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Prevalence of Beers Criteria Medications Among Elderly Patients in a Military Hospital

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Abstract

Objective: This study aims to examine potentially inappropriate medication (PIM) prevalence and factors that affect the use of PIMs in a military treatment facility. **Method:** Admission and discharge medication lists of 60 patients aged ≥65 years were retrospectively reviewed by a clinical pharmacist and a member of the study team for the presence of PIM using the 2012 Beers Criteria. Patients included were those discharged between December 2012 and September 2013 from the Womack Army Medical Center, Internal Medicine unit. **Results:** Among the 60 patients evaluated, 44 (73%) were on at least one PIM at admission, whereas the prevalence of PIM at discharge (30 patients) was 50% ($p < .001$). The top three classes of PIM at admission were antihistamines (11, 15.3%), nonsteroidal anti-inflammatory drugs (10, 13.9%), and benzodiazepines (6, 8.3%). Patients on >10 medications at admission (37, 62%) were 4 times more likely to have a PIM ($p < .001$). **Conclusion:** Data showed a high and a previously unknown PIM prevalence among older adults in a U.S. military treatment facility.

Keywords

potentially inappropriate medication, Beers Criteria, military, inappropriate prescribing

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Introduction

According to IMS Institute for Healthcare Informatics estimates, health care costs caused by improper and unnecessary use of medicines exceeded $200 billion in 2012 (IMS Institute for Healthcare Informatics, 2013). In 2013, the estimated health care expenditures related to potentially inappropriate medications (PIMs) was $1.3 billion, with a range of $900 million to $1.7 billion (IMS Institute for Healthcare Informatics, 2013). PIMs are medications with risks that outweigh their therapeutic benefit and should be avoided in people aged 65 or older (Campanelli, 2012; O'Connor, Gallagher, & O'Mahony, 2012). The prevalence of PIM reported in the literature ranges from 35% to 47% (Gallagher et al., 2011; Gallagher & O'Mahony, 2008) in hospitalized older adult patients and up to 73% in nursing homes (Byrne et al., 2011; Clyne et al., 2013).

A similar study in Ireland attributed 9% of the overall expenditure on pharmaceuticals to PIMs (Cahir et al., 2010). PIMs such as nonsteroidal anti-inflammatory drugs (NSAIDs) are the most common cause of gastropathy among geriatrics, with an average admission cost of over $14,000 (Fick et al., 2003). These numbers are expected to only increase with rising health care costs and the use of multiple specialty physicians that increases the likelihood of polypharmacy and the prescribing of PIMs (Takane, Balignasay, & Nigg, 2013).

Inappropriate prescribing is associated with negative outcomes including adverse drug events, readmission rates, higher mortality rates, medication nonadherence, increased risk of falls, and increased health care costs (O'Connor et al., 2012). A 2005 study estimated that more than 4.3 million health care visits were attributed to an adverse drug event as a result of polypharmacy (Maher, Hanlon, & Hajjar, 2014). Furthermore, polypharmacy and PIMs are estimated to cause adverse drug events in up to 35% of outpatients and 40% of inpatient older adults (Maher et al., 2014). There are no clear guidelines for prescribers to determine what type of PIM should be used; clinicians must therefore consider

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multiple factors when choosing such agents for geriatric use (Campanelli, 2012).

Efficient use of medication among older military beneficiaries represents a significant challenge for the Department of Defense (DoD). Many older DoD beneficiaries use both TRICARE (military health care service) and Medicare for their medical needs. TRICARE is the Health Maintenance Organization (HMO) equivalent for military service members, including retirees and their qualified dependents. As civilian and government hospitals do not have combined medical records, it is difficult for the DoD to properly manage medications. In one study of 123,682 TRICARE beneficiaries 65 years and older, 50% obtained six or more medications, and 3% obtained 16 or more medications from the pharmacy during a 90-day period (Linton, Garber, Fagan, & Peterson, 2007).

