A Study on Potentially Inappropriate Medications in Geriatric Patients Admitted to the Medical Wards in Bentong Hospital Using Beers Criteria

Chu Chee Teng¹, Yeong Jean Yean¹, Lee Sai Hong¹

¹ Hospital Bentong, Pahang, Ministry of Health Malaysia

Abstract

Introduction: Geriatric patients are more susceptible to adverse drug reactions due to the changes in pharmacokinetics and pharmacodynamics in the elderly. The American Geriatric Society (AGS) Beers Criteria were developed to identify potentially inappropriate medications (PIMs) prescribed to the geriatric patients.

Objective: This study was carried out to identify the frequency and risk factors of PIM prescription among the geriatric patients using the AGS Beers Criteria.

Methods: This was a single-centred cross-sectional descriptive study that included patients aged 65 years and above that was admitted to the male and female medical wards of Bentong Hospital, Pahang from August 2018 to October 2018. The case records of the included patients were analysed by referring to the AGS Beers Criteria 2015. Data was analysed using SPSS and multiple logistic regression analysis was used to evaluate the risk factors associated with PIM prescriptions.

Result: A total of 150 patients were included in the study. Among them, 107 (71.3%) received at least one PIM. After excluding the drugs to be used with caution, the frequency of PIMs decreased to 55.3%. The most prescribed PIMs among the geriatric patients in Bentong Hospital were metoclopramide, frusemide and ranitidine. Inappropriate medication use was significantly associated with female gender (adjusted odd ratio 2.64, 90% confidence interval (CI) 1.38 to 5.05, p=0.014) and number of medications prescribed per patient (adjusted odd ratio 1.12, 90% CI 1.06 to 1.19, p= .001).

Conclusion: The study showed that PIMs prescription constituted a major problem among the elderly patients in Bentong Hospital. Attention needs to be paid to improve healthcare providers' awareness about PIMs for geriatric patients to improve care and minimise adverse drug reactions.

Keywords: geriatric, potentially inappropriate medications, elderly, Beers Criteria

NMRR ID: NMRR-18-412-40201

Corresponding Author: Chu Chee Teng

Department of Pharmacy, Hospital Bentong, Jalan Tras, 28700 Bentong, Pahang. Email: chee_teng1018@hotmail.com

Introduction

Malaysia is aging fast and the elderly population (65 years old and above) was about 6.2% of the total population in 2017 (1). As Malaysia prepares itself to be an ageing nation when 7% of its population will be 65 years and above in the future, measures have to be taken to overcome the problems and challenges that would arise. One among them would be patient safety, especially in relation to the safety of medications for elderly adults who are more likely to have more than one chronic disease and require concomitant prescription of multiple medications.

The altered pharmacokinetics and pharmacodynamics in the elderly due to aging cause them to be more susceptible to adverse drug reactions. Physiological changes like changes in hepatic and renal functions as well as the decline in total body water lead to an increase in the volume of distribution of lipid-soluble drugs and reduced clearance of lipid-soluble and water-soluble drugs, respectively. These changes may prolong plasma elimination half-life of certain drugs. Significant pharmacodynamic changes such as age-related changes in specific receptors and target sites also lead to the increased sensitivity to drugs. Thus, many drugs are inappropriate for elderly patients because of their pharmacological or potential adverse effects (2). Therefore, this necessitates judicious use of drugs to prevent adverse drug reactions and hence reducing the rate of morbidity in the elderly.

Certain drugs are classified as potentially inappropriate medications (PIM) for the elderly due to their increased risk of adverse drug events when used in this patient group. Several assessment tools have been developed to identify PIMs for older people. The American Geriatric Society (AGS) Beers Criteria 2015 is the most frequently used among those explicit methods to aid the health care providers in safe prescribing. The Beers Criteria have been used internationally over the past three decades to study PIM use. It was first developed in 1991, which included a list of drugs that were likely to cause more harm than benefits in the elderly. The list was based on the consensus of experts from different disciplines like geriatrics, clinical pharmacology, and psychopharmacology using an adopted Delphi method. In 2012, the AGS revised and updated the Beer's list, listing the PIMs into three categories. The first category included drugs to be avoided for many or most older adults regardless of disease or condition. The second category included medications to avoid for older adults with certain diseases or syndromes as these medications may exacerbate the disease or syndrome. The third category included medications that should be prescribed with caution as they have the potential of causing adverse reactions, which may be used if no other alternatives are available (3). The Beers lists were updated again in 2015 with the addition of two major components, which were potentially clinically important drug-drug interactions to avoid and medications to avoid or which dose adjustment is needed based on kidney function (4).

