Gastroenteritis and Food-Borne Disease in Elderly People Living in Long-Term Care

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Elderly people in long-term care facilities (LTCFs) may be more vulnerable to infectious gastroenteritis and food-borne disease and more likely to experience serious outcomes. We review the epidemiology of gastroenteritis and food-borne diseases in elderly residents of LTCFs to inform measures aimed at preventing sporadic disease and outbreaks. Gastroenteritis in elderly people is primarily acquired from other infected persons and contaminated foods, although infections may also be acquired when residents have poor personal hygiene, have contaminated living environments or water, or have contact with infected pets. Early recognition of outbreaks and implementation of control measures is critical to reduce the effects on LTCF residents and staff members. Although outbreaks among LTCF residents are common, they are challenging to investigate, and there are still major gaps in our knowledge, particularly in regards to controlling noroviruses, the incidence and causes of specific infections, and sources of food-borne disease.

The number of people aged >65 years is increasing globally [1, 2]. Elderly people may be vulnerable to gastroenteritis and food-borne infections because of changes in immune response [3, 4], gastrointestinal physiology [5], use of immunosuppressive or acid-suppressive medications [6, 7], and comorbid conditions [6] associated with aging. One subpopulation at higher risk of food-borne diseases are elderly people living in long-term care facilities (LTCFs) [8, 9]. In the United States between 1994–1998, LTCF residents were 4 times more likely to die from gastroenteritis than people living in the community [10], and 17.5% of deaths involving gastroenteritis occurred in LTCFs [11]. In the 1980s, the Food and Drug Administration recommended that LTCFs, where the case fatality rate was 70 times that of other settings, not feed residents unpasteurized eggs because of Salmonella Enteritidis outbreaks; the recommendation resulted in a subsequent decrease in outbreak and associated deaths [12].

LTCF residents tend to have poorer health status [9, 13] with higher prevalence of chronic diseases [1] and greater use of antibiotics and other medication [9]. In the United States, 18,000 facilities house ~1.6 million predominantly female residents with a median age of 83 years (National Nursing Home Survey 2004, Centers for Disease Control and Prevention, unpublished data) [1]. The close living arrangements of elderly people and contact with visitors and staff make LTCFs a unique environment for the spread of infectious agents [9, 13, 14]. In addition, centralized preparation and service of food to LTCF residents has inherent risks for transmission of food-borne agents [15, 16].

METHODS AND DEFINITIONS

The aim of this review was to describe the epidemiology of gastroenteritis and food-borne diseases in elderly residents of LTCFs, to inform measures aimed at preventing sporadic disease and outbreaks. We considered both gastroenteritis due to all modes of transmission and food-borne infections presenting with nongastrointestinal symptoms. We searched PubMed and the Web of Science for articles published in English language from 1970 through mid-2009, using a variety of search terms relating to LTCFs, enteric pathogens, and modes of transmission. One of us (M.D.K.) evaluated articles for relevance to the review and extracted information into an Endnote, Version 11 (Thomson Reuters), database, which resulted in >200 articles (search strategy and full reference list available on request).
Despite many studies published in the literature, there is a paucity of information from well-designed trials, and evidence is largely derived from outbreak investigations, which are often deficient. We considered persons aged ≥65 years to be “elderly” [1]. In this article, LTCFs are institutions providing short- or long-term health care to elderly people who, because of disability, frailty, or illness, are unable to live in the community [17], and we restrict our discussion to the developed world.

CHARACTERISTICS OF GASTROENTERITIS AND FOOD-BORNE DISEASE

The major causes of gastroenteritis and food-borne diseases in LTCF residents are shown in Table 1.

Difficulty of diagnosing infectious gastroenteritis. Signs and symptoms of infectious disease may be atypical in elderly persons, making early recognition of illness difficult [6, 9, 27]. Infectious diarrhea may be difficult to distinguish from fecal incontinence, fecal impaction with overflow, aperient use, irritable bowel syndrome, or drug-induced diarrhea [27]. Similarly, vomiting may be attributable to many other causes [30, 31], and fever may be absent in elderly people [32]. To assist with diagnosis, the Infectious Diseases Society of America has established clinical practice guidelines for evaluation of fever and infection in LTCF residents [32] and management of infectious diarrhea [33].

