

ORIGINAL ARTICLE

IDENTIFICATION OF POTENTIALLY INAPPROPRIATE MEDICATION (PIM) BASED ON BEERS CRITERIA IN GERIATRIC INPATIENT AT ANUTAPURA HOSPITAL PALU CITY, CENTRAL SULAWESI PROVINCE INDONESIA: A DESCRIPTIVE CROSS-SECTIONAL DESIGN

Muhamad Rinaldhi Tandah¹, Muhammad Fakhru Hardani¹, Desika Aulia Putri, Andi Atirah Masyita¹, Rudi Safarudin^{1,2}, Arya Dibyo Adisaputra¹

¹Department of Pharmacy, Tadulako University, Central Sulawesi, Indonesia, ²Prescription Drug Misuse Education and Research (PREMIER) Center, College of Pharmacy, University of Houston, Texas, USA

ABSTRACT

Background: The geriatric population comprises elderly individuals exhibiting multipathological characteristics and physiological decline, rendering them susceptible to the potential pitfalls of inappropriate medication use, with consequential impacts on morbidity, mortality, healthcare costs, and the risk of drug-related side effects. The aim of this study was to determine the incidence rate of inappropriate medication use (Potentially Inappropriate Medication or PIM) based on the Beers Criteria 2019 in geriatric inpatients at Anutapura Hospital

Materials & Methods: This research aimed to elucidate the medication usage profile and the incidence of Potentially Inappropriate Medication (PIM) based on the Beers Criteria 2019 among geriatric inpatients at Anutapura Hospital. Applying a descriptive research design, data collection was carried out retrospectively utilizing medical records from the year 2022. A controlled quota sampling method was applied to select 321 patient records for analysis based on the Beers Criteria 2019.

Results: The findings revealed that out of 321 geriatric inpatients at Anutapura Hospital, 49 (15.26%) patients were identified with PIM, resulting in a total of 56 instances of PIM. Category 1 medications comprised digoxin (45.83%), alprazolam (43.75%), and diazepam (10.42%). Category 2 medications included meloxicam (100%). Category 3 medications encompassed diuretic (100%). Category 4 medications involved corticosteroid-NSAID interactions (50%) and opioid-benzodiazepine interactions (50%). Category 5 medications included spironolactone (25%) and ranitidine (75%).

Conclusions: The medication usage profile in geriatric inpatients at Anutapura Hospital involved a total of 2287 medication items. The total incidence of Potentially Inappropriate Medication (PIM) was 56 medications out of the total identified medication usage based on the Beers Criteria.

KEY WORDS: Beers Criteria; Geriatrics; Potentially Inappropriate Medication.

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Corresponding Author:

Dr. Arya Dibyo Adisaputra
Lecturer
Department of Pharmacy
Tadulako University
Indonesia

E-mail: adibyoadisaputra@gmail.com

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INTRODUCTION

Geriatric patients are elderly patients who are described as a vulnerable group and categorized as elderly when they reach the age of 60 and above.¹ Aging in the elderly leads to a decline in health by increasing the potential for chronic diseases.² Lack of attention to physiological changes in geriatric patients can contribute to the inappropriate or improper use of medication.³ Potentially Inappropriate Medication (PIM) is associated with increased risk of hospitalization

and mortality in the elderly. Additionally, it can have negative impacts on quality of life and increase healthcare costs.⁴ Beers Criteria is a set of guidelines designed to assist healthcare professionals in assessing the appropriateness of medication use in the elderly.⁵ Beers Criteria is supplemented with the strength of recommendations for each medication included in its categories, as well as levels of scientific evidence.⁶

The prevalence of PIM occurrence in geriatric patients based on the Beers Criteria from the study by Wulansari et al.³ is 63.1%, which is classified as high. Previous research by Al-Azayzih et al.⁷, stated the incidence rate of PIM in geriatric patients as 62.5%. Related research on PIM has also been conducted in Central Sulawesi, specifically at Anutapura General Hospital by Rumi et al.⁸, and the results indicate that out of 97 samples studied, 65 patients were identified as experiencing Potentially Inappropriate Medication (PIM).

