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## REVIEW ARTICLE

# Enteric outbreaks in long-term care facilities and recommendations for prevention: a review

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(Accepted 9 April 2008; first published online 12 May 2008)

### SUMMARY

Outbreaks of enteric illness in long-term care facilities (LTCFs) were reviewed to identify preventative recommendations. Systematic review methodology identified outbreak reports of gastrointestinal illness in LTCFs either published or that occurred from January 1997 to June 2007. The inclusion criteria captured 75 outbreaks; 23 (31 %) associated with bacterial agents and 52 (69 %) with viral agents. Transmission was mainly foodborne (52 %) for those of bacterial origin and person-to-person (71 %) for viral outbreaks. Norovirus infection was associated with 58 % of hospitalizations. Sixty deaths were reported, about half from *Salmonella* infections. Recommendations for foodborne outbreaks emphasized appropriate sourcing and preparation of eggs, staff training, and temperature control during food preparation. Recommendations from outbreaks transmitted person-to-person centred on controlling residents' movements, effective environmental cleaning and disinfection, cancelling social events and restricting visitors, excluding ill staff, encouraging effective hand hygiene, and preventing cross-contamination through gloving and gowning. In none of the 75 published outbreak reports were the suggested recommendations evaluated for effectiveness in controlling the outbreak. Applied research of this type could greatly help in the acceptance of prevention and control strategies.

### INTRODUCTION

Chronic diseases, decreased immune function, malnutrition, malabsorption and immobility contribute to the vulnerability of the elderly to infectious illnesses, including those of the gastrointestinal tract [1, 2]. High rates of antibiotic use in the elderly [1] may contribute to enteric illness by decreasing harmless, competing gut flora. Institutionalized confinement promotes transmission of disease agents by sharing rooms and equipment and touching common

surfaces. Unfortunately not all long-term care facilities (LTCFs) have adequate infection control programmes that emphasize the importance of staff remaining home while ill, cleaning and disinfection routines, or reporting enteric outbreaks to appropriate authorities. The purpose of this study was to review documented outbreaks of enteric illness in LTCFs published in the last ten years to identify aetiology, mode of transmission, morbidity and mortality patterns, and recommendations implemented or recommended for control and prevention. Additionally, published studies on the effectiveness of strategies to minimize enteric outbreaks in LTCFs were also reviewed. If effective infection control policies in LTCFs were widely adopted, outbreaks could be

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reduced, decreasing economic and social burdens while providing a healthier environment for residents and staff.

## METHODS

### Inclusion criteria

A systematic review of the literature was performed to identify outbreak reports of gastrointestinal illness in LTCFs either published or that occurred from January 1997 to June 2007. The review was not limited to any geographical area. There were four report categories: (1) published in peer-reviewed scientific journals, (2) published on the Internet by government organizations, (3) internal reports from public health agencies, (4) published non-peer reviewed articles.

### Exclusion criteria

The following types of studies were excluded:

- Outbreaks of respiratory and other communicable diseases.
- Community-acquired illness or outbreaks associated with hospital and outpatient settings.
- Reports not written in English.
- Outbreaks reported by the press but not confirmed by a public health agency.
- Long-term retrospective studies, burden of disease studies, and reviews.

### Search strategy

Computer-aided searches of Medline, CINAHL, *Ageline*, *Abstracts in Social Gerontology*, *Biological Sciences* and *Scopus* from the earliest entry to May 2007, as well as all databases within Current Contents<sup>®</sup>, The Institute for Scientific Information from 1999 to 2007 were completed to identify outbreak reports. Search words used: ('Homes for the Aged' or 'Nursing Homes' or 'Housing for the Elderly' or 'assisted living facilities' or 'senior housing') and (outbreak or outbreaks or diarrhea or diarrhoea or gastrointestinal or gastroenteritis or vomit or vomits or vomiting outbreak or outbreaks or gastrointestinal or diarrhea or diarrhoea or vomit\*).

Reference lists were hand-searched to validate the electronic search methodology. Government and public health websites were searched for outbreaks associated with LTCFs.

