Original Article

Prevalence of Potentially Inappropriate Medication and Its Associated Factors in Elderly Patients in the Primary Care Unit of a University Hospital of Southern Thailand

Thareerat Ananchaisarp MD[1], Panya Chamroonkiadtikun MD[1], Narucha Komolsuradej MD[1]

[1] Family Medicine Unit, Department of Family Medicine and Preventive Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand

Objective: To assess the prevalence of potentially inappropriate medication [PIM] prescribed among elderly patients in the primary care unit of a university hospital in southern Thailand and identify the associated factors.

Materials and Methods: A cross-sectional study was conducted retrospectively in the primary care unit of a university hospital. The medical records of all the patients aged 60 years or older that visited the primary care unit during the year of 2016 were included. PIM was identified based on the 2015 Updated Beers Criteria. The prevalence of PIM was described and the associated factors were analyzed.

Results: Of 490 elderly patients, 64.1% were female and the median age was 66.3 years. The prevalence of PIM was 40.4%. The most common type of PIM was medications to avoid for many or most elderly patients (49.8%). Factors associated with PIM prescriptions were female gender, visited the PC clinic, received an increased number of medications, had some underlying disease, and presented with acute illness.

Conclusion: The prevalence of PIM was high among elderly patients in the primary care unit of a university hospital in southern Thailand. This is an alarming result for a medical school. Physicians should be aware when prescribing medications to patients who have associated factors.

Keywords: Elderly patient, Inappropriate medication, Beers Criteria

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The population of elderly people is increasing worldwide and most face chronic diseases and require several medications for prevention and treatment. Therefore, elderly people are prone to the risk of medication-related problems such as adverse drug reactions. Studies found that about a quarter of adverse drug events were avoidable[1,2]. Those could be prevented by lowering the potentially inappropriate medication [PIM] used. A PIM is defined as medication that potentially causes a health threat because the risk is beyond the benefit. Evidence showed that PIMs detected in older people resulted in high frequencies of visiting ambulatory care and emergency departments with increased hospital admissions[3,4] and medical costs[5]. The prevalence of PIM prescriptions varies in each country and can range from 11.6% to 55.0%[3,6-11]. These variations were due to the populations studied and the methods to assess PIM. The Beers Criteria is a criterion-based method popularly used to screen for PIM. These criteria were initially published in 1991 by the American Geriatrics Society and were updated in 2015[12], which divided PIM into five groups.

Previous studies[3,4,6-9,13,14] showed various associated factors for PIM prescriptions such as female gender, increased age, diagnosed with some diseases, increased number of underlying diseases, and the number of medications received. Although many studies reported on the prevalence and risk factors of PIM in various countries, only a few studies were done in Thailand such as a study in one community in Maha Sarakham Province[11]. However, no study has been performed in the primary care unit of Songklanagarind Hospital. The present study aimed to assess the prevalence of PIM prescription among elderly patients in the primary care unit of a university hospital in southern Thailand and identify the associated factors.

Correspondence to:

Ananchaisarp T. Department of Family Medicine and Preventive Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Phone: +66-74-451330, **Fax**: +66-74-451333
Email: thareerat.a@psu.ac.th

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Materials and Methods

Study design and setting

A cross-sectional study was conducted retrospectively in the primary care unit of Songklanagarind Hospital using the medical records of January through December 2016. Songklanagarind Hospital belongs to the Faculty of Medicine, Prince of Songkla University in Hat Yai District of Songkhla Province, Thailand. The hospital has 847 beds to serve the people in southern Thailand for tertiary and primary care services. The primary care services are mainly provided in the primary care unit of the hospital, which is divided into primary care [PC] and general practice [GP] clinics. The numbers of patients who visited the primary care unit in the years 2013, 2014, and 2015 were 47,983, 52,970, and 55,485, respectively. The PC and GP clinics that provide primary care service to patients were selected.

Study sample and sampling

The medical records of patients aged 60 years or older who visited the PC and GP clinics in 2016, received at least one oral medication, and had the results of the GFR test during the previous one year were included. Due to the recommendation for an annual renal function evaluation for elderly patients[15] and the Beers Criteria for the group of PIM based on kidney function, the results of the GFR were essential to classify the patients. The medical records of patients who came to refill their medications after reviewed were excluded. The sample size was calculated based on a precision formula for the first objective of PIM prevalence that considered the prevalence of 55% in a previous study[11], 95% confidence interval, precision error of 5%, and incomplete data from medical records of 20%. The results indicated that at least 477 medical records of elderly patients who attended the PC and GP clinics were required.

