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Development and Application of a Surveillance Method for Healthcare-Associated Infections in Long-Term Care Hospitals in Korea

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Background: This study developed a surveillance method for healthcare-associated infections (HAIs) in long-term care hospitals (LTCHs) and investigated the current status of HAIs in LTCHs in Korea. **Methods:** We applied the HAI-related surveillance criteria for long-term care facilities developed by McGeer in six LTCHs. **Results:** The 197 confirmed HAIs corresponded to incidence rates of 30.38/100 inpatients and 1.57/1,000 days of hospitalization and included 84 cases of respiratory tract infection (43.8%), 78 cases of systemic infection (40.6%), 24 cases of gastrointestinal tract infection (12.5%), and 6 cases of skin and soft tissue mucosal infection (2.1%). The subtypes included 78 cases of unexplained febrile illness (40.6%); 40 cases of pneumonia (20.8%); 27 cases of lower respiratory tract infection (14.1%); 21 cases of gastroenteritis (10.9%); 9 cases of influenza-like illness (4.7%); 8 cases of common cold or pharyngitis (4.2%); 4 cases of cellulitis, soft tissue, or wound infection (2.1%); 3 cases of *Clostridium difficile* infection (1.6%); 1 case of conjunctivitis (0.5%); and 1 case of fungal oral/perioral and skin infection (0.5%). **Conclusion:** Establishing an HAI surveillance method for LTCHs and identifying HAI rates and risk factors among LTCH patients may help prevent HAIs in LTCHs in Korea.

Key Words: Long-term care, Hospital infections, Epidemiology, Korea

INTRODUCTION

Korea became an aging society in 2000, with an older adult population exceeding 7% and has since exceeded 14% in just 17 years. Since the mid-2000s, the number of long-term care hospitals (LTCHs) caring for older adults began to surge, reaching 800 in 2010, exceeding 1,400 in 2016, and reaching 1,470 by July 2019.[1)] Some of the most common illnesses presented by patients admitted to LTCHs in Korea include dementia, cerebrovascular disease, Parkinson disease, hypertension, and diabetes mellitus. Most of these patients are older adults and thus have reduced immunity.[1,2)] In LTCHs, an individual care provider tends to cater to multiple patients, which increases the facility's risk for the development and transmission of infectious diseases. Thus, active infection surveillance and preventive activities are required.

One previous study revealed that 53.7% had indwelling urinary catheters inserted, and 38.7% had infectious diseases such as pneumonia, urinary tract infection, and bloodstream infection among Korean LTCH inpatients.[3)] The agents of bloodstream infection were gram-positive bacteria (34.8%), gram-negative bacteria (31.3%), multidrug-resistant bacteria (13.0%), and methicillin-resistant *Staphylococcus aureus* (MRSA) (8.7%).[4)]

Investigation of the current status of healthcare-associated infections (HAIs) is essential for systematic and efficient infection control in LTCHs.[4,5)] In contrast to acute care facilities, LTCHs mostly treat patients undergoing rehabilitation and older patients requiring long-term care; both are populations with complex and diverse comorbidities. Furthermore, even with serious infections, more

than half of these patients do not present with fever,[6] and HAIs manifest differently from those observed in acute care facilities. Therefore, the diagnostic criteria for HAIs in LTCHs differ from those used in acute care facilities.[6,7]

The US Centers for Disease Control and Prevention (CDC) developed a national standard for infection surveillance in long-term care (LTC) facilities[8] using the HAI-related surveillance criteria for LTC facilities developed by McGeer via a Delphi technique using a panel comprising infection specialists, gerontologists, and infection control personnel.[7,9] LTC facilities in the United States are defined as those that provide medical and non-medical support and care to older adults and vulnerable individuals who cannot live independently in the community. These facilities include nursing homes, skilled nursing facilities, LTCHs, intermediate/chronic care facilities for the developmentally disabled, assisted-living facilities, and residential care facilities.[10] Particularly, LTCHs provide medical treatment and rehabilitation treatment to individuals with chronic and complex problems requiring long-term hospital-level care.[10] LTCHs in Korea have mixed functions that are equivalent to LTCHs in the United States, which provide long-term treatment, and to LTC facilities, which focus on providing medical and non-medical support and care.[11]

