

The Prevalence of Potentially Inappropriate Medications Prescribed in Elderly Patients Admitted in a Tertiary Teaching Hospital: A Retrospective Cross-Sectional Study

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Abstract

Background: The number of elderly people (aged 60 years or over) is expected to double in the next 35 years as a result of decreasing mortality and declining fertility worldwide. The elderly population is at increased risk of being prescribed potentially inappropriate medications (PIM).

Objectives: To determine the prevalence of PIM prescribed among the geriatric patients admitted in a tertiary teaching hospital in Valenzuela City in 2014.

Methods: This is a retrospective cross-sectional study on patients who are 65 years and older admitted under Internal Medicine between January 2014 to December 2014. Medical records were reviewed for PIM prescription according to the updated 2012 Beers Criteria.

Results: PIMs were noted in 303 out of 618 patients. The most common PIMs were insulin sliding scale, digoxin, orphenadrine, ipratropium, ketorolac, clonazepam, clonidine, hydroxyzine, amiodarone and spironolactone.

Conclusion: The prevalence of PIM prescription is 49% among geriatric patients admitted in a tertiary teaching hospital in Valenzuela City in 2014. It is recommended to determine prevalence of PIM use in other geriatric care settings, the predictors for PIM use, and the economic burden of PIM use.

Keywords: potentially inappropriate medications, PIM prescription, geriatric patients

Introduction

Globally, the number of older persons (aged 60 years or over), which at present is predominantly female, is expected to increase, from 841 million people in 2013 to more than two billion, in 2050. This population ageing results from decreasing mortality, and, most importantly, declining fertility. Older persons are projected to exceed the number of children for the first time in 2047. Presently, about two thirds of the world's older persons live in developing countries. Because the older population in less developed regions is growing faster than in the more developed regions, the projections show that older persons will be increasingly concentrated in the less developed regions of the world. It is projected that by 2050, nearly eight in 10 of the world's older population will live in the less developed regions.¹

In the Philippines, it is estimated that the elderly comprise 4.3 million of the country's more than 73 million population in 2013, of whom at least more than one million are classified

as indigents. By 2040 the country's senior citizen population is estimated to increase to 19.6 million per National Statistics Office (NSO), which bring significant concerns about our elderly people today.²

Due to the presence of multiple chronic diseases and conditions in the elderly, there is a great risk for medication-related problems as a result of age-related physiological changes and the types and numbers of prescription and non-prescription medications they consume.³ Likewise, potentially inappropriate medications (PIMs) add an economic burden to the elderly and their families in the setting of limited resources in a developing country. With the projected increase in the elderly population, the economic burden becomes even more significant on a national level.

The elderly patients consume medications at a comparatively high rate and numerous other factors add to the increased prevalence of medication-associated morbidity and mortality affecting this vulnerable population. Contributing to this are the physiologic changes associated with aging. The Center for Medicare and Medicaid Services in the US recognized that consumption of multiple medications is an expensive practice and costs its nation's health plans more than US\$50 billion annually.⁴

Currently, a PubMed search using the words "prevalence", "elderly", "PIMs", and "Philippines", found no matched items, hence, this could be the first prevalence

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study on the use of PIMs locally. Additionally, since there are plans to put up a geriatrics section in this hospital within the next two years, this study can increase awareness among admitting physicians of the internal medicine department on the prevalence of PIMs prescription and the updated Beers Criteria.

An increase in inter-individual variability is the main change in pharmacokinetics with aging. Of the pharmacokinetic changes seen in normal aging, reduced hepatic and renal clearance are generally the most significant, and these affect maintenance dose and dosing interval. The changes in volume of distribution are smaller, and affect the half-life of drugs (to a lesser extent than the changes in clearance do) and the loading dose. The main changes in bioavailability with aging result from reduced first pass metabolism, with increased bioavailability of drugs that undergo significant first pass hepatic metabolism and decreased activation of prodrugs. Pharmacodynamic changes with aging are less well-characterized or understood than pharmacokinetic changes.⁵

Since drug-related problems on the elderly population has received worldwide attention, various measures have been implemented to reduce the likelihood of such complications like developing implicit and explicit criteria.