The numbers of eligible medical records from the PC and GP clinics based on the inclusion criteria were 1,853 and 1,272, respectively. According to proportional probability to size basis, 290 patients from the PC clinic and 200 patients from the GP clinic were sampled by computer generated random list.

Variables

The main outcome measure was PIM prescription assessed by the 2015 Updated Beers Criteria[12]. Independent variables that included patient characteristics consisted of gender, age, number and type of underlying diseases, and visit characteristics that consisted of type of physician, diagnosis using the International Statistical Classification of Diseases and Related Health Problems Tenth Revision [ICD-10], and the number of drugs received.

Data collection

The details of the medical records of every prescription for each patient were reviewed. Patients who received at least one PIM in the study period were documented as PIM prescription. The name and group of PIMs were listed from each prescription.

Data management and analysis

Data were entered in the EpiData (version 3.1, Denmark) with double entry basis and analyzed using the R program (R Core Team 2017, Vienna, Austria). Descriptive statistical analysis was used to analyze the baseline characteristics and characteristics of the PIMs. Categorical data were then presented in terms of percentage and continuous data were presented in terms of median and interquartile range [IQR]. Comparisons between categorical variables were performed by the Chi-square or Fisher's exact test. Comparisons between continuous variables were performed by the Wilcoxon test. Factors associated with PIM prescriptions were analyzed by univariate analysis and Generalized Linear Mixed Models using Penalized Quasi-Likelihood. A *p*-value less than 0.05 was considered as statistically significant.

Ethic consideration

The authors' protocol was approved by the Ethics Committee of the Faculty of Medicine of Prince of Songkla University. Informed consent of the patients was not obtained because the data were retrieved from the hospital information system and medical record were retrospectively reviewed. However, patient's confidentiality was protected by codifying the recorded information and all results were reported in overall data.

Results

The characteristics of 490 eligible elderly patients from the PC and GP clinics are shown in Table 1. Two-thirds of them were female and the median age was 66.3 years. The percentage of patients with at least one underlying disease was 93.3%, while the remaining 6.7% had no underlying disease. In the current study, dyslipidemia was the most common underlying disease, followed by hypertension. Patients who visited the PC clinic had various underlying diseases and the number of some diagnosed diseases was significantly

higher in patients that visited the PC clinic than patients that visited the GP clinic.

The prevalence of PIM was 40.4% (198 of 490 patients). However, when the criteria were not applied for PIMs in the group of medications to be used with caution, the prevalence of PIM decreased to 33.3% (163 of 490 patients). There were 1,444 prescriptions in 490 patients of which PIMs were found in 516 (35.7%). The prevalence of PIM in one prescription ranged from 1 to 6. Most of the prescriptions (78.9%, 407 of 516) had only one PIM followed by two PIMs in 16.1% and three PIMs in 2.9%. One patient received six PIMs simultaneously. Of 1,444 prescriptions, 4,994 drugs were prescribed, in which a PIM showed in 13.4% of all prescribed drugs (667 of 4,994 drugs).

Details of the PIMs using the Beers Criteria of 2015 are shown in Table 2. Among 667 drugs that were inappropriate, about half of them were found in the group of medications to avoid for many or most older adults (49.8%), followed by the group of medications that should be used with caution (39.4%), and medications for older adults with specific diseases or syndromes to avoid (9.7%). The most common class of PIMs was diuretics (34.3%), which are in the group of medications that should be used with caution. The next two common PIMs were benzodiazepines

Table 1. Patient characteristics (n = 490)

Characteristics	Total	Clinic		*p*-value
		PC (n = 290)	GP (n = 200)	
Gender, n (%)				0.90
Female	314 (64.1)	187 (64.5)	127 (63.5)	
Male	176 (35.9)	103 (35.5)	73 (36.5)	
Age (years), median (IQR)	66.3 (62.9, 71.7)	66.6 (63.1, 72.2)	66.1 (62.9, 70.9)	0.25
Number of underlying diseases, median (IQR)	2.0 (1.0, 3.0)	2.0 (2.0, 3.0)	1.0 (1.0, 2.0)	<0.001
Type of underlying diseases, n (%)				
Dyslipidemia	360 (73.5)	228 (78.6)	132 (66.0)	0.003
Hypertension	273 (55.7)	211 (72.8)	62 (31.0)	<0.001
Diabetes mellitus	123 (25.1)	100 (34.5)	23 (11.5)	<0.001
Dyspepsia	34 (6.9)	20 (6.9)	14 (7.0)	1.00
Cardiovascular disease	32 (6.5)	19 (6.6)	13 (6.5)	1.00
Chronic kidney disease	19 (3.9)	16 (5.5)	3 (1.5)	0.04
Depression	7 (1.4)	5 (1.7)	2 (1.0)	0.71

