Assessment of Potentially Inappropriate Medication (PIMs) in Older Adult Patients at The Geriatric Polyclinic of a General Hospital in Central Java

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Abstract : One of the most critical issues affecting older adults is the increasing use of potentially inappropriate medication (PIMs). The use of PIMs is associated with drug-related problems, as well as undesirable drug effects. This study aimed to assess the prevalence of potentially inappropriate medication and the most commonly prescribed PIMs category in older adults. This research method is observational with a cross-sectional design. Drugs were analyzed using the 2019 Beers criteria compiled by The American Geriatrics Society (AGS), classifying PIMs into five categories. The inclusion criteria in this study were patients aged ≥65 years, using at least one drug, with a duration of drug use of at least one month, and analyzing this research data descriptively. The results showed that out of 134 prescriptions consisting of 773 drug items, 95 drug items were potentially inappropriate for use in older adults. The prevalence of PIMs was 12%, and if classified by category, then partly in order, inappropriate medication included category 1 (8.2%); category 2 (0.6%); category 3 (2.8%); category 4 (0.3%); category 5 (0.1%). The most common drugs included in category 1 PIMs criteria were proton pump inhibitors (PPIs), namely lansoprazole and omeprazole. Conclusion: In this study, the prevalence of potentially inappropriate Medication in older adults was 95 drug items (12%), and the more commonly prescribed category of PIMs is category one drugs and should avoid category one drugs in older adults

Keywords: PIMs, older adults, Beers 2019 criteria, Prevalence, and Category

1. INTRODUCTION

The world's older adult population will continue to increase every year. The global population of those aged 60 years and above is estimated to grow from 900 million in 2015 to 2 billion in 2050 and will double from 12% to 24% of the global population (WHO, 2022). In Indonesia, the older adult population increased significantly from 2010 to 2019, increasing by 18 million (7.56%) to 25.9 million (9.7%). This trend is estimated to continue, with the number of older adults expected to reach 48.2 million (15.77%) by 2035 (Kemenkes RI, 2019).

The older adult population can impact aspects of life, including health and infectious and non-communicable diseases. Non-communicable diseases prevalent in older persons encompass hypertension, dental issues, joint disease, oral complications, diabetes mellitus, heart disease, and stroke. Common infectious disorders that affect older persons include upper respiratory tract infections (URIs), diarrhea, and pneumonia (Riset Kesehatan Dasar (Riskesdas), 2018). One of the health problems in older adult patients consists of the prescription of potentially inappropriate medication or PIMs. Potentially inappropriate medication or PIMs are drugs whose use in the older adult population requires caution due to an increased risk of adverse responses (Díez *et al.,* 2022).

One significant and enduring issue with administering drugs to older adult individuals is inappropriate use. Beers and his colleagues created the "Beers criteria," which are clear standards for possibly unsuitable drugs thought to have particular adverse effects in older adult patients, to prevent drug-related problems in older adults. The currently used version of the Beers criteria is the 2019 edition. The Beer criteria 2019 Guidelines encompass many components, such as drug-drug interactions, preventive strategies for specific medical issues, cautious drug administration, inappropriate drug utilization in older patients, and dosage modifications based on renal function (Fick *et al.,* 2019).

Based on the research results conducted in Jordan Hospital in 2019, of the 4,622 (62.5%) older adult patients evaluated and prescribed, there was at least one PIMs. The most characteristic of PIMs in the hospital was category 3, which explicitly refers to medications that need to be used cautiously in older adults, at around 69% (Al-Azayzih, *et al.,* 2019). These results differ from Alhawassi et al. 2019 study in a Saudi Arabia hospital, which showed that 4,073 (39.9%) older adult patients evaluated had at least one PIMs. The characteristics of PIMs in the hospital were the category of PIMs that avoided as much as 57.5% and the category of PIMs used with caution as much as 37.5% (Alhawassi *et al.,* 2019). Meanwhile, research conducted by Viviandhari et al. in 2022 in a Jakarta hospital showed that it included 136 patients (41.85%) and 181 drugs that met the PIMs criteria. The most PIMs characteristics were found in criterion 3, "drugs that must be used with caution," as much as (47.5%) (Viviandhari et al., 2022). A study by Maharni et al. in 2019 at a health facility in Pekanbaru City found that out of 287 prescriptions, 77 (26.8%) contained at least one potentially inappropriate medication (PIMs) according to Beers 2015 criteria. The most common type of PIMs found was category 1, which explicitly refers to drugs that older adults should avoid, which is around 20.9% (Muharni *et al.,* 2019).

