Food Safety Guidance for Older Adults

Patricia A. Kendall,1 Virginia Val Hillers,2 and Lydia C. Medeiros3

1Department of Food Science and Human Nutrition, Colorado State University, Fort Collins; 2Department of Food Science and Human Nutrition, Washington State University, Pullman; and 3Department of Human Nutrition, Ohio State University, Columbus

Aging is associated with loss of the physical barriers and immune efficiency that typically control pathogens’ access to and multiplication within the body, thus making infection more likely in elderly persons. Chronic diseases and other health factors, such as malnutrition and immobility, may increase susceptibility to and severity of infections, including foodborne illnesses, in elderly persons, as well as associated morbidity and mortality. Prevention is the best way to avoid foodborne illnesses, but older adults have long-established food preparation and handling practices, some of which may increase the likelihood of illness. Elderly persons rely on physicians as trusted sources of health information. Physicians and other health care professionals can help prevent and control foodborne diseases by educating their patients about the risks of foodborne illness, providing sound advice on safe food-handling and consumption practices, making rapid appropriate diagnoses, and reporting cases promptly to public health authorities.

Older adults represent an increasing proportion of the population in the United States and worldwide. In 2000, an estimated 35 million individuals in the United States were ≥65 years old, accounting for 12.4% of the total population [1]. By 2030, it is estimated that 71 million Americans (1 in 5 individuals) [1] and >1 billion individuals worldwide [2] will be ≥65 years old. As a population, older adults vary widely in terms of physiological function, health, and susceptibility to disease [3–5]. Although many Americans who are 65–84 years old enjoy sufficient health for full physical function, older adults, particularly adults ≥85 years old, are at increased risk for both infections and death from infections, including foodborne illnesses, because of the decrease in immune function associated with aging, chronic diseases, and health factors, such as malnutrition and immobility [3, 6, 7].

Annual rates of foodborne disease are estimated to be ~1 case per 4 persons in the United States [8] and 1 case per 5 persons in England [9]; most cases are classified as acute, involving diarrhea, vomiting, or other gastrointestinal problems, and they are relatively short lived. Although deaths due to acute foodborne illnesses are relatively rare (<0.1%), they are more likely to occur in very young persons, elderly persons, or persons with compromised immune systems [7]. Elderly persons also may be more likely to experience sequelae than the general population [10]. Retrospective examination of data from the US National Hospital Discharge Survey between 1979 and 1995 indicated that hospitalization rates for adults with gastroenteritis was highest (7.6 hospitalizations per 1000 persons) among adults ≥75 years old [11]. The mean length of stay and case-fatality rate for adults hospitalized with gastroenteritis also increased with age. In fact, adults in the oldest group (≥75 years old) were 33 times more likely to die during hospitalization from gastroenteritis than were patients 20–49 years old [11].

Physicians are considered to be a trusted and important source of information regarding health and food safety [12–14]. Health care professionals can play an important role in preventing foodborne illness by educating their patients about the risks of foodborne illness, making rapid, appropriate diagnoses, and reporting cases promptly to public health authorities [15]. Wong et al. [16] reported that physicians are more likely to discuss food safety issues with their patients if the physician perceives foodborne disease to be a serious problem, considers him or herself to be an important source of food safety information, and is comfortable making food safety recommendations. The purpose of this article is to explore factors that contribute to the increased susceptibility to and severity of foodborne illnesses among older adults, discuss path-
ogens of particular importance for elderly persons, and provide food safety recommendations that can be used with confidence in providing guidance to elderly patients.

**FACTORS THAT CONTRIBUTE TO INCREASED SUSCEPTIBILITY TO AND SEVERITY OF FOODBORNE PATHOGENS AMONG ELDERLY PERSONS**

The aging immune system. Intestinal motility and mucosal immune function decrease with normal aging, increasing susceptibility to systemic infection via the gut [17, 18]. Overuse of H2-receptor antagonists or over-the-counter antacids, which is common among older adults, may cause hypochlohydria and further reduce the ability to resist infection [19]. Fecal impaction from loss of smooth muscle contractility is also common with aging, but it is not clear whether prolonged exposure of pathogens to intestinal epithelium is a risk factor for pathogen infection [18, 20]. Prolonged use of antibiotics may stimulate overgrowth of colonic pathogens and the loss of competitive inhibition provided by the natural microflora [19].

Older adults lose adaptive immune function as a natural part of aging [20]. Defective constitutive functioning of macrophages and granulocytes and the natural shift to memory T cells with aging reduces older adults’ ability to mount a cell-mediated response when new exposures to pathogens occur [20, 21]. Cytokine production decreases with natural aging, and without optimal function of IL-2 and IL-8, immune efficiency is further reduced. Thus, susceptibility to foodborne infections can increase for elderly persons when they are exposed to newly emerging or genetically-mutated pathogens.