PC = primary care; GP = general practice; IQR = interquartile range

Table 2. Details of PIM using the Beers criteria of 2015 (n = 667)

Drug type and list	Total of PIM, n (%)	Clinic, n (%)	
		PC	GP
1. Medications to avoid for many or most older adults	332 (49.8)	282 (42.3)	50 (7.5)
First generation antihistamine	86 (12.9)	66 (9.9)	20 (3.0)
Short-acting benzodiazepines	83 (12.4)	75 (11.2)	8 (1.2)
Tricyclic antidepressants	45 (6.7)	42 (6.3)	3 (0.4)
Long-acting benzodiazepines without indication	37 (5.5)	36 (5.4)	1 (0.1)
Glibenclamide	29 (4.3)	29 (4.3)	-
PPI use >8 weeks	20 (3.0)	16 (2.4)	4 (0.6)
Muscle relaxants	19 (2.8)	6 (0.9)	13 (1.9)
Prazosin for hypertension	12 (1.8)	12 (1.8)	-
Metoclopramide for non-gastroparesis	1 (0.1)	-	1 (0.1)
2. Medications for older adults with specific diseases or syndromes to avoid	65 (9.7)	64 (9.6)	1 (0.1)
NSAIDs in hypertension	56 (8.4)	55 (8.3)	1 (0.1)
HCTZ in gout	3 (0.4)	3 (0.4)	-
Other	6 (0.9)	6 (0.9)	-
3. Medications to be used with caution	263 (39.4)	259 (38.8)	4 (0.6)
Diuretics	229 (34.3)	225 (33.7)	4 (0.6)
Selective serotonin reuptake inhibitors	27 (4.0)	27 (4.0)	-
ASA for primary prevention in ≥80 years old	7 (1.0)	7 (1.0)	-
4. Non-anti-infective drug - drug interactions	6 (0.9)	6 (0.9)	-
5. Medications to avoid or dosage adjustment based on kidney function	1 (0.1)	1 (0.1)	-

PPI = proton pump inhibitor; NSAIDs = nonsteroidal anti-inflammatory drugs; HCTZ = hydrochlorothiazide

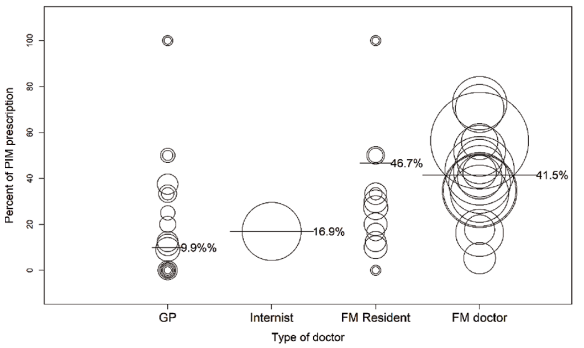

Figure 1. Distribution of percentages of physicians who prescribed one or more PIMs by type of physician. Each circle represents the percentage of prescriptions where the physician prescribed at least 1 PIM per total of prescriptions for each physician. The transverse lines represent the mean of the percentages of PIM prescriptions for each type of physician.

(17.9%) and first-generation antihistamines (12.9%), which are in the group of medications to avoid for many or most older adults. The use of non-steroidal anti-inflammatory drugs [NSAIDs] in hypertensive patients (8.4%) was commonly identified as drug-disease interaction. More PIM prescriptions were found in the PC clinic than in the GP clinic, except muscle relaxants and metoclopramide for non-gastroparesis.

Figure 1 shows the prevalence of PIM by physicians classified by GP, internist, family medicine [FM] resident, and FM doctor. Only one internist looked after the patients (n = 57) in the present study. More patients per one FM doctor than those per one GP or FM resident were found. A high average rate of PIM prescriptions was found among the FM residents (46.7%) and FM doctors (41.5%) compared to the internist (16.9%) or GP (9.9%).

Factors associated with PIM prescriptions are shown in Table 3. Female gender, visited the PC clinic, had underlying disease (i.e., hypertension, dyspepsia, chronic kidney disease or depression), presented with acute illness, and received increased number of drugs were significantly associated with higher PIM prescriptions. However, an increased number of underlying diseases was significantly associated with fewer PIM prescriptions.