The McGeer HAI diagnostic criteria were developed for patients in LTC facilities who have difficulty undergoing blood and imaging tests. In 2012, the surveillance criteria for urinary tract infections (UTIs) and respiratory tract infections (RTIs) were revised to increase the specificity for these infections, and the definitions for norovirus gastroenteritis and *Clostridium difficile* infection were newly added to minimize the gap between the diagnostic criteria used by acute care and LTC facilities.[9,12]

In Korea, the Korean Society for Healthcare-associated Infection Control and Prevention (KOSHIC) and the Korea CDC implemented an HAI surveillance method in 2006 primarily for intensive care unit and surgical site infections surveillance.[13] However, LTCHs have lower percentages of severely ill and surgical patients but a higher percentage of older long-term inpatients compared to acute care facilities. Thus, it is inappropriate to conduct HAI surveillance based on the nationwide HAI criteria focused on acute care facilities. Furthermore, surveillance data should be obtained using valid and reliable surveillance criteria so that the data can be compared to those of other healthcare facilities in Korea and HAI surveillance results from other countries. Thus, it is necessary to develop and assess the surveillance criteria for HAIs in LTCHs in Korea.

This study aimed to develop an HAI surveillance method appropriate for LTCHs that primarily admit older patients requiring LTC and to investigate the current status of HAIs in LTCHs in Korea to systematize and standardize HAI surveillance and contribute to prevention of HAI in such facilities.

METHODS

Selection of Participating Facilities

This study was approved by the Institutional Review Board of Konyang University (No. KYU-2019-282-01). Written informed consent was obtained from the participating institution and the patient's physician. After checking the willingness to participate from the heads of the nursing department in LTC hospitals that completed the "Infection control in LTC hospitals" program administered by the Human Resource Development Institute for Health and Welfare, six LTC hospitals (198 to 522 beds) from the Seoul, Incheon, and Daejeon areas were selected via snowball sampling. One of these hospitals had to withdraw from the surveillance program during the study and was replaced by another LTC hospital in July 2000.

Personnel Training for Infection Surveillance

One or two infection control personnel from each participating organization were designated as infection surveillance personnel. A total of nine such personnel were provided group education and training that included briefings about the purpose, outline, infection surveillance criteria and method, case-based training, and questions and answers.

Infection Surveillance Diagnostic Standard

Based on the HAI surveillance standard for LTC facilities developed by the US CDC,[9] the surveillance report was modified and its content validity was reviewed by two infection control nurses, two nursing professors, one infectious disease professor, one gerontology professor, and three infection control personnel in LTCHs through one face-to-face and two e-mail meetings. The standard[8] was updated[9] in 2012 by the CDC to enhance the specificity and positive predictive value through a 2009 review of literature by the Society for Healthcare Epidemiology of America and Long-Term Care Special Interest Group and expert review based on the HAI surveillance criteria developed by McGeer[7] in 1991, in consideration of the nature of LTCHs in which blood tests, body fluid tests, and imaging tests cannot be performed. HAIs were classified into five categories: namely RTI, UTI, skin and soft tissue infections (SSTIs), gastrointestinal tract infection (GTI), and systemic infection. These categories were further classified into 16 subtypes as follows: RTI (pneumonia, lower RTI, influenza-like illness, common cold, or pharyngitis), UTI (catheter or no catheter), SSTIs (cellulitis/soft tissue/wound infections, scabies,

fungal oral/perioral and skin infections, herpes, conjunctivitis), GTI (gastroenteritis, norovirus gastroenteritis, *C. difficile* infection), and systemic infection (primary bloodstream infection, unexplained febrile illness). Although systemic infection was not included in the 2012 CDC criteria,[9] we included it in the present study to improve the sensitivity of surveillance as LTCHs have little experience in surveillance studies, and the McGeer criterion was newly applied (Supplement A). In terms of fever, the axillary criterion was also added, which is commonly used in Korea. The activities of daily living (ADL) index was changed to the ADL scoring system in the patient assessment form that is used as the standard in LTC hospitals and is submitted to the Health Insurance Review and Assessment (HIRA) service monthly.[1] In addition, while the McGeer criteria consisted of seven items rated on a 4-point scale, for a total score of 28, the criteria for use in Korea consisted of 10 items rated on a 5-point scale, for a total score of 50 (Table 1).