The Bentong Town is a municipality located in the west of Pahang, Malaysia. According to the Census 2010, 5.7% of the Bentong population was 65 years and above (5). The percentage is believed to have increased by the moment due to the substantial improvement in life expectancy throughout the world. In addition, there is an inflow of retirees to Bentong due to its peaceful environment and fresh air. Despite the aging of the population, studies about the prescribing pattern and prevalence of PIM among the geriatric patients were scarce in the state. Therefore, this study was carried out to identify the frequency and risk factors of PIM prescription among the admitted geriatric patients in Bentong Hospital using the AGS Beers Criteria. This study was hope to shed some light on the quality and rationality of drugs prescribing for the elderly patients in the state.

Methods

Study Participants

It was a single-centred cross-sectional descriptive study that was conducted for three months from August 2018 to October 2018 in Bentong Hospital, Pahang. Bentong Hospital is a general government hospital located in the centre of Bentong district.

The study included patients aged 65 years and above that was admitted to the male and female medical wards within the study period. Patients with hospital stay less than 12 hours, who did not receive any medication, admitted for observation only and those who passed away or transferred out within 12 hours of admission were excluded from the study.

Non-probability sampling was used as the sampling technique. The sample size was calculated to be 68 using the Cochran's Formula, based on 50% prevalence rate of PIMs, accounting for a standard error of 10% with a 90% confidence interval. Nevertheless, 150 patients (additional 120%) were targeted in this study taking into consideration of any missing or incomplete data.

Data Collection

Data was collected using a data collection form designed to extract information from the patients' medical records. Patient information including the age, gender, race, diagnosis, comorbid conditions, medication history, duration of hospitalisation and relevant laboratory investigations were extracted from the patient medical record files. Drug information such as the name of drug, strength, frequency, duration together with the starting and ending dates, dosage form and route of administration were extracted from the patient medication charts.

Data Analysis

The entire course of prescribed medications in the patient's case records during the hospital admission was analysed by referring to the AGS Beers Criteria 2015 to detect any PIMs use in older adults. The categories of PIMs listed in the Beers Criteria (4) were named PIM 1 to PIM 5 in this study, as summarised in Table 1.

Category	Description
PIM 1	Medications to avoid for older adults
PIM 2	Medications for older adults with specific diseases or syndromes to avoid due to drug- disease or drug-syndrome interactions that may exacerbate the disease or syndrome
PIM 3	Medications to be used with caution in older adults
PIM 4	Potentially clinically important non-anti-infective drug-drug interactions that should be avoided in older adults
PIM 5	Non-anti-infective medications that should be avoided or have their dosage reduced according to kidney function in older adults

Table 1: PIMs listed in the AGS Beers Criteria 2015

We performed our analysis using SPSS software version 22. The results were presented as frequency (n) and its respective percentage in the form of tables and figures as appropriate. Multiple logistic regression analysis was used to identify the risk factors associated with PIM prescriptions.

Results

A total of 150 case records of patients aged 65 years and above were reviewed. The demographic characteristics of these patients were shown in Table 1. Out of these 150 patients, 75 were male (50%) and 75 were female (50%). The study revealed that majority of the geriatric patients in Bentong Hospital were Chinese (51.3%), followed by Malay (40.0%) and Indian (8.7%). The age of the patients ranged from 65 years to 93 years, with the average age of 77.21 years. The average number of comorbidities per patient was 2.69 while the average length of hospitalisation was found to be 6.25 days. A total of 2120 medications were prescribed, with an average of 14.13 drugs for each patient.

The prescription of PIMs according to the medication categories listed in the AGS Beers Criteria 2015 was shown in Table 3 and the prescription of PIMs with respect to the characteristics of patients were enlisted in Table 4. Of the 150 patients, 107 received at least one PIM (71.3%). After excluding drugs listed under Criteria 3 of AGS 2015 Beers criteria, namely the drugs to be used with caution in older adults, the percentage of PIMs use was observed to be 55.3%. The most prescribed PIMs according to the PIM categories can be seen in Table 5. The most prescribed PIMs in this study were metoclopramide (category PIM 1), frusemide (category PIM 3) and ranitidine (category PIM 5).