Canadian and American Federal Government websites, individual states with populations  $\geq 3$  million population, and Canadian provincial (Ontario, Alberta, Manitoba, and British Columbia) public health websites were searched for outbreaks associated with LTCFs using search words ('epidemiology', 'epidemiology newsletters', 'publications', 'reports', 'outbreaks', 'investigations', 'surveillance', 'nursing home outbreak', 'long term care outbreak').

Abstracts were examined to determine if the inclusion criteria were met. A relevance tool was then applied to the selected reports: (1) occurred or published between 1997 and 2007, (2) a gastrointestinal outbreak, (3) reported in English and (4) laboratory-confirmed aetiology. If the four criteria were not met, the report was excluded. Reports were read to ensure there was no duplication; if duplication occurred, the published manuscript was used as the reference.

### Data extraction

For each outbreak, the following information was extracted: country and year of outbreak; number at risk of infection/population of the LTCF; number of residents ill; number of laboratory-confirmed cases; number of hospitalized cases; age; aetiology; mode of transmission; food vehicle if foodborne; number of staff ill; recommendations to contain the outbreak.

### Level of evidence

The causal agent was identified by laboratory confirmation from cases.

## RESULTS

Of the 75 outbreaks that met the inclusion criteria, 26 were from peer-reviewed journals, 29 from health unit reports, 16 from government publications and four from non-peer-reviewed publications. Database searches resulted in 585 abstracts with 369 remaining after the de-duplication process. Application of the inclusion criteria produced 73 abstracts while application of the exclusion criteria resulted in 28 reports with useful information for the review. The following countries were represented in the review: the United States (23), Canada (19), Australia (15), Europe (14), and Asia (4).

Viral agents were associated with 52 (69%) outbreaks and bacterial agents 23 (31%) outbreaks

Table 1. Mortality data by pathogen associated with enteric outbreaks in long-term care facilities

Pathogen	Number of outbreaks (%) (n = 75)	Number ill	Confirmed cases	Hospitalized	Deaths	Staff ill
<b>Bacterial</b>						
<i>Salmonella</i> spp.	11 (14.7)	247	172	16	28	24
<i>Escherichia coli</i>	6 (8)	120	45	12	11	62
<i>Clostridium perfringens</i>	3 (4)	76	29	4	3	0
<i>Shigella</i> spp.	1 (1.3)	13	1	0	0	9
<i>Clostridium difficile</i>	1 (1.3)	9	1	1	0	2
Multiple pathogens	1 (1.3)	119	Both 25	31	1	2
<i>Campylobacter jejuni</i>			14			
<i>Salmonella</i>			24			
Total bacterial	23 (30.7)	584	311	64	43	99
<b>Viral</b>						
Norovirus	43 (57.3)	2117	171	89	16	897
Rotavirus	4 (5.3)	84	11	0	1	31
Calicivirus	4 (5.3)	210	28	0	0	15
Astrovirus	1 (1.3)	12	5	0	0	0
Total viral	52 (69.3)	2423	215	89	17	943
Total	75 (100)	3007	526	153	60	1042

(Table 1). Viral agents had four times more cases (81%) than bacterial (19%). The mean number of cases per viral outbreak was 47 (median 35), for bacterial outbreaks 25 (median 16). Norovirus was the most frequently reported pathogen with 43 outbreaks. *Salmonella* spp. was identified in 11 outbreaks and *Escherichia coli* in six.

The stated modes of transmission for bacterial outbreaks included foodborne (52%), person-to-person (26%), water (4%) and unknown (17.4%). Transmission for viral outbreaks included person-to-person (71% – four included public vomiting episodes), rarely with food (4%) and unknown (25%).

There were 3007 residents ill with 18% laboratory confirmed; 153 residents were hospitalized (Table 1), the majority with norovirus infections (89 cases). Sixteen cases were hospitalized with salmonellosis and 12 with *E. coli* infections. There were 60 deaths reported, about half associated with *Salmonella*. Other pathogens associated with deaths included norovirus (16), *E. coli* (11), *Clostridium perfringens* (3) and rotavirus (1). There were 1042 staff cases identified in the reports, 943 from viral infections (Table 1). The median duration of illness for 11 *Salmonella* outbreaks with stated duration, was 16 days (range 8–1520 days). In four pathogenic *E. coli* outbreaks the median duration was 10 days (range 9–49 days), and

for 27 norovirus outbreaks the median duration was 21 days (range 6–43 days).