Infection Surveillance Method

Surveillance was conducted based on reviews of medical charts and/or direct inspection of patients at least weekly for 3 months from July 1 to September 30, 2019, in five of the six LTCHs, and for 2 months from August 1 to September 30, 2019, in the other hospital. When the infection surveillance personnel could not perform active surveillance, nurses in the wards entered the infection criteria (Table 1) and symptoms to be monitored (Table 2) on the major symptoms form and reported them to the surveillance personnel, who then determined whether the patient had an HAI; thus, both passive and active surveillance were performed. Each case was recorded in a checklist for infection surveillance criteria and patient state. The authors and infection surveillance personnel then determined whether each case met the diagnostic criteria.

Data for the denominators were the electronic records of the monthly numbers of inpatients, lengths of hospital stays, and the numbers of days of catheter use or were computed by summing the daily numbers.

RESULTS

Statuses of the Participating LTCHs

The characteristics of the six participating LTCHs are presented in Table 3. The hospitals were based in Daejeon (n=3), Seoul (n=2), and Incheon (n=1). A mean of 257 beds were under surveillance (range, 198–522 beds), with 1,801 total beds (Table 3). The surveillance periods were 3 months for five hospitals and 2

Table 1. Surveillance of the constitutional criteria for infection in long-term care hospitals

Category	Criteria
Fever	Single axillary[a] temperature > 37.5°C OR
	Single oral/tympanic[a] temperature > 37.8°C OR
	Repeated axillary[a] temperature > 37°C OR
	Repeated oral/tympanic[a] temperature > 37.2°C OR
	Single temperature > 1.1°C from baseline from any site
Leukocytosis	> 14,000 leukocytes/mm^3 OR
	> 6% bands OR
	≥ 1,500 cells/mm^3
Acute mental status change	Acute onset[b] AND
	Fluctuating course[c] AND
	Inattention[d] AND
	Disorganized thinking[e] OR altered level of consciousness[f]
ADL dependency[g]	A new 3-point increase in total ADL score (range, 0–50) from baseline based on the following 10 ADL items, each scored from 0 (independent) to 5 (total dependence): dressing, face washing, teeth brushing, bathing, eating, position changing, sitting up, transfer from bed to chair, locomotion out of the room, and toilet use.

ADL, activities of daily living.
[a]Main area where body temperature is assessed in the hospital.
[b]Evidence of acute change in the mental status of the resident from baseline.
[c]Behavior fluctuation (e.g., coming and going or changing in severity during the assessment).
[d]Residents have difficulty in focusing their attention (e.g., unable to keep track of discussions or are easily distracted).
[e]The thinking of the resident is incoherent (e.g., rambling conversation, unclear flow of ideas, or unpredictable switches in subject).
[f]The level of consciousness of the resident is different from baseline (e.g., hyper-alert, sleepy, drowsy, difficult to arouse, nonresponsive).
[g]Cited from ADL items within the monthly recorded inpatient data set, which is composed of 10 evaluation questions about basic ADLs of long-term care inpatients.

Table 2. Symptoms to be monitored according to the healthcare-associated infection classification

Classification	Symptoms
Respiratory tract infection	Runny nose or sneezing
	Stuffy nose or nasal congestion
	Sore throat, hoarseness, or difficulty in swallowing
	Dry cough, new, or increased cough
	Swollen or tender glands in the neck (cervical lymphadenopathy)
	Chills
	New headache or eye pain
	Myalgias or body aches
	Malaise or loss of appetite
	New or increased sputum production
	O_2 saturation of < 94% with room air or > 3% decrease from baseline O_2 saturation
	New or changed lung exam abnormalities
	Pleuritic chest pain
	Respiratory rate of ≥ 25 breaths/min
	Acute dysuria
Urinary tract infection	Pain, swelling, or tenderness of the testes, epididymis, or prostate
	Acute costovertebral angle pain or tenderness
	Suprapubic pain
	Gross hematuria
	New or marked increase in incontinence
	New or marked increase in urgency
	New or marked increase in frequency
	Fever, rigors, or new-onset hypotension, with no alternate site of infection
	Purulent discharge from around the catheter
Skin and soft tissue infection	Pus at wound, skin, or soft tissue site; Heat (warmth) at the affected site
	Redness (erythema) at the affected site
	Swelling at the affected site
	Tenderness or pain at the affected site
	Maculopapular and/or itching rash
	Presence of raised white patches on inflamed mucosa or plaques on oral mucosa
	Characteristic rash or lesions
	A vesicular rash
	Pus from one or both eyes for ≥ 24 hr
	New or increased conjunctival erythema ± itching
	New or increased conjunctival pain for ≥ 24 hr
Gastrointestinal tract infection	Diarrhea: ≥ 3 liquid or watery stools above what is normal for the resident within 24 hr
	Vomiting: ≥ 2 episodes in 24 hr
	Nausea
	Abdominal pain or tenderness
Systemic infection	New hypothermia (< 34.5°C or does not register on the thermometer being used)
	A drop in systolic blood pressure of > 30 mmHg from baseline