Anutapura Hospital is a type B hospital owned by the Palu City Regional Government and serves as a referral hospital for patients from various age groups in the surrounding areas. The number of patients, especially geriatric inpatient ward reached 1627 patients in 2022. Geriatric patients in this hospital have various diagnoses and comorbidities, so special attention needs to be paid to the potential for inappropriate drug use. In addition, no research has been conducted on PIM in geriatric patients at Anutapura Palu Hospital. Therefore, this research was conducted with the aim of determining the incidence rate of inappropriate medication use (Potentially Inappropriate Medication or PIM) based on the Beers Criteria 2019 in geriatric inpatients at Anutapura Hospital in 2022.

MATERIAL AND METHODS

This study utilized a descriptive cross-sectional

design with retrospective data of patients' medical record at Anutapura Hospital in 2022. The sample used in this study was selected using the controlled quota sampling method. The inclusion criteria in this study were medical records of geriatric patients aged 60 years and over with complete data, while the exclusion criteria were patients referred to other hospitals and patients who died while undergoing treatment in 2022. Then determining the minimum sample size can be obtained by using the Slovin formula as follows:

$$n = \frac{N}{1+N(e)^2}$$

$$n = \frac{1627}{1+1627(0,05)^2}$$

$$n = \frac{1627}{5,0675}$$

$$n = 321,0656$$

$$n = 321$$

The variables in this study were Potentially Inappropriate Medication (PIM) based on the Beers Criteria at Anutapura Regional Hospital, which included 5 assessment categories. The data were then identified using the Beers Criteria 2019 and processed using Excel Software. This research has been approved by the Medical and Health Research Ethics Committee of Tadulako University Faculty of Medicine with reference number 8536/UN.28.1.30/KL/2023 dated October 19, 2023.

RESULTS

Demographic information of the 321 patients is presented in the Table 1 below. Patients were asked about their gender, age, and length of hospital stay. In Table 2, the drug profile of geriatric patients is presented.

Table 1. Characteristics of Geriatric Inpatients at Anutapura Hospital

Characteristics	Number of Patients	Percentage
Gender		
Female	163	50.78%
Male	158	49.22%
Age		
Elderly (60-70)	199	61.99%
High-Risk Elderly (> 70)	122	38.01%
Length of Hospital Stay		
≤ 9 Days	285	88.79%
> 9 Days	36	11.21%

Table 2. Drug Profile of Geriatric Patients at Anutapura Hospital

Drug Therapy Class	Number	Percentage
Antihypertensive	468	20.46%
Antiulcer	322	14.08%
Antibiotic	252	11.02%
Antiischemic/Antiplatelet	166	7.26%
Analgesic (NSAID & Opioid)	160	7.00%
Supplements, Vitamins, Minerals	141	6.17%
Mucolytic	98	4.29%
Antiemetic	90	3.94%
Lipid-lowering drug	83	3.63%
Antidiabetic	70	3.06%
Bronchodilator	55	2.40%
Antidote	52	2.27%
Laxative	51	2.23%
Urinary Tract Drug	47	2.06%
Antiarrhythmic	36	1.57%
Nootropic Drug	34	1.49%
Anticoagulant	29	1.27%
Corticosteroid	24	1.05%
Benzodiazepine	23	1.01%
Norepinephrine	16	0.70%
Antidiarrheal	14	0.61%
Antiepileptic	14	0.61%
Antivertigo	11	0.48%
TB Medication	9	0.39%
Hemostatic Drug	8	0.35%
Expectorant	6	0.26%
Antihistamine	6	0.26%
Antimigraine	1	0.04%
Hematopoietic	1	0.04%
Total Number of Drugs	2287	100,00%

In table 3, the occurrence of Potentially Inappropriate Medication (PIM) of Geriatric Patients at Anutapura Hospital is presented.

DISCUSSION

In our study it can be observed that the majority of elderly patients in the inpatient ward of Anutapura Hospital are females, totaling 163 (50.78%), while males number 158 (49.22%). This is consistent with data from Central Bureau of Statistics⁹ which depicts that health complaints and diseases in the elderly are more commonly experienced by females compared to males. Based on age, the characteristic of patients reveals that the majority fall within the age range of 60-70 years, comprising 199 patients (61.99%), while patients aged >70 years amount to 122 patients (38.01%), with cardiovascular disease being the dominant illness. This aligns with research conducted by Manuel et al.¹⁰ which indicates that the highest number of patients admitted are in the age group of 60-70 years. The overall risk of cardiovascular disease tends to significantly increase in individuals aged 40 years or older. The range of hospital stays for geriatric patients at Anutapura Hospital varies between 1-14 days. Based on data obtained from at Anutapura Hospital, patients admitted have various diseases including cardiovascular disease, kidney failure, dyspepsia, pneumonia, bronchitis, delirium, and fractures. Treatment-related factors may contribute to the variability in patient length of stay; both longer and shorter stays can be influenced by the patient's condition.¹¹