Invasive and complicated food-borne illnesses. Food-borne infections may manifest with nongastrointestinal manifestations, such as septicemia, meningitis, pneumonia, septic arthritis, and osteomyelitis [7, 23, 34]. Listeria monocytogenes causes meningitis and septicemia in elderly persons, particularly those who are immunocompromised [7]. Elderly people have higher rates of invasive Salmonella infection [35], with 13 (45%) of 29 deaths due to invasive infection in United States surveillance sites occurring in people aged ≥60 years [35]. Clostridium species, including Clostridium perfringens, may cause pseudomembranous colitis in elderly residents [27, 36]. Elderly people more commonly experiencing invasive infection and serious sequelae, such as acute renal failure, although data are lacking to contrast risks for people living in LTCFs with those for people in the community.

Treatment. The Infectious Diseases Society of America practice guidelines for gastroenteritis [33] emphasize supportive treatment and rehydration, which may be difficult in LTCF residents [37]. Antibiotics are not generally indicated for residents with gastroenteritis, except where there is a higher likelihood of bacteremia [38]. Overuse of antibiotics in LTCF residents may lead to endemic Clostridium difficile [39]. Treatment with antimotility agents may result in toxic megacolon when infected with C. difficile [38] or hemolytic uremic syndrome when infected with Escherichia coli O157:H7 [33, 40].

Incidence. LTCF residents experience 0.04–1.9 episodes of gastroenteritis per 1000 bed days [41, 42], equating to 1 episode every 3–100 years. This incidence is lower than for elderly people living in the community [43], although differing study methods and study populations make comparison difficult. The incidence of gastroenteritis among LTCF residents is lower than that of respiratory and urinary tract infections but similar to that of skin and soft-tissue infections [9].

Surveillance in LTCFs. A primary reason to conduct infection surveillance in LTCF is to detect outbreaks; surveillance is mandatory in some countries as part of licensing and accreditation [17]. Case definitions developed at a Canadian consensus conference in 1991 recommended that a case have ≥2 diarrheal stools or vomits within 24 h or fecal tests indicating enteric pathogens with consistent symptoms. Conference participants expressed reservations about the definition [44], and validation studies have not been published. Definitions are probably applied loosely, where the priority of surveillance is to identify cases and establish control. Nosocomial surveillance in LTCFs is challenging because of difficulties diagnosing sporadic infections, high patient-to-staff ratios, training requirements, lack of nurses with experience in surveillance [45], and high staff workloads.

DISEASE OUTBREAKS

Summaries of outbreak investigations in LTCFs have provided insights into food-borne disease and gastroenteritis in LTCF residents [13, 15, 24, 46]. Improved surveillance and new diagnostic tests have highlighted the burden of outbreak-associated gastroenteritis in LTCF residents [18, 47]. In Australia in 2007, 1010 (54%) of 1882 outbreaks of gastroenteritis occurred in LTCFs (K. Fullerton [OzFoodNet], personal communication), representing 60% (939 of 1556) of outbreaks spread from person to person [48]. In other countries, 12%–57% of all gastroenteritis outbreaks occur in LTCFs [24, 49, 50].

In recent years, noroviruses have emerged as the main cause of epidemic gastroenteritis in LTCFs and hospitals and have challenged traditional measures to manage infectious diseases [18, 47, 51]. Reports of norovirus outbreaks in LTCFs have increased because of improved surveillance and global circulation of 2 strains of GII.4 norovirus, designated 2006a and 2006b [52, 53]. In LTCFs, norovirus outbreaks are predominantly spread from person to person [46, 53]. Noroviruses are highly infectious [54] and pose risks for residents, visitors, and staff members [55].

C. difficile is spread from person to person or via contaminated living environments and can result in serious outbreaks [39]. C. difficile infection presents with highly variable symptoms, from mild diarrhea to colitis, toxic megacolon, and death [28, 56]. Colonization and asymptomatic carriage amongst LTCF residents is common and may be associated with prior C. difficile infection or exposure to antibiotics [29]. In a study
### Table 1. Key Features of Main Pathogens Causing Gastroenteritis and Food-Borne Disease Affecting Long-Term Care Facility (LTCF) Residents