months for one hospital.

HAI Rates in LTCHs

The incidence of HAI per 100 inpatients was 30.4%. The HAI rate per 1,000 days of hospital stay was 1.57, with rates of 0.81, 1.10, 3.20, 1.62, 1.20, and 1.60, respectively, in each of the six hospitals (Table 4).

Types of HAIs in LTCHs

A total of 192 HAIs were confirmed during the study period (Table 5). These included 84 cases of RTI (43.8%), 78 cases of systemic infection (40.6%), 24 cases of GTI (12.5%), and 6 cas-

es of SSTIs (2.1%). The subtypes of HAIs included 78 cases of unexplained febrile illness (40.6%); 40 cases of pneumonia (20.8%); 27 cases of lower RTI (14.1%); 21 cases of gastroenteritis (10.9%); 9 cases of influenza-like illness (4.7%); 8 cases of common cold or pharyngitis (4.2%); 4 cases of cellulitis, soft tissue, or wound infection (2.1%); 3 cases of *C. difficile* infection (1.6%); 1 case of conjunctivitis (0.5%); and 1 case of fungal oral/perioral and skin infection (0.5%). There were no cases of UTI, scabies, or herpes among SSTIs, norovirus gastroenteritis among GTI, or primary bloodstream infection among systemic infections.

Characteristics of Patients with HAI in an LTCH

Of the 192 patients who developed HAI, 103 (53.6%) were men and 89 (46.4%) were women. The mean age was 78.0 years, and the highest number of patients were in their 80s (n = 88, 45.8%). The time from admission to HAI diagnosis was 398.6 ± 517.5 days (Table 6).

DISCUSSION

This is the first study to adapt and apply the McGeer infection surveillance definition, which was developed for LTC facilities lacking adequate manpower and resources for infection surveillance,[7,9] for use in Korea. The modified version differed from the CDC's HAI surveillance method standard for LTC facilities in that the diagnostic criteria included systemic infections due to inadequate HAI surveillance experience and data in LTCHs, axillary temperature criterion for fever because of its common use in LTCHs in Korea, and 10 items rated on a 5-point scale based on the ADL scoring system reported to the HIRA by LTCHs in Korea.[1]

In addition, considering the reality in LTCHs in which infection control personnel cannot spare adequate time for infection surveillance, we performed passive surveillance, in which nurses providing direct care to patients checked for symptoms included in the HAI surveillance diagnostic criteria, such as fever, increased leukocyte count, altered consciousness, reduced functioning, urinary

Table 3. Characteristics of the participating long-term care hospitals (n=6)

Hospital name	Area (city)	Number of beds	Surveillance period
A	Daejeon	262	July to October 2019
B	Daejeon	198	July to October 2019
C	Daejeon	281	July to October 2019
D	Seoul	522[a]	July to October 2019
E	Incheon	299	July to October 2019
F	Seoul	239	August to October 2019

[a]Only 260 beds were monitored, excluding single rooms and rehabilitation wards.