The Beers Criteria for Potentially Inappropriate Medications Use in Older Adults (the Beers Criteria), devised by Beers and his colleagues in 1991 for use in nursing homes, was subsequently expanded and revised in 1997, 2003, and 2012, and consists of 53 medications or classes of medications that are divided into three groups: PIMs to avoid in older adults, PIMs to avoid in older adults with diseases and syndromes that the drugs can exacerbate, and medications to be used with caution (Campanelli, 2012). The Beers Criteria (mainly designed for use in the United States) is a well-validated tool that allows easy comparison with other studies (Fick et al., 2003). It is a well-known, comprehensive list endorsed by the American Geriatrics Society, creating a standard list of medications that may be deemed potentially inappropriate. Among community-dwelling older adults, a systemic review identified an association between medications listed on the Beers Criteria and hospitalizations (Jano & Aparasu, 2007). The Beers Criteria is currently being updated and is set for release in 2015 (The John A. Hartford Foundation, 2015).

The aim of this study is to determine the prevalence and types of PIMs at admission and upon discharge, and to compare these findings with the national average. In addition, the factors that affect the number of PIMs at admission and discharge were also evaluated using the 2012 Beers Criteria.

Method

A retrospective study was conducted by a clinical pharmacist and a member of the study team. Data were collected at a large military hospital between December 2012 and September 2013. Three electronic record systems were used: the Composite Health Care System (CHCS), the Armed Forces Health Longitudinal Technology Application (AHLTA), and ESSENTRIS (an inpatient system). All admission and discharge medications were assessed for PIM using the 2012 Beers Criteria. In this study, medications in the patient's record that were listed on the Beers Criteria were considered PIMs. Medications were not assessed for appropriateness.

Inclusion criteria included patients 65 years and older who had been discharged from the Internal Medicine unit, patients with at least one medication prescribed at time of admission, patients with medications who had been in active status with or without multiple refills within 180 days of admission, patients with medications of sufficient quantity to warrant chronic use (at least a 30-day supply), patients who received medical care for chronic disease management, and patients with available medication records. All readmissions within 30 days of initial discharge from the Internal Medicine unit were also examined.

All patient medications were evaluated and verified 6 months prior to admission and at discharge. Medications used during hospitalization were excluded from the study. Patients who died during hospitalization and/or left against medical advice were excluded from the study; patients admitted and discharged from other clinics such as Family Medicine, Step Down, Intensive Care, Surgery, and Psychiatry units were also excluded. Patients were also excluded if they had no medication history prior to admission and had expired or discontinued medications. It was assumed that patients were not taking expired or discontinued medications. A total of 285 charts were linked to the Internal Medicine unit for the study period; after exclusion criteria were assessed, a random sample of 60 patients was included in the study due to time limitations and a stringent inclusion criterion.

The PIM prevalence was determined by dividing the total number of patients with at least one PIM by the total number of patients. Only medications listed in the hospital electronic medical record that were covered by TRICARE were reviewed. Over-the-counter (OTC) medications were not reviewed because they are not kept in the electronic medical record. Contraindicated diseases/conditions at admission were identified to determine both acute and chronic disease state, and compared with the 2012 Beers Criteria for potential drug–disease interactions.

Factors affecting number of PIMs at admission and discharge were determined by fitting regression using two models. The first model was fitted for number of PIMs at admission, with gender, age, and total number of medications used by the patient at admission as independent variables. The second model fitted a global model with number of PIMs at discharge, with gender, age, length of stay at hospital, total number of medications used by the patient at admission, total number of medications used by the patient at discharge, and number of PIMs at admission as independent variables.

Descriptive data were analyzed to determine differences in baseline characteristics. A two-tailed t test was used to compare continuous variables. Chi-square test was used to compare categorical variables. Statistical significance was established at a p value of $\leq .05$.

Table 1. Patient Demographics at Admissions.