One of the first set of explicit criteria for inappropriate drug use was developed by Mark H. Beers, MD, while a junior faculty at the University of California, Los Angeles and was published in 1991. He defined inappropriate prescribing as the use of medication where the potential risks outweigh the potential benefits.⁶ Hence derived the term "potentially inappropriate medication" or "PIM". The criteria were subsequently revised in 1997 and 2003 to include all settings of geriatric care. The 2012 version was a product of a comprehensive, systematic review and grading of evidence by an 11-expert interdisciplinary panel, on drug-related problems and adverse drug events in adults with support from The American Geriatrics Society. Fifty-three medications or medication classes encompass the final updated criteria, which are divided into three categories: PIMs and classes to avoid in older adults, PIMs and classes to avoid in older adults with certain diseases and syndromes that the drugs listed can exacerbate, an finally medications to be used with caution in older adults.⁷

Numerous researches on the subject of PIMs have been done in different parts of the world – prevalence, risk factors, and clinical outcomes. These studies revealed different prevalence of PIM use in different settings. Harugeri et.al. in 2009 concluded that PIM was common (23.5% prevalence) among elderly patients during their stay in medicine wards in two tertiary care hospitals in India.⁸ One study of de Lima et.al. in 2013 in Brazilian care homes revealed 82.6% of elderly were taking at least one PIM according to updated Beers

criteria, with antipsychotics and analgesics being the most commonly used.⁹ Another study by Al-Shamri in 2014 which determined the prevalence of PIM use in recently admitted geriatric patients in rural hospitals showed 60-70% were taking at least one PIM when Beers and STOPP (Screening Tool of Older Persons' Potentially Inappropriate Prescriptions) criteria were utilized.¹⁰

Some studies have determined the factors associated with or predictors of PIM use. And these were polypharmacy, psychiatric disorders, cerebrovascular diseases and dependency.⁹ While in the study by Undela in 2014, the important predictors of PIM prescribing were found to be age ≥ 80 years, male sex, >3 diagnoses, ≥ 6 medications prescribed, and ≥ 10 days of hospital stay.¹¹

A study by Floroff et.al. revealed that PIM use is associated with poor clinical outcomes and longer lengths of stay in critically ill elderly patients with neurological injury and they recommended further studies to determine the impact of PIM use on mortality.¹² Rosemann et.al. in 2014 concluded that cumulative levels of PIM use acted significantly as a factor related to greater hospitalization rates in older patients in Swiss managed care plans.¹³ Onda et al have found that adverse drug events caused by PIMs had occurred in 8.0% of patients routinely visited by a pharmacist.¹⁴

Objectives

General Objective: To determine the prevalence of PIMs prescription among geriatric patients admitted in a tertiary teaching hospital in Valenzuela City from January 2014 to December 2014.

Specific Objectives:

1. To describe the sociodemographic and clinical profile of admitted geriatric patients included in the study
2. To determine the frequency of PIMs commonly prescribed to admitted geriatric patients included in the study

Methods

This is a retrospective cross-sectional study and involved medical charts of all patients aged ≥ 65 years admitted under the Department of Internal Medicine from January 2014 to December 2014.

Inclusion Criteria: Medical charts of patients aged 65 years and above who were admitted in the ward and ICU for more than 24 hours up to 60 days.

Exclusion Criteria: Medical records of patients who:

1. Died <24 hours of admission
2. Went home against medical advice
3. Were transferred to different service within the hospital
4. Were transferred to different institution
5. Are in hospice care

The study was done in an ISO certified, tertiary teaching hospital in Valenzuela City, Metro Manila serving patients coming from the Caloocan, Malabon, Navotas, Valenzuela (CaMaNaVa) and the southern areas of Bulacan province from June - October 2015. Medical charts of all patients aged ≥ 65 years admitted under the Department of Internal Medicine from January 2014 to December 2014 were retrieved from the Records Department and thoroughly reviewed. A total of 618 patients' charts were reportedly available and evaluated.

A cross-sectional study design was used to form the database for this study. In this design, there was a purposive probe of all geriatric patients' charts available covering period January 2014 to December 2014 who were admitted in the Department of Internal Medicine and then later arrive at conclusions about the frequency of PIM use. All the 618 patients aged ≥ 65 years, receiving at least one medication during hospital stay were purposely sorted out to form the database for this investigation. General demographic characteristics such as age, gender, comorbidities, maintenance medications, length of hospital stay, and number of drugs prescribed during hospital stay were noted. Beers Criteria 2012 were used to assess PIM use.

Statistical Analysis: The various frequencies were entered into Microsoft EXCEL for Windows (version 2013) and the figures and tables all developed.

Results

A total of 618 patients aged ≥ 65 years were included (Table I). The age is divided into subgroups ≥ 65 -74 years ("young old"), 75-84 years ("old old"), and ≥ 85 years ("oldest old"). The number of comorbidities were from zero to five diseases. The five most frequent comorbidities were hypertension (79%), diabetes mellitus type 2 (35%), previous stroke (20%), bronchial asthma/COPD (14%), and benign prostatic hyperplasia (6.0%). On an average, the patients were taking four (range 0-9) maintenance medications. The patients stayed in the hospital for an average of six (range two to 32) days. During their admission, the patients received an average of 12 drugs.