Table 5. Proportions of the types of healthcare-associated infections in 6 long-term care hospitals

Type of infection	Overall infections
Respiratory tract infection	84 (43.8)
Pneumonia	40 (20.8)
Lower respiratory tract (bronchitis or tracheobronchitis)[a]	27 (14.1)
Influenza-like illness	9 (4.7)
Common cold or pharyngitis	8 (4.2)
Gastrointestinal tract infection	24 (12.5)
Gastroenteritis	21 (10.9)
Clostridium difficile	3 (1.6)
Skin and soft tissue infection	6 (3.1)
Cellulitis or soft tissue or wound infection	4 (2.1)
Conjunctivitis	1 (0.5)
Fungal oral or perioral and skin	1 (0.5)
Systemic infection	78 (40.6)
Unexplained febrile illness[b]	78 (40.6)
Total	192 (100)

Values are presented as number (%).
[a]Symptoms of pneumonia examined without pathologic findings in chest X-rays are categorized as lower respiratory tract infections.
[b]McGeer criteria for infection in long-term care facilities. Am J Infect Control 1991;19:1–7.

Table 4. Incidence rates of HCAIs in 6 long-term care hospitals

Hospital	Number of admitted patients	Patient-days	Number of infections	Incidence rate (HAIs per 100 patients)	Incidence density (HAIs per 1,000 patient-days)
A	71	24,823	20	28.2	0.81
B	151	20,942	23	15.2	1.10
C	105	22,500	72	58.6	3.20
D	80	13,606	22	27.5	1.62
E	40	24,993	30	75.0	1.20
F	185	15,608	25	13.5	1.60
Total	632	122,472	192	30.4	1.57

HCAIs, healthcare-associated infections.

Table 6. Characteristics of patients with healthcare-associated infections in nursing homes (n=192)

Characteristic	Value
Sex	
Male	103 (53.6)
Female	89 (46.4)
Age (y)	78.0 ± 11.9
< 70	34 (17.7)
70–79	50 (26.0)
80–89	88 (45.8)
≥ 90	20 (10.4)
Hospital stay until infection (day)	398.6 ± 517.5
< 100	77 (40.1)
100–499	64 (33.3)
500–999	27 (14.1)
≥ 1,000	24 (12.5)

Values are presented as number (%) or mean±standard deviation.

and bowel dysfunctions, skin and mucosal lesions, and digestive symptoms, and periodically reported to the infection control personnel. While active infection surveillance is the most effective method to investigate HAIs, combining passive infection surveillance amid the inadequate infection surveillance infrastructure in LTCHs in Korea was one difference from the nationwide infection surveillance method focusing on acute care facilities.[13]

During the recent coronavirus disease 2019 (COVID-19) pandemic, infection control has become critical in LTCHs that generally provide care to older patients. The COVID-19 guidelines for LTCHs developed by the Korean Geriatrics Society are a good example of infection control.[14] In addition, as caregiving staff, including nurses, actively monitor suspected COVID-19 symptoms, such as respiratory symptoms, fever, and digestive symptoms, we recommend a systematic combination of passive infection surveillance, in which the infection surveillance personnel are given a report, and active infection surveillance, which involves a direct investigation by the infection surveillance personnel.

A total of 192 cases of HAIs were reported by six LTCHs, corresponding to an incidence rate of 30.38%. This rate differed from that previously reported in LTC facilities (3.4% and 4.1%)[15,16] using the 2012 updated version of the McGeer criteria.[9,12] This difference could be attributed to the addition of unexplained febrile illness in our study. Another explanation may be the high prevalence of frailty among LTCH patients who are more physically vulnerable compared to those in other nursing homes.[17]

Rothan-Tondeur et al.[16] reported bronchitis (35.5%) to be the most common type of HAI, followed by gastroenteritis (23.8%), UTI (16.7%), otorhinolaryngological infection (8.7%), and pneumonia (7.0%). In our study, the most common type of HAI was unexplained febrile infection (40.6%), followed by pneumonia (20.8%), lower RTI (14.1%), and gastroenteritis (10.9%). The high rate of unexplained febrile illness could explain the higher infection rate compared to that reported previously. In the future, the rate of unexplained febrile illness may be lowered by identifying the cause of fever.

