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Original Study

A Comparison of Beers and STOPP Criteria in Assessing Potentially Inappropriate Medications in Nursing Home Residents Attending the Emergency Department

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A B S T R A C T

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Objectives: The Beers (2012) criteria and the screening tool of older persons' potentially inappropriate prescriptions (STOPP) criteria are often used to identify potentially inappropriate medication (PIM) use in elderly patients. The aim of this study is to determine the prevalence of PIM use in nursing home residents (NHRs) aged ≥ 65 years presenting to the Emergency Department (ED); to compare the Beers and STOPP criteria and to identify the potential role of PIMs in ED attendances.

Setting: The ED of an urban tertiary referral hospital.

Participants: Acutely unwell long-term care NHRs seeking medical assistance at the ED.

Design and Measurements: This is a retrospective cohort study. Demographic and clinical data were retrieved from the ED electronic record system, from the clinical records, and transfer letters for all NHRs who attended the ED in 2011. Beers 2012 and STOPP criteria were used to identify PIMs.

Results: Of 195 NHRs identified, 165 were included. The mean age (\pm standard deviation) was 82.5 (± 7.7) years; 110 (66.7%) were female and 157 (95.2%) were prescribed at least 1 PIM by either criterion. One hundred forty patients (84.8%) received a PIM according to STOPP criteria and 147 (89.1%) according to the Beers criteria. In the majority of patients (148; 89.7%), there was a difference in the medications Beers and STOPP identified as inappropriate. Fifty patients (30.3%) were considered to have a link between their attendance at ED and the PIM prescribed when assessed subjectively. Objective assessment using the WHO-UMC criteria found 7 (4.2%) had a 'probable' link and 45 (27.3%) a 'possible' link.

Conclusions: These results show a high rate of PIM prescribing in this cohort. The use of criteria such as Beers and STOPP may be a useful guide for physicians coordinating the long-term care of NHRs and may have the potential to reduce attendances at ED.

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A potentially inappropriate medication (PIM) is defined as a medication where the potential risk from its use outweighs the potential benefit.¹ The prescription of PIMs is a common phenomenon,^{2–5} and several criteria exist to assist physicians in avoiding such potentially inappropriate prescribing. Two of the most widely used

measures are the Beers criteria⁶ and the screening tool of older persons' potentially inappropriate prescriptions (STOPP)⁷ criteria.

The Beers criteria were first published in 1991 by the American Geriatrics Society and are updated regularly, most recently in 2012. The 2012 version now contains 3 sections: (1) medications that are potentially inappropriate in older adults-listed by therapeutic category or physiological system; (2) medications that are potentially inappropriate in the presence of certain diseases or conditions; and (3) a list of drugs to be used with caution in older adults. The previous 2003 Beers criteria did not group drugs by therapeutic or organ system nor did they contain a 'drugs to be used with caution' list.

The authors declare no conflicts of interest.

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Further changes included in the updated Beers criteria involve the removal and addition of specific medications; notably, cimetidine and fluoxetine were removed as their potential for interaction is not limited to older people and the list was expanded to include all benzodiazepines, both short and long acting.⁸

The STOPP criteria were designed more recently by an Irish group and use a biological systems-based approach and also include a section on duplicate drug use. It was accepted previously that the Beers criteria were more relevant in North America and the STOPP criteria in Europe; however, the most recent version of Beers is considered more applicable to European practice.⁹

The prevalence of PIM use in Irish nursing home residents (NHRs) has been reported as 59.8%,¹⁰ a higher rate than similar studies have shown in other European NHRs.^{11–13} In general, the rate of PIM use in NHRs is greater than in other populations; for example, a study of PIM use in Irish Primary Care found a prevalence of 18.3%.¹⁴ A particularly vulnerable subgroup of older patients comprises those NHRs that attend the emergency department (ED) with acute medical problems. Not only are these patients more susceptible to adverse outcomes from PIM use, but the effect of such outcomes is usually disadvantageous to the individual¹⁵ and costly to the health service.

The aims of this study are to determine the prevalence of PIM use in long-term care nursing home patients aged over 65 years presenting to the ED using both the STOPP and Beers criteria; to compare the 2 sets of criteria and to identify the potential role of PIM use in the reasons necessitating ED attendance.

