Potentially Inappropriate Prescribing (PIP) based on Beers Criteria in Geriatric Patients at the Inpatient Unit of a Hospital in Bandar Lampung

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ABSTRACT

Geriatric patients often experience polypharmacy due to multimorbidity. This is a factor that increase the risk of Potentially Inappropriate Prescribing (PIP), which can cause serious health problems. Beers Criteria are one of the guidelines used to identify PIP in geriatric patients. This study aims to evaluate PIP in geratric patients using Beers criteria. This study used a cross-sectional approach. The sampling technique was purposive sampling. The study subjects were the medical records of geriatric patients at the inpatient installation of one of the hospitals in Bandar Lampung, totaling 76 subjects. Geriatric patients at the inpatient unit of one of the hospitals in Bandar Lampung were predominantly male with 48 (63.2%) patients, aged group 60 – 69 years with 45 (59.2%) patients, and receiving ≥5 types of medications with 74 (97.4%) patients. The incidence of PIP was found in 26 (34.2%) patients with a total of 33 PIP events consisting of PIP category 1, 2 and 4, are 16 (48.48%), 9 (27.27%) and 8 (24.24%) events respectively.

Keywords: Beers criteria, geriatri, PIP, polypharmacy

INTRODUCTION

Indonesia has entered a phase of an aging population, where approximately 1 in 10 inhabitants is considered elderly, defined as individuals over 60 years old. By 2045, it is estimated that elderly population will reach 20.31% of the total population (BPS, 2024). While the increase in the elderly population reflects a significant achievement in development, it also present challenges. The primary chalange curently faced is maintaining the quality of life for the elderly, as aging often leads to declines in physical capabilities and health status (Adioetomo, 2018).

Health problems in the elderly are caused by declining body functions resulting from the accumulation of various cellular and molecular level damages over a long period, known as the aging process. The aging process is characterized by a decrease in physical and mental ability and an increased risk of developing disease thet can lead to death (Pangribowo, 2022; Kemenkes RI, 2016).

Geriatrics is a branch of medicine that focuses on the diagnosis and treatment of diseases and health problems affecting the elderly (Kemenkes RI, 2016). Geriatric patients often experience polypharmacy (defined as consuming more than 5 medications daily) due to multimorbidity (Lavan, 2016). Therefore, it is essential to monitor medication use and prescribing in patients by identifying potentially inappropriate prescribing, also called Potentially Inappropriat Prescribing (PIP) (Wiyono, 2019).

PIP is the prescribing of medications that potentially increase the risk of adverse drug-related problems. This includes the use of medications that are not clinically necessary, not economical, or may cause more harm than benefit. PIP is reported to negatively impact increased hospital admissions, adverse drug events, and emergency unit visits. PIP also impacts healthcare costs by driving unnecessary medication use or additional health services. There is a possibility that 20% of prescriptions given to geriatrics may be inappropriate (Khatter, 2021; Hedna, 2015). Several studies show a high prevalence of PIP in geriatric patients (Safitri, 2023; Sasfi, 2022; Al-Azayzih, 2019). This indicates that geriatric patients continue to receive inappropriate medications, which can lead to problems with a higher risk. Therefore, it is essential to minimize the use of medications that may not comply with applicable guidelines or specific references. Beers Criteria is one of the guidelines or references that are used to evaluate medication use and prescribing in geriatrics (Sasfi, 2022; Wahyuni, 2023).

METHODS

This study is observational using a cross-sectional approach to identify potentially inappropriate prescribing in geriatric patients according to the Beers Criteria at the inpatient unit of one of the hospitals in Bandar Lampung during January-June 2023. The sample in this study was the medical records of geriatric patients who met the inclusion and exclusion criteria, with a total sample size of 76. The inclusion criteria in this study were (i) medical records of geriatric patients (>60 years old) who were hospitalized, (ii) medical records of patients receiving drug therapy. The exclusion criteria in this study were medical records with data that were not clearly legible or incomplete. Data collection in this study used the purposive sampling method, where samples were selected by simple random sampling. After the data was collected, univariate analysis was performed to determine patient characteristics (age, gender, length of hospital stay, number of medications used) and the incidence of potentially inappropriate prescribing (PIP).