PIMs was observed in 124 (56%) males and 179 (45%) females. The patient age subgroup with the highest prevalence of prescribed PIM is the "oldest old" (34 out of 53, 64%), while the "young old" and "old old" had a prevalence

Table I. The Sociodemographic and Clinical Profile of Admitted Geriatric Patients

	All Patients (n=618)	%	With PIM	%
Sex				
Male	220	36	124	56
Female	398	64	179	45
Age (Years)				
65-74	239	39	118	49
75-84	326	53	151	46
>85	53	9	34	64
No. of Comorbidities				
0	43	7	11	26
1	204	33	93	46
2	242	39	129	53
3	80	13	50	63
4	43	7	17	40
5	6	1	3	50
Comorbidities				
Hypertension	486	79		
Diabetes Mellitus type 2	216	35		
Previous Stroke	123	20		
Bronchial Asthma/COPD	89	14		
Benign Prostatic Hyperplasia	37	6		
Pulmonary Tuberculosis	35	6		
Chronic Kidney Disease	33	5		
Average and Range				
Ave. number of Maintenance Drugs (range)	4 (0-9)			
Ave. Length of Hospital Stay, (range)	6 (2-32)			
Hospital Stay (days)				
<4	281	45	119	42
5—9	296	48	153	52
10—14	33	5	28	85
>15	8	1	3	38
Average and Range				
Ave. No. of Medications received during Hospital Stay	12			
No. of Medications during hospital Stay				
1—4	45	7	8	18
5—8	171	28	61	36
9—12	179	29	84	47
13-16	134	22	76	57
>17	89	14	74	83

Table II. Prevalence of prescribed potentially inappropriate medications (PIMs)

	No. of Patients	Percentage
Received at least one PIM during hospital stay	303	49.0
PIMs to be avoided in older adults regardless of disease/condition		
Alprazolam	5	1.7
Amiodarone	21	6.9
Clonazepam	28	9.2
Clonidine	22	7.3
Diazepam	12	4.0
Diclofenac	3	1.0
Digoxin	56	18.5
Hydroxyzine	22	7.3
Insulin, sliding scale	69	22.8
Ipratropium, inhaled	35	11.6
Ketoprofen	4	1.3
Ketorolac	30	9.9
Meloxicam	6	2.0
Orphenadrine	44	14.5
Spironolactone	21	6.9
PIM to avoid in older adults with certain diseases and syndromes		
Tramadol	3	1.0
PIM to be used with caution in older adults		
Aspirin	4	1.3
Dabigatran	4	1.3

of 49% (118 out of 239) and 46% (151 out of 326) respectively.

In terms of number of comorbidities, patients with no known comorbidities upon admission had 26% (11 out of 43) prevalence of prescribed PIM. As the number of comorbidities increase from one to two and three, the prevalence of PIM also increased to 46% (93 out of 204), 53% (129 out of 242), and 63% (50 out of 80) respectively. Patients with four known comorbidities had 40% (17 out of 43) prevalence while patients with five known comorbidities upon admission had 50% (three out of six) prevalence of PIM.

As to length of hospital stay, 42% (119 out of 281) patients who stayed in the hospital for four days and below were given PIMs. The prevalence of PIM when patients stayed for five to nine days, 10-14 days, and ≥ 15 days were 52% (153 out of 296), 85% (28 out of 33), and 38% (three out of eight) respectively.

In terms of number of medications received during hospital stay, 18% (eight out of 45) patients who received

one to four medications had PIM. While 36% (61 out of 101) of those who were given five to eight medications during hospital stay had PIM. Forty seven percent (84 out of 179) patients who were given nine to 12 medications, 57% (76 out of 134) patients who received 13-16 medications, and 83% (74 out of 89) patients who received > 17 medications received PIM.

For the whole study population, PIMs were received by 303 out of 618 (49%) patients (Table II). These patients received at least one PIM (range 1-3) during their hospital stay. The PIMs identified belong to three categories presented in Beers Criteria 2012. PIMs to be avoided in older adults regardless of disease/condition: alprazolam, amiodarone, clonazepam, clonidine, diazepam, diclofenac, digoxin, hydroxyzine, insulin sliding scale, inhaled ipratropium, ketoprofen, ketorolac, meloxicam, orphenadrine, and spironolactone. PIM to avoid in older adults with certain diseases and syndromes: tramadol. PIM to be used with caution in older adults: aspirin and dabigatran. The three most common PIMs prescribed were insulin sliding scale (69 out of 303, 22.8%), digoxin (56 out of 303, 18.5%), and orphenadrine (44 out of 303, 14.5%).