The effectiveness of recommendations for outbreak control was not statistically evaluated in any outbreak report reviewed. Recommendations for prevention were not mentioned in 28 (37%) reports (Tables 2 and 3). Safe food preparation in LTCFs was emphasized because 19% of outbreaks were foodborne. Over 70% of foodborne outbreaks provided recommendations; 36% related to cross-contamination, 24% to infection control measures, 21% to staff training and 19% to temperature control. Nine outbreak reports contained recommendations concerning sources, type, and preparation of eggs, while four referred to effective cleaning of kitchen equipment.

Person-to-person transmission was reported in 56% of the outbreak reports – over 70% of these provided recommendations. Managing the movement of residents primarily by temporarily halting new admissions, not transferring ill residents between wards, and isolating ill residents represented 17% (27/155) of recommendations. Effective cleaning and disinfection accounted for 16% of recommendations while 14% focused on cancelling social events or restricting visitors. Another 13% recommended excluding ill staff until symptom-free for 48 h or until the laboratory reported two consecutive negative stool cultures while

Table 2. *Recommendations from foodborne outbreaks (number of recommendations in parentheses)*

Type of recommendation	Specific recommendation
Cross-contamination (15)	Do not serve raw eggs in foods (2)/cook eggs thoroughly (1) Buy eggs from regulated producers (2) Do not use shell eggs/use only pasteurized eggs (1) Clean hands, surfaces and utensils after working with shell eggs (1) Observe best-before dates (eggs) (1) Disassemble and clean equipment after preparing raw foods (2) Thoroughly clean utensils (1) After sanitization of all kitchen equipment, record activity in log book (1) Licensing of butchers, HACCP in shops and enforcement of controls (1) Individual food items should be wrapped, i.e. sandwiches and cookies (1) Food served by staff/restrict self-service food bars or shared food (1)
Infection control (10)	Reinforce infection control through personal and environmental hygiene (3) Depending on pathogen, antibiotics may decrease shedding time (1) During a suspected outbreak stool samples from cases must be analysed (1) Cohort confirmed cases with dedicated staff (1) Ill staff not to return to work till two consecutive negative stool samples (1) Social activities cancelled (1) Residents to remain on campus (1) Close pool, ice machines and fitness centre (1)
Staff training (9)	Formal training for kitchen staff (4) Kitchen procedures must follow HACCP plans (3) During an outbreak health officials will inspect the kitchen and food must not be discarded until directed to do so (1) Board of Directors of LTCFs must understand the risks/consequences of communicable disease outbreaks (1)
Temperature control (8)	Maintain temperature control during preparation, storage and serving (2) Chill foods rapidly to <10 °C and store at <4 °C (1) Reheat foods to 70 °C before serving (2) Maintain hot foods at 70 °C (1) No slow cooling or anaerobic/microaerobic conditions (1) Serve puréed food immediately (1)

HACCP, Hazard analysis critical control points; LTCFS, long-term care facilities.

Total = 40 recommendations.

13% emphasized effective personal hygiene, primarily hand hygiene. The remaining recommendations included 10% on health-care workers (HCWs) preventing cross-contamination by wearing protective gear, namely gloves and gowns; 9% on restricting staff movements by having staff only work on one floor and in one institution; and, 8% on the need for infection control policies (Table 3).

## DISCUSSION

Only a fraction of outbreaks occurring over the same period are included in this review due to under-reporting, lack of publication and the English-language requirement. Nonetheless, our data are somewhat representative of all outbreaks. A study of residential facilities from 1992 to 1994 in the United

Kingdom attributed 57% of outbreaks to viral causes and 29% to bacterial causes [3], similar to the present study, 61% and 39% respectively.

Transmission of enteric pathogens in LTCFs is frequently by the person-to-person route, usually viral, and due to close contact during caregiving or touching of common surfaces. Viral enteric outbreaks frequently resulted in twice as many resident cases as bacterial sources.

The mortality rate from enteric illness is generally higher for the elderly than for the general population because of their fragile state of health. In this review 2% (60/3007) of residents died, similar to other studies [4]. Morbidities and mortalities may be prevented in the LTCF population by rapid recognition of an outbreak, provision of treatment and implementation of control strategies.