Methods

This is a retrospective cohort study. The electronic record system (Symphony) in the ED of an urban tertiary referral hospital was searched for all nursing home patients greater than 65 years of age who attended in 2011. Previous reports have described in detail the characteristics and outcomes for NHRs attending the ED in this hospital.¹⁶ There are approximately 900 nursing home beds within the immediate catchment of the hospital. In addition, this hospital is a national trauma orthopedic center and occasionally cares for patients with injuries from outside the catchment area. Where patients had multiple attendances to the ED over the course of the year, the medication list and details for their first attendance was used. Patients from intellectual disability and respite care services were excluded.

Each patient record was analyzed and data on demographics, presenting complaint, comorbidities, and medical diagnoses were extracted from the clinical notes and/or the general practitioner or nursing home referral letters. Medications prescribed prior to arrival in the ED were also recorded from these sources. Any medications

commenced after arrival in the ED were not included. A Charlson Comorbidity Index score was calculated for each patient. Beers and STOPP criteria were applied to determine if a patient had been prescribed a PIM. The nature of any PIM prescribed was recorded as either cardiovascular, psychotropic, opiate, or 'other' (Table 1).

Comparisons between the 2 sets of criteria were made by noting the frequency with which certain drugs were identified as potentially inappropriate; by evaluating the concordance between the 2 criteria and by comparing negative outcomes between the 2 groups. Four outcomes were chosen: (1) the number of attendances at ED; (2) admission to hospital from the ED; (3) length of stay greater than 7 days if admitted; and (4) 12-month mortality (Table 4). Data on admission, length of stay, and mortality were obtained from each patient's electronic hospital record, whereas the number of attendances was retrieved from the electronic ED file.

To evaluate the potential role of PIMs in patients' attendance at ED, 2 approaches were taken. A subjective analysis was achieved by a clinical panel, comprising 2 physicians in geriatric medicine (A.G., R.B.), who together evaluated the documented presenting complaint, medications prescribed, and any comorbid illnesses; these were compared with identified PIMs and reviewed to assess the potential role of those drugs in the patient's attendance at ED. The WHO-UMC causality system was used for objective assessment.¹⁷ This system is made up of 6 categories of causality in relation to adverse drug events: 'certain,' 'probable or likely,' 'possible,' 'unlikely,' 'conditional/unclassified,' and 'assessable/unclassifiable.' Its focus is pharmacovigilance and drug monitoring, and it is designed for use in case-reports. The system states clearly that it is not able to prove a definitive connection between drug use and adverse events, nonetheless, it is a useful tool for objectifying the assessment of causality.

Statistical analysis was completed using SPSS 20 (SPSS Inc, Chicago, IL). Data are presented as means \pm one standard deviation. Phi correlation coefficient and kappa statistic were calculated for the relationship between PIMs identified by Beers and by STOPP. Relative risk and odds ratios were calculated for the risks of negative outcomes in patients prescribed a Beers PIM compared with a STOPP PIM.

Results

There were 409 ED attendances by 206 patients aged over 65 years coming from 30 different nursing homes in 2011. Of the 206 patients identified, 195 (94.7%) fulfilled the inclusion criteria and of these patients, a pre-admission medication list was available for 165 (84.6%) (Figure 1) who attended from 22 different nursing homes.

One hundred ten patients (66.7%) were female. The mean age (\pm SD) was 82.5 (\pm 7.7) years. The mean number of medical diagnoses

Table 1
List of Potentially Inappropriate Medications Prescribed

Medications Identified as Potentially Inappropriate (Beers and STOPP) (n = Frequency of Prescription)			
Psychotropic	Cardiovascular	Opiate	Other
Antipsychotics (68)	Antiplatelets (66)	BuTrans patch (6)	PPI (33)
Benzodiazepines (66)	Diuretics (35)	Tramadol (3)	Drugs acting on GIT (14)
Nonbenzodiazepine hypnotics (59)	Nitrates (6)	Meperidine (3)	Alpha antagonists (6)
SSRI (45)	Calcium Channel Antagonists (4)	Oxycontin (3)	Antimuscarinics (6)
Anti-epileptics (21)	Beta antagonists (5)	Tylenol (1)	NSAIDs (5)
Mirtazepine (19)	Warfarin (5)	MST (1)	Nitrofurantoin (3)
Venlafaxine (11)	Digoxin (2)	Fentanyl patch (1)	Antihistamines (3)
TCA (6)	Ace Inhibitors (1)		Anti-diabetic drugs (3)
Duloxetine (2)			Miscellaneous* (5)
Total frequency of prescription			
297	124	18	78
Total number of medications identified as potentially inappropriate = 91			

*Miscellaneous includes Biperiden, procyclidine, paracetamol, prednisolone, combivent nebulas.