Discussion

In this study, the observed majority of females (64.4%) in the sample is consistent with global figures of female predominance in the elderly population. This is due to the fact that women have greater life expectancy than men because of the lower mortality rate in women.¹ The observation that hypertension is the most common comorbidity in the elderly population⁵ was also confirmed. The main findings of these study are that in a tertiary teaching hospital in Valenzuela City, 49% of patients age ≥ 65 years under the Department of Internal Medicine received at least one PIM during their hospital stay from January 2014 to December 2014. The calculated prevalence was observed to be higher than the prevalence in two teaching hospitals in India 23.5%⁸, and acute medical geriatric unit in France 43.6%¹⁶. The calculated prevalence of prescribed PIM was observed to be lower than the prevalence reported from the studies in Brazilian care homes 82.6%⁹, and Indian rural hospitals 62.92%.¹⁰ The differences in the prevalence according to Harugeri is probably due to differences in patient characteristics, disease prevalence, study settings, and availability of drugs listed in Beers Criteria 2012.⁸

The updated Beers criteria is applicable to patients aged 65 years and above because the published systematic reviews and meta-analyses used during the formulation of the criteria were limited to the said age group.⁷

Due to the dramatic increase in people reaching age 65 and above, this age group is divided into three subgroups – young old (65-74 years), old (75-84 years), and oldest old

(≥ 85 years).¹⁷ From this study, it was noted that the oldest old group had the highest chance of being prescribed with a PIMs. Similar to other studies,^{11,18,19,20} older age was associated with increased prevalence of PIM prescribed.

It was observed that the more comorbidities the patient had, the higher was the chance of being given a PIM compared with those without comorbidity (Table I). But it also showed no correlation between increasing number of comorbidities and frequency of prescribed PIM. This is similar to the finding of Harugeri⁸ that the number of diseases was not a predictor of PIM use.

When it comes to length of hospital stay, it was also observed that the longer the patients stay, the higher is the chance of being given a PIM, this is due to the proportional relationship between length of stay and number of medications used.⁸ But it also noted that those who stayed for more than 15 days had lower prevalence of prescribed PIM. This may be due to the fact that many of these patients had an infection and antimicrobials are basically not in the Beers Criteria.

In terms of number of medications during hospital stay, it was observed in this study that as the number of medications or drugs increased the prevalence of PIMs being prescribed also increased. Polypharmacy is a common predictor of exposure to PIMs as revealed by studies of Harugeri⁸, de Lima⁹, and Undela¹¹. But Bushardt²¹ mentioned in 2008 that no consensus existed in the medical literature on the definition for polypharmacy. In his meta-analysis he revealed that the two most commonly cited definitions of polypharmacy is "use of a potentially inappropriate drug" or "use of six or more concomitant drugs". Harugeri⁸ stated in his findings that the increased number (\geq nine) of concurrent medications' use during hospital stay was the only influential predictor of PIM use.

Most of the observed PIMs prescribed in this study belong to the category "PIMs to be avoided in older adults regardless of disease/condition". This category was referred to as "high severity" PIMs in the study of Harugeri⁸. The observation of increased prevalence of prescribed PIMs in this category was similar to the studies of Cartwright²¹, Mandavi²², and Blalock²³

Conclusion

The prevalence of PIMs use as defined by the 2012 Beers Criteria in elderly patients admitted in a private, tertiary, teaching hospital in Valenzuela City is 49%. Most of the PIMs prescribed are under the medications to be avoided in older adults regardless of disease/condition. The three most common PIMs prescribed were insulin sliding scale (69 out of 303, 22.8%), digoxin (56 out of

303, 18.5%), and orphenadrine (44 out of 303, 14.5%).

Limitations

This study has several limitations. It did not determine whether PIMs prescribed in this setting is associated with age, sex, number of comorbidities, length of hospital stay, number of drugs prescribed. It did not determine whether the patients were already taking PIMs as part of their maintenance medications which could be related to their hospital admission. It also did not use other explicit criteria for PIM use like the STOPP criteria. The result of this study is different from other studies due to the fact that it was conducted in a tertiary hospital wherein many physicians are subspecialists and are more aware of possibilities of PIM use.

Recommendations

The researcher recommends that a similar study could be replicated in other tertiary hospitals and compared in other settings of geriatric care – government hospitals, private nonteaching hospital, "homes for the aged", etc. Another study on whether PIM use can lead to the proven "predictors" like polypharmacy, increased length of hospital stay or if PIM as defined by Beers or STOPP criteria or both is associated with increased adverse drug events, clinical outcomes (e.g. mortality). Aside from clinical outcomes, association of PIMs with economic outcomes can also be explored.

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