Simple and multiple logistic regression analyses were carried out, and the factors that exhibited significant associations with PIMs were shown in Table 6. The multiple logistic regression revealed that female gender (adjusted odd ratio 2.64, 90% confidence interval (CI) 1.38 to 5.05, p=0.014) and number of medications prescribed (adjusted odd ratio 1.12, 90% CI 1.06 to 1.19, p=0.001) were significantly associated with PIM use.

Table 2: Demographic char	acteristics of the	elderly patients	(n=150)

Variables	n	(%)
Gender		
Male	75	(50.0)
Female	75	(50.0)
Race		
Malay	60	(40.0)
Chinese	77	(51.3)
Indian	13	(8.7)
Age		
65 – 69 years	44	(29.3)
70 – 74 years	31	(14.0)
75 – 79 years	42	(28.0)
\ge 80 years	33	(22.0)
Number of comorbidities per patient		
≤ 1	29	(19.3)
2	34	(22.7)
3	45	(30.0)
4	30	(20.0)
5	12	(8.0)
Length of hospitalisation		
1 – 5 days	95	(63.3)
6 – 10 days	33	(22.0)
11 – 15 days	9	(6.0)
\geqslant 16 days	13	(8.7)
Number of medications prescribed per patient		
1 – 5	11	(7.3)
6 – 10	44	(29.3)
11 – 15	42	(28.0)
≥ 16	53	(35.3)

Table 3: Prescription of PIMs according to AGS Beers Criteria 2015 medication categories (n=150)

Category	Patients prescribed with PIMs, n (%)
PIM 1	77 (51.3)
PIM 2	6 (4.0)
PIM 3	52 (34.7)
PIM 4	5 (3.3)
PIM 5	22 (14.7)

Table 4: Prescription of PIMs accor	ding to AGS Beers	Criteria 2015 medication	categories and the	demographic
characteristics of elderly patients (n=150)			

Variable	Р	IM 1	Р	IM 2	Р	IM 3	Р	IM 4	F	PIM 5
Gender										
Male	38	(50.7)	4	(5.3)	21	(28.0)	3	(4.0)	9	(12.0)
Female	39	(52.0)	2	(2.7)	31	(41.3)	2	(2.7)	13	(17.3)
Age										
65-69 years	25	(56.8)	1	(2.3)	14	(31.8)	4	(9.1)	4	(9.1)
70-74 years	14	(45.2)	2	(6.5)	13	(41.9)	0	(0)	4	(12.9)
75-79 years	18	(42.9)	1	(2.4)	12	(28.6)	0	(0)	7	(16.7)
≥ 80 years	20	(60.6)	2	(6.1)	13	(39.4)	1	(3)	7	(21.2)
Number of comorbidities										
≤ 1	16	(55.2)	2	(6.9)	7	(23.8)	2	(6.9)	6	(20.7)
2	14	(41.2)	2	(5.9)	12	(35.3)	1	(2.9)	5	(14.7)
3	20	(44.4)	0	(0)	15	(33.3)	0	(0)	6	(13.3)
4	19	(63.3)	1	(3.3)	15	(50.0)	2	(6.7)	3	(10.0)
5	8	(66.7)	1	(8.3)	5	(41.7)	0	(0)	2	(16.7)
Length of hospitalisation										
1 – 5 days	45	(47.4)	4	(4.2)	36	(37.9)	4	(4.2)	13	(13.7)
6 – 10 days	17	(51.5)	2	(6.1)	8	(24.2)	1	(3.0)	7	(21.2)
11 – 15 days	7	(77.8)	0	(0)	4	(44.4)	0	(0)	2	(22.2)
≥ 16 days	8	(61.5)	0	(0)	4	(30.8)	0	(0)	0	(0)
Number of medications prescribed										
1 – 5	3	(27.3)	0	(0)	0	(0)	0	(0)	0	(0)
6 – 10	16	(36.4)	4	(9.1)	13	(29.6)	1	(2.3)	7	(15.9)
11 – 15	19	(45.2)	0	(0)	16	(38.1)	1	(2.4)	6	(14.3)
≥ 16	39	(73.6)	2	(3.8)	23	(43.4)	3	(5.7)	9	(17.0)

