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Factors associated with an increased risk of potentially inappropriate prescriptions at hospital discharge in comorbid older patients

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ABSTRACT

Objective: The objective of this study was to identify clinical or demographic variables associated with potentially inappropriate prescriptions (PIP) at hospital discharge in older patients.

Method: A single-center, cross-sectional study was performed on patients aged ≥ 65 years who had been discharged from a university hospital. Data on the patients' demographics, primary diagnosis, prescribed medications, and related pathologies were collected, and each patient's Charlson co-morbidity index was calculated. The Beers (2012) and STOPP (2008) criteria were used to define PIP, and the strength of the association between each variable and the presence of PIP was estimated.

Results: Six hundred twenty-four persons were included in the study. The frequency of PIP was not associated with the patients' sex, age, or length of hospital stay. However, it was associated with the number of medications prescribed and was higher for patients discharged from the internal medicine service (Beers: cOR 2.39, 95% CI 1.47-3.90; STOPP: cOR 2.21, 95% CI 1.44-3.38). Besides these factors, when the Beers criteria were used to define PIP, several comorbid conditions were associated with a significantly higher frequency of PIP. For STOPP criteria, only the presence of hypertension or chronic obstructive pulmonary disease acted as independent risk factors. Ischemic heart disease and cerebrovascular disease acted as protective factors in both criteria.

Conclusion: The risk factors for PIP differed depending on the type of criteria used to define PIP. However, the results of this study highlight the importance of hypertension management on the prevention of PIP.

INTRODUCTION

Potentially inappropriate prescriptions (PIP) are a widespread problem among older patients[1,2] and are associated with several negative health outcomes such as adverse drug events, hospitalization,[3-5] and high costs.[6] A recent study in a primary care setting showed that reducing PIP in older patients may help to lower the burden of adverse drug events, reduce costs associated with hospital visits, and increase patients' quality of life.[7] However, further studies are necessary at all levels of health care to clarify the associated factors and underlying causes of PIP [8].

Among the most frequently used tools to identify PIP and improve the process of prescribing drugs to older patients are the

Beers criteria (recently updated in 2012) and the Screening Tool of Older People's potentially inappropriate Prescriptions (STOPP) criteria. [9,10] Different approaches have been undertaken to identify and reduce PIP,[11-13] and the outcomes of these approaches have shown that PIP can be minimized and even prevented. Widespread agreement exists regarding the notion that it is necessary to identify those patients with a higher risk of PIP, [14-16] as well as those drugs with a higher risk of being involved in PIP. [17-19]

Along with advanced age, the main factors influencing the risk of receiving PIP and the negative outcomes associated with these medications are polypharmacy (a higher risk is associated with a greater number of drugs prescribed) and female sex. [14,19,20] In a few studies, the number of prescribers, [21,22] multiple diseases, [23] black skin color, [24] and institutionalization [17] were also associated with a higher risk of PIP. Most such studies were performed in the primary care setting or at hospital admission. Very few [25,26] analyzed the factors associated with PIP at hospital discharge, which is an especially critical period with respect to the transition between levels of care.[27] Hospital discharge represents a potentially effective target for the reduction of PIP.

The objective of this study was to identify the factors associated with PIP in older patients (≥ 65 years of age) at hospital discharge, as defined by the Beers (2012) and/or STOPP (2008) criteria.

METHOD

Patients and study design

This cross-sectional study was performed on older patients (≥ 65 years of age) who had been discharged from the San Cecilio University Hospital, Granada from 1 July 2011 to 30 June 2012. Selection of patients and information sources have been reported in the previous article by Hudhra K et al. [28] the final sample included 624 patients.

Data analysis

The statistical package Stata, version 10.0 (Stata Corp LP) was used for data analysis. We estimated the strength of the association between each variable and the presence of at least one PIP by calculating the odds ratio (OR) and 95% confidence interval (CI). Adjustment for confounding variables was performed using a multiple logistics regression model that included all variables with a statistically significant effect, along with the patients' sex and age. Both saturated and selected models were estimated by a stepwise forward algorithm with an entry level of $p<0.25$.