In our study, the incidence of HAI per 1,000 days of hospital stay was 1.57. The National Healthcare Safety Network (NHSN), an infection surveillance module for LTC facilities in the United States, includes UTI, *C. difficile* and multi-resistant bacteria infection, and hand hygiene and protective device compliance surveillance.[18] Notably, it was difficult to directly compare the results obtained from the surveillance method used in our study to that used for US infection surveillance due to the differences in these methods. Yet, the NHSN reported an incidence of 0.59 per 1,000 days of hospital stays for UTI and 0.98 per 1,000 days of hospital stays for *C. difficile* infection between 2013 and 2015[19] while we observed no cases of UTI and three cases of *C. difficile* infection (0.0024 per 1,000 days of hospital stay). These two types of infections may be difficult to diagnose, as microbial testing is needed for diagnosing them; however, LTCHs are not equipped with the resources for their own microbial testing, and the process of requesting it at an external laboratory is time- and labor-intensive. The McGeer criteria for UTI did not require microbial testing at the time of development in 1991; however, microbial testing was added in the 2012 update to increase the specificity to decrease unnecessary use of resources.[12] As the resource utilization group system was used as the payment model in LTCHs in Korea,[2] it was practically difficult to prescribe microbial testing. Thus, it was difficult to apply the McGeer criteria for UTI based on microbial testing.

In our study, RTI was the second-most common type of HAI after unexplained febrile illness. According to the European data applying the same McGeer criteria,[20] UTI was the most common infection in LTC facilities, followed by RTI and skin infection. In Korea, the diagnosis of UTI is limited by the difficulty in obtaining prescriptions for microbial tests; thus, in our study, RTI was a more frequently diagnosed HAI among patients under long-term care in LTCHs because the diagnosis does not require microbial tests. Furthermore, respiratory symptoms are the main symptoms of the current COVID-19 pandemic,[21] highlighting the importance of RTI prevention in LTCHs. Furthermore, Quach et al.[22] reported that patients aged 65 years or older who visited the emergency department of an acute care facility had risks of developing RTIs and digestive tract infections. Since patients are frequently transferred between LTCHs and acute care facilities, collective efforts are needed to prevent HAIs.

This study has some limitations. First, the findings are not generalizable because only six LTCHs that chose to participate were monitored for a relatively short period of 2–3 months. Second, there is a potential bias as some HAIs are underdiagnosed because of the difficulty in obtaining prescriptions for microbial tests for diagnoses. However, all cases were reviewed twice and the authors and the infection surveillance personnel in each LTCH tried to improve the accuracy and sensitivity of cases with periodic online Q&A discussions and sharing of ambiguous cases. Third, LTCH-specific medical fee regulation of the resource utilization group payment system could have constricted microbiological laboratory studies such as urine or blood culture. In the future, improvements in manpower, health insurance systems, and surveillance systems are needed for more LTCHs to continuously participate in HAI surveillance.

In conclusion, the surveillance method applied in our study can be used to assess the infection control methods and level of infection control activities in LTCHs. Particularly, the HAI diagnostic criteria, surveillance form, and checklist that were developed based on the characteristics of inpatients under LTC could contribute substantially to the systematization and standardization of HAI surveillance in LTCHs. Standardizing the surveillance method and investigating the infection rates and infection risk factors will help to prevent HAIs in LTCHs.

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CONFLICT OF INTEREST

The researchers claim no conflicts of interest.

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AUTHOR CONTRIBUTION

Conceptualization, SYJ, JHC; Investigation, JHC, JYK; Methodology, JHC, JYK; Writing-original draft, SYJ, HG; Supervision, HG; Writing-review & editing, SYJ, HG, JHC, JYK.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via http://doi.org/10.4235/agmr.20.0067

