transporters, workers in various seg-
that they meet their responsibilities for food safety. This in-
volved in the food safety farm-to-table continuum to ensure
this goal. Such education is required for all individuals in-
clusion of food safety in the
analysis approach to reducing foodborne illness, and the in-
Risk communication
Food safety education is essential to the government’s risk
analysis approach to reducing foodborne illness, and the in-
clusion of food safety in the Dietary Guidelines will facilitate
this goal. Such education is required for all individuals in-
volved in the food safety farm-to-table continuum to ensure
that they meet their responsibilities for food safety. This in-
cludes producers, growers, transporters, workers in various seg-
ments of the food processing industry, retail food service
workers, consumers, regulators and health professionals.

Fortunately, the President’s Food Safety Initiative and the
President’s Council on Food Safety have identified profes-
sional and consumer education as integral parts of the overall
strategy to reduce foodborne illness. Therefore, a number of
partnerships to improve food safety knowledge and behavior
have already been established, and many food safety resources
are available currently for professionals to use. Partnerships are
especially important in extending available resources, capital-
izing on unique opportunities for reaching the public and
removing barriers between groups and organizations that
might otherwise have conflicting food safety concerns and
training needs.

The Food Safety Training and Education Alliance for Re-
tail, Food Service, Vending, Institutions, and Regulators, the
result of the President’s Food Safety Initiative, shares food
safety education materials and conducts joint education activi-
ties in order to leverage resources. The Alliance carries out
activities related to professional education, including review-
ing food safety training materials, encouraging research per-
taining to food safety training and education, identifying the
need for food safety training and education in foreign lan-
guages, and expanding food safety and training partnerships
among government, industry and academia (38).

The National Food Safety System Steering Committee,
formerly known as the “50-State Project,” is bringing together
government food safety officials nationwide to encourage the
integration of food safety activities, including education, at all
levels of government (39).

The Partnership for Food Safety Education, a public-private
partnership composed of ~25 Federal agencies and private
organizations involved with food safety, successfully launched
and continues to promote the Fight BAC! consumer education
campaign (40). Tens of thousands of educators and health
professionals have received materials for distribution, and sur-
veys conducted for the Partnership by Yankolovich, in 1998
and 1999, indicate that 13% of the U.S. population is aware of
the campaign. Anecdotal data provided by locally based edu-
cators show a correlation between improved food safety be-
avior and exposure to Fight BAC! materials or programs. The
Canadian Partnership for Consumer Food Safety Education,
www.canfightbac.org, is an official Fight BAC! international
partner, and other countries are using the messages and ma-
terials as well.

Many food safety resources have been developed through-
these and other partnerships and by individual groups and are
available to educators and health professionals. The materials,
and the messages they contain, are based on scientific data and
behavioral research. The goal is to develop messages that are
technically accurate, but at the same time simple, clear and
action oriented. For the future, FSIS will continue to work
through these partnerships and use new scientific information
to develop educational campaigns. These activities include
educational strategies to reach individuals at risk of foodborne
illness and the health professionals and family members who
work with them.

FSIS recently began a nationwide educational campaign to
instruct consumers on the importance of using a food ther-
ometer with foods such as hamburgers for which it is critical
to know that a safe internal temperature of the foods has been
reached. This was particularly necessary in light of results from
a 1998 study by the Agricultural Research Service indicating that ~25% of ground beef patties turn brown before they have
reached the safe internal temperature of 160°F (41). This
indicates that color by itself cannot be depended on by con-
sumers to determine the safety of a hamburger. The renewed
focus on thermometers culminated recently with the kick-off
of an educational campaign involving Thermo, and the mes-
sage “It’s Safe to Bite When the Temperature is Right.” The
campaign was designed through focus group testing, with
strong support from consumers, educators, industry and health
professionals (www.fsis.usda.gov/Thermo).

New communications strategies will help spread the word
by making access possible and affordable for large segments of the population. The National Food Safety Strategic Plan includes a state-of-the-art national food safety information network. The network will promote the exchange of information, provide online food safety training and access to interactive Web sites with downloadable educational files and materials to facilitate dissemination (31).

The inclusion of food safety in the Dietary Guidelines for Americans will go a long way toward ensuring that the public has access to a safe and nutritious food supply.

LITERATURE CITED


