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SHORT COMMUNICATION

Potentially Inappropriate Medications in the Elderly in Korean Long-Term Care Facilities

Hee-Jin Hwang[1] · Sang-Hwan Kim[2] · Kang Soo Lee[3]

Abstract

Background Elderly residents of long-term care facilities are more vulnerable to being prescribed inappropriate medications because of the high incidence of co-medication in this population resulting from the presence of multiple chronic diseases and also age-related changes in pharmacokinetics and pharmacodynamics.

Objective We evaluated the frequency of potentially inappropriate medications and factors influencing their frequency.

Methods A retrospective cross-sectional study was conducted in 20 long-term care facilities located in the northwest regions of South Korea for 824 patients aged 65 years and older who were assessed between January and February of 2012. Potentially inappropriate medications were identified using the 2012 American Geriatric Society's Beers Criteria. We assessed the relationship between the frequency of potentially inappropriate medications prescribed and patient age, sex, co-medications, comorbidity, activities of daily living, length of stay, grade of long-term care insurance for seniors, and the bed size and business type of the long-term care facility.

Results Of the 529 participants who satisfied our inclusion criteria, 308 (58.2 %) had received at least one inappropriate medication according to the 2012 Beers Criteria. The most frequently prescribed classes of inappropriate medications were central nervous system drugs (58.7 %), anti-cholinergics (21.2 %), and cardiovascular medications (10.8 %). The most commonly used drugs were quetiapine (28.4 %), chlorpheniramine (15.8 %), risperidone (6.5 %), and zolpidem (5.8 %). Inappropriate medication use was associated with the number of co-medications and long-term care insurance grade 3, which means less dependence and a requirement of low-level care.

Conclusions Central nervous system drugs (58.7 %) were the most prescribed class of inappropriate medications. Quetiapine was the drug most often given inappropriately (28.4 %). There was a relationship between inappropriate medication use and the number of co-medications. The frequency of inappropriate medication prescriptions was higher among patients whose long-term care insurance for seniors was grade 3, which means less dependence and a requirement of low-level care.

Hee-Jin Hwang and Sang-Hwan Kim contributed equally as co-first authors.

✉ Kang Soo Lee
kpsimon@hanmail.net

1 Department of Family Medicine, International St. Mary's Hospital, Catholic Kwandong University College of Medicine, Incheon, South Korea

2 Yonsei Woori Geriatric Hospital, Goyang, South Korea

3 Department of Psychiatry, CHA Bundang Medical Center, CHA University, 59 Yatap-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 463-712, Republic of Korea

Key Points

Central nervous system drugs (58.7 %) were the most prescribed class of inappropriate medications in Korean long-term care facilities.

Inappropriate medication use was associated with the number of co-medications and long-term care insurance grade 3, which means less dependence and a requirement of low-level care.

Effective management of nursing home residents belonging to long-term care grade 3 via reducing potentially inappropriate medications is considered.

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1 Introduction

Korea became an "aging society" in 2000, and in 2008, the prevalence of individuals aged 65 years or older was 10.3 %. In 2018, Korea will become an "aged society" when 14.4 % of its population comprise the elderly, and a "super-aged society" by 2026 [1, 2]. To overcome this situation, the Korean Government introduced a new social insurance scheme for long-term care (LTC) in July 2008 [3]. The LTC Insurance Program provides social services for elderly people with a few functional limitations. The purpose of this insurance system was to meet the markedly increased demand for elderly healthcare as a result of a rapidly aging population, elevated expectations for healthcare, and a change in the pattern of medical conditions in the elderly from acute illness to chronic disability. This insurance uses the LTC grade for denoting how much help is required for an elderly person in their daily lives. After the implementation of LTC insurance, the number of nursing facilities in Korea also increased sharply from 1717 locations (68,581 people) in 2008 to 3751 locations (116,782 people) [4].