RESULTS AND DISCUSSION

A. Characteristic of Geriatric Patients

The total number of geriatric patients at the inpatient unit of one of the hospitals in Bandar Lampung from January-June 2023 who met the inclusion and exclusion criteria of this study was 76 patients. The characteristics of geriatric patients include age, gender, length of hospital stay, and number of medications used, presented in Table 1.

Table 1. Characteristic of Geriatric Patients

Characteristic	Number (N=76)	Persentage (%)
Age		
60-69 years	45	59.2
≥ 70 years	31	40.8
Gender		
Male	48	63.2
Female	28	36.8
Lenght of Hospital stay		
< 5 days	41	53.9
≥ 5 days	35	46.1
Number of medications		
< 5 medications	2	2.6
≥ 5 medications	74	97.4

The highest percentage of geriatric patients was in the group aged 60 – 69 years, totaling 45 (59.2%) patients. Meanwhile, patients aged ≥70 years totaled 31 (40.8%) patients. The result of this study is in line with the Central Statistics Agency data for Lampung Province in 2022, which showed that the prevalence of geriatric patients in Lampung was highest in the age group 60 – 69 years.

Geriatric patients at the inpatient unit of one of the hospitals in Bandar Lampung consisted of 48 (63.2%) male patients and 28 (36.8%) female patients. This finding is consistent with the data presented in the Bandar Lampung City health profile in 2021, which indicated that the highest number of patients receiving health services in Bandar Lampung were male patients (Dinkes, 2021).

The prevalence of degenerative diseases is higher in male geriatric patients compared to female patients. Unhealthy lifestyle patterns, such as smoking, alcohol consumption, poor diet, obesity, and lack of physical activity, can be risk factors for male geriatric patients to experience single or multipathology degenerative diseases. In male geriatric patients, these risk factors were found to be twofold higher, making them more vulnerable to disease development. Therefore, male geriatric patients undergo more hospitalizations compared to female geriatric patients (Sasfi, 2022).

Geriatric patients who underwent hospitalization for <5 days totaled 41 (53.9%) patients, while 35 (46.1%) geriatric patients underwent hospitalization for ≥5 days. The severity of the disease experienced by geriatric patients and the receipt of appropriate care are factors that lead to more geriatric patients undergoing hospitalization for <5 days (Eskandari, 2022). This result is in line with research conducted by Nurhasnah, *et al.* (2022), which showed that the number of geriatric patients hospitalized for <5 days was higher than geriatric patients hospitalized for ≥5 days, with a ratio of 200 (61.5%) patients compared to 125 (38.5%) patients. Geriatric patients hospitalized for ≥5 days have a higher risk of experiencing a PIP event (Nurhasnah, 2022).

The percentage of geriatric patients receiving ≥5 types of medications was 74 (97.4%) patients, while those receiving <5 types of

medications were only 2 (2.6%) patients. The result of this study is consistent with research conducted by Wulansari, *et al.* (2023), which found that 112 (79.4%) geriatric patients received ≥ 5 types of medications during hospitalization, while only 29 (20.6%) geriatric patients received <5 types of medications (Wulansari, 2023).

The simultaneous use of 5 to 9 medications in a patient is considered polypharmacy (Şahne, 2016). Polypharmacy often occurs in geriatric patients with multimorbidity, where patients require several types of medications to manage chronic conditions or prevent complications related to certain chronic conditions. This polypharmacy is associated with adverse effects, including the risk of mortality, falls, adverse drug reactions, increased duration of hospital stay, and high likelihood of rehospitalization after discharge. The risk of side effects and harm tends to increase with the increasing number of medications used by geriatric patients (Masnoon, 2017). Polypharmacy in geriatric patients is also associated with a higher risk of experiencing PIP events (Alhawassi, 2019).

