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Research Article

Who Comes to the Emergency Room with an Infection from a Long-term Care Hospital? A Retrospective Study Based on a Medical Record Review

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SUMMARY

Purpose: Health care–associated infections increase disease prevalence and mortality and are the main reason for the hospitalization of the elderly. However, the management of underlying infections in patients hospitalized in long-term care hospitals (LTCHs) is insufficient, and the transfer of these poorly managed patients to the emergency room (ER) of an acute care hospital can lead to rapid spread of infection. This study investigated the risk factors associated with an ER visit due to infections that developed in LTCHs.

Methods: The electronic medical records of patients who were transferred to the ER of a university hospital in South Korea were used. Infection prevalence, causative infectious agent, and antibiotic sensitivity were assessed. The associations between patient characteristics and hospital-associated infections were examined using multiple logistic regression analyses.

Results: Among the 483 patients transferred to the ER during the study period, the number of infection cases was 197, and 171 individuals (35.4%) had one or more infections, with pneumonia being the most common (52.8%), followed by urinary tract (21.3%) and bloodstream (17.8%) infections. Patients with bedsores, fever, an indwelling catheter, and a higher nursing need were more likely to be seen in the ER because of infectious disease from an LTCH.

Conclusion: Both an intensive care system and surveillance support should be established to prevent infections, particularly in high-risk patients at LTCHs.

Introduction

The proportion of people older than 65 years in South Korea has been increasing: 7.3% in 2000, 9.5% in 2006, 11.8% in 2012, and 13.4% in 2015. The increase has been accompanied by an increase in the proportion of dependent older adults [1]. To offer proper care services to the elderly disabled population, in July 2008, South Korea implemented long-term care insurance [2]. The demographic changes have been accompanied by an increase in the number of long-term care hospitals (LTCHs) over the past 10 years. Before older adults die, they spend an average of 347 days in such hospitals. The average length of time spent in nursing homes and LTCHs in the 10 years before the death of an older person is 20 months. In Korea, long-term care includes simple forms of treatment, analogous to the care provided in care institutions [3].

However, deficits in the quality of service and degree of safety in LTCHs as well as in the ability of these institutions to provide timely and adequate care have been reported [2]. Dependent, frail patients are vulnerable to worsening symptoms and infections, for which they are often transferred to acute hospitals or an emergency room (ER) [4]. However, unnecessary and undesirable ER admission increases the medical and economic burden on older adults, their families, and society [5].

Health care–associated infections (HAIs) [6] increase disease prevalence and mortality and are the main reason for hospitalization among the older population [7]. Most patients in LTCHs are older adults, a population that is often immunologically compromised, has a reduced cognitive ability, and tends to suffer from diseases that alter physical functioning [8,9]. Moreover, older patients are at high risk for complications of infections, particularly

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urinary tract infections (UTIs), respiratory tract infections (pneumonia or bronchitis), and skin and soft-tissue infections, which are often difficult to diagnose [7].

In a previous study, the most commonly reported HAIs in LTCHs were UTIs, respiratory tract infections, and skin infections, with a combined prevalence of 2.8–32.7% and 1.8–13.5 cases per 1,000 inpatient days [10]. On average, patients at LTCHs are exposed to at least one serious infection per year [11]. They are also at risk for infection arising from conditions such as colonization by antibiotic-resistant strains, including methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and multidrug-resistant gram-negative bacteria [12]. Rates of MRSA colonization as reported in different studies range from 16.4% [13] to 17 and 20.0% [14] to 66.7% [15]. Colonized resistant strains can spread to other patients or contaminate the hospital surroundings via transmission by the medical staff or medical devices [14]. Pneumonia, in particular, increases mortality and disease prevalence and is a critical threat to patient safety [16]. The health-care cost of HAIs is considerable [14], and the annual cost of managing these infections at a 100-bed hospital has been estimated at 78,511,500 KRW [17].

Despite the burden imposed by HAIs, management of the infections by themselves and the underlying risk factors remains highly insufficient, due to shortcomings in patient management in LTCHs. In this study, we investigated the risk factors associated with the need for an ER visit in patients with infections acquired at LTCHs. The results will help inform decisions when identifying patients at LTCHs who are at high risk for infection leading to an emergency state. Our findings have implications for infection management systems and the education of health-care professionals working at LTCHs and the ERs of acute hospitals.

Methods

Study design

The data for this retrospective medical record review were extracted from the electronic medical record system of a university hospital in northern Gyeonggi province, South Korea, from January 2014 to December 2016. Patients transferred to the ER from LTCHs during the study period were enrolled.

Setting and sample

Among the 15,194 patients who visited the ER with a medical referral, 483 had been transferred from LTCHs. Patients transferred from long-term care facilities, homes, or acute care hospitals were excluded.