The most commonly used medication was amlodipine (15.41%), with a total of 106 medications in the antihypertensive drug therapy class, followed by n-acetylcysteine (100%) with a quantity of 98 medications in the mucolytic therapy class, and omeprazole (29.81%) with a quantity of 96 medications in the antiulcer therapy class. Amlodipine belongs to the group of calcium channel blockers (CCBs) that are frequently prescribed due to their effectiveness in treating hypertension.¹² Antihypertensive medications are the most commonly consumed type of cardiovascular drugs. Additionally, other cardiovascular medications frequently used include drugs for heart failure, antiarrhythmics, lipid-lowering drugs, and drugs for angina.¹³ N-acetylcysteine is the second most commonly used drug as a mucolytic agent among patients in the study. Sum up to 81 patients from the data obtained at Anutapura Hospital experienced respiratory system disorders such as bronchitis, asthma, pneumonia, and even pulmonary tuberculosis. N-acetylcysteine (NAC) consumed as a mucolytic agent to address chronic respiratory diseases by helping to reduce the thickness of mucus.¹⁴ Next to another drug utilized was omeprazole as antiulcer, used both injection and oral formulations to address gastrointestinal issues. According to Aminatus et al.¹⁵ omeprazole has been used as

Table 3. Occurrence of Potentially Inappropriate Medication (PIM) of Geriatric Patients at Anutapura Hospital

Category	Drugs	Description	Number	Percentage	Total
Category 1 Inappropriate medication use in the elderly	Digoxin	If used for atrial fibrillation or heart failure, avoid doses > 0.125 mg/day. Avoid use, as this drug class can increase the risk of cognitive impairment, delirium, and falls in the elderly.	22	39.29%	85.71%
	Alprazolam		21	37.50%	
	Diazepam		5	8.93%	
Category 2 Inappropriate medication use in the elderly due to drug-disease interactions and potential exacerbation of diseases	Meloxicam	Inappropriate for patients with kidney impairment. Can increase the risk of acute kidney injury and further decline in kidney function in patients with creatinine <30 mL/minute.	1	1.79%	1.79%
Category 3 Potentially inappropriate medications requiring cautious use in the elderly	Diuretic (Furosemide and Spironolactone)	Use with caution as it can worsen or cause SIADH or hyponatremia; monitor sodium levels carefully.	1	1.79%	1.79%
Category 4 Medication use with drugs clinically prone to interactions and should be avoided in the elderly	Dexamethasone + Diclofenac Sodium	Increased risk of peptic ulcer disease or gastrointestinal bleeding.	1	1.79%	3.57%
	Codeine + Alprazolam	Increased risk of overdose.	1	1.79%	
Category 5 Medications to be avoided or dose-reduced based on renal function levels in the elderly	Spironolactone	Increased potassium levels in patients with creatinine <30.	1	1.79%	7.14%
	Ranitidine	Reduce dosage in patients with creatinine levels <50. Patients taking this medication may experience changes in mental status.	3	5.36%	

the first proton pump inhibitor used in the treatment of gastritis and is highly effective in reducing gastric acid levels. Omeprazole works by reducing gastric acid production through inhibition of the hydrogen potassium adenosine triphosphatase enzyme activity in gastric parietal cells. The result was significant and long-lasting inhibition of acid secretion.¹⁶

As seen in Table 3, there were two groups of medications included in the Beers Criteria category 1. Firstly, there was the group of antiarrhythmic drugs, namely digoxin (39.29%). Based on data obtained, patients with atrial fibrillation and heart failure were prescribed digoxin at a dose of 0.250 mg/day. This was inappropriate because according to the Beers Criteria 2019, digoxin is to be avoided for atrial fibrillation and heart failure at greater doses than 0.125 mg/day. High doses do not provide benefit and can increase digoxin toxicity. Secondly, the group of

benzodiazepine drugs that were inappropriate for use in the elderly, which are alprazolam (37.50%) and diazepam (8.93%). The elderly should avoid using these drugs due to the risk of cognitive impairment, delirium, falls, fractures, and high dependency.¹⁷ The medication included in Beers Criteria category 2 is NSAIDs, specifically meloxicam which can worsen stage IV or higher chronic kidney disease or with a creatinine level <30 mL/minute in the elderly. Administration of NSAIDs can increase the risk of acute kidney injury and further decline in kidney function. This has been explained by Listiani et al.¹⁸ that NSAIDs reduce prostaglandin production, leading to sodium retention, which can ultimately result in complications such as hypertension, kidney dysfunction, and edema formation.