Researchers have documented the widespread incidence of inappropriate medication use in elderly persons and reported an estimated prevalence from 4.8 to 45.6 % [5–11]. The proper use of medicines and monitoring for adverse effects are important factors in the treatment of elderly patients. Aging is associated with a reduction in first-pass metabolism and therefore an increase in the bioavailability and distribution of drugs, which increases the risk of adverse effects; these risks grow exponentially when a number of different drugs are used. Because of the potentially serious consequences of exaggerated or incorrect prescriptions, screening tools have been created to detect inadequacies in drug prescriptions. In 2012, the American Geriatrics Society (AGS) and an interdisciplinary panel of experts in geriatric care and pharmacotherapy reached a consensus on the 2012 AGS Beers Criteria [12]. Fifty-three medications or medication classes encompass the final updated criteria, which are divided into three categories: potentially inappropriate medications (PIMs) or classes to avoid in older adults; PIMs or classes to avoid in older adults with certain diseases and syndromes that the listed drugs can exacerbate; and medications to be used with caution in older adults. Elderly nursing home residents regularly receive complex multi-drug therapy because of the presence of both acute and chronic diseases. For this reason, inappropriate medication use is a major patient safety concern, especially for the elderly [13].

There have been few reports dealing with the prevalence of PIM prescriptions or their adverse effects on elderly patients in South Korea [14, 15]. To our knowledge, there have been no reports on the prevalence of PIM prescriptions in South Korea LTC facilities using the 2012 version of the Beers criteria. Hence, we evaluate the frequency of inappropriate medication use in elderly patients admitted to nursing homes in Korea by applying the newly revised 2012 AGS Beers Criteria. In addition, the characteristics and risk factors for such prescribing were investigated.

2 Methods

A retrospective cross-sectional survey study was performed in patients aged 65 years or older, which produced a sample of 824 people admitted to 20 nursing facilities in northwest Korea from January 2012 to February 2012. We excluded four patients who did not take any medications, 259 patients with incomplete medical records, and 32 patients who were not included in any LTCI programs. The participants' medical records were collected from the record section of the institute. We assessed the patients' age, sex, co-medication, comorbidity, activities of daily living (ADL), length of stay, grade of LTC insurance for seniors, and the bed size and business type of the LTC care facilities. The LTC grade is based on standards of five areas of physical functions (ADL), cognition, behavioral changes (behavioral problems), demand on nursing care, and need for rehabilitation, and judgment standards made in consideration of service necessary according to the state of functions. On a checklist with a maximum score of 100, a score of 55 and over makes an individual eligible for insured care. Categories of LTC grade are defined as follows [4]: grade 1 (most severe)—the elderly person has one of the following handicaps: he or she cannot go to or get out of bed unaided; experiences behavioral difficulties, impaired judgment, and frequent memory loss as a result of severe brain injury; or completely needs full assistance with all the activities of daily life and records a LTC acknowledgment score of at least 95; grade 2 (severe)—the elderly person cannot eat, defecate nor dress themselves unaided; has impaired judgment and memory loss due to dementia; needs considerable help in moving or moving in a wheelchair; spends most parts of daily life in bed and records an LTC acknowledgment score of at least 75 but less than 95; grade 3 (moderate)—the elderly person partially needs considerable LTC protection; some degree of help for eating, dressing/undressing, using the toilet, looking after himself or herself, performing household tasks, and performing their everyday activities outside the home; and records an LTC acknowledgement score of at least 55 but less than 75; no grade (mild)—the elderly person needs some help in one or two activities of daily

life, including bathing and dressing/undressing and records an LTC acknowledgment score of less than 55.

Prescriptions were assessed for the use of PIMs according to the 2012 AGS Beers Criteria [12]. We focused on evaluating 34 PIMs to avoid in older adults and one of the categories in the 2012 update to the AGS's Beers Criteria. Drug–disease interactions and drugs to be used with caution in geriatric patients were also assessed using the Beers Criteria [12]. Anti-cholinergics include brompheniramine, carbinoxamine, chlorpheniramine, clemastine, cyproheptadine, dexbrompheniramine, dex-chlorpheniramine, diphenhydramine (oral), doxylamine, hydroxyzine, promethazine, and triprolidine. Cardiovascular medications include alpha blockers, alpha agonists, guanabenz, guanfacine, methyldopa, reserpine (>0.1 mg/day), anti-arrhythmic drugs (Class Ia, Ic, III), and amiodarone. Central nervous system drugs include tertiary tricyclic antidepressants, antipsychotics, barbiturates, and benzodiazepines.