Population characteristics	Internal medicine unit	
Total patients	60	
Age, years (*M*, range)	76.5 (66-92)	
Gender, female (*n*, %)	32 (52)	
Length of hospital stay, days (*M*, range)	2.3 (0-12)	
	Admission	
Medication group	Number of patients (*n*, %)	Number of medications (*n*, %)
≤5 drugs	7 (11)	26 (4)
6-10 drugs	15 (25)	120 (17)
11-16 drugs	25 (42)	328 (45)
>16 drugs	13 (22)	248 (34)

All data were analyzed using SAS version 9.4 (www.sas.com). This study was approved by the Womack Army Medical Center Institutional Review Board.

Results

Table 1 provides an overview of population characteristics including age, gender, and length of hospital stay. An examination of polypharmacy found that 93% of patients at admission and 90% of patients at discharge had at least five medications. Among the 60 patients evaluated, 44 (73%) were on at least one PIM at admission; the prevalence at discharge was 50% ($p < .001$). Overall, 11% (77/722) of medications at admission and 7.1% (46/647) of discharge medications were found to be potentially inappropriate (Table 2).

The top three classes of PIM at admission were antihistamines (15.3%), NSAIDs (13.9%), and benzodiazepines (8.3%); whereas antihistamines (18.6%), central alpha blockers (11.6%), and antiarrhythmics (9.6%) were the most frequently prescribed PIMs at discharge. Several other drugs and drug classes accounted for the remaining PIM at admission and include calcium channel blockers (8.3%), central alpha blockers (6.9%), opioids (5.6%), antidepressants (5.6%), antiarrhythmics (5.6%), hypnotic (4.2%), alpha blockers (4.2%), skeletal muscle relaxants (4.2%), antimuscarinic (4.2%), and medications less frequently prescribed (tricyclic antidepressants, antispasmodics, antiparkinson, sulfonylurea, thiazolidinedione, mirtazapine, and megestrol; Table 3).

Gender did not make a statistically significant difference in number of PIMs at either admission or discharge (Table 4). Length of hospital stay did not affect number of PIMs at discharge. The length of hospital stay ranged from 0 to a maximum of 12 days. Age was negatively related to number of PIMs at admission meaning older patients were likely to have smaller number of PIMs. However, this relationship was not found between number of PIMs at discharge and total number of medications at discharge. Number of PIMs at both admission and discharge were positively related with total number of medications at admissions and discharge, respectively. At admission, each increase in number of medications was associated with .1 PIMs. At discharge, each increase in number of medications was associated with .07 PIMs.

According to the global model, number of PIMs at discharge was positively associated with the number of PIMs at admission as well as the total number of medications used at discharge. However, somewhat surprisingly, number of PIMs at discharge was negatively associated with the total number of medications used at admission. The reason for this may be that those who are known to use a larger number of medications at admission are assumed to be more likely users of PIMs and as such may be given more intensive scrutiny and care in reducing the number of PIMs.

Three patients were readmitted within 30 days of discharge; only one had a PIM (meclizine), but the PIM was unrelated to the readmission diagnosis (pleural effusion).

PIMs identified at admission were grouped into three categories using the 2012 Beers Criteria. The frequencies based on this group classification at admission were as follows: medications to avoid (61%), medications that cause disease interaction (20.3%), and medications to be used with caution (2.7%). Similar results, although slightly lower, were observed at discharge.

PIM with potential drug–disease interaction identified at admission include zolpidem (hypnotic), verapamil and diltiazem (calcium channel blockers), terazosin (alpha blocker), and pseudoephedrine and theophylline (central nervous system [CNS] stimulants). Two antipsychotics, risperidone and paliperidone, were identified at both admission and discharge as medications to use with caution.

Discussion

This study found a high prevalence of PIM use at both admission and discharge among older adult patients in a U.S. military hospital. Among the 60 patients evaluated, 44 (73%) were on at least one PIM at admission, whereas the prevalence of PIM at discharge (30 patients) was 50% ($p < .001$). The top three classes of PIM at admission were antihistamines (11, 15.3%), NSAIDs (10, 13.9%), and benzodiazepines (6, 8.3%). Patients on >10 medications at admission (37, 62%) were 4 times more likely to have a PIM ($p < .001$). Several studies that examined the prevalence of PIMs using solely the Beers Criteria reported lower rates of 30%, 32%, and 34%, respectively (Jones & Bhandari, 2013). However, studies conducted at long-term care facilities show similar or higher prevalence rates (Clyne et al., 2013).