Note: values were presented as n (%)

Table 5: The most	prescribed PIMs	according to	AGS Beers	Criteria 2015	medication	categories (n=150)
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Category	Medicine	n	(%)
PIM 1	Metoclopramide	51	(34.0)
	Diphenhydramine	11	(7.3)
	Mineral oil	10	(6.7)
	Hyoscinamine	6	(4.0)
	Atropine	6	(4.0)
	Prazosin	6	(4.0)
	Chlorpheniramine	5	(3.3)
	Others	9	(6.0)
PIM 2	Ranitidine	4	(2.7)
	Alprazolam	1	(0.7)
	Verapamil	1	(0.7)
PIM 3	Frusemide	49	(32.7)
	Aspirin	6	(4.0)
PIM 4	Ranitidine	1	(0.7)
	Lorazepam	1	(0.7)
PIM 5	Ranitidine	18	(12.0)
	Tramadol	3	(2.0)
	Fondaparinux	1	(0.7)

Variabla	S	Simple Logistic Regressic	on	Multiple Logistic Regression *			
vanable	В	Crude OR (90% CI)	P value	В	Adjusted OR (90% CI)	P value	
Gender							
Male	0.0	1	0.049	0.0	1	0.014	
Female	0.73	2.07 (1.13-3.82)		0.97	2.64 (1.38-5.04)		
Number of medications prescribed per patient	0.10	1.11 (1.05-1.17)	0.002	0.11	1.12 (1.06-1.19)	0.001	

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* Forward LR Multiple Logistic Regression model was applied. Multicollinearity was checked and not found. Interaction was found between gender and number of medications. Hosmer–Lemeshow test, (p=0.539), classification table (overall correctly classified percentage=74.7%) and area under the ROC curve (74.9%) were applied to check the model fit.

Discussion

The results of this study showed that PIM prescription was common among the elderly inpatients in Bentong Hospital. Among our study population, as many as 71.3% received at least one PIM listed in the AGS Beers Criteria 2015. However, if we exclude drugs listed in category PIM 3, namely the drugs to be used with caution in older adults as these drugs were not considered as PIMs to be avoided, the percentage of patients prescribed with PIMs was observed to be 55.3%. This figure was lower than a Korean study (6) but higher than most of the other similar studies (7-9). The higher prevalence could be attributed to the fact that this study utilised Beers criteria 2015 which was a more comprehensive list than Beers criteria 2012 used in the other studies.

Drugs in category PIM 1 which included PIMs to avoid for older adults, formed a majority of inappropriate use of medications, followed by category PIM 3 which was drugs to be used with caution and category PIM 5 which was PIMs to be avoided or adjusted according to creatinine clearance. This was comparable to a study by Narvekar *et al.* which showed that majority of PIMs use were listed under Criteria 3, followed by Criteria 1 and Criteria 5 (9).

It was observed that, in general, as the number of comorbidities increased, the percentage of PIMs use also increased, which conformed to category PIM 1 and category PIM 3. However, this increasing trend of PIMs use was not observed for category PIM 2, PIM 4 and PIM 5, in contrast to the findings by Hwang *et al.* and Narvekar *et al.* (8,9). We also observed that with the advancement of patients' age, no increased incidences of PIMs prescription were noted, in contrast to the study by Lin *et al.* (10). When we looked at the use of PIMs with respect to the length of hospitalisation, interestingly, there was an increased use of PIMs up to 15 days of hospitalisation, followed by a drop beyond 15 days of hospitalisation. This was similar to the findings by Narvekar *et al.* (9). Besides that, we also noted that as the number of medications prescribed per patient increased, the prescription of PIMs also increased, which was observed for all categories of PIMs in the Beers list. This corresponded with the observations made by Hwang *et al.* and Lin *et al.* (8,10). Geriatric patients are more likely to be in poor health and need multiple medications, which may have contributed to the increased risk of receiving PIMs.