Chronic disease. Ill elderly persons are at increased vulnerability to opportunistic infection, because of immune suppression associated both with aging and disease [7], as well as therapeutic regimens that may be used to treat the disease [22]. Leading causes of death in individuals ≥65 years old are often related to compromise of the immune system [23]. For example, 70% of deaths due to cancer occur among elderly patients [24]. Diabetes mellitus, which affects 18%–20% of persons ≥65 years old in the United States [25], can promote systemic pathogenic infection through persistent hyperglycemia [26, 27] and loss of microcirculation efficiency [28].

Nutritional status, dementia, and physical activity. In older individuals, there is a greater likelihood of malnutrition, which also increases susceptibility for infection [29]. A deficiency of protein, zinc, selenium, iron, copper, vitamins A, C, E, or B-6, or folic acid can lead to impaired immune function [30, 31].

The influence of dementia on malnutrition and susceptibility to infection is unclear. One study of patients with Alzheimer disease found further impairment of cognitive function after infection due to elevations in the level of IL-1β [32]. Malnutrition affects taste acuity in elderly persons and may account for the behavioral tendency to consume contaminated food items [33, 34]. Although these associations are not directly causal, these studies reinforce the need to protect cognitively impaired adults from foodborne infections.

Loss of mobility in older adults can impair immune function. Elderly male runners have increased production of IL-2, IL-4, and IFN-γ, compared with sedentary elderly control subjects [35]. In a review of accumulated data, Kohut and Senchina [36] concluded that long-term exercise interventions may be useful in improving immune function in elderly persons.

Risky food storage, handling, and consumption behaviors. There are established food preparation and handling practices for older adults, some of which may increase the likelihood of a foodborne infection [37]. Multistate surveys have found that persons >60 years old are more careful than younger adults with respect to some, but not all, food-handling and consumption behaviors [38–40]. For example, Yang et al. [38] found that persons >60 years old were less likely to eat pink hamburgers or raw oysters and more likely to wash their hands and food preparation surfaces than younger persons. Still, ~13% of older adults reported eating pink hamburgers and not usually washing their hands or cutting boards after contact with raw meat or chicken, and 50% said they ate undercooked eggs [38, 39]. Among older adults, men and individuals living alone were more likely to practice unsafe food-handling behaviors than women and persons living with a significant other [41].

Li-Cohen and Bruhn [42] found that consumers ≥65 years old were more likely than younger consumers to rinse cutting boards and sinks before and after washing fresh produce but less likely to keep raw animal products separated from fresh produce in the refrigerator and to wash whole melons before cutting. Others have reported not using a meat thermometer to determine doneness, not refrigerating foods promptly, putting large quantities of hot food in the refrigerator without portioning into smaller amounts, and thawing frozen food on the counter as common practices among older adults who regularly prepare meals at home [37, 43]. In addition, Johnson et al. [44] found that 70% of elderly consumers studied had refrigerators that were too warm for safe storage of food (≥6°C).

**PATHOGENS OF SPECIAL IMPORTANCE TO ELDERLY PERSONS, AS EVIDENCED BY INCIDENCE OR OUTBREAK DATA**

Elderly persons have higher incidences of infection from some but not all foodborne pathogens, compared with younger adults. Factors that might affect the differing incidences among elderly persons include immunity developed from prior exposure to common food and waterborne pathogens [45], food...
consumption patterns that result in different rates of exposure to some pathogens among age groups [38], concurrent chronic underlying illnesses [46, 47], and decreased ability of the aging immune system to mount an immune response on exposure to novel pathogens [3].

The Foodborne Diseases Active Surveillance Network (FoodNet) of the Centers for Disease Control and Prevention (CDC) uses active surveillance and epidemiological studies to produce national estimates of the burden, trends, and sources of specific foodborne diseases in the United States. Table 1 provides a summary of information compiled from FoodNet and other sources [8, 48–56].

FoodNet data from 2003 indicated that, compared with younger adults (aged 20–59 years), persons ≥60 years old had a higher incidence of infections caused by Listeria, Salmonella, Vibrio, and Yersinia species and Escherichia coli O157 and a similar or lower incidence of infections caused by Campylobacter, Cryptosporidium, Cyclospora, and Shigellosis species [57]. FoodNet data do not include incidence data on Clostridium perfringens or Staphylococcus aureus; however, Smith [3] reported an increased susceptibility to these pathogens among elderly persons.

The hospitalization rate associated with foodborne infection among older persons also varies by pathogen. Among FoodNet-identified case patients from 1996 to 2001, hospitalization rates for persons ≥60 years old were highest for infections caused by Listeria species (96%), E. coli O157 (67%), Yersinia species (56%), Vibrio species (49%), Salmonella species (49%), Shigella species (29%), and Campylobacter species (28%) [58].