Measurement and data collection

The data were organized and arranged according to the relevant items in a survey by the researcher and included physician treatment records, nursing information questionnaires, nursing records, administration records, and examination results recorded in the electronic medical records. Data were coded from admission and discharge summaries [length of stay (LOS), type of admission, and discharge], progress records (fever, culture result, and antimicrobial susceptibility), doctor's instructions (indwelling device), medical records, and procedural records from the physician treatment records (antibiotics and treatment procedure). The reason for ER transfer, triage level, mental status, and history of antibiotics use was investigated from nurse information surveys. Nursing records, administration records, discharge nursing plans, and clinical observation records (vital signs) were reviewed to confirm credibility. Nursing severity refers to a measure of vital signs, monitoring, respiration therapy, intravenous infusion and medication, and basic need for nursing. It was determined based on a severity classification score measured during admission to the intensive care unit (ICU) and hospital ward. The extent of the nursing care required was assessed by analyzing the nursing records. These indicated the severity of each case based on the classification scales used by the ICU or inpatient unit. Patients were classified into six groups according to their care needs: Group 1 (self-care) scored 0–12 points, Group 2 (intermediate) scored 13–31 points, Group 3 scored 32–63 points, Group 4 (concentrated nursing) scored 64–95 points, Group 5 (continuous nursing) scored 96~145 points, and Group 6 (crisis nursing) scored at least 146 points, in accordance with the Workload Management System for Critical Care Nurses [18].

Health care–associated infection

All infections related to medical care, including outpatient care, affecting the health of patients, caregivers, or health-care workers, were defined as HAIs. Patients were diagnosed within 48 hours after admission to the ER and subsequent hospitalization at the hospital. Infection was defined as an infection that developed at an LTCH. Also, patients could have more than one infection.

The criteria for hospital-related infections were based on the 2014 surveillance definition of the center for disease control (CDC), as distributed by the Korean Nosocomial Infections Surveillance System (KONIS). The criteria recognize UTIs, bloodstream infections, and pneumonia. Other infectious diseases are classified as such.

Ethical consideration

This study was approved by the Institutional Review Board at Catholic University Hospital (Approval no. UIRB-00151_1-002), where the study was conducted.

Data analysis

The data were analyzed using SPSS for Windows software (ver. 21.0; IBM Corp., Armonk, NY, USA). The socioeconomic characteristics, health status, and medical histories of the patients were analyzed descriptively (frequencies, percentages, and means ± standard deviations). For the 197 cases (171 individuals) of infection, the infection status, causative agent, and antibiotic sensitivity results were recorded. Multiple logistic regression analyses were used to evaluate indicators of an increased likelihood of an ER visit for infection, using the information of all 483 patients from LTCHs. Socioeconomic characteristics (age and sex), health status (body weight, mental status, chronic disease prevalence, pain, and triage level), and medical history (fever, severity, Foley catheter, endotracheal tube, tracheostomy, mechanical ventilator, and LOS) were entered into the logistic regression model. The model fit was determined by comparing the observed and expected frequencies, applying the Hosmer–Lemeshow goodness-of-fit test. The final model was not rejected for goodness of fit, based on a p-value of .18.

Results

Characteristics of the study population

Women were more often admitted to the ER from LTCHs (52.0%) than men. The study population ranged in age from 29 to 99 years (average, 73.31 years), with 38.1% between the ages of 70 and 79 years and 17.2% between the ages of 60 and 69 years. The average LOS in the LTCH was 231 days. The LOS of 163 patients

(33.7%) was ≤25 days, that of 159 patients was 26–172 days (33.0%), and that of 161 patients (33.3%) was ≥173 days.

Most of the patients suffered from multiple chronic diseases, with high blood pressure as the most frequent disease (66.3%), followed by cerebrovascular disease (56.3%) and diabetes (39.7%). Other underlying diseases included cardiovascular disorders, genitourinary disease, and neoplasm.

The triage level represented the emergency severity index. Level 1–2 (requiring emergency treatment) was recorded in 33.5% of the patients, Level 3 (urgent condition) was documented in 63.1% of cases, and levels 4–5 (less or nonurgent situation for minor conditions or injuries) was reported in 2.7% of patients. Pressure ulcers (bedsores) acquired at the LTCH and confirmed via nurse assessment at the ER were observed in 110 patients (22.8%). The mental state of most patients (76.2%) was alert; among the others, 57 patients (11.8%) could respond to a pain stimulus, 43 (8.9%) were able to respond to a voice stimulus, and 15 (3.1%) were unresponsive. Fever (>38°C) was determined on ER admission in 29 patients (6.0%). Ninety-two patients were admitted to the ICU, 60 (12.4%) of whom were classified as Group 4 in terms of nursing severity, as measured by the nurse in charge of patient admission.