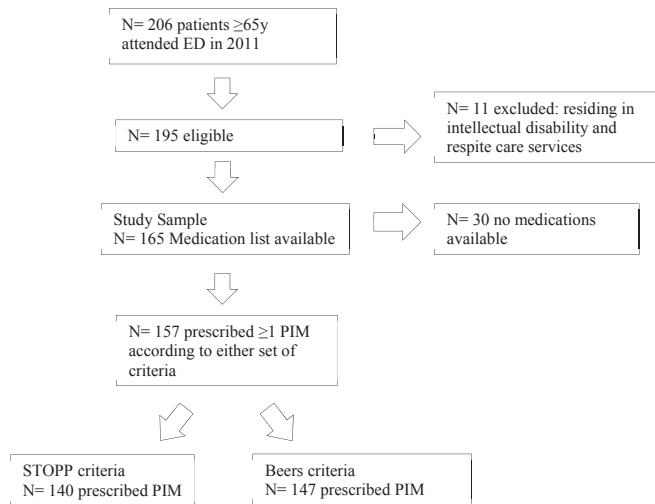


Fig. 1. Patient selection for assessment of PIM use in NHRs.

was 6.43 (± 3.14) and the Charlson Comorbidity Index scores revealed a high burden of comorbid illness with an average score of 6.95 (± 1.7). The most common reason for attending the ED was a fall ($n = 45$, 27.3%), followed by respiratory pathology: either a lower respiratory tract infection or an infective exacerbation of chronic obstructive pulmonary disease ($n = 26$, 15.8%) (Figure 2).

The number of medications prescribed ranged from zero to 25, median 10, with 78 patients (47.3%) being prescribed 10 or more medications. In total, 242 different drugs were prescribed across the patient cohort, and 91 different medications were identified as PIMs according to either the Beers or STOPP criteria (Table 1).

Potentially Inappropriate Medications

One hundred fifty-seven patients (95.2%) were prescribed at least 1 PIM by either criterion. Of the 165 patients in the study, 140 (84.8%)

Table 2
Comparison of Frequently Prescribed PIMs Beers vs STOPP

Most Commonly Prescribed PIMs by Beers vs STOPP (n = Frequency of Prescription)	
Beers	STOPP
Antipsychotics (68)	Antipsychotics (68)
Benzodiazepines (66)	Antiplatelets (49)
Nonbenzodiazepine hypnotics (59)	Benzodiazepines (44)
Antiplatelets (59)	PPIs (33)
SSRIs (45)	DDC (29)

received a PIM according to STOPP criteria and 147 (89.1%) according to the Beers criteria (Table 2). Without differentiating between STOPP and Beers, the most common type of PIM prescribed was psychotropic medication in 130 patients (78.8%). These medications include selective serotonin re-uptake inhibitors (SSRIs), mirtazapine/duloxetine, antipsychotics, nonbenzodiazepine hypnotics, and benzodiazepines. The next most frequent type of PIM prescribed was a cardiovascular drug in 88 patients (53.3%); medications in this group included aspirin, diuretics, and beta-blockers. Fourteen patients (8.5%) were prescribed an opiate PIM, whereas 50 patients (30.3%) were prescribed 'other' PIMs (Table 1).

Beers vs STOPP

According to the STOPP criteria, 113 (68.5%) patients were prescribed a psychotropic PIM, 85 (51.5%) a cardiovascular PIM, and 14 (8.5%) an opiate PIM; when using the Beers criteria, 133 (80.6%) were prescribed a psychotropic PIM, 80 (48.5%) a cardiovascular PIM, and 12 (7.3%) an opiate PIM. The most commonly prescribed classes of PIMs according to each criterion are listed below (Table 2). This reveals some of the differences and similarities between the criteria, for example, both recommend avoiding long-term antipsychotic use as hypnotics or for behavioral problems of dementia or use with a history of falls. The differences are also apparent: STOPP criteria recommend avoiding SSRIs only if a history of clinically significant