Antihistamines (diphenhydramine, chlorpheniramine, loratadine, meclizine) were identified as the predominant PIM followed by analgesics (NSAIDs; ibuprofen, naproxen, indomethacin, meloxicam) at admission. These classes of PIMs were similar to that reported in other

Table 2. Results of Primary Endpoints Showing PIMs Prevalence and PIMs Index.

Medications	Admission	Discharge
Total medications	722	647
M number of medications (range)	12 (2-23)	10.8 (2-23)
Patients on ≥5 medications (*n*, %)	56 (93)	54 (90)
Number of PIM (*n*, %)	77 (11)	46 (7.1)
PIM index	0.11 (95% CI = [0.084, 0.13]; $p < .001$)	0.071 (95% CI = [0.051, 0.091]; $p < .001$)
PIM prevalence	73% (95% CI = [62.1, 84.5]; $p < .001$)	50% (95% CI = [37.4, 62.7]; $p < .001$)

Note. PIM = potentially inappropriate medication; CI = confidence interval.

Table 3. Common PIM Identified at Admission and Discharge Based on the 2012 Beers Criteria.

Admission	Discharge
Antihistamines • Diphenhydramine, chlorpheniramine, meclizine, loratadine	Antihistamines • Diphenhydramine, chlorpheniramine, meclizine, loratadine, hydroxyzine
NSAIDs • Ibuprofen, naproxen, meloxicam, indomethacin	Alpha blockers • Terazosin, clonidine
Benzodiazepines • Alprazolam, clonazepam, diazepam	Antiarrhythmics • Propafenone, amiodarone

Source. Campanelli (2012).
Note. PIM = potentially inappropriate medication; NSAIDs = nonsteroidal anti-inflammatory drugs.

studies (Gallagher et al., 2011; Gallagher & O'Mahony, 2008). Various studies show a clear and positive association between polypharmacy and PIM use (Akazawa, Imai, Igarashi, & Tsutani, 2010; Bao, Shao, Bishop, Schackman, & Bruce, 2012; Nixdorff et al., 2008; Varallo, Capucho, Planeta, & de Carvalho Mastroianni, 2011). We observed a similar association in our study. Approximately 93% of patients at admission had ≥5 medications, and the mean number of medications used per day prior to admission was 12.3 (range = 2-23). PIM use increased from 3.8% with ≤4 drugs to 11.7% with 5 to 9 drugs and to 47% with >15 drugs (Figure 1). Patients taking >10 medications at admission were 4 times more likely to have a PIM ($p < .001$). Although hospital readmissions have been linked with PIM use among older adult patients, our study did not find any association between PIM and readmission diagnosis within 30 days of discharge. This finding may be due in part to the small sample size.

It is interesting to report that seven patients (11.7%) had admission diagnosis that could potentially be attributed to PIM use. One patient diagnosed with weakness was on diazepam at the time of admission, another patient with syncope was on clonazepam, one patient with gastrointestinal reflux disease was on ibuprofen, one patient with dizziness was on both alprazolam and zolpidem, one patient with anemia was on naproxen, and two patients with chest pain and hypertension were on ibuprofen.

In our study, the prescribing of PIMs may have been the result of patients taking many medications and having multiple comorbidities, hospitalizations, and visits with multiple providers. The lack of a geriatric specialty clinic, the proliferation of newer medications, easy access to OTC medications, and misdiagnosing the side effect of drugs as symptoms of another clinical condition and treating with additional drugs (prescription cascade) can further increase the prevalence of PIM among such vulnerable population (Hunt, Kreiner, & Brody, 2012).

This study is the first to examine the prevalence and types of PIMs among older adult patients in a U.S. military hospital. The population used was unique in the fact that a military hospital serves a predominantly young population. Furthermore, this study is one of the first studies that used the revised 2012 Beers Criteria (Campanelli, 2012). At the time of this writing, a 2015 version of the Beers Criteria was being updated and set for release (The John A. Hartford Foundation, 2015).