Treatment-related characteristics

The most common indwelling device was a Foley catheter. While 126 patients (26.1%) arrived from the LTCH with the device in place, another 134 patients (27.7%) had a catheter inserted at the ER. Among the 54 patients with endotracheal tube insertion, 10 (2.1%) arrived from the LTCH with the device in place and 44 (9.1%) required its insertion on ER admission. A tracheotomy tube had been inserted in 53 patients, with 33 patients arriving with the tube in place and 20 patients undergoing tube placement in the ER. A ventilator was needed in 40 patients, most often in the ER (37 patients; 7.7%). Twenty-five patients (5.2%) arrived from the LTCH with a central venous catheter in place and an additional 82 (17.0%) required insertion of a central venous catheter in the ER. After the ER visit, 41.0% of the patients were admitted to the general ward, and 14.1% went to the ICU; 44.9% were discharged and not admitted to the hospital. Among the 483 patients, 133 (27.5%) who were already receiving antibiotic treatment at the LTCH were seen in the ER.

Infection status of patients residing in an LTCH

Infection distribution

Infections (including overlapping infections) were detected in 197 of the 483 patients residing in an LTCH (33.3%): pneumonia in 104 patients (52.8%), UTIs in 42 patients (21.3%), bloodstream infection in 35 patients (17.8%), and other infections in 16 patients (8.1%).

Ten patients with UTIs (12%) had asymptomatic bacteremic UTIs, and 32 patients (76.1%) had symptomatic UTIs. In the latter group, 24 patients (57.1%) had catheter-associated infections. All these patients were admitted with a Foley catheter that had been inserted at the LTCH.

Within the group with bloodstream infections, all cases were laboratory confirmed, and none were catheter related. Among the 16 cases (8.1%) of other infections, there were four cases of cardiovascular infection, four of skin and soft-tissue infection, and two of respiratory tract infection other than pneumonia (see Table 1, Table 2 and Table 3).

Distribution of causative agents by infection and antibiotic sensitivity

S. aureus (41.2%) was the most common cause of pneumonia, and all isolated bacteria were MRSA strains. *Escherichia coli* was the most common cause of UTIs (42.9%), with 72% of the cultivated strains identified as extended-spectrum β-lactamase–producing strains. Coagulase-negative staphylococci were the most common (31.4%) causative agents of bloodstream infections, and 72.7% of the strains were methicillin-resistant ones. The distribution of other causative agents of infection is shown in Table 4.

Table 1 *General Characteristics of the Patients at LTCHs Who Visited the ER (N = 483).*

Characteristics	Categories	n (%)
Gender	Women	251 (52.0)
	Men	232 (48.0)
Age (yrs)	<50	21 (4.3)
	50-59	41 (8.5)
	60-69	83 (17.2)
	70-79	184 (38.1)
	≥80	154 (31.9)
LTCH LOS (days)	≤25.0	163 (33.7)
	26.0-172.0	159 (33.0)
	≥173.0	161 (33.3)
Underlying disease[a]	DM	190 (39.7)
	HTN	321 (66.3)
	Tuberculosis	13 (2.7)
	Hepatitis	13 (2.7)
	Heart disease	91 (18.8)
	Cerebrovascular disease	272 (56.3)
	Gastrointestinal disease	31 (6.4)
	Respiratory disease	36 (7.5)
	Genitourinary disease	85 (17.6)
	Neoplasm	64 (13.3)
	Other	89 (18.4)
Triage level	1–2	162 (33.5)
	3	305 (63.1)
	4–5	13 (2.7)
Bedsores	No	370 (76.6)
	Yes	110 (22.8)
Mental status (AVPU scale)	Alert (A)	368 (76.2)
	Voice response (V)	43 (8.9)
	Pain response (P)	57 (11.8)
	Unresponsive (U)	15 (3.1)
Pain (NRS)	None	248 (51.3)
	1–2	145 (30.1)
	≥3	90 (18.6)
Fever (>38.0°C)	No	454 (94.0)
	Yes	29 (6.0)
ICU, nursing severity (n = 92)	3	4 (0.8)
	4	60 (12.4)
	5	28 (5.8)
GW, nursing severity (n = 232)	1	10 (2.1)
	2	151 (31.3)
	3	67 (13.9)
	4	3 (0.6)
	5	1 (0.2)

Note. Missing values are excluded in the total in each variable.
DM = diabetes mellitus; ER = emergency room; GW = general ward; HTN = hypertension; ICU = intensive care unit; LOS = length of stay; LTCH = long-term care hospital; NRS = numeric rating scale; yrs = years.
[a] Multiple response.