The most prescribed PIMs in this study were metoclopramide, frusemide and ranitidine. Metoclopramide is usually given to patients prescribed with tramadol as a prophylaxis against emesis which is a common side effect of tramadol. Metoclopramide, however, should be avoided in the elderly unless indicated for gastroparesis, as the drug can cause extrapyramidal effects and the risk may be higher in frail older adults (4). The most common "drug to be used with caution" prescribed was frusemide. Frusemide is a loop diuretic which may cause hyponatremia. Therefore, it is advised to monitor the sodium level closely while an elderly patient is on the drug (4). On the other hand, for category PIM 5 medications which are PIMs to be avoided or have their doses adjusted according to the kidney functions, we found that ranitidine was most often being prescribed inappropriately. According to the Beers Criteria, the dose of ranitidine should be reduced for older patients with creatinine clearance below 50mL/min as ranitidine will undergo renal excretion and in patients with renal impairment, it will accumulate in the body and may lead to mental status changes (4,11).

The results described in the multiple variable regression analysis revealed that the factors associated with a PIM use included female gender and the number of medications prescribed during the patient's

hospitalisation. It was unclear why female patients were more likely to be prescribed a PIM compared to male patients. Therefore, further studies are needed to examine how gender differences may predict inappropriate drug use. It is possible that women tend to be more concerned with their health and may report pain and symptoms of depression more often than men, which exposed them to a higher risk of PIM prescriptions (12). Multiple logistic regression also revealed that the number of medications prescribed seem to be one of the important factors in predicting PIM prescription. Therefore, since elderly patients often require higher number of medications to treat their diseases in the wards, PIMs should be considered during the prescribing process.

Based on the high prevalence of PIMs prescribing observed in this study, efforts must be made to improve the prescribing practice for elderly patients. It would be important for physicians to consider avoiding PIMs and to select better-tolerated alternatives with less adverse effects for the elderly patients. The use of PIMs should be avoided in the elderly as this will lead to higher rate of of adverse drug reactions among them, which is also associated with increased healthcare costs (7,13). The use of Beers Criteria in conjunction with other tools such as the 'Screening Tools of Older Persons' potentially inappropriate Prescriptions' (STOPP) and 'Screening Tool to Alert doctors to Right Treatment' (START) criteria is recommended to allow reduce PIMs prescription among the geriatric patients (14). In addition, a systemic strategy can be developed to prevent medication-related complications. For example, common interactions can be listed in the wards to guide doctors to consider PIMs in their clinical decision making. It is essential to encourage the prescriber to be aware of PIMs in their day-to-day clinical practice to deliver better health care to the geriatric population.

Despite the high prevalence of PIMs use among the warded geriatric patients as demonstrated in this study, PIMs were not seriously considered as an important issue during the prescribing process for older patients. Drugs can affect quality of life and morbidity in the elderly. Therefore, judicious prescribing needs to take into consideration the risk-benefit ratio to minimise iatrogenic complications in the aged. A better understanding of ageing physiology and pharmacology is necessary for primary care physicians to adopt in their practice in caring for this subgroup of patients. As iatrogenic complications are more common and more serious among the elderly than among younger patients, the avoidance of PIMs with a high risk of adverse drug effects represents an important strategy.

This study had several limitations. First, since this was a single-centred study, the sample was statistically small and the overall prevalence of PIMs in the state of Pahang could not be estimated in this study. Additionally, the Beers Criteria were developed for the United States, different populations may not share the same effects or adverse effects for some of the listed medications. Finally, there may be drugs that are PIMs for Asian or Malaysian elderly but not listed in the Beers Criteria .

Conclusion

This study gave us a remarkable insight into the current status of drug prescribing for the geriatric patients in Bentong Hospital. High frequency of PIMs use constituted a major problem among the elderly patients with the most prescribed PIMs being metoclopramide, frusemide and ranitidine. Female gender and higher number of medications prescribed per patient were the risk factors associated with PIM prescription for the elderly patients. Since PIM exposure is a key element to ensure care quality, attention needs to be paid improve prescribers' awareness about PIMs for geriatric patients. More studies should be conducted to investigate PIMs use the in outpatient departments, other healthcare facilities, specialties, and even private practitioners.

Acknowledgement

The authors thank the Director-General of Health for his permission to publish this article.

Conflict of interest statement

No external funding was received and the authors declare no conflict of interest.

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