We calculated the descriptive statistics to illustrate characteristics of the study population by comparing persons on PIMs with those not on PIMs. The distributions of baseline descriptive statistics are expressed as proportions and means with standard deviations. In the case of categorical variables, cross-tabulations with chi-square tests were used in comparing the differences. For continuous variables, the statistically significant difference in means was determined by the independent t test. Concurrent PIM use was defined as the number of PIM prescriptions within an individual incidence year. Logistic regression analysis was performed to identify the risk factors for PIM exposure where PIM use (0 or 1) was the dependent variable and the independent variables included age, sex, ADL, length of stay, number of comorbidities, number of co-medications, and grade of LTC insurance. Use of PIMs has been consistently associated with female sex, higher number of medications, higher number of chronic diseases, and older age [16–21]. Length of stay was also found to significantly increase the risk of PIMs [22]. A two-sided p value <0.05 was considered significant. All statistical analyses were performed using SPSS 18.0 for Windows (SPSS Inc., Chicago, IL, USA).

3 Results

This study recruited 529 patients; 221 of these did not use a PIM, while the remaining 308 patients were currently taking PIMs. Descriptive statistics for the incident PIM cases are displayed in Table 1. Significant differences between those prescribed and those not prescribed a PIM were found for sex, age, deductible class, number of different medications used, number of chronic conditions,

total healthcare costs in the previous year, and number of concurrent PIMs. The average number of medications in the PIM group was 4.0 ± 2.3, while the non-PIM group's average number of medications was 6.4 ± 2.9 ($p < 0.001$). In addition, the average number of comorbidities was 3.3 ± 1.4 in the PIM group and 3.8 ± 1.5 in the non-PIM group ($p < 0.001$). The number of patients whose LTC insurance for seniors was grade 3 was relatively higher in the PIM group than it was in the non-PIM group. The six most commonly prescribed classes of medicines within the Anatomical Therapeutic Chemical classification system were as follows: central nervous system ($n = 930$; 36.4 %), alimentary tract and metabolism ($n = 553$; 21.6 %), cardiovascular system ($n = 388$; 15.1 %), blood and blood-forming organs ($n = 236$; 9.2 %), respiratory system ($n = 115$; 4.5 %), and musculoskeletal system ($n = 72$; 2.8 %). Table 2 presents the number of PIMs prescribed in LTC facilities.

The six most commonly prescribed classes of medications in our patients were as follows: central nervous system ($n = 271$; 58.7 %), anticholinergics ($n = 98$; 21.2 %), cardiovascular system ($n = 50$; 10.8 %), endocrine system ($n = 22$; 4.8 %), analgesics ($n = 9$; 1.9 %), and anti-parkinsonian drugs ($n = 9$; 1.9 %) (Table 3). Specifically, the most common PIM subtype was quetiapine ($n = 131$; 28.4 %), followed by chlorpheniramine ($n = 73$; 15.8 %), risperidone ($n = 30$; 6.5 %), zolpidem ($n = 27$; 5.8 %), and spironolactone ($n = 26$, 5.6 %) (Table 4). Multivariate logistic regression analyses were applied, and the factors that exhibited significant associations with PIM prescriptions are shown in Table 5.

4 Discussion

The present study focuses on a growing public health problem: inappropriate medication prescriptions in LTC facilities. A disturbingly high level of PIMs were prescribed (58.2 %), which is of concern, indicating room for improvement. A comparison with the results from studies conducted previously worldwide is not straightforward owing to variations in methods, such as data and duration of collection, study criteria, and characteristics of the population groups. Despite these variations, this prevalence was similar to those observed in the USA, with values of 49 % of elderly patients who were admitted with one or more of the seven most common medical diagnoses [23] and 55.3 % in those undergoing surgery during their hospitalization [24], and 56.1 % of those in acute care hospitals in Japan [25].