B. Incidence of Potentially Inappropriate Prescribing (PIP) in Geriatric Patients

The identification of Potentially Inappropriate Prescribing (PIP) in geriatric patients used the Beers Criteria 2023. The results of this study found that 26 (34.2%) patients experienced a PIP event, while 50 (65.8%) patients did not. The description of PIP events in geriatric patients is presented in Table 2.

Table 2. Description of Potentially Inappropriate Prescribing in Geriatric Patients

Potentially Inappropriate Prescribing	Number	Percentage %
Not Occuring	50	65.8
Occuring	26	34.2
Total	76	100.0

In the 26 patients found to have Potentially Inappropriate Prescribing (PIP), there were 33 events included in the Beers Criteria 2023 categories. These included Category 1 (medications considered potentially inappropriate in geriatric patients), Category 2 (medications potentially inappropriate in geriatric patients with specific diseases or syndromes), and Category 4 (potentially inappropriate drug-drug interactions in geriatric patients). The description of PIP events in geriatric patients based on the Beers Criteria 2023 categories are presented in Table 3.

Table 3. Description of PIP Incidence in Geriatric Patients Based on Beers Criteria 2023 Categories

PIP Category	Medication Name	Number N=33	Percentage %
Category 1 Medications considered potentially inappropriate in geriatric patients	Glimepiride	4	12.12
	Short-Acting Insulin	4	12.12
	Diazepam	3	9.09
	Acetylsalicylic Acid	2	6.06
	Phenobarbital	1	3.03
	Ketorolac	1	3.03
	Amitriptyline	1	3.03
Total		16	48.48
Category 2 Medications potentially inappropriate in geriatric patients with specific diseases or syndromes	NSAID + Heart Failure	9	27.27
Total		9	27.27
Category 4 Potentially inappropriate drug-drug interactions in geriatric patients..	Captopril + Spironolactone	2	6.06
	Gabapentin + Eperisone HCl + Tramadol	2	6.06
	Lisinopril + Spironolactone	1	3.03
	Candesartan + Spironolactone	1	3.03
	Ramipril + Spironolactone	1	3.03
	Captopril + Lisinopril + Spironolactone	1	3.03
Total		8	24.24

In Category 1, the most frequent cases occurred in geriatric patients using the sulfonylurea class (glimepiride), with 4 (12.12%) cases. According to the Beers Criteria 2023, the use of the sulfonylurea class in geriatric patients increases the risk of cardiovascular events and can be a cause of death, ischemic stroke, and hypoglycemia. A case report from India described a 74-year-old female patient who presented to the emergency department with severe sulfonylurea-induced hypoglycemia while receiving standard doses of glyburide (5 mg once daily) and metformin (1,000 mg twice daily) (Pradeep, 2025).

Sulfonylureas work by rapidly lowering blood glucose levels, but a rapid decrease in blood glucose levels can potentially cause the side effect of hypoglycemia, which, in fatal circumstances, can lead to loss of consciousness in patients (Gumantara, 2017). Among the sulfonylurea class, long-acting agents (such as glimepiride and glibenclamide) pose a higher risk of prolonged hypoglycemia compared to short-acting agents (such as glipizide). The use of sulfonylureas should be avoided as first or second-line monotherapy or as additional therapy. However, if the use of sulfonylureas is necessary, it is recommended to use short-acting agents such as glipizide (American Geriatrics Society, 2023).

The use of short-acting insulin (Novorapid), which contains insulin aspart, occurred in 4 (12.12%) cases. According to the Beers Criteria 2023, the use of short-acting or rapid-acting insulin should be avoided in geriatric patients because it can increase the risk of hypoglycemia. Short-acting or rapid-acting insulin in geriatric patients should be used in combination with basal or long-acting insulin (American Geriatrics Society, 2023). The combination of short-acting insulin (insulin aspart) with long-acting insulin (insulin glargine), for example, provides a faster onset of action with a longer duration of action, thus more closely approximating the normal insulin profile in the body (Udayani, 2021).