Based on Beers Criteria category 3, data regarding the use of diuretic medications, namely furosemide

and spironolactone. Both were obtained for one geriatric patient with a secondary diagnosis of hyponatremia. According to the Beers Criteria 2019, the use of diuretic medications needs to be approached with caution as it carries the risk of exacerbating or triggering Syndrome of Inappropriate Antidiuretic Hormone (SIADH) or low blood sodium levels (Hyponatremia). SIADH is a condition caused by an increase in ADH (antidiuretic hormone) levels. Elevated ADH levels result in increased water reabsorption by the renal tubules, leading to water retention and the occurrence of hyponatremia.¹⁹

There were two types of drug interactions that geriatric patients should avoid according to Beers Criteria category 4. The first was the interaction between corticosteroid medication (dexamethasone) and NSAID medication (diclofenac sodium). Geriatric patients need to avoid using this combination of medications because their concurrent use can increase the risk of peptic ulcers or gastrointestinal bleeding.¹⁷ The second was the interaction between opioid medication (codeine) and benzodiazepine medication (alprazolam). As explained in Beers Criteria 2019, the use of benzodiazepines with opioids caused an interaction that can increase the risk of overdose. According to Cahyaningsih et al.²⁰, this combination increased the risk of respiratory depression, which mutually reinforces and potentially leads to death due to overdose. In elderly patients with a creatinine clearance below 30, the administration of spironolactone needs to be carefully monitored as it can cause an increase in blood potassium levels. Hyperkalemia has the potential to disrupt normal electrical function in the heart, which can result in serious issues including cardiac rhythm disturbances.²¹ The second medication that geriatric patients should avoid in this category was ranitidine. The use of this medication needed to be reduced in dosage for elderly patients with kidney function levels below 50 mL/minute as it can impact the patient's mental status.¹⁷ This was aligned with the study by Andriani et al.²² which stated that ranitidine belongs to the category of H₂ receptor antagonists and requires dose adjustment when given to patients with decreased creatinine clearance rates.

Multimorbidity has an impact on older patients' elevated risk of PIM as well. Diabetes mellitus, CAD, cerebrovascular disease, endocrine and metabolic disorders, and other comorbidities raise the likelihood of polypharmacy drug use.²³ In addition, a greater number of diseases has the potential to increase the number of drugs prescribed to patients.²⁴ In the research findings, the incidence rate of Potentially Inappropriate Medication (PIM) based on the Beers Criteria in geriatric inpatients at Anutapura Hospital is relatively low, at a percentage of 15.26%. This indicated that the medication provided to geriatric patients in this hospital is appropriate. Although

the Beers Criteria provides guidance on medication used in the geriatric population, it is not the sole reference in clinical practice. Doctors still have the flexibility to choose the most suitable therapy for each patient's specific condition and needs. Therefore, continuous collaboration among various healthcare professionals was essential to ensure that the risk of side effects or adverse events due to medication mismatches in patients can be minimized through careful monitoring and evaluation.

CONCLUSION

In conclusion, the medication usage profile in geriatric inpatients at Anutapura Hospital involved a total of 2287 medication items. The total incidence of Potentially Inappropriate Medication (PIM) was 56 medications out of the total identified medication usage based on the Beers Criteria. The identified PIM occurrences ranged from category 1 with 48 medications (85.71%), category 2 with 1 medication (1.79%), category 3 with 1 medication (1.79%), category 4 with 2 medications (3.57%), and category 5 with 4 medications (7.14%).

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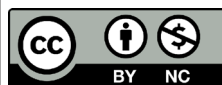
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MRT, MFH
Acquisition, Analysis or Interpretation of Data:	MRT, MFH, DAP, AAM, RS
Manuscript Writing & Approval:	MRT, MFH, DAP, AAM, ADA

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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