The results described in the multivariate analysis regarding the factors associated with a potentially

Table 1 General characteristics of the residents in long-term care facilities

Variables	Non-PIMs [n = 221 (%)]	PIMs [n = 308 (%)]	P value
Age (years)	81.6 ± 8.9	80.2 ± 8.4	0.067
Sex (male)	64 (29.0%)	59 (19.2%)	0.080
Number of co-medications	4.0 ± 2.3	6.4 ± 2.9	<0.001[a]
0–3	105 (47.5%)	51 (16.6%)	
4–5	82 (37.1%)	112 (36.4%)	
6–7	32 (14.5%)	103 (33.4%)	
≥8	2 (0.9%)	42 (13.6%)	
Number of co-morbidities	3.3 ± 1.4	3.77 ± 1.5	<0.001[b]
0–2	70 (31.7%)	58 (18.8%)	
3	52 (23.5%)	90 (29.2%)	
4	61 (27.6%)	66 (21.4%)	
≥ 5	38 (17.2%)	94 (30.5%)	
Number of ADLs	1.2 ± 1.2	1.3 ± 1.2	0.405
ADL			
Bathing	8 (3.6%)	7 (2.3%)	0.357
Dressing	52 (23.5%)	62 (20.1%)	0.348
Eating	132 (59.7%)	209 (67.9%)	0.054
Toileting	58 (26.2%)	87 (28.2%)	0.611
Walking	22 (10.0%)	42 (13.6%)	0.200
Length of stay (months)	28.4 ± 25.9	26.7 ± 29.2	0.494
Grade of long-term care insurance for senior			
1	38 (17.2%)	31 (10.1%)	0.008[c]
2	83 (37.6%)	100 (32.5%)	
3	100 (45.2%)	177 (57.5%)	
Bed size of long-term care facilities			
<29	54 (24.4%)	74 (24.0%)	0.950[d]
30–59	66 (29.9%)	96 (31.2%)	
≥60	101 (45.7%)	138 (44.8%)	
Business type of long-term care facilities			
Corporation	159 (71.9%)	223 (72.4%)	0.908[e]
Private operator	62 (28.1%)	85 (27.6%)	

Values are presented as number (%)

PIM potentially inappropriate medication, *ADL* activities of daily living

[a] *P* value applied to row 4–7 inclusive

[b] *P* value applied to row 9–12 inclusive

[c] *P* value applied to row 20–22 inclusive

[d] *P* value applied to row 23–25 inclusive

[e] *P* value applied to row 26–27 inclusive

inappropriate prescription showed that the likelihood was determined by the number of drugs prescribed during the patient's hospitalization. Some of these findings were in line with those from previous research. In India, the results of a logistic regression model showed that multiple diseases and a higher use of drugs during hospital stay predicted PIM prescription [26]. Multivariate analyses also revealed that the number of drugs prescribed seemed to be one of the most important independent predictors for receiving an inappropriate medication [27, 28].

Furthermore, inappropriate medication use was higher with the LTC insurance grade 3, which means less dependence and a requirement of low-level care. This can be explained by the fact that most of the residents in Korean LTC facilities have been diagnosed with dementia or another neurodegenerative disorder. Considering central nervous system drugs (58.7 %) were the most prescribed class of inappropriate medications, such prescriptions are used to manage behavioral and psychiatric symptoms.

Table 2 Number of potentially inappropriate medications in the residents of long-term care facilities

Number of potentially inappropriate medications	Number (%)
0	221 (41.8)
1	189 (35.7)
2	92 (17.4)
3	20 (3.8)
4	6 (1.1)
5	1 (0.2)
Total	529 (100.0)

Table 3 Six most commonly prescribed potentially inappropriate medications classes

Medications class (ATC code)	Number (%)
Central nervous system (N05-N06)	271 (58.7)
Anticholinergics (N04A)	98 (21.2)
Cardiovascular system (C)	50 (10.8)
Endocrine system (G03)	22 (4.8)
Analgesics (N02)	9 (1.9)
Anti-parkinsonian drugs (N04)	9 (1.9)

Medication classes are stratified according to 2012 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

( ) means codes of Anatomical Therapeutic Chemical (ATC) Classification

Table 4 Prevalence of potentially inappropriate medications according to individual drugs