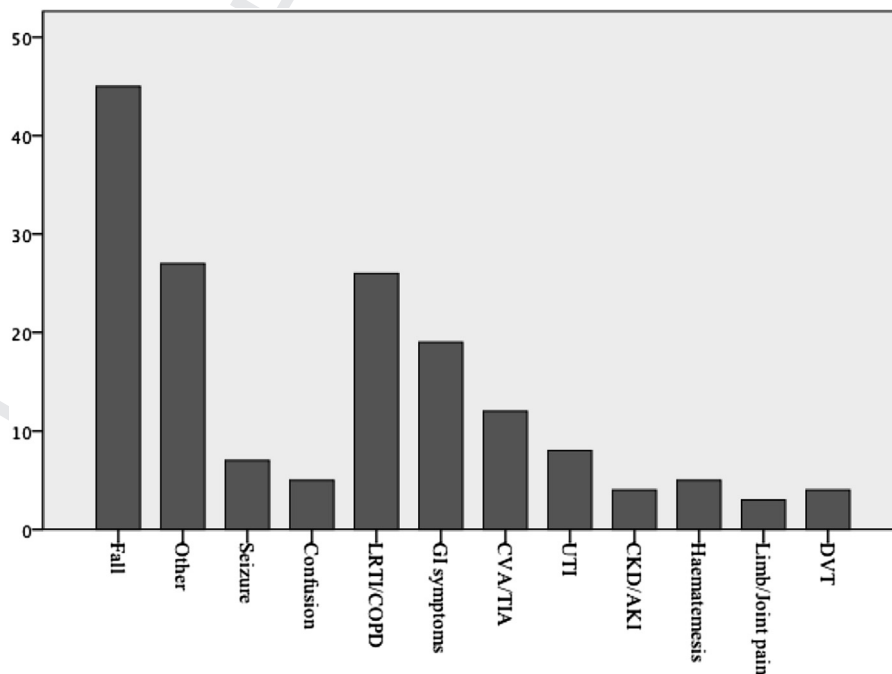


Fig. 2. Reasons for attending the Emergency Department. *Other includes epistaxis, thrombophlebitis, electrolyte abnormalities, tonsillitis, and acute cholecystitis.

Table 3
Beers/STOPP Criteria Concordance

	STOPP+	STOPP–	Total
Beers+	128	19	147
Beers–	12	6	18
Total	140	25	165

hyponatremia is present, whereas Beers advises that SSRIs be used with caution in all elderly patients. Beers also includes non-benzodiazepine hypnotics, whereas STOPP does not.

Interestingly, in the majority of patients (148; 89.7%) there was a difference in the medications Beers and STOPP identified as potentially inappropriate. Despite these differences in the individual medications identified by the 2 criteria, they do identify largely the same group of patients with concordance in 134 cases (81.2%) (Table 3). Kappa statistic for this data is 0.18 indicating a slight agreement, however, phi correlation coefficient was calculated at 0.232 (P value .003), and this shows a significant relationship compared with the χ^2 value (8.855).

Relative risk and odds ratios were calculated for negative outcomes (length of stay greater than 7 days, 12 month mortality, greater number of attendances at ED, and visit to ED resulting in admission) in patients prescribed Beers PIMs vs those prescribed PIMs identified using STOPP criteria (Table 4). These show that there is largely no difference in the risk of negative outcomes occurring between the 2 groups.

Association between PIM and Reason for Attending ED

When assessed by subjective clinical judgment, 50 patients (30.3%) were considered to have a 'probable' link between their attendance at ED and the PIM they were prescribed. The majority (42/50, 84%) of these patients was at risk of a fall or had a history of falls or fractures and was then prescribed a medication designated as potentially inappropriate because of the patient's history of falls. The relationship between PIM use and falls in elderly patients attending the ED has been previously reported.¹⁸ Five patients presented acutely with confusion, and all were on medications classed as inappropriate by Beers and STOPP because of their potential to increase or cause confusion. According to the WHO-UMC causality criteria, 7 (4.2%) patients had a 'probable' association; 45 (27.3%) a 'possible' and 106 (64.2%) an unlikely association (the remaining 7 patients had no PIM prescribed).