Patient risk factors for infection

Factors associated with an increased risk for infection on arrival at the ER were bedsores [odds ratio (OR): 3.63; 95% confidence interval (CI): 2.06–6.38] and fever (≥38.1°C) (OR: 3.64; 95% CI: 2.41–5.50). Patients who had a malignant neoplasm were less likely to have an infection when seen in the ER (OR: 0.25; CI: 0.11–0.57). The greater the nurse-rated nursing severity, the higher the likelihood of infection on ER arrival (OR: 1.38; 95% CI: 1.12–1.71). Infection was twice as likely in patients with than without an indwelling Foley catheter (OR: 2.20; 95% CI: 1.27–3.81) (see Table 5).

Table 2 *Characteristics Associated with Treatment of the Patients at LTCHs Who Visited the ER (N = 483).*

Characteristics		Categories	n (%)
Indwelling device	Foley catheter	No	222 (46.0)
		Insertion/removal	126 (26.1)
		ER insertion	134 (27.7)
	Endotracheal tube	No	428 (88.6)
		Ex-insertion	10 (2.1)
		ER insertion	44 (9.1)
	Mechanical ventilation	No	442 (91.5)
		Ex-insertion	3 (0.6)
		ER insertion	37 (7.7)
	Central venous catheter	No	375 (77.6)
		Ex-insertion	25 (5.2)
		ER insertion	82 (17.0)
	Tracheostomy	No	429 (88.8)
		Ex-insertion	33 (6.8)
		ER insertion	20 (4.1)
Type of admission	General ward		198 (41.0)
	ICU		68 (14.1)
	No admission		217 (44.9)
Antibiotics (ER)	No		180 (37.3)
	Yes		303 (62.7)
Antibiotics (LTCH)	No		340 (70.4)
	Yes		133 (27.5)
Procedure in hospital	No		308 (63.8)
	Yes		175 (36.2)
Surgery in hospital	No		449 (93.0)
	Yes		31 (7.0)

Note. ER = emergency room; Ex-insertion = insertion at the LTCH; ICU = intensive care unit; LTCH = long-term care hospital.
Missing values are excluded in the total in each variable.

Discussion

About 41.0% of patients in the ER coming from LTCHs had infectious diseases, with pneumonia and UTIs as the most common infections. Having a fever, bedsores, or a Foley catheter implanted were the main risk factors for an increased likelihood of an ER visit by patients at LTCH.

Patients at LTCHs are mostly older adults, and thus, they are prone to UTIs and respiratory tract infections. Pneumonia is the second most common infection among patients in nursing homes in the USA, and among all infections at long-term care facilities, it is the infection with the highest mortality rate and highest prevalence [8,19]. In Korea, pneumonia is the fourth leading cause of death among elderly patients [1], which highlights the need for more careful treatment and better overall care. To prevent pneumonia in elderly patients residing in hospitals or facilities, it is necessary to

Table 3 *Type of Health Care–Associated Infections among ER-Transferred Patient from LTCHs.*

Characteristics	Categories	n (%)
Pneumonia	PNEU1	104 (52.8)
Urinary tract infection	Noncatheter associated	18 (9.1)
	Catheter associated	24 (12.2)
Bloodstream infection	Laboratory-confirmed bloodstream infection	35 (17.8)
Other infections	Cardiovascular system infection	4 (2.0)
	Skin and soft-tissue infection	4 (2.0)
	Gastrointestinal tract infection	3 (1.5)
	Respiratory tract infection, other than pneumonia	2 (1.1)
	Oral cavity infection	1 (0.5)
	Spinal abscess without meningitis	1 (0.5)
	Bone and joint infection	1 (0.5)
Total infections		197

Note. ER = emergency room; LTCH = long-term care hospital; PNEU1 = clinically defined pneumonia.
The duplicated cases of infections were 26.

Table 4 *Microorganisms Isolated from the Clinical Specimens of Patients Transferred to the ER from LTCHs and Diagnosed with Infection (N = 483).*

Organism (MDRO)	No. of isolates				All
	UTI	BSI	Pneumonia	Other	n (%)
Gram-positive cocci					41 (35.7)
Enterococcus faecalis	1	2			3
Enterococcus faecium	2	1			3
Alpha-hemolytic *Streptococcus*	1	1			2
Staphylococcus aureus (MR, n)		4(4)	14(14)	1(1)	19
Coagulase-negative *Staphylococcus* (MR, n)		11(8)			8
Streptococcus pneumoniae			1		1
Staphylococcus schleiferi (MR, n)		1(1)			1
Micrococcus sp.	1				1
Gram-negative bacilli					70 (60.9)
Acinetobacter baumannii (IR, n)	1(1)	1(1)	7(7)		9
Aeromonas hydrophila				1	1
Citrobacter freundii	2				2
Enterobacter agglomerans		1			1
Enterobacter cloacae	2				2
Escherichia coli (ESBL producing, n)	18(13)	7(3)	1(1)	1	27
Klebsiella pneumoniae (IR, n)	3	1	2(1)	1	7
Morganella morganii (IR, n)	2(2)				2
Proteus mirabilis	4	1			5
Providencia rettgeri (IR, n)	1(1)	2			3
Pseudomonas aeruginosa (IR, n)	3		6(4)		9
Stenotrophomonas maltophilia			2		2
Fungal species					4 (3.5)
Candida albicans		1	1		2
Candida tropicalis	1	1			2
Total	42	35	34	4	115

Note. BSI = bloodstream infection; ER = emergency room; ESBL = extended-spectrum β-lactamase; IR = imipenem resistant; LTCH = long-term care hospital; MDRO = multidrug-resistant organism; MR = methicillin resistant; UTI = urinary tract infection.