Discussion

The prevalence of PIM was high among elderly patients in the primary care unit of a university hospital in southern Thailand. Physicians should be alert when prescribing medications to patients who have associated factors that include female gender, visiting PC clinic, have underlying diseases (i.e., hypertension,

Table 3. Univariate analysis and generalized linear mixed models using penalized quasi-likelihood for factors associated with PIM (n = 1,444)

	Crude OR (95% CI)	Adjusted OR (95% CI)	*p*-value (Wald's test)
Sex			
Male	1	1	
Female	1.58 (1.06 to 2.36)	1.41 (1.05 to 1.88)	0.02
Age	0.99 (0.97 to 1.02)	0.99 (0.97 to 1.02)	0.63
Clinic			
PC	1	1	
GP	0.20 (0.14 to 0.28)	0.40 (0.29 to 0.57)	<0.001
Number of prescriptions	1.10 (1.03 to 1.18)	0.99 (0.94 to 1.04)	0.58
Number of underlying disease	1.43 (1.22 to 1.68)	0.76 (0.60 to 0.98)	0.03
Underlying disease			
Dyslipidemia	0.94 (0.61 to 1.44)	0.92 (0.60 to 1.40)	0.70
Hypertension	2.67 (1.80 to 3.99)	1.62 (1.08 to 2.43)	0.02
Diabetes mellitus	1.16 (0.75 to 1.79)	0.70 (0.47 to 1.05)	0.08
Dyspepsia	3.36 (1.52 to 7.81)	1.73 (1.03 to 2.92)	0.04
Cardiovascular disease	0.88 (0.38 to 1.94)	0.90 (0.47 to 1.71)	0.75
Chronic kidney disease	2.09 (0.75 to 6.09)	3.13 (1.47 to 6.66)	0.003
Depression	3.76 (0.61 to 39.72)	4.85 (1.39 to 16.95)	0.01
Diagnosis			
Follow-up only	1	1	
Follow-up with acute illness	5.24 (3.65 to 7.63)	2.08 (1.59 to 2.73)	<0.001
Acute illness	1.06 (0.78 to 1.44)	2.34 (1.68 to 3.26)	<0.001
Check up	0.41 (0.12 to 1.10)	2.01 (0.89 to 4.55)	0.09
Number of drug received	1.82 (1.70 to 1.96)	1.69 (1.57 to 1.81)	<0.001

PC = primary care; GP = general practice

dyspepsia, chronic kidney disease or depression), diagnosis of acute illness, and multiple number of drug prescriptions.

The present study had about twice the number of females than males, which was similar to the proportions of elderly patients who visited the primary care unit in Songklanagarind Hospital and similar with other studies[5,16]. The distribution of ages in both genders was not different. The average age of the subjects in the present study (66.3 years) was close to other studies conducted in developing countries (range 68.5 to 71.6 years)[11,17], but lower than other studies from developed countries (range 74.8 to 81.3 years)[6,16,18] due to different definitions of elderly. Subjects who visited the PC clinic had significantly more underlying diseases than those who visited the GP clinic because most patients at the PC clinic had non-communicable diseases, whereas most patients at the GP clinic had acute illnesses and annual health examinations.

The present study used the Beers Criteria to assess PIM similar to most other studies[3,4,6,7,10,11,16-19]. The prevalence of PIMs in the present study was lower than the previous study in one community in Thailand (55.0%)[11]. This was possibly due to the number of drugs received, which was a risk factor of PIM. Furthermore, in the present study, the number of drugs received was lower. The prevalence in the present study was higher than other studies from both Asian and Western countries (11.6% to 27.6%)[3,6-10]. This higher prevalence was likely the result of conducting the study in a university hospital that treats complicated diseases compared with community hospitals. Furthermore, we used the 2015 Updated Beers Criteria[12] that added two types of inappropriateness to the previous version in 2012[20]. However, the prevalence of PIM in the present study was even higher than the study conducted in a tertiary care hospital in South India that assessed PIM by the 2015 Updated Beers Criteria (8.5%)[16]. It is probably because the previous study was conducted in medicine outpatient department where the patients had a higher number of underlying diseases than in the present study. Therefore, the well-trained physicians is more aware when prescribing medications to the elderly with multiple underlying diseases. This was compatible with the results of the study because fewer PIM prescriptions were associated with two factors, an increased number of underlying diseases, and being treated by an internist specialist.

The most inappropriately prescribed medication class was diuretics, which are included in the new drug list of the Beers Criteria of 2015 as a group of medications to be used with caution. This finding was consistent with the high prevalence of hypertension in the elderly. In Thailand, the recommendation is to treat isolated systolic hypertension in the elderly with diuretics[21]. As found in some other studies, the next most frequently prescribed PIMs were benzodiazepines[5,7,18] because sleep problems and depression are common in elderly patients[22]. The third most commonly prescribed PIMs were first-generation antihistamines, which were also common PIMs in other studies[3-7].