RESULTS

The study population comprised slightly more men (54.9%) than women and had a mean age of 77.7 years [standard deviation (SD), 6.8 years], with a predominance of 75- to 84-year-old. The mean number of drugs prescribed per patient was 8.5 (SD, 3.6). The mean Charlson co-morbidity index was 3.2 (SD, 1.4). **Table 1** shows the distribution of pathologies in the study population.

Table 1. Distribution of pathologies in the study population.

Pathology	N	%
Moderate to severe hypertension	395	63.30
Antecedents of ischemic cardiopathy, CVD, PAD or arterial occlusion	209	33.49
Renal failure	191	30.61
Cardiac failure	172	27.56
COPD	165	26.44
Arrhythmia	159	25.48
Permanent atrial fibrillation	105	16.83
Prostatism	67	10.74
Dementia	42	6.73
Gout	33	5.29
Gastro duodenal Ulcer	22	3.53
Parkinson Disease	8	1.28

Abbreviations: CVD=Cerebrovascular Disease, PAD=Peripheral Arterial Disease, COPD=Chronic Obstructive Pulmonary Disease

The overall number of PIP identified by the Beers criteria was 143 among 20.8% of the discharged patients had one PIP identified by the Beers criteria; this number was lower than that identified by the STOPP criteria (240 PIP among 38.4% of the discharged patients).

The patients' sex and length of hospital stay did not seem to be associated with PIP, unlike the type of hospital service, which was found to have a statistically significant influence ($p<0.01$) according to both criteria **(Table 2).** The risk of PIP was higher among patients discharged from the internal medicine service [Beers: adjusted odds ratio (aOR), 2.7; 95% CI, 1.4–5.2; STOPP: aOR, 2.3; 95% CI, 1.3–4.0] than among patients discharged from surgical services. The higher risk of PIP among patients discharged from the internal medicine service was maintained even when adjusting for potential confounding variables. Increasing age was a significant risk factor for PIP only when adjusting for other comorbid conditions and the number of drugs using the Beers criteria. The Charlson comorbidity index was a risk factor for PIP according to the Beers criteria (aOR, 1.1; 95% CI, 1.0–1.3), but not when PIP were defined by the STOPP criteria.

Table 2. Crude and adjusted association between study variables and PIP defined for Beers and STOPP criteria.