Table 5 *Risk Factors of Infections among Patients Transferred to the ER from an LTCH (N = 483).*

Characteristics	Adjusted OR	CI	*p*
Men (Ref = women)	1.65	0.98 -2.77	.058
Age (yrs)	1.00	0.98-1.02	.842
Body weight	0.99	0.97-1.01	.303
LTCH LOS (days)	1.00	0.99-1.00	.173
Sore (Ref = none)	3.63	2.06-6.38	<.001
Fever in ER	3.64	2.41-5.50	<.001
Mental status	1.09	0.80-1.50	.589
Heart disease (Ref = none)	0.64	0.34-1.23	.180
Cerebrovascular disease (Ref = none)	0.94	0.58-1.53	.807
Respiratory disease (Ref = none)	1.04	0.41-2.60	.941
GI disease (Ref = none)	1.53	0.57-4.08	.398
Genitourinary disease (Ref = none)	1.81	0.95-3.43	.072
Neoplasm (Ref = none)	0.25	0.11-0.57	.001
DM (Ref = none)	0.98	0.58-1.66	.944
HTN (Ref = none)	1.16	0.66-2.04	.597
ICU, nursing severity	0.99	0.84-1.17	.912
GW, nursing severity	1.38	1.12-1.71	.003
Foley catheter (Ref = none)	2.20	1.27-3.81	.005
Endotracheal tube (Ref = none)	2.31	0.79-6.79	.127
Tracheostomy (Ref = none)	1.44	0.66-3.14	.366
Mechanical ventilator (Ref = none)	1.56	0.51-4.73	.433
Central line (Ref = none)	1.23	0.66-2.29	.515
Pain	0.93	0.68-1.28	.663
Triage level	0.89	0.59-1.34	.575

Note. Adjusted OR = adjusted odds ratio; CI = confidence interval; DM = diabetes mellitus; ER = emergency room; GI = gastrointestinal; GW = general ward; HTN = hypertension; ICU = intensive care unit; LTCH = long-term care hospital; LOS = length of stay; yrs = years.
Variables with $p < .05$ in the univariate analysis were entered into the stepwise multiple logistic regression analysis. The statistical significance of the analysis results was set at a less than 5% significance level, and odds ratios (OR) and 95% confidence intervals (CIs) were calculated.

improve oral hygiene and assess swallowing disorders, and, if required, induce rehabilitation, modify meals, and maintain a stationary posture to prevent airway aspiration [7,16,19]. The patients at the LTCH with unmanaged pneumonia will eventually visit the ER in a severe state [4].

Although UTIs have little influence on the mortality rate, they are the most prevalent and common infection in long-term care facilities, both in Korea and in other countries [8,20–23], and Foley catheter insertion is the main cause of UTIs [21].

In our study, *S. aureus* was the most common (41.2%) causative agent in pneumonia cases, and all isolated *S. aureus* strains were MRSA. *S. aureus* is the main cause of HAIs and community bacteremia. Infections by this bacterium have been reported in 29.0% of elderly patients in LTCHs, including a carrier rate of 16.4% and a methicillin resistance rate (including MRSA) of 56.5% [13]. The rate of MRSA found in clinical samples in the present study was very high (100%); however, differences are to be expected as this research was conducted 7 years after the publication of the previous studies [13], in which we reported the antimicrobial agent susceptibility of strains isolated from clinical samples.

The most common (42.9%) causative agent of UTIs was *E. coli*, and most of the cultivated strains were extended-spectrum β-lactamase–producing ones. This coincides with a prior study in which *E. coli* was the most common causative agent of UTIs among elderly adults, followed by *Klebsiella pneumonia* and *Enterococcus* species [21,22,24]. An investigation of HAIs in small- to mid-sized hospitals by the Korean Society for Nosocomial Infection Control in 2011 reported similar findings [16]. Studies in different countries have similarly found that the primary causative agent of UTI is *E. coli* [20,21]. However, in a study by KONIS, among patients in the ICU, *Candida* species were the primary cause of UTIs, followed by *E. coli* (11.5%) [25]. Thus, the primary organism causing UTIs may differ among different LTCHs. The use of broad-spectrum antibiotics to treat patients increases the risk for infection with multidrug-resistant bacteria. Patients with these infections must be isolated, and precautions should be taken to avoid contact between such patients and uninfected individuals.