REFERENCES

1. Ga H, Won CW. Medical guidelines for long-term care hospitals for senior citizens. 3rd ed. Seoul, Korea: Koonja; 2016.
2. Park SK, Lee YJ. Categorization of long term care hospital in Korea using cluster analysis. Public Health Aff 2019;3:71-81.
3. Kim KW, Jang S. Characteristics and mortality risk factors in geriatric hospital patients visiting one region-wide emergency department. J Korean Acad Community Health Nurs 2016;27:327-36.
4. Kim YJ, Ahn SY, Jhee JH, Kim CO. Clinical finding and antimicrobial resistance in bacteremia associated geriatric hospital. Korean J Clin Geri 2015;16:63-8.
5. Moro ML, Jans B, Cookson B, Fabry J. The burden of healthcare-associated infections in European long-term care facilities. Infect Control Hosp Epidemiol 2010;31 Suppl 1:S59-62.
6. High KP, Bradley SF, Gravenstein S, Mehr DR, Quagliarello VJ, Richards C, et al. Clinical practice guideline for the evaluation of fever and infection in older adult residents of long-term care facilities: 2008 update by the Infectious Diseases Society of America. Clin Infect Dis 2009;48:149-71.
7. McGeer A, Campbell B, Emori TG, Hierholzer WJ, Jackson MM, Nicolle LE, et al. Definitions of infection for surveillance in long-term care facilities. Am J Infect Control 1991;19:1-7.
8. Bjerke NB. APIC–HICPAC surveillance definitions for home health care and home hospice infections. Atlanta, GA: Centers for Disease Control and Prevention; 2008.
9. Stone ND, Ashraf MS, Calder J, Crnich CJ, Crossley K, Drinka PJ, et al. Surveillance definitions of infections in long-term care facilities: revisiting the McGeer criteria. Infect Control Hosp Epidemiol 2012;33:965-77.
10. Chan WF, Bond TG, Adamson B, Chow M. Identifying core competencies of infection control nurse specialists in Hong Kong. Clin Nurse Spec 2016;30:E1-9.
11. National Healthcare Safety Network. Long term care facility component: tracking infections in long-term care facilities [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; c2018 [cited 2019 Feb 19]. Available from: https://https://www.cdc.gov/nhsn/pdfs/validation/2018/ltcf-manual-508.pdf.
12. Moro ML. A significant step forward: new definitions for surveillance of infections in long-term care. Infect Control Hosp Epide-

miol 2012;33:978-80.
13. Korean Society for Healthcare-associated Infection Control and Prevention. KONIS Manual 2016 [Internet]. Seoul, Korea: Korean National Healthcare-associated Infections Surveillance System; c2016 [cited 2020 Dec 22]. Available from: http://konis.cafe24.com/xe/index.php?mid=manual&page=2&document_srl=609.
14. Ga H, Won CW, Lee E, Kim CO, Jang IY, Jang HC, et al. The Korean Geriatrics Society COVID-19 Strategy for Older Adults. Ann Geriatr Med Res 2020;24:59-61.
15. Ripabelli G, Salzo A, Mariano A, Sammarco ML, Tamburro M; Collaborative Group for HAIs Point Prevalence Surveys in Molise Region. Healthcare-associated infections point prevalence survey and antimicrobials use in acute care hospitals (PPS 2016-2017) and long-term care facilities (HALT-3): a comprehensive report of the first experience in Molise Region, Central Italy, and targeted intervention strategies. J Infect Public Health 2019;12:509-15.
16. Rothan-Tondeur M, Piette F, Lejeune B, de Wazieres B, Gavazzi G. Infections in nursing homes: is it time to revise the McGeer criteria? J Am Geriatr Soc 2010;58:199-201.
17. Ga H, Won CW, Jung HW. Use of the frailty index and FRAIL-NH scale for the assessment of the frailty status of elderly individuals admitted in a long-term care hospital in Korea. Ann Geriatr Med Res 2018;22:20-5.
18. National Healthcare Safety Network. Long term care facility component: tracking infections in long-term care facilities [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; c2020 [cited 2020 Dec 22]. Available from: https://www.cdc.gov/nhsn/pdfs/ltc/ltcf-manual-508.pdf.
19. Palms DL, Mungai E, Eure T, Anttila A, Thompson ND, Dudeck MA, et al. The National Healthcare Safety Network long-term care facility component early reporting experience: January 2013-December 2015. Am J Infect Control 2018;46:637-42.
20. Health Protection Surveillance Centre. European point prevalence survey on healthcare associated infections and antibiotic use in long-term care facilities [Internet]. Dublin, Ireland: Health Protection Surveillance Center; 2010 [cited 2020 Dec 22]. Available from: https://www.hpsc.ie/az/microbiologyantimicrobialresistance/infectioncontrolandhai/surveillance/hcaiinlongtermcarefacilities/haltreports/2010report/File,4723,en.pdf.
21. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497-506.
22. Quach C, McArthur M, McGeer A, Li L, Simor A, Dionne M, et al. Risk of infection following a visit to the emergency department: a cohort study. CMAJ 2012;184:E232-9.