Variable	Beers Criteria						STOPP Criteria					
	cOR	CI 95%		aOR[4]	CI 95%		cOR	CI 95%		aOR[4]	CI 95%	
Gender[1]	1,00	0,69	1,46	1,04	0,70	1,54	1,05	0,76	1,44	1,07	0,76	1,55
Age (years)	1,02	0,99	1,05	1,03	1,00	1,06	1,01	0,99	1,04	1,02	0,99	1,04
Internal Medicine Service[2]	2,39	1,47	3,90	2,74	1,44	5,21	2,21	1,44	3,38	2,31	1,34	4,00
Other Medical Services[2]	1,19	0,73	1,93	1,60	0,86	2,99	1,20	0,81	1,79	1,43	0,85	2,38
Charlson comorbidity Index	1,16	1,03	1,32	1,00	0,84	1,20	1,05	0,94	1,18	0,98	0,85	1,13
Number of drugs	1,14	1,08	1,20	1,14	1,08	1,20	1,15	1,09	1,20	1,15	1,10	1,21
Length of hospital stay	1,01	0,99	1,03	1,01	0,98	1,03	1,01	0,99	1,03	1,00	0,99	1,03
Revision of clinical history[3]	1,46	0,96	2,22	1,76	1,13	2,74	1,31	0,90	1,91	1,52	1,02	2,26
Moderate to severe hypertension[3]	2,19	1,43	3,35	1,76	1,13	2,76	2,69	1,88	3,86	2,24	1,54	3,28
Antecedents of ischemic cardiopathy, CVD, PAD or arterial occlusion[3]	0,57	0,37	0,87	0,44	0,28	0,70	0,51	0,36	0,73	0,39	0,26	0,57
COPD[3]	1,32	0,88	1,99	1,08	0,69	1,68	2,01	1,40	2,89	1,79	1,21	2,63
Cardiac failure[3]	2,80	1,89	4,15	2,40	1,54	3,73	1,54	1,08	2,19	1,19	0,80	1,77
Arrhythmia[3]	2,57	1,72	3,83	2,29	1,50	3,48	1,46	1,02	2,11	1,25	0,85	1,83
Permanent atrial fibrillation[3]	2,91	1,86	4,54	2,51	1,58	4,00	1,19	0,78	1,82	0,98	0,62	1,53
Renal failure[3]	2,74	1,86	4,04	2,36	1,52	3,65	1,27	0,90	1,80	1.03	0,70	1,54
Gastro duodenal Ulcer[3]	0,33	0,08	1,42	0,41	0,09	1,84	0,74	0,30	1,84	1,00	0,39	2,58
Prostatism[3]	2,21	1,30	3,78	2,71	1,48	4,97	0,70	0,41	1,21	0,68	0,38	1,22
Dementia[3]	7,23	3,73	14,03	8,21	4,05	16,62	1,50	0,80	2,80	1,50	0,77	2,89
Parkinson Disease[3]	2,04	0,48	8,64	1,44	0,31	6,75	1,61	0,40	6,50	1,05	0,24	4,66
Gout[3]	2,64	1,29	5,41	2,08	0,97	4,44	2,59	1,27	5,32	2,22	1,04	4,72

[1]Reference: men; [2]Reference: surgical services; [3]Reference: patients without this condition
[4]Adjusted by sex, age, Charlson comorbidity index, number of drugs, and revision of clinical history
Abbreviations: cOR=Crude Odds Ratio, aOR=Adjusted Odds Ratio, CVD=Cerebrovascular Disease, PAD=Peripheral Arterial Disease, COPD=Chronic Obstructive Pulmonary Disease

The number of prescribed drugs was another evident risk factor, as shown in **Table 2.** Specific comorbid conditions that influenced the occurrence of PIP as identified by the Beers criteria were hypertension, cardiac failure, arrhythmia, permanent atrial fibrillation, renal failure, prostatism, and particularly dementia (aOR, 8.2; 95% CI, 4.0–16.6). Conversely, preexisting ischemic cardiopathy, cerebrovascular disease, and peripheral arterial disease acted as protective factors (aOR, 0.4; 95% CI, 0.2–0.7). Analysis of the remaining analyzed comorbid conditions revealed no significant association.

When the STOPP criteria were used for PIP identification, only hypertension, chronic obstructive pulmonary disease, and gout increased the risk of PIP, while the protective factors were identical to those identified using the Beers criteria (aOR, 0.3; 95% CI, 0.2–0.5).

Considering only the PIP associated with the five drugs or drugs groups most frequently used, the associated factors were almost identical between the two criteria (data not shown), the only difference being a lower effect of dementia in the STOPP criteria than in the Beers criteria (OR, 3.1; 95% CI, 1.5–6.3).

DISCUSSION

A reduced frequency of PIP is a targeted intervention strategy for improved pharmacotherapy in older patients. Identifying both the risk and protective factors associated with PIP would greatly help in their detection and careful consideration. [14]

Being discharged from the internal medicine service was associated with a significantly higher risk of PIP than being discharged from surgical services. This may have been owing to the higher age of patients admitted to the internal medicine service; such patients generally have more comorbidity and prescribed drugs. However, this effect was maintained when the analysis was adjusted for these variables, including adjustment for the need to review the clinical history, which indirectly assesses the quality of the discharge report.