Foodborne disease outbreaks that occur in long-term care institutions for elderly persons can have severe consequences. Between 1975 and 1987, the case-fatality rate for foodborne outbreaks associated with nursing homes was 1%, ten times the case-fatality rate of 0.1% for foodborne outbreaks at all other sites [59]. Morbidity was especially high for outbreaks due to Salmonella species, staphylococcal foodborne disease, and E. coli O157:H7 infection. Deaths due to Campylobacter species and Clostridium perfringens have also occurred at an increased rate in nursing homes [3, 59].

In recognition of the increased rate of foodborne illnesses among some populations, a separate section with special requirements for food establishments that serve highly susceptible populations was added to the US Food and Drug Administration Food Code in 1997 [60]. Under the current guidelines, nursing homes are not allowed to serve raw seed sprouts, prepackaged juices or beverages bearing warning labels regarding lack of pasteurization, or foods containing raw or partially cooked eggs, fish, and meats [61]. Although the food code addresses some causes of foodborne illnesses in nursing homes, food-handling errors made by food service workers are difficult to control. Illnesses have resulted in nursing homes and senior centers from cross-contamination of ready-to-eat foods with raw meats [62, 63]. Infected food workers also transmit foodborne pathogens, particularly pathogens with a low infectious dose, such as noroviruses [64, 65].

**Table 1. Estimated incidence, hospitalizations, deaths, and foods associated with infection with selected foodborne pathogens.**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>No. of cases of foodborne illness per year</th>
<th>No. of hospitalizations associated with foodborne illness per year</th>
<th>No. of foodborne illness-related deaths per year</th>
<th>Foods associated with infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campylobacter species</td>
<td>1,100,000* [48]</td>
<td>10,000 [8]</td>
<td>99 [8]</td>
<td>Undercooked poultry [49]; ready-to-eat foods cross-contaminated by equipment or hands used in poultry preparation [50]</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>2500 [8]</td>
<td>2300 [8]</td>
<td>499 [8]</td>
<td>Refrigerated ready-to-eat foods with a long shelf life, such as deli meats, frankfurters, paté and meat spreads, and smoked seafood [52]; soft cheeses made with raw milk [52]</td>
</tr>
<tr>
<td>Salmonella species</td>
<td>1,400,000 [54]</td>
<td>15,000 [54]</td>
<td>400 [54]</td>
<td>Raw and/or undercooked foods of animal origin [55]; fresh produce contaminated by animal manure [55]</td>
</tr>
</tbody>
</table>

* We assume that 80% of campylobacteriosis is foodborne.
highest age-specific incidence (8.6 cases per 100,000 persons) being among persons 70–79 years old [66].

E. coli O157:H7 infections. Despite regulatory efforts to reduce E. coli O157:H7 contamination of food, foodborne E. coli O157:H7 outbreaks are common and accounted for 52% of E. coli O157:H7 outbreaks between 1982 and 2000 [51]. Among these outbreaks, those occurring in residential facilities, such as nursing homes or acute-care facilities, had a case-fatality rate of 6.6%, 13 times higher than the overall case-fatality rate of 0.5% [51].

Listeriosis. Listeria monocytogenes is widespread in the environment and present in many ready-to-eat foods [67]; however, invasive listeriosis typically occurs in individuals with underlying conditions that interfere with T cell–mediated immunity [68]. In reports of 2 listeriosis outbreaks, elderly persons had the highest rate of infection and the highest mortality rate [69, 70], with immunocompromised elderly persons at particular risk [70]. Liver disease and use of gastric-acid–reducing medications are additional risk factors for listeriosis [71].

Norovirus infections. Noroviruses are highly infectious and may cause up to one-half of all foodborne outbreaks in the United States [72]. Koopmans and Duizer noted that the majority of outbreaks of gastroenteritis in institutions, such as nursing homes and hospitals, are likely caused by noroviruses [53].

Salmonellosis. Invasive Salmonella infections occur more commonly among infants, elderly persons, and immunocompromised individuals [47, 73]. Among persons infected with Salmonella, persons ≥60 years old have the highest rate of hospitalization and death [74, 75].

Vibrio infections. According to FoodNet data, the rate of Vibrio infections in the United States is highest in persons ≥60 years old [57, 76]. Infections with Vibrio vulnificus are more likely to result in invasive illness, hospitalization, and death than infections with other Vibrio species [77]. Risk factors for severe forms of vibriosis include liver disease, alcohol use, and immunosuppression [56].