According to the KONIS findings on the main antimicrobial-resistant organisms, the methicillin resistance rate of *S. aureus* is 87.6%, and the imipenem resistance rates of *Acinetobacter baumannii* and *Pseudomonas aeruginosa* are 88.2% and 44.3%, respectively [25]. The high resistance of all strains except vancomycin-resistant enterococci further demonstrates the urgent need to control the use of antimicrobial agents in patients at LTCHs and to adhere to infection management guidelines. The rate of antibiotic treatment among the patients in LTCHs in this study was 27.5%, which is higher than that reported in studies of MRSA at LTCHs in Germany (17.7%) [26] but lower than that reported in a European study (38.8%) [27]. Although antibiotic treatment is a risk factor for infection [26], this was not the case in our study. However, because this was a retrospective study based on the medical records of patients from LTCHs, we cannot rule out the potential for selection bias, and the possibility that the history of antibiotic use was omitted from the medical records.

Fever may develop at the first exposure to an infectious agent and is an important clinical indicator, based on the diagnostic criteria for HAIs. However, in reports from Korea and other countries [19,28], many atypical infections do not trigger fever and thus are difficult to identify. In this study, although 6.0% of patients (29 patients) arrived at the ER with a chief complaint of fever (>38°C), other patients had received a fever reducer or antimicrobial agent at the LTCH, and their body temperature was, therefore, within the normal range on ER arrival. In these patients, other indicators of infection should be assessed. Kline and Bowdish [8] pointed out that elderly adults characteristically have lower body temperatures owing to changes in their immune system; consequently, increases in white blood cells tend not to be apparent, and the potential for missing a diagnosis or misdiagnosis is accordingly higher. Therefore, close examination of patients residing in an LTCH is required, including periodic checks of the severity of illness.

Foley catheter placement was a risk factor for infection in our patients. These indwelling catheters are inserted in elderly patients residing in an LTCH or nursing home. The elderly are highly susceptible to infections such as UTIs and pneumonia, as well as skin and soft-tissue infections [7], due to age-related dysfunctions of the immune system, physiological changes, functional disability, and comorbidities. Some residents have impaired cognitive abilities and poor personal hygiene. Many patients in this group are immobile, suffer from fecal and urinary incontinence, and/or need indwelling devices. Foley catheters are the most commonly used indwelling devices among patients at LTCHs. These are a major cause of UTIs [8,10,20].

Pressure sores frequently occur among elderly residents at LTCHs [8,29], but they can be prevented through regular bedsore assessment and nutritional management [9]. LTCHs must establish infection management systems to ensure nursing competence. The patient mortality rate will be reduced by taking proactive measures to minimize bedsores and their infection [28].

HAIs can be fully prevented by the implementation of an infection surveillance system, regular training, and adherence to infection management guidelines [20]. In Korea, the ratio of nurses to medical personnel in the LTCHs is one nurse per six patients. Two-thirds of these nurses could be replaced by nursing assistants. According to the National Health Insurance Review and Assessment Service, nurses account for 45.0% of the staff at nursing hospitals, which is a much lower proportion than that in advanced general hospitals (93.4%), general hospitals (86.6%), and hospitals (64.1%). To prevent infection in hospitals, it is essential to use the personnel required to conduct infectious disease monitoring and to implement employee infection control education programs. Health-care workers at LTCHs are poorly trained in infection control practices, and understaffing problems are common. Thus, managers at LTCHs must enforce infection guidelines, including by regularly providing hospital staff training on aseptic techniques and infection management, such as hand sanitation, and by improving staff training levels.

The need for infection management of patients residing in LTCHs is high. Studies in Korea have shown that knowledge of infection management is lacking among caretakers and nurses directly involved in managing infections [2,16]. In addition, there is both a shortage of specialized staff with sufficient knowledge and experience to diagnose and care for patients at risk for HAIs [5] and a high turnover rate among qualified staff at long-term care facilities [28,30]. The shortage of caretakers can contribute to a reduction in patients' abilities to perform daily functions, given that nurses and their competence influence patient care at LTCHs [30].