Discussion

These results indicate that most NHRs (157, 95.2%) who attend the ED are prescribed at least 1 potentially inappropriate medication. This has repercussions for the individual and also for health care systems: it has been estimated that PIM use in Ireland costs approximately €45 million per year.¹⁹ A 2009 report from Ireland's regulatory body, the Health Information and Quality Authority, recommended that NHRs on long-term medication should have this medication reviewed

on a 3-month basis.²⁰ The use of criteria such as Beers and STOPP has the potential to be a useful guide to physicians coordinating the long-term care of this often complex and frail cohort.

When comparing Beers and STOPP criteria, a number of differences become apparent. In this population, Beers criteria identified a greater number of PIMs largely because of the inclusion of more sedative medication and to the provision of lists of medications to be used with caution. This list includes medications commonly prescribed in this cohort, for example: antipsychotics, SSRIs, and mirtazapine. Unlike the STOPP criteria, Beers' criteria do not include PPIs or a section on duplicate drug use, both of which occur commonly in these patients. However, despite these differences, it is important to note that both sets of criteria identified largely the same patients and that there was no difference in risk of adverse outcomes when comparing patients prescribed a PIM according to Beers' criteria to those prescribed a PIM according to STOPP criteria. It may be that perhaps the most important function of these instruments is not their ability to identify specific drugs but their role in highlighting vulnerable patients who may benefit from ongoing medication review.

This study identified a link between the presence of PIM use and attendance at ED in 30.3% of patients when assessed subjectively and in almost 30% using objective measures. As the WHO-UMC causality assessment system is designed for use in pharmacovigilance, it is perhaps more suitable for assessing the role of 1 drug in an adverse event while many of the patients in this study were prescribed more than 1 PIM. The most important association that emerged was the link between PIM use and attending the ED with a fall. Falls have the potential for devastating consequences to patients, and any opportunity to reduce their incidence, such as their potential link with PIM use, must be explored and exploited.

There are some limitations to this study. Although it is a single site study, it is likely to be representative of the situation in most Irish hospitals. Data on prehospital medication were unavailable for 30 of 195 patients (15.4%). The study is also limited by its retrospective design, in particular with regards to confirmation of the presenting complaint and conditions that may not have been recorded in the notes. The investigators did not have access to some information such as previous blood test results and so may not have identified all patients with a history of hyponatremia or chronic renal disease. Having access to detailed electronic and hard-copy medical and nursing records offset these limitations. The clinically complex nature of this population and the high rate of PIM use made this study ideal for comparing the 2 sets of prescribing criteria. In addition, given the nature of the study, the ascribed objective and the population, there were no confounding agents identified that were likely to skew or bias the data.

Several studies have compared the STOPP criteria with the new Beers 2012 criteria. The results so far are mixed with some research, including data from Ireland, detecting a higher prevalence of PIMs using STOPP criteria compared with the Beers criteria.^{21,22} Another study, however, found a greater rate of PIM use with the Beers criteria.²³

Table 4
RR and OR for Patients Prescribed a PIM Identified Using the STOPP vs Beers Criteria

	ED Attendances		Admission		LOS ≥ 7 Days		12-Month Mortality*	
	≥ 2	< 2	Y	N	≥ 7	< 7	RIP	Alive
STOPP PIM (n)	79	62	91	50	48	93	35	106
Beers PIM (n)	79	65	92	52	49	95	38	106
RR (95% CI)	1.020 (0.8–1.3)		1.009 (0.75–1.3)		1.000 (0.85–1.2)		0.939 (0.85–1.1)	
OR (95% CI)	1.090 (0.66–1.7)		1.029 (0.63–1.7)		1.001 (0.61–1.6)		0.921 (0.54–1.6)	

CI, confidence interval; OR, odds ratio; RR, relative risk.

Conclusions

This research shows that this frail and vulnerable group of long-term NHRs needs more attention given to the medications they are prescribed. The attendance of these patients at ED should be considered an opportunity for ED and hospital physicians to review their medications with a view to limiting potential adverse events and readmissions in the future. The STOPP and Beers criteria can prove useful tools to assist physicians in this task. Although there are differences between the criteria, the fact that they largely identify the same cohort of patients suggests that both successfully achieve their aim, which is to make doctors reflect regularly on repeat prescriptions and most importantly to think before they prescribe for their frail older patients.

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