The use of the benzodiazepine class (diazepam) was used in geriatric patients, with 3 (9.09%) cases. According to the Beers Criteria 2023, the benzodiazepine class should be avoided in geriatric patients because they tend to experience increased sensitivity to benzodiazepine drugs and decreased long-term drug metabolism. Continuous use of the benzodiazepine class can cause clinically significant physical dependence and increase the risk of cognitive impairment, delirium, falls, fractures, and motor vehicle accidents in geriatric patients (American Geriatrics Society, 2023). Benzodiazepine drugs can be substituted with trazodone or low-dose doxepin (≤6mg/day) as alternatives. If the use of the benzodiazepine class is necessary, the dose needs to be reduced to half, and the duration of treatment also needs to be shortened. During the use of these medications, side effects must be monitored (Nurmainah, 2022).

The use of acetylsalicylic acid in geriatric patients occurred in 2 (6.06%) cases. According to the Beers Criteria 2023, acetylsalicylic acid in geriatric patients should be avoided because it risks causing major bleeding, and failure to reduce the risk of cardiovascular disease when used for primary prevention. Acetylsalicylic acid is indicated for secondary prevention in geriatric patients who have previously suffered from cardiovascular disease (American Geriatrics Society, 2023; Saad, 2019).

There was 1 (3.03%) case of using phenobarbital in geriatric patients. Phenobarbital is an anticonvulsant that works by enhancing inhibition through interaction with GABA-A receptors and reducing glutamatergic excitation through AMPA receptors (Trinka, 2013). According to the Beers Criteria 2023, the use of phenobarbital in geriatric patients should be avoided because it causes a high level of physical dependence, tolerance to sleep benefits, and a greater risk of overdose at low doses (American Geriatrics Society, 2023). Preferred therapy for seizures in geriatric patients experiencing polypharmacy is lamotrigine and levetiracetam because these two drugs have relatively few drug interactions, good side effect profiles, and minimal impact on cognitive function (Seo, 2020).

The Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) class is very frequently prescribed to geriatric patients; in this study, there was 1 (3.03%) case. The mechanism of action of the NSAID class is to inhibit the activity of cyclooxygenase (COX) 1 and 2 enzymes. Inhibition of COX enzymes results in a decrease in the formation of prostaglandin (PGE2) and thromboxane (TXA2) from arachidonic acid (Zhang, 2019). According to the Beers Criteria

2023, the use of NSAIDs in geriatric patients, in this study, ketorolac, should be avoided. It can increase the risk of gastrointestinal bleeding or peptic ulcer in high-risk groups, including geriatric patients or patients using oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents. Long-term use of NSAIDs can cause perforation, increased blood pressure, and kidney injury. For geriatric patients who require NSAIDs, it is recommended to use gastroprotective agents such as a Proton Pump Inhibitor (PPI) or misoprostol because they can reduce gastrointestinal bleeding caused by NSAIDs (American Geriatrics Society, 2023).

The use of amitriptyline occurred in 1 (3.03%) case. In geriatric patients, amitriptyline should be avoided because it potentially causes a strong anticholinergic effect, such as sedation, and leads to orthostatic hypotension (American Geriatrics Society, 2023). Administration of drugs with a strong anticholinergic effect in geriatric patients can result in cognitive impairment that tends to develop into dementia, cause confusion, delirium, dry mouth, difficulty urinating, constipation, decreased motor function, and increased hospitalization (Lupitaningrum, 2019). If amitriptyline is used in geriatric patients, dose adjustment needs to be done by giving a low dose to reduce the possibility of side effects (Suga, 2019).