CONSUMER FOOD HANDLING AND CONSUMPTION BEHAVIORS OF SPECIAL IMPORTANCE TO ELDERLY PERSONS AND RECOMMENDATIONS FOR CLINICIANS

On the basis of food sources most associated with common foodborne illness—causing pathogens and errors in food-handling behaviors most often practiced by food handlers, we have advocated 5 major pathogen-control factors that food-safety education curricula for consumers should emphasize [78]. These control factors are as follows: practice personal hygiene, cook foods adequately, avoid cross-contamination, keep foods at safe temperatures, and avoid foods from unsafe sources (including ready-to-eat foods produced or processed in a manner that does not ensure pathogen destruction). Specific behaviors associated with each pathogen control factor have also been identified [79].

Interventions that have targeted adults with food safety information have generally reported improvements in self-reported behaviors [80–82]. To be most effective, food safety education should target changing those behaviors most likely to result in illness [78]. Gettings and Kiernan [37] found that seniors believed the food handling behaviors they practiced most consistently were not causing them to become ill. When consumers underestimate the frequency or seriousness of foodborne illness, they are less interested in making behavior changes [83].

Kendall and associates [84] used a 4-round, Web-based Delphi process with nationally recognized food safety experts to identify 14 food-handling and consumption behaviors of special importance for elderly persons (table 2). Interestingly, 9 of these behaviors are best controlled by avoiding foods from unsafe sources, a control factor that has not traditionally been included in food safety curricula [85]. Several behaviors are associated with avoiding raw or undercooked foods (seafood, eggs, and sprouts) and foods associated with L. monocytogenes outbreaks (soft cheeses, cold smoked fish, cold deli salads, luncheon meats, and cold hot dogs). From 1996–1998, raw sprouts were associated with more than one-half of all outbreaks in California that were multistate in nature [86]. Eggs,
a known source of *Salmonella* Enteritidis [87], are of special concern because they are relatively inexpensive, easy to fix, and generally well-liked by elderly persons. Altekruse et al. [39] found that among those who ate undercooked eggs, 56% ate them >4 times per month.

Primary care and emergency physicians are the health care providers most likely to see the index case of a potential food-related disease outbreak [88]. In recognition of the critical role physicians and other health care professionals play in the prevention and control of foodborne diseases, the American Medical Association, the American Nurses Association, and several government agencies collaboratively developed a teaching tool: *Diagnosis and Management of Foodborne Illnesses: A Primer for Physicians and Other Health Care Professionals* [88]. Another educational tool designed for health professionals is *Food Safety for High Risk Populations* [89], a 6-module, online, continuing education course that examines the immune system and why various population groups, including elderly persons, are at high risk for foodborne illness.

Most cases of foodborne infection are not reported. Reasons for the lack of reporting include that the ill person may not seek medical care, the health care provider may not obtain a specimen for diagnosis, the laboratory may not perform the necessary diagnostic test, and/or the findings may not be communicated to public health officials [8, 9]. Many clinicians view the evaluation of stool cultures as an unnecessary expense, because the results may not be available in time to impact clinical management decisions and because most cases of diarrheal illness are self-limiting [90]. However, each stool culture with positive results may represent the sentinel case of foodborne illness in a more widespread outbreak [88]. Furthermore, without a stool culture to confirm a specific diagnosis, patients are more likely to receive inappropriate treatment, potentially worsening the course of the illness or facilitating the emergence of antibiotic resistance in the pathogen [90]. Guerrant et al. [90] recommend that any diarrheal illness lasting >1 day should prompt the evaluation of a fecal specimen, especially if it is accompanied by fever, bloody stools, systemic illness, recent use of antibiotics, day-care attendance, hospitalization, or dehydration.

Physicians and other health care professionals are urged to consider the potential for a foodborne etiology in a patient’s illness; to realize that many, but not all, cases of foodborne illness have gastrointestinal tract symptoms; to perform stool cultures when appropriate; to report suspected cases to appropriate public health officials; and to talk with their patients about ways to prevent foodborne illness [88].

**APPLICATIONS**

In conclusion, we recommend that physicians who see patients with acute gastroenteritis consider foodborne pathogens as a possible source of the infection and obtain a diagnostic stool specimen from the patient. Physicians are encouraged to view themselves as critical sources of food safety information for their elderly patients. Food handling and consumption behaviors of special importance to elderly persons include avoiding raw or undercooked seafood, raw sprouts, and foods containing raw or undercooked eggs, drinking only pasteurized milk and fruit juices, using cheese and yogurt made from pasteurized milk, and thoroughly rinsing fresh fruits and vegetables under running water before eating. In addition, frail elderly persons should avoid foods that are known sources of *Listeria monocytogenes*, including soft cheeses made with raw milk, cold smoked fish, cold deli meats, and hot dogs served without reheating. Health care providers are reminded that all food safety guidelines (including washing hands frequently, cooking meat, poultry, fish, and eggs properly, avoiding cross-contamination, and keeping foods at safe temperatures) are fundamental in controlling foodborne illnesses in all populations.

**Acknowledgments**

*Potential conflicts of interest.* All authors: no conflicts.

**References**