Drugs (ATC code)	Number (%)
Quetiapine (N05AH04)	131 (28.4)
Chlorpeniramine (R06AB04)	73 (15.8)
Risperidone (N05AX08)	30 (6.5)
Zolpidem (N05CF02)	27 (5.8)
Spironolactone (C03DA01)	26 (5.6)
Olanzapine (N05AH03)	21 (4.5)
Lorazepam (N05BA06)	19 (4.1)
Alprazolam (N05BA12)	16 (3.5)
Hydroxyzine (N05BB01)	13 (2.8)
Cyproheptadine (R06AX02)	12 (2.6)
Doxazosin (C02CA04)	12 (2.6)
Sliding Scale Insulin (A10AB01)	12 (2.6)
Amitriptyline (N06AA09)	11 (2.4)
Megestrol (G03AC05)	10 (2.2)
Meloxicam (N01AC06)	9 (1.9)
Benztropine (N04AC01)	7 (1.5)
Nifedipine (C08CA05)	7 (1.5)
Diazepam (N05BA01)	6 (1.3)
Clonazepam (N03AE01)	5 (1.1)
Terazosin (G04CA03)	3 (0.6)
Total	462 (100)

Medication classes are stratified according to 2012 American Geriatrics Society Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

( ) means codes of Anatomical Therapeutic Chemical (ATC) Classification

When interpreting the findings of the current study, some limitations to the methodology that could bias estimates are worth mentioning. The first limitation lies with the fact that the study was cross sectional, which does not allow us to identify the causal relationship of PIM with associated factors in nature. Second, the Beers Criteria have been examined extensively in research since their development and found to be effective in identifying PIM and advising close monitoring of certain medications. However, evidence supporting the effectiveness of the Beers Criteria in consistently reducing the adverse effects of drugs or decreasing costs or mortality is lacking [29, 30]. The Beers Criteria does not take into account geriatric patients in palliative care or hospice, does not detect prescribing omissions, underuse of medications, inappropriate dosing of medications, or duplication of drug classes [31, 32]. Third, although the information was gathered mainly from a chart review, recall bias may have been a problem because patients reported their current medications through a structured interview that took place before admission, including the duration of treatment and the dosage; this information may have been inaccurate. Fourth, this sample is unlikely to be representative of all Koreans because the study was conducted in one region of the country and, therefore, the ability to generalize the findings is questionable.

Central nervous system drugs (58.7 %) were the most prescribed class of inappropriate medications in Korean LTC facilities. Inappropriate medication use was associated with the number of co-medications and LTC insurance grade 3, which means less dependence and a requirement of low-level care.

5 Conclusions

Central nervous system drugs (58.7 %) were the most prescribed class of inappropriate medications. Quetiapine was the drug most often given inappropriately (28.4 %). There was a relationship between inappropriate medication use and the number of co-medications. The frequency of inappropriate medication prescriptions was higher among patients

Table 5 Logistic regression analysis for potentially inappropriate medications used in the residents of long-term care facilities

Variables	β	Standard error	P value	Adjusted OR (95 % CI)
Age	−0.003	0.012	0.800	1.00 (0.98–1.02)
Sex (female)	0.136	0.316	0.666	1.15 (0.62–2.13)
Number of co-medications				
0–3				1.00
4–5	0.903	0.243	<0.001	2.47 (1.53–3.97)
6–7	1.688	0.316	<0.001	5.41 (2.91–10.06)
≥8	3.600	0.761	<0.001	36.61 (8.24–162.68)
Number of co-morbidities				
0–2				1.00
3	0.488	0.271	0.073	1.63 (0.86–2.76)
4	−0.074	0.278	0.791	0.93 (0.54–1.60)
≥5	0.438	0.294	0.137	1.55 (0.87–2.76)
Grade of long-term care insurance for seniors				
1				1.00
2	0.271	0.312	0.385	1.31 (0.71–2.42)
3	0.709	0.344	0.039	2.03 (1.04–3.99)

Adjusted for activities of daily living, length of stay, bed size and business type of long-term care facilities

Grade of long-term care insurance for seniors made based on standards of five areas of physical functions (activities of daily living), cognition, behavioral changes, demand on nursing care, and need for rehabilitation and judgment standards made in consideration of service necessary according to the state of functions. Categories of LTC grade are defined as follows: grade 1 (most severe); grade 2 (severe); grade 3 (moderate)

whose LTC insurance for seniors was grade 3, which means less dependence and a requirement of low-level care.

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