This study had several limitations. First, it was retrospective, with electronic medical records used to assess the patient status. Thus, it was not possible to exclude patients whose data were missing or inadequate, as may have been the case in patients from other long-term care institutions and acute care hospitals. The hospitalized patients were classified based on their demographics, treatment-related characteristics, and microbiological findings. However, other factors such as infectious activity and appropriate patient management, as well as structural factors such as hospital size and staffing level, could not be evaluated. Second, generalization of the results of this study is hindered by the fact that the participants were from the ER of one hospital. Although several LTCHs transferred patients to the ER, there was no description of the type of each LTCH. This information is relevant because

different LTCHs have different treatment approaches, and the level of infection control might also differ. Future studies should examine the effects of facility standards and staffing on the infection of patients in LTCHs. HAIs are classified into those that occur at acute versus long-term care institutions. In Korea, LTCHs function as long-term care institutions, similar to nursing homes. However, in our study, HAIs were defined based on the acute care definition because Korean LTCHs typically have medical staff and patients are covered by medical insurance, Korea does not use separate infection standards for LTCHs. The risk factors for HAIs vary widely among different types of infection. Future studies should identify the risk factors for each type of infection, based on a larger number of patients and a longer follow-up. Finally, the use of antibiotics was investigated in terms of multidrug-resistant bacteria, but the prescribed antibiotic and the reason for the prescription, both of which are at the physician's discretion, were unknown. Thus, we assumed that antibiotics were prescribed in the ER for empirical antibiotic therapy.

Our study also has nursing implications, in that it emphasizes the importance of research and nursing education on the distribution and pathway of infections in elderly patients. This information will contribute to the development of measures for the prevention of hospital infections and the improvement of patient safety, particularly in rapidly aging societies. Thus far, only a few studies have examined the infectious disease profiles of patients in the ER transferred from LTCHs, but the infection problem in long-term care settings requires further investigation.

Conclusion

Patients from LTCHs seen at the ER presented with severe symptoms of infection, including pneumonia and UTIs. Having fever, bedsores, and implanted Foley catheters were risk factors for ER presentation among this population. Our results emphasize the need for measures to ensure the efficient management of patients in LTCHs as they will improve patient safety and infection prevention.

Conflicts of interest

The authors declare no conflict of interests.