The risk factors of PIM prescription in the present study were similar to other studies, which were female gender[3,4,10,11,18,19], increased number of drugs received[3-7,11,18,19,23], and a diagnosis of an acute illness[6]. These may be explained by a new acute disease that leads to an increased number of drugs received, which in turn increases the chance of a PIM prescription. Increased age was not found to be associated with a PIM prescription, which was the same as in a previous study[5] but different from most previous studies[6,18,19]. It may be because the median age of the subjects in the present study was lower than those studies and it may not be enough to find an association between age and PIM prescription. Comorbidities of depression, chronic kidney disease, dyspepsia, and hypertension were significant predictors of a PIM prescription similar to previous study[5]. Patients with these diseases possibly caused the physicians to prescribe medications that should be avoided or used with caution in older patients, such as diuretics in hypertension or tricyclic antidepressants in depression. In addition, these diseases may interact with some medications, such as NSAIDs in hypertensive patients. Additionally, some other medications should be avoided, or dose adjusted, due to renal impairment.

PIM prescriptions were more common in the PC clinic than the GP clinic, probably because the PC patients were more frequently diagnosed with hypertension and chronic kidney disease, which are risk factors of a PIM prescription. In addition, hypertensive patients had an increased chance to receive a diuretic, which was the most common PIM in the present study. PIM prevalence was high in FM residents (46.7%) and doctors (41.5%) but lower than family physicians in Saudi Arabia (52.5%)[17]. In addition, the prevalence of PIM in FM and GP doctors was high compared with other specialties[3]. The preventive factor of PIM prescription in the present study was the increased number of underlying diseases, which was not the

case in some studies[11,18] but similar with some other studies[23]. Increased awareness of the physicians was the possible preventive factor of PIM prescription when treating patients with multiple diseases.

The strength of the present study is the 2015 Updated Beers Criteria to assess PIM but there were some limitations. First, the inclusion criteria of the present study were the patients who received medication with results of the GFR in the previous one year, which may reveal moderate to high risk elderly patients. This would lead to an overestimated prevalence of PIM; however, the findings of PIM in the present study were in the range of the previous studies[3,6-11,16]. Second, the study design was a retrospective medical records review possibly affected by the incompleteness of information to endorse the prevalence of PIM such as underlying disease, prescribed medication by other health care settings, or over-the-counter medications, and indications for medication prescriptions. Third, the study setting was a university hospital. Therefore, it cannot be generalized to other hospital settings. Finally, the factors used in the explicit criteria of PIM were possibly not completely counted when compared to the implicit criteria.

Conclusion

The prevalence of PIM was high among elderly patients in a university hospital in southern Thailand. This is an alarming result for a medical school. The three most inappropriately prescribed medication classes were diuretics, benzodiazepines, and first-generation antihistamines. The risk factors of PIM prescription in the present study consisted of female gender, visited the PC clinic, increased number of drugs received, had some underlying disease (i.e., hypertension, dyspepsia, chronic kidney disease or depression), and presented with an acute illness.

Suggestion

The high prevalence of PIM in elderly patients was an alarm for the hospital to set up a system to inform and urgently prevent PIM. The authors suggest non-pharmacological treatments before prescribing a medication to prevent PIM such as advice for sleep hygiene before prescribing benzodiazepine, and using explicit criteria such as the Beers Criteria to screen for inappropriateness before prescribing new medication[24]. About half of PIM prescriptions were in the group of medications to avoid for many or most older adults. Therefore, it may be necessary to offer alternative safer medications in PC and encourage physicians to use them instead of PIMs. Examples of alternate medications are second-generation antihistamines instead of first-generation, or calcium channel blockers instead of diuretics for treatment of isolated systolic hypertension in the elderly[21]. In addition, physicians should be careful when prescribing medications to elderly patients who have risk factors of PIM prescriptions. Future research should be conducted in community hospitals for other types of inappropriate drug use.

What is already known on this topic?

Previous studies on the prevalence of PIM prescription and its associated factors were done in various countries and PIM was assessed by various methods such as the Beers Criteria and the START criteria. However, few studies were done in Thailand, such as the study in one community in Maha Sarakham Province[11]. Furthermore, the reference is frequently updated, which leads to updated versions of each method that assesses PIM. Few studies have used the updated Beers Criteria 2015 to assess PIM.

What this study adds?

This study used the updated Beers Criteria 2015[12] to assess PIM in a university hospital in southern Thailand. The results showed a high prevalence of PIM and associated factors of PIM prescription. It is time to encourage physicians to be aware of PIM prescriptions and find a method to resolve this problem.

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Potential conflicts of interest

The authors declare no conflict of interest.

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