### Foodborne illness

Foods of animal origin are often contaminated with pathogens and cross-contamination and/or inadequate temperature controls are frequent contributing factors to foodborne illness (Table 2) as illustrated by an outbreak associated with custard made from raw eggs. Temperatures were not measured during preparation and storage resulting in bacterial amplification; five residents died [5]. In another outbreak, a staff member became ill after only touching egg shells [6]. Another outbreak occurred when mayonnaise made from raw eggs was stored at room temperature for 5–8 h [7]. Pooling of raw eggs is associated with increased risk because a single egg can contaminate an entire batch. Raw shell eggs should not be used without further treatment and pasteurized egg products should be substituted. When eggs are added to other foods they must be cooked to at least 63 °C for 15 s or higher if the food contains meat [8].

Five outbreaks involved contaminated meats. In an outbreak of *Salmonella* Heidelberg and *Campylobacter jejuni* infections in New York State, cooked chicken livers were placed in a bowl which previously contained raw chicken liver juices and inadequately stored overnight [9]. A clean, sanitized receptacle should have been used followed by refrigeration at 4 °C.

A coroner's report following an Australian *C. perfringens* outbreak concluded that the caterer had contributed to a death through failure to properly reheat puréed food [10] which can be particularly hazardous because puréed foods are often made from leftover foods and served the next day.

Preventing cross-contamination is particularly important for ready-to-eat foods. An outbreak of *E. coli* O157 infections in Scotland resulted from cross-contamination of cooked cold meats from raw products in a butcher's shop probably via a slicing machine or a tray [11]. Management of LTCFs must ensure that product is supplied only from licensed, inspected establishments with a quality assurance programme.

Standardized food handling training is provided by private companies such as TrainCan (Canada), and ServeSafe (USA), as well as most local health units and community colleges. An increasing number of health departments are requiring food handler training courses by a supervisory person on duty in all food premises, including nursing homes.

Although this review concentrates on public health interventions, it is important that cases or

their caregivers seek medical attention as soon as possible because administration of antibiotics (*Shigella*) and other supportive measures may be warranted. Antibiotics may also decrease shedding (*Salmonella*) [5].

### Person-to-person transmission

Managing the movement of residents (17% of recommendations) is important for outbreak containment (Table 3). Seven reports recommended 'no new admissions' during an outbreak. An outbreak of norovirus infections in three institutions (two were LTCFs) were probably linked by transfers of infected individuals from one institution to another [12]. A study of ten individuals, aged 79–94 years, demonstrated that norovirus can be shed for up to 15 days although symptoms may have resolved by the fourth day of illness [13]. If symptoms are severe and admission to hospital is necessary, then personnel must be notified of the possible infectious state of cases.

Six reports identified isolation of cases (Table 3). Eight LTCF residents were not isolated when admitted to an Austrian hospital with presumed salmonellosis, resulting in ten patient and 18 staff cases of norovirus infection [14]. Isolation is often difficult or impossible in the LTCF because of room availability but most importantly, an individual's room in a LTCF is their 'home' and personal space, very different from a hospital room. One report noted that there were emotional and psychological risks associated with isolation of residents during an outbreak [15]. A study on measures to control residents colonized with vancomycin-resistant *Enterococcus faecium* (VRE) supported cohorting as an effective alternative strategy accomplished by dedicating one nurse to care for the ill residents throughout the outbreak [16]. Minimizing transmission within a facility by restricting staff to one institution and preferably one floor was often recommended in the present study (14% of recommendations).

Appropriate cleaning and disinfection (16% of recommendations) is essential to eliminate pathogens in the environment, especially in bathrooms and other 'high touch' areas. Disinfectant use may be controversial due to safety concerns for housekeeping staff and surface disinfection is transient [17] although targeted disinfection would be reasonable. During an outbreak of norovirus infections in a Pennsylvania veterans' LTCF, 127 residents and 84 staff were



Table 3. Recommendations from outbreaks with person-to-person transmission (total 155). Number of recommendations in parentheses