The results between these studies may be due to differences in research places, time, sample size, research design, disease patterns, prescribing patterns, or different versions of the Beers criteria. Further research is needed to assess PIMs in older adult patients. Researchers are interested in evaluating PIMs in older adult patients at the geriatric polyclinic of one of the government hospitals in Central Java based on the Beers 2019 criteria. The findings of this study can help hospitals choose older patients' treatments more rationally.

2. Material and Method

This cross-sectional observational study collected data from medical records and prescriptions of older adult patients at the geriatric polyclinic of a state hospital in Central Java from May to July 2023. Sociodemographic information, diagnosis, and treatment records were among the data collected. The study received approval with number 332/III/HREC/2023 from the Health Research Ethics Commission of Dr. Moewardi Hospital Surakarta.

The study population was all elderly outpatients at the geriatric polyclinic of the Central Javan State Hospital. The sample comprised older adult patients who met the study's inclusion requirements. The study's inclusion criteria required participants to be 65 years of age or older, to have used drugs for at least one month, and to have taken at least one drug.

The analysis of medication use in older adults was examined using the 2019 Beers criteria, developed by *The American Geriatrics Society* (AGS) (Fick *et al.,* 2019). This guideline aims to assess the efficacy of pharmacological therapy, improve the appropriateness of drug choice, optimize cost-effectiveness, and minimize adverse drug reactions in the older adult population. The 2019 Beers criteria guidelines cover five categories of drugs that have the potential to cause adverse effects, including **Category 1** is drugs avoided for older adults. Examples: Proton Pump Inhibitors (PPIs), sulfonylureas, rapid or short-acting insulin (single administration) without the combination of long-acting insulin, and Nonsteroidal anti-inflammatory drugs (NSAIDs); **Category 2** are drugs that older adults with specific clinical conditions or diseases should avoid. Example: drugs that affect the cardiovascular system, older individuals with a past of falls or fractures, delirium, gastrointestinal, renal, or urinary tract issues, and involuntary loss of urine in females; **Category 3** dextromethorphan, tramadol, oxcarbazepine, dabigatran, antipsychotics mirtazapine, selective serotonin-norepinephrine reuptake inhibitors (SNRIs*)*, diuretics, tricyclic antidepressants (TCAs), selective serotonin reuptake inhibitors (SSRIs), oxcarbazepine, rivaroxaban, trimethoprim-sulfamethoxazole; **Category 4** are drugs that clinically should be avoided in older adults due to the potential for drug-to-drug interactions. Examples: drugs that act on the renin-angiotensin system (RAS), angiotensin-converting enzyme inhibitors (ACEis), angiotensin receptor-neprilysin inhibitors (ARNIs), angiotensin receptor blockers (ARBs), opioids that interact with benzodiazepines, anticholinergics that interact with other anticholinergics, and corticosteroids that interact with NSAIDs; **Category 5** are medications that should be avoided or adjusted in dosage in older adults with reduced renal function. Examples: drugs acting on the central nervous system (duloxetine, gabapentin, pregabalin, levetiracetam), analgesics (Tramadol), gastrointestinal (Cimetidine, famotidine, ranitidine), anti-infectives (ciprofloxacin, trimethoprim-sulfamethoxazole), hemostasis drugs (apixaban, dabigatran, enoxaparin, fondaparinux, rivaroxaban, triamterene), and cardiovascular drugs (amiloride and spironolactone).

Data processed with the PIMs guidelines from *The American Geriatrics Society (AGS)* continued the process of coding, editing, and grouping using Microsoft Excel. Seeing the percentage of prevalence of drugs that experience PIMs using the following formula:

$$\% \text{ PIMs incidents } = \frac{\text{PIMs listed drugs}}{\text{total drug items}} \text{ x}100$$

The percentage of PIMs categories were calculated using the following formula:

$$\% \text{ Category} = \frac{\text{cPIMs}}{\text{total PIMs listed drugs}} \text{ x } \% \text{ PIMs incidents}$$

Note:
cPIMs: PIMs drugs item category (1,2,3,4, and 5)

3. Results and Discussion

Sociodemographic, clinical, and drug characteristics are in Table 1. This study obtained drug prescription data from 134 older adult patients undergoing outpatient care at the geriatric polyclinic of a Regional General Hospital in Central Java. There were more female than male

patients, 82/134 (61%). This statement is by BPS 2022, which states that the older adult population is primarily women, 51.81%, and men, 48.19% (Badan Pusat Statistik, 2022).