Unlike other studies, [14,20,21] we found no association between the frequency of PIP and increasing age or sex, with the exception of increasing age with the Beers criteria after adjustment for other pathological conditions and the number of drugs. The pathological conditions mostly associated with PIP in both criteria were moderate to severe hypertension (risk factors) and preexisting ischemic cardiopathy, cerebrovascular disease, and peripheral arterial disease (protective factors). Hypertension as an important risk factor is most clearly understood by analyzing both criteria because specific drug groups were considered to be inappropriate when prescribed in patients with hypertension (Beers: alpha blockers; STOPP: NSAIDs and loop diuretics). Preexisting ischemic cardiopathy, cerebrovascular disease, and peripheral arterial disease acted as protective factors for PIP according to both criteria. This can be easily explained for STOPP criteria by the fact that aspirin was not considered to be inappropriate in the presence of these conditions, however we have no any comparable explanation for Beers criteria.

When factors associated with PIP were analyzed separately for Beers and STOPP, other pathological conditions seemed to have a greater influence, particularly dementia for Beers and chronic obstructive pulmonary disease for STOPP. Dementia ceased to be a risk factor with application of the STOPP criteria. This is explained by the fact that benzodiazepines were considered to be potentially inappropriate when prescribed in the presence of dementia only according to the Beers criteria. Chronic obstructive pulmonary disease acted as a risk factor only for the STOPP criteria because of the inappropriate prescription of non-cardio selective beta-blockers. These drugs were always inappropriate according to the Beers criteria; however, when the STOPP criteria were used, they were considered to be inappropriate only in the presence of chronic obstructive pulmonary disease.

The pathological conditions that acted as risk factors for PIP only with the Beers criteria are explained by the specific drug–disease interactions described in this set of criteria, such as NSAIDs and spironolactone prescribed in the presence of renal failure and cardiac failure or antiarrhythmic drugs prescribed in the presence of permanent atrial fibrillation.

The differences identified in the present study reflect the different contents of the two criteria, suggesting the need for consensus on the optimal tool for PIP identification, as already noted by Vishwas et al. [23]

Even after narrowing the PIP definition to only the five drug groups associated with more frequent PIP, the associated factors remained the same.

The validation of prescribed treatment at discharge by clinical pharmacists would improve the quality of such treatment. Identifying the factors associated with increased risk of PIP would enable to select the groups of patients who would benefit more from medication reconciliation by pharmacists, therefore improving the efficiency of the intervention. It could also allow generating an alert for a closer monitoring of these patients in primary care.

The main limitation of our study is the restriction of the study population to one university hospital in southern Spain; therefore the results should be reproduced to other health centers and populations. The essential strength is the identification of factors associated with PIP, detected by two different tools, in a particular critical moment of care transition such as hospital discharge, suggesting possible targets for intervention.

CONCLUSION

Risk factors for PIP according to both criteria used (Beers and STOPP) were discharge from the internal medicine service, a higher number of prescribed drugs, and the presence of moderate to severe hypertension. Conversely, preexisting ischemic cardiopathy, cerebrovascular disease, peripheral arterial disease, and arterial occlusion acted as protective factors. For the Beers criteria, additional pathological conditions were found to increase the risk of PIP, namely cardiac failure, arrhythmia, permanent atrial fibrillation, renal failure, and dementia.

Overall, the results of this study revealed differences between the risk factors for PIP depending on the type of criteria used to define PIP. However, both sets of criteria highlight the importance of hypertension management on prevention of PIP.

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CONTRIBUTION OF AUTHORS

ABC, KH and MGC designed the study. KH and ECF identified the patients and collected the necessary data. KH, MGC and OMA applied the criteria. OMA and ABC completed the statistical analysis. ABC, KH, MGC and BJ interpreted the results. KH wrote the manuscript. All authors read and approved the final manuscript.

COMPETING INTERESTS

None declared.

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