Contributing factors	Recommendations enacted during outbreak	Effectiveness of recommendation
Resident movement (27)	No new admissions during an outbreak (7). Refuse admissions until 96 h after last onset of illness (1) No transfers between wards/institutions during an outbreak (5) If case must be admitted to hospital notify of possible infectious state (1) Isolate cases (6) – suggested up to 2 weeks Restrict resident movement (2) Confine to room until 48 h symptom free (2) Cohort cases (2) Dining room closed or ill residents ate in room (1)	Control measures thought effective and easy to implement in preventing spread of VRE in a study of five colonized residents in a nursing home included education (in-services, fact sheets), cohorting of colonized, VRE precautions (alcohol sanitizers, gloves, and gowns), treatment, and environmental cleaning [double cleaning and disinfecting with bleach (1:100 dilution)] [16]  Control measures thought to contribute to a significant decline in VRE transmission during a hospital outbreak in eight wards were education, weekly surveillance cultures of suspect patients, contact isolation of colonized, handwashing with antiseptic soap, restricted use of vancomycin, and enhanced environmental disinfection. Proximity to unisolated patients was statistically associated with an increased risk of VRE acquisition ( $P=0.0016$ ) [21]
Ineffective cleaning and sanitation (24)	Daily environmental cleaning (8) Sequencing of cleaning strategies and disinfect common areas appropriately (1)  Handle soiled laundry as little as possible/bag (6) Wash laundry for maximum time and temperature (3) Standardize operating procedure for toilet cleaning (1) Improved cleaning of toilets and washrooms (2) Clean shower chairs and dedicated equipment (1) Change rooms and decontaminate following vomiting or diarrhoeal episodes (1) Effective terminal cleaning of room on patient discharge (1)	Feline calicivirus survived up to 72 h on inanimate objects [20]. In a 2-year study, a comprehensive infection control programme (education emphasizing handwashing and environmental cleaning and disinfecting) reduced gastrointestinal infections by 68% in four of the intervention LTCFs compared to 10% of the control LTCFs ( $P=0.31$ ). Reduction of respiratory infections was almost statistically significant ( $P=0.06$ ) [23]  Residential care facilities in British Columbia that had gastrointestinal outbreaks (27) were matched with control facilities (27). Although not statistically significant, decreased outbreak length was observed when ill employees were excluded, shared outings and activities were cancelled, visitors restricted, residents' hands were washed after toileting and before meals, housekeeping was enhanced, bathrooms cleaned daily, and more private rooms were available [22]  [16] (as above) [21] (as above)
Increasing contact with individuals outside facility (21)	Cancel social events (11) – one report suggested until 96 h after last onset of illness Restrict visitors (9); told to report to nurse's station for instruction on infection control Restrict movement of volunteers (1)	[22] (as above)
Staff working while ill (20)	Staff excluded while ill or until symptom free for 48 h or two consecutive negative stool cultures (20)	A case-cohort study of New York State nursing homes indicated that homes with paid employee sick leave were less likely to have communicable disease outbreaks [26] [22] (as above)

Table 3. (cont.)

Contributing factors	Recommendations enacted during outbreak	Effectiveness of recommendation
Ineffective personal hygiene (20)	Effective handwashing by all staff and visitors (17) No sharing of towels (1) Reinforce personal hygiene (1)  Use hand gels when appropriate (1)	Promoting use of alcohol hand sanitizers through provision of 4 oz. sanitizers to HCWs in an acute care hospital resulted in a 36% decrease in nosocomial infection rates over 10 months [31]; use of alcohol gel hand sanitizers by HCWs in an extended care facility resulted in a 30% decrease in nosocomial infection rates in a 34 month study [32]  [21] (as above) [22] (as above) [23] (as above)
Cross-contamination (15)	Use protective wear such as gloves and gowns (9) Wear a mask when cleaning heavy contamination (1) Use spill kits (vomiting or diarrhoea incidents) (1) Droplet precautions (1) No rectal temperatures (1) Continue precautions 2–3 days after symptoms stop (1) Reinforce safe food handling procedures and use disposable dishes during an outbreak (1)	Regular glove use by HCWs during contact with all residents was as effective as contact isolation for residents with MRSA and VRE to limit spread [33] [16] (as above)
Staff movement between floors or institutions (14)	Staff should work on one floor of one institution (14)	
Lack of infection control policies (12)	LTCF must cooperate fully with health agency (4) Need established infection control policies that can be implemented immediately (3) Compliance with infection control policies and monitoring (2) LTCF should have a surveillance system in place to identify infections and report to appropriate agencies (2) Stool specimens must be collected for culture and viral testing (1)	
Lack of knowledge concerning enteric disease and prevent/control (2)	Regular education sessions for all staff concerning infection control (1) During an outbreak, education sessions will be needed for visitors and volunteers as well (1)	[16] (as above) [21] (as above) [23] (as above)

VRE, Vancomycin-resistant *Enterococcus faecium*; LTCFS, long-term care facilities; HCW, health-care worker.