<table>
<thead>
<tr>
<th>Agent</th>
<th>Signs and symptoms</th>
<th>Incubation period (I), duration (D), and shedding (S) following cessation of symptoms</th>
<th>Main mode of transmission</th>
<th>Main control measures</th>
<th>Comments</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>Vomiting (&gt;50% of affected), nausea, abdominal pain, anorexia, diarrhea</td>
<td>I, 24–48 h; D, 12–60 h; S, 2–45 days</td>
<td>Person-to-person, with some food-borne</td>
<td>Infection control; intense environmental sanitation; cohort ill patients; restrict ill staff from working</td>
<td>Major cause of gastroenteritis outbreaks in facility residents; course of illness may be complicated and duration of illness or recovery may be prolonged in hospital patients; incubation period during person-to-person outbreaks difficult to assess</td>
<td>[18, 19]</td>
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<tr>
<td>Rotavirus</td>
<td>Diarrhea, vomiting, fever</td>
<td>I, 24–72 h; D, 1–5 days; S, 1–20 days</td>
<td>Person-to-person</td>
<td>Infection control; cohort ill patients</td>
<td>Infections can occur throughout the year, but outbreaks occur commonly in winter</td>
<td>[20]</td>
</tr>
<tr>
<td>Shiga toxin–producing Escherichia coli</td>
<td>Bloody diarrhea, abdominal pain, hemolytic uremic syndrome, thrombotic thrombocytopenic purpura</td>
<td>I, 2–12 days; D, 4–14 days; S, 1 day–3 months</td>
<td>Food-borne, with some person-to-person</td>
<td>Investigate food-borne sources; avoid undercooked hamburgers, unpasteurized milk or juice, and some raw fruits and vegetables; increased infection control</td>
<td>Occasional cause of food-borne disease outbreaks in LTCF residents that may propagate person to person after introduction to facility; severity of illness can vary markedly</td>
<td>[21, 22]</td>
</tr>
<tr>
<td>Salmonella enterica</td>
<td>Diarrhea, vomiting, blood in stool, abdominal pain, fever</td>
<td>I, 24–72 h; D, 4–7 days; S, 1–21 days</td>
<td>Food-borne, with some person-to-person</td>
<td>Evaluate food-borne sources; avoid undercooked meats, raw egg dishes, unpasteurized milk and juices, and untreated water; increased infection control</td>
<td>Presentation can be complicated in immunocompromised residents</td>
<td>[23]</td>
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<tr>
<td>Campylobacter</td>
<td>Diarrhea, vomiting, blood in stool, abdominal pain, fever</td>
<td>I, 2–5 days; D, 2–10 days; S, 1–69 days</td>
<td>Food-borne</td>
<td>Food safety program; thoroughly cook poultry products and minimize cross contamination; avoid unpasteurized milk and untreated water</td>
<td>Occasional cause of sporadic infections in LTCF residents</td>
<td>[23]</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>Watery diarrhea, abdominal pain, nausea</td>
<td>I, 8–16 h; D, 24–48 h; S, NA</td>
<td>Food-borne</td>
<td>Food safety program; minimize holding food at inappropriate temperatures and reuse of foods from day to day.</td>
<td>Routine testing of stool in pathology laboratories will not detect C. perfringens; duration of C. perfringens outbreaks much shorter than for other pathogens, which may be a hallmark for this etiology; may cause recurrent diarrhea or antibiotic-associated diarrhea in LTCF residents</td>
<td>[24–26]</td>
</tr>
<tr>
<td>Clostridium difficile</td>
<td>Diarrhea, colitis, fever, abdominal pain, leukocytosis</td>
<td>I, 1–10 days; D, variable; S, NA</td>
<td>Person-to-person</td>
<td>Environmental decontamination; increased infection control; cease offending antibiotic treatment</td>
<td>Common cause of antibiotic-associated diarrhea and causes wide spectrum of illness; high rate of asymptomatic carriage of C. difficile with 4%–10% of LTCF residents colonized; in outbreak settings ~50% of residents without symptoms have positive stools</td>
<td>[27–29]</td>
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<tr>
<td>Listeria</td>
<td>Headache, fever, myalgia, chills, abdominal pain, and coma</td>
<td>I, &gt;30 days; D, variable; S, NA</td>
<td>Food-borne</td>
<td>Food safety program; appropriate dietary assessment to avoid high-risk foods in vulnerable elderly residents</td>
<td>A single case in an LTCF requires assessment of food exposures and clinical history; case fatality rate in elderly people 20%–30%; 75% of infections occur in people who are immunocompromised</td>
<td>[7]</td>
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in Ohio, the rate of *C. difficile* detection in stool samples of hospital patients was 3 times higher than for LTCF residents, in whom the rate of detection was 0.2–0.3 per 1000 bed days [57]. Controlling *C. difficile* transmission in acute care settings is vital for preventing infections in LTCF residents who are more likely to have recently been hospitalized [58].