References

1. Statistics Korea. Elderly statistics in Korea. Seoul: Statistics Korea; 2015 [cited 2016 March 26]. Available from: http://www.stat.go.kr
2. Cho HJ, Kim DH, Han KS, Park JS, Moon SW, Lee SW, et al. Analysis of emergency department patients transferred from geriatric hospitals: case series descriptive study. J Korean Soc Emerg Med. 2011;22(5):531–5. Korean.
3. Cooperation NHI. Health insurance statistics. National Health Insurance Cooperation. Wonju: National Health Insurance Cooperation; 2017.
4. Griffiths D, Morphet J, Innes K, Crawford K, Williams A. Communication between residential aged care facilities and the emergency department: a review of the literature. Int J Nurs Stud. 2014;51(11):1517–23 https://doi.org/10.1016/j.ijnurstu.2014.06.002
5. Burke RE, Rooks SP, Levy C, Schwartz R, Ginde AA. Identifying potentially preventable emergency department visits by nursing home residents in the United States. J Am Med Dir Assoc. 2015;16(5):395–9. https://doi.org/10.1016/j.jamda.2015.01.076
6. Korean Nosocomial Infections Surveillance System. KONIS manual 2014. Korea. Korean Society for Nosocomial Infection Control.; 2014.
7. Mutters NT, Günther F, Heininger A, Frank U. Device-related infections in long-term healthcare facilities: the challenge of prevention. Future Microbiol. 2014;9(4):487–95. https://doi.org/10.2217/fmb.14.12
8. Kline KA, Bowdish DM. Infection in an aging population. Curr Opin Microbiol. 2016;29:63–7. https://doi.org/10.1016/j.mib.2015.11.003
9. Matheï C, Niclaes L, Suetens C, Jans B, Buntinx F. Infections in residents of nursing homes. Infect Dis Clin North Am. 2007;21(3):761–72. https://doi.org/10.1016/j.idc.2007.07.005
10. Heudorf U, Boehlcke K, Schade M. Healthcare-associated infections in long-term care facilities (HALT) in Frankfurt am Main, Germany, January to March 2011. Euro Surveill. 2012;17(35):pii=20256. https://doi.org/10.2807/ese.17.35.20256-en.
11. Deniger A, Troller P, Kennelty KA. Geriatric transitional care and readmissions review. J Nurse Pract. 2015;11(2):248–52. https://doi.org/10.1016/j.nurpra.2014.08.014
12. Denkinger CM, Grant AD, Denkinger M, Gautam S, D'Agata EM. Increased multi-drug resistance among the elderly on admission to the hospital: a 12-year surveillance study. Arch Gerontol Geriatr. 2013;56(1):227–30. https://doi.org/10.1016/j.archger.2012.05.006
13. Korea Centers for Disease Control and Prevention. Surveillance of infection control and prevalence of methicillin resistant *Staphylococcus aureus* carriers in long-term care facilities. Publ Health Wkly Rep. 2009;2(24):376–9.
14. Romaniszyn D, Pobiega M, Wójkowska-Mach J, Chmielarczyk A, Gryglewska B, Adamski P, et al. The general status of patients and limited physical activity as risk factors of methicillin-resistant *Staphylococcus aureus* occurrence in long-term care facilities residents in Krakow, Poland. BMC Infect Dis. 2014;14:271 https://doi.org/10.1186/1471-2334-14-271
15. Barrufet MP, Vendrell E, Force L, Sauca G, Rodriguez S, Martinez E, et al. Prevalence and risk factors for meticillin-resistant *Staphylococcus aureus* in an acute care hospital and long-term care facilities located in the same geographic area. Rev Esp Quimioter. 2014;27(3):190–5.
16. Cha KS, Park HR. Endotracheal colonization and ventilator-associated pneumonia in mechanically ventilated patients according to type of endotracheal suction system. J Korean Acad Nurs. 2011;41(2):175–81. https://doi.org/10.4040/jkan.2011.41.2.175. Korean.
17. Park ES, Jeong JS, Kim KM, Kim OS, Jin HY, Jung SY, et al. A study on the costs of hospital infection control and prevention. Korean J Nosocomial Infect Control. 2007;12(1):50–7. Korean.
18. Cho Y, Shin H, Cho J, Jung M, Lee B. Development and application of the workload management system for critical care nurses (WMSCN) using the workload management system for nurses (WMSN). Am J Crit Care. 2006;15(3):324–46.
19. Dhawan N, Pandya N, Khalili M, Bautista M, Duggal A, Bahl J, et al. Predictors of mortality for nursing home-acquired pneumonia: a systematic review. BioMed Res Int. 2015;2015:285983. https://doi.org/10.1155/2015/285983
20. Montoya A, Cassone M, Mody L. Infections in nursing homes: epidemiology and prevention programs. Clin Geriatr Med. 2016;32(3):585–607. https://doi.org/10.1016/j.cger.2016.02.004
21. Ikram R, Psutka R, Carter A, Priest P. An outbreak of multi-drug resistant *Escherichia coli* urinary tract infection in an elderly population: a case-control study of risk factors. BMC Infect Dis. 2015;15:224. https://doi.org/10.1186/s12879-015-0974-0
22. Wald HL, Bandle B, Richard AA, Min SJ, Capezuti E. Implementation of electronic surveillance of catheter use and catheter-associated urinary tract infection at Nurses Improving Care for Healthsystem Elders (NICHE) hospitals. Am J Infect Control. 2014;42(10 Suppl):S242–9. https://doi.org/10.1016/j.ajic.2014.04.016
23. Park ES, Jin HY, Jeong SY, Kweon OM, Yoo SY, Park SY, et al. Healthcare-associated infection surveillance in small and medium sized hospitals. Korean J Nosocom Infect Control. 2011;16(2):54–62. Korean.
24. Fagan M, Lindbæk M, Grude N, Reiso H, Romøren M, Skaare D, et al. Antibiotic resistance patterns of bacteria causing urinary tract infections in the elderly living in nursing homes versus the elderly living at home: an observational study. BMC Geriatr. 2015;15:98. https://doi.org/10.1186/s12877-015-0097-x
25. Jeon MH, Kim TH, Kim SR, Chun HK, Han SH, Bang JH, et al. Korean nosocomial infections surveillance system, intensive care unit module report: data summary from July 2012 through June 2013. Korean J Nosocom Infect Control. 2015;20(2):37–48. https://doi.org/10.14192/kjnic.2015.20.2.37. Korean.
26. Nillius D, von Müller L, Wagenpfeil S, Klein R, Herrmann M. Methicillin-resistant *Staphylococcus aureus* in Saarland, Germany: the long-term care facility study. PLoS One. 2016;11(4):e0153030. https://doi.org/10.1371/journal.pone.0153030
27. Rossio R, Franchi C, Ardoino I, Djade CD, Tettamanti M, Pasina L, et al. Adherence to antibiotic treatment guidelines and outcomes in the hospitalized elderly with different types of pneumonia. Eur J Intern Med. 2015;26(5):330–7 https://doi.org/10.1016/j.ejim.2015.04.002
28. Trinkoff AM, Han K, Storr CL, Lerner N, Johantgen M, Gartrell K. Turnover, staffing, skill mix, and resident outcomes in a national sample of US nursing homes. J Nurs Adm. 2013;43(12):630–6. https://doi.org/10.1097/NNA.0000000000000004
29. Herzig CTA, Dick AW, Sorbero M, Pogorzelska-Maziarz M, Cohen CC, Larson EL, et al. Infection trends in US nursing homes, 2006–2013. J Am Med Dir Assoc. 2017;18(7):635.e9–20. https://doi.org/10.1016/j.jamda.2017.04.003
30. Dwyer R, Stoelwinder J, Gabbe B, Lowthian J. Unplanned transfer to emergency departments for frail elderly residents of aged care facilities: a review of patient and organizational factors. J Am Med Dir Assoc. 2015;16(7):551–62 https://doi.org/10.1016/j.jamda.2015.03.007