Total = 155 recommendations.

affected [18]. Environmental surface swabs from multiple sites were all positive for norovirus. Widespread environmental contamination probably played a significant role in this outbreak considering the swabs were collected 2 weeks after the outbreak peak! A phenolic agent was routinely used for environmental surfaces and may have been inadequate to render inactive a non-enveloped virus such as norovirus [19]. Studies on feline calicivirus, a surrogate for norovirus, have shown the ability of the virus to survive on inanimate objects such as telephone buttons for up to 72 h [20]. Other studies demonstrated the effectiveness of environmental cleaning as part of comprehensive control measures to reduce enteric infections [16, 21–23]. For instance, a case-control study of residential facilities in British Columbia (B.C.) showed that residents who shared bathrooms were twice as likely to experience gastrointestinal outbreaks, although this was not statistically significant [22]. Hand hygiene, however, is considered more critical to pathogen control than cleaning and disinfection of environmental surfaces [17].

Cancelling social events and managing visitors (14% of recommendations) prevents the introduction of illness into the institution and may prevent further illness in the community. Two reports identified visitors as the possible source of infection in LTCFs [14, 24]. Visitors were restricted in nine outbreaks – usually to immediate family members (Table 3). Postings should direct visitors to the nurse's station for further instruction on infection control. Restricting visitors was one of several control measures thought to reduce the duration of enteric outbreaks in the B.C. study [22].

An important component of staff training is recommending ill staff to remain at home (13% of recommendations). A Pennsylvanian report described the employees' role in the amplification of the outbreak because initial cases were employees, bedridden residents were more likely to be cases, and ill employees were observed providing direct patient care [18]. Anecdotal evidence during a UK outbreak noted that staff hesitated to report symptoms of personal illness because they were not paid for sick leave [25]. A case-cohort study in New York [26] showed that LTCFs with paid employee sick leave were less likely to have respiratory or gastrointestinal outbreaks. Another important message for LTCFs is that employment conditions that encourage early return to work after viral illness may contribute to prolonged outbreaks [27]. Staff working while ill is

an important issue for administrators of LTCFs to consider from an economic and public health perspective.

Effective handwashing (13% of recommendations) protects residents and staff. During an Israeli outbreak of norovirus infections many residents were bedridden suggesting that transmission was from direct contact by staff members and residents [28]. Bacterial transmission from person-to-person can occur when the infectious dose is low as demonstrated by an outbreak of *E. coli* O157 infections in England with 75 clinical cases, 40 of them residents, identified over a 48-day period [25]. An audit of the outbreak identified poor handwashing facilities for staff. During a shigellosis outbreak in Queensland use of communal towels may have perpetuated the outbreak for several months [29]. Although one report recommended the use of hand gels, they are not recommended for visibly soiled hands which should be washed with soap using friction to lift the soil to the lather, and then rinsed and dried on paper towels to further remove soiling [30].

Many studies support the effectiveness of handwashing to control transmission of enteric infections. During a 2-year comprehensive infection control programme (education emphasizing handwashing, environmental cleaning and disinfection) gastrointestinal infections were reduced by 68% in four intervention LTCFs compared to 10% in four control LTCFs, although the finding was not statistically significant [23]. In another comprehensive infection control programme in a hospital (emphasizing education, handwashing, surveillance, contact isolation, and environmental disinfection), there was a significant decline in VRE transmission [21]. Provision of 4-oz alcohol hand sanitizers to HCWs in an acute care hospital resulted in a 36% decrease in nosocomial infection rates over 10 months [31]; use of alcohol gel hand sanitizers by HCWs in an extended care facility resulted in a 30% decrease in nosocomial infection rates in a 34-month study [32].