Two reviews of food-borne disease outbreaks highlight *Salmonella* as a common cause of food-borne disease outbreaks in LTCFs, causing 25 (43%) of 58 outbreaks in the United Kingdom [24] and 27 (23%) of 115 outbreaks in the United States [15]. The case fatality rate for *Salmonella* outbreaks ranged from 3% to 4% [15, 24]. Toxin-based illnesses were also common, with *C. perfringens* responsible for 23 (40%) of 58 food-borne outbreaks in LTCFs in the United Kingdom [24] and 6 (5%) of 115 in the United States. *Staphylococcus aureus* also caused 12 (10%) of 115 outbreaks in the United States [15]. The importance of *C. perfringens* may be underestimated because of difficulties in microbiological diagnosis of intoxications. Despite gastroenteritis normally having a mild presentation, multiple deaths in LTCF residents may occur during a single outbreak of *E. coli* O157, *Salmonella*, or *C. perfringens* infections [15, 24].

Highly infectious norovirus may be transmitted by food when catering or food service staff work while ill [55]. Outbreaks due to agents, such as Shiga toxin–producing *E. coli* and *Salmonella*, spread initially in food can subsequently spread from infected persons or contaminated environments when infection control is poor [21, 59]. *Shigella*, *Vesíria*, *Giardia* [60], *Cryptosporidium*, rotaviruses, adenoviruses, sapoviruses, and astroviruses [20, 24] cause occasional outbreaks in LTCFs, although little is known about the introduction or propagation of these agents.

### PREVENTION, DETECTION, AND MANAGEMENT OF OUTBREAKS

#### Prevention.

Despite the commonness of outbreaks, few studies have assessed measures to prevent food-borne diseases or gastroenteritis in LTCFs. A systematic review of 75 published outbreaks in LTCFs concluded that data were insufficient for quantitative assessment and made only general recommendations [46]. Prevention of gastroenteritis outbreaks in LTCF residents can be understood in terms of interrupting the possible transmission pathways as shown in Figure 1. Pathogens may be transmitted within a facility by ingestion of microorganisms or toxins via exposure to (1) an infected person, (2) contaminated food or (3) water, (4) contaminated objects in the residential environment, or (5) infected animals.

Facilities are vulnerable to the introduction of infections due to a complex traffic of people between the community, hos-
Table 2. Key Research Gaps in the Literature Regarding Food-borne Disease and Gastroenteritis in Long-Term Care Facility (LTCF) Residents

| 1. What is the incidence, cause and cost of gastroenteritis and food-borne disease in LTCF residents compared to elderly people living in the community? |
| 2. What are the best practices to manage outbreaks of gastroenteritis in LTCFs? |
| 3. What is the relative contribution of different microbiological agents to gastroenteritis in LTCF residents? |
| 4. What is the most appropriate means of conducting surveillance for gastroenteritis in LTCFs, including validation of case definitions? |
| 5. How can gastroenteritis and food-borne disease be prevented within LTCFs and what strategies should be in place relating to architecture & fittings (including toilets), food handling, cleaning, and response to single cases? |
| 6. What is the most useful diagnostic strategy for a case of gastroenteritis in an LTCF resident? |
| 7. What factors facilitate introduction and initial transmission of enteric agents, such as norovirus, within LTCFs? |
| 8. What are the risks posed to different categories of LTCF workers from infectious gastroenteritis? |
| 9. What is the role of contaminated living environments for transmission of enteric agents? |

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led by a physician or nurse [77] and including facility managers and domestic staff should aim to minimize the early spread of the outbreak. A sensitive definition of ≥2 cases of gastroenteritis occurring in a facility in a week may be appropriate to trigger an outbreak response, given the low background incidence of gastroenteritis [9, 31].