This study has several limitations. One limitation of the study is the small sample size, this is due in part that only 6,500 adults >60 years old were seen at the hospital annually. The small sample size is attributed to a stringent inclusion criterion and time limitations that did not evaluate all patients receiving regular medical care for managing chronic disease states at other clinics, hence limiting the generalizability of this study. The results of this study must therefore be interpreted with caution. Data were obtained from only one department in the hospital, thus introducing selection bias. The prevalence and types of PIMs found in our results are most likely lower than the actual amount due to only including medications covered by TRICARE. For example, an OTC antihistamine taken by a patient would not have been evaluated. In addition, in our sample, only 52% of women were included. This is significantly lower than the national average of 56% of the population >65 years old who are women. Another limitation is providers' knowledge and awareness of the latest Beers Criteria. The period from which data for the study were compiled (December 2012-September 2013) may have been too close to the introduction of the revised Beers Criteria (April 2012), thus not providing health professionals sufficient time to adapt and incorporate the new evidence into their practice. We

Table 4. Regression Coefficients With Associated *p* Values for Each Regression Model.

Dependent variable	Independent variable	Regression coefficient	*p*	95% CI
PIMs at admission	Gender	.327	.23	[−0.21, 0.87]
	Age	−.047	.03	[−0.09, 0.00]
	Total number of medications at admission	.109	<.01	[0.06, 0.16]
PIMs at discharge	Gender	−.071	.67	[−0.41, 0.26]
	Age	.024	.09	[−0.00, 0.05]
	Length of hospital stay	−.009	.81	[−0.09, 0.07]
	Number of PIMs at admission	.757	<.01	[0.59, 0.92]
	Total number of medications at admission	−.130	<.01	[−0.17, −0.07]
	Total number of medications at discharge	.121	<.01	[0.07, 0.17]

Note. CI = confidence interval; PIM = potentially inappropriate medication.

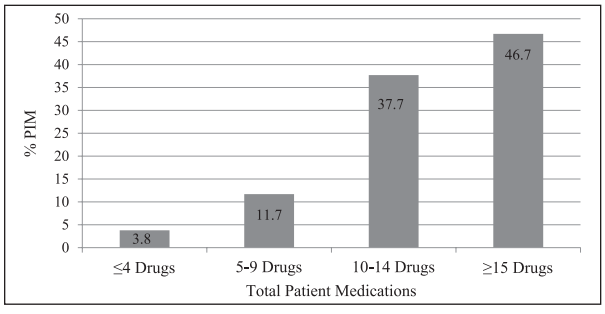

Figure 1. Relationship between polypharmacy and PIMs at admission.
Note. PIM = potentially inappropriate medication.

also recognize that there are other reasons for admission other than PIM and polypharmacy.

Finally, the list and number of medications captured were those paid for by TRICARE; filled at Womack Army Medical Center, other military hospitals, and nonnetwork pharmacies; and documented in various hospital record systems. Any medication purchased out of pocket and not provided by the patient at admission was not evaluated and could be a limitation to this study.

Conclusion

Our study shows a high prevalence of PIM among older adult patients who receive care at a U.S. military hospital.

Health care providers should screen medications to minimize polypharmacy, a major risk factor for PIM, and address PIMs and justification for their use at each hospital visit. Furthermore, health care managers must also look at ways to incorporate the Beers list into electronic prescribing systems to alert providers. Providers must be aware of the Beers Criteria and minimize PIM use except where clinically warranted to help mitigate potential harms that may be associated with using these types of medications.

The results of this study may help create awareness, and provide knowledge and understanding of the importance of the application of the Beers Criteria and PIM prevalence in the Military Health System.

Future studies should involve larger sample size, investigate justification for PIM use, analyze any association between PIM and readmission, and address comorbidity and PIM association if any.

Authors' Note

The views expressed herein are those of the authors and do not reflect the official policy of the Department of the Army, Department of Defense, or the U.S. Government.

Declaration of Conflicting Interests

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