Gloves and/or gowns (10% of recommendations) should be worn at least when there is an expectation of becoming soiled (Table 3). An Israeli outbreak report noted that staff may have remained free of norovirus infection had they worn gloves and aprons during patient care [28]. During a shigellosis outbreak in Queensland, glove use was not evident during patient care or during environmental cleaning of vomitus and faeces, although it was part of their infection control policy [29]. Regular glove use by



HCWs during contact with all residents in a LTCF was as effective as isolation for residents with MRSA and VRE [33]; the cost was 40% greater to isolate than routine glove use.

Infection control policies (8% of recommendations) require LTCFs to cooperate with governing health agencies that have outbreak control information and can act promptly providing access to laboratories. An effective working partnership between LTCF management and the health unit during an outbreak of norovirus infections in New South Wales resulted in strict implementation of infection control recommendations [34]. Outbreak management plans should be incorporated in accreditation standards and include notification of hospitals where ill residents may be sent, limitation of resident transfers between LTCFs, and exclusion of ill staff from work duties [12].

Surprisingly, only 1% of recommendations (two) indicated that educational sessions are necessary for prevention and outbreak control. Continual training of LTCF nursing staff is justified due to high turnover rate – up to 56% for certified nursing aides in the United States [35]. Local health units frequently provide infection control sessions. In Ontario it is mandatory for each health unit to offer LTCFs at least one in-service session annually (Mandatory Health Programs and Services Guidelines, 1997, under the Health Protection and Promotion Act, 1990). Educational sessions during an outbreak must be tailored to the pathogen, its transmission routes and methods of control. A good ‘selling point’ to HCWs is that a strict infection control measure protects the residents and themselves. This review reported 3007 resident cases and 1042 staff cases. Signage or pamphlets may provide instruction to visitors and volunteers, particularly for handwashing or using gel sanitizers [36]. Many comprehensive infection control programmes have incorporated education as an important component [16, 21, 23].

## CONCLUSIONS

Seventy-five outbreaks reported between 1997 and 2007 associated with enteric illness in LTCFs were reviewed. Of the >3000 resident cases, there were 153 hospitalizations and 60 deaths, as well as 1000 staff cases. Norovirus was associated with the largest number of outbreaks (43), followed by *Salmonella* spp. (11), and pathogenic *E. coli* (6).

The mode of transmission was mainly foodborne for bacterial outbreaks and person-to-person for viral outbreaks.

Key strategies identified for controlling foodborne outbreaks:

- Kitchen staff should be trained in safe food handling, emphasizing temperature controls for hazardous foods and methods for cleaning and sanitizing surfaces.
- Use only pasteurized egg products.
- Food suppliers to have quality assurance programmes.
- Prompt medical consultation for cases.

Key strategies identified for controlling outbreaks transmitted person-to-person:

- Limit movement of residents, staff, and visitors.
- Daily environmental cleaning with additional targeted disinfection of ‘high touch’ areas.
- Management to support effective handwashing and education for staff, residents, and visitors.
- Protective gear to be worn as required, especially during direct contact with residents.
- Have infection control policies in place – seek expertise of local health unit.

In none of the 75 published outbreak reports were recommendations evaluated for effectiveness in controlling the outbreak. Applied research of this type could greatly aid in the acceptance of prevention and control strategies. Table 3 presents the ‘expert opinion’ recommendations from the 75 outbreaks plus a summary of evaluative studies which attempt to address effectiveness of strategies, usually by comparison against a control group. These latter recommendations that were found effective, inexpensive and easy to implement include: enhanced handwashing; enhanced environmental cleaning/disinfecting, especially during an outbreak; increased use of alcohol hand gel sanitizers; regular glove use by HCWs when contacting residents; cancelling shared outings and activities, and restricting visitors. Other strategies shown to be effective but more difficult to implement included paid staff sick leave and cohorting ill residents.

## ACKNOWLEDGEMENTS

The authors thank Ms. Janet Harris of the Public Health Agency of Canada for her kind assistance in the computer-aided searches of the literature.

## DECLARATION OF INTEREST

J.G. is an employee of the Public Health Agency of Canada. M.L. is an employee of Ryerson University.

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