In Category 2, there were geriatric patients with a diagnosis of heart failure who were prescribed NSAIDs. In this case, paracetamol was prescribed in 9 (27.27%) cases. Potentially inappropriate medication (PIM) related to NSAID use was also identified in a study conducted by Samara (2023) in Palestine, with an incidence of 3.1%. NSAIDs inhibit the activity of the cyclooxygenase (COX) enzyme, which produces prostaglandin H2 (PGH-2) from arachidonic acid. PGH-2 is converted into prostanoids (prostaglandin (PGE-2), prostacyclin (PGI-2), and thromboxane (TXA-2) by tissue-specific enzymes (Varga, 2017). Inhibition of prostanoid production in the kidneys can reduce glomerular filtration and the excretion of sodium and water. Therefore, the use of NSAIDs is associated with the risk of hypovolemia and exacerbation of heart failure. The use of NSAIDs in patients with heart failure increases the risk of cardiac decompensation (Varga, 2017). According to the Beers Criteria 2023, the use of NSAIDs in geriatric patients with a diagnosis of heart failure potentially increases fluid retention and aggravates the heart failure condition, so it must be avoided in symptomatic geriatric patients (American Geriatrics Society, 2023).

In Category 4, there were geriatric patients who potentially experienced drug interactions, specifically the use of Renin-Angiotensin System (RAS) inhibitors with other RAS inhibitors or potassium-sparing diuretics, which can lead to an increased risk of hyperkalemia. Hyperkalemia in geriatric patients can have fatal consequences. It is reported that there is a significant relationship between hyperkalemia and morbidity and mortality in the elderly. A study conducted by Özkan, et al. (2025) found that mortality due to hyperkalemia was 22 cases (12%), compared with 7 cases (3.9%) among patients without hyperkalemia.

The simultaneous use of 2 or more RAS inhibitors, or the use of RAS inhibitors with potassium-sparing diuretics, should be routinely avoided in patients with chronic kidney disease stage 3a or higher (American Geriatrics Society, 2023). In this study, there were patients prescribed Angiotensin Converting Enzyme Inhibitor (ACEI) class drugs such as lisinopril, captopril, and ramipril, with the potassium-sparing diuretic (spironolactone) simultaneously. There were also patients prescribed Angiotensin II Receptor Blockers/ARB (candesartan), simultaneously with spironolactone. The use of ACEI or ARB together with a potassium-sparing diuretic can increase the risk of hyperkalemia because ACEI or ARB decrease aldosterone secretion, which can exacerbate the increase in serum potassium that may be caused by the potassium-sparing diuretic. Therefore, if ACEI or ARB is used together with a potassium-sparing diuretic, regular monitoring of serum potassium and renal function must be performed, and potassium supplementation should be avoided. If spironolactone is prescribed together with an ACEI or ARB, the dose should not exceed 25 mg/day.

Geriatric patients were found to potentially experience drug interaction events, specifically the use of a combination of ≥3 types of drugs that are active on the central nervous system (CNS), with 2 (6.06%) cases. According to the Beers Criteria 2023, the use of a combination of ≥3 types of drugs that are active on the CNS must be avoided, and it is recommended to minimize the number of CNS-

active drugs in geriatric patients (American Geriatrics Society, 2023). In this study, there were patients prescribed a combination of ≥3 types of CNS-active drugs, namely gabapentin (an antiepileptic) combined with tramadol (an opioid), and eperisone HCl (a skeletal muscle relaxant). The use of a combination of CNS-active drugs in geriatric patients can cause interactions that increase the risk of falls and fractures. This is due to side effects such as sedation, dizziness, and cognitive impairment that may occur (American Geriatrics Society, 2023; Gray, 2019).

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CONCLUSION

The conclusions from the results of this study are as follows: the most frequent patient age group was 60 – 69 years with 45 (59.2%) patients, predominantly male with 48 (63.2%) patients, underwent hospitalization for < 5 days with 41 (53.9%) patients, received ≥ 5 types of medications with 74 (97.4%) patients, and PIP events occurred in 26 (34.2%) patients. The incidence of PIP was found in 26 (34.2%) patients with a total of 33 PIP events consisting of PIP category 1, 2 and 4, are 16 (48.48%), 9 (27.27%) and 8 (24.24%) event respectively.

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