The etiology and likely mode of transmission of outbreaks can guide control measures (Table 1 and Figure 1). Facility outbreak plans should include stool sample test kits [78] to allow collection of 4–6 fecal specimens from ill residents, to increase the probability of confirming the etiology [78, 79]. Clinicians should consult laboratorians, because pathogens such as *C. difficile*, *C. perfringens*, and norovirus require specialized tests [23]. Isolating agents, such as *C. difficile*, that may be carried asymptomatically can cause confusion, and it is important to consider whether clinical features are characteristic of the pathogen [80]. The team should maintain a list of affected residents and staff and review it daily [77].

Outbreaks with a high proportion of residents and staff experiencing vomiting may indicate norovirus spread from person to person, whereas tightly clustered onset of diarrheal illness without vomiting among residents but not staff may indicate food-borne *C. perfringens* [46, 81]. Outbreaks of longer duration affecting both staff and residents may be caused by agents spread from person to person [22, 82] or may be from a persisting food-borne source [61].

Investigating outbreaks in LTCFs is challenging. Patients usually cannot recall consuming specific foods, and food intake may not be recorded in detail [12]. During the investigation, outbreak teams should formally evaluate food preparation and service, facility cleanliness, waste management, hand hygiene, laundry cleaning, and infection control to identify how the outbreak occurred and to prevent future occurrences [46].

**Control.** Noroviruses are incredibly difficult to control because of their infectivity and environmental persistence [31, 53, 54, 72] and can be detected in residents’ stool samples an average of 28 days after cessation of symptoms [19, 30]. Both acutely ill and convalescent patients pose infectious hazards in hospitals and LTCFs [83]. Staff must be made aware of and communicate this risk, without jeopardizing the care and accommodation of the case patient [32]. For highly transmissible agents, such as norovirus and *Salmonella*, exposure to vomit and diarrhea pose an infectious risk for staff, including those working in the laundry [53, 54, 84]. Friesma et al [53] reported that attack rates were lower among staff during norovirus outbreaks in which a toilet was dedicated for ill persons for ≥7 days following recovery, face masks were used during contact with vomit, and staff worked in the first unit affected within the LTCF. Many guidelines mention cohorting ill residents [46], but implementation is difficult because residents may be difficult to shift during outbreaks [53]. It is preferable to close the unit to new admissions or limit exchange of staff [53, 83]. Outbreak control teams may restrict staff from working in certain parts of a facility and limit access by health care workers or visitors [83]. LTCF staff with gastroenteritis should not return to work until ≥48 h after symptoms resolve [53, 85].

Some agents that cause gastroenteritis are persistent in the environment and difficult to eradicate [39, 72]. Vomit and feces on surfaces or floors should be initially cleaned away with a detergent-soaked cloth or mop. The soiled area should then be disinfected with a solution containing 1000 parts per million of available chlorine [86]. Some evidence suggests that higher concentrations may be required (>5000 parts per million) to effect a substantial reduction of norovirus [72]. Persons cleaning must be protected by standard precautions, supplemented by a gown, gloves, and eye protection. Soiled carpet is problematic; steam cleaning is required. Ineffective cleaning with cloths may spread norovirus within a facility [72], whereas *C. difficile* spores require high compliance with protocol and an effective disinfectant [39].

The best approach to hand hygiene in the setting of an outbreak of gastroenteritis in a LTCF is unclear. Alcohol-based hand hygiene products have been widely adopted in many health care settings [87]. Concerns have been raised as to whether the concentration and type of alcohol in a typical product are sufficient to adequately reduce the concentration of norovirus or *C. difficile* on contaminated hands [88, 89]. The alternative approach, hand washing with soap and water, may be compromised in LTCFs if taps and basins are not easily accessible [90]. Well-controlled studies are needed to evaluate which approach is most effective in practice during outbreaks in LTCFs. Staff caring for infected residents should use personal protective equipment, such as gowns, gloves, and surgical masks [53]. Once the etiology of the outbreak has been identified, infection control measures should specifically target the infective agent [39, 55].

**CONCLUSION**

The key means of preventing gastroenteritis in LTCF residents are well-functioning infection control programs and food-safety plans, although there is a paucity of data on the most-effective approaches [53]. To further our knowledge about gastroenteritis and food-borne diseases in LTCF residents, there is a need for more research to address key gaps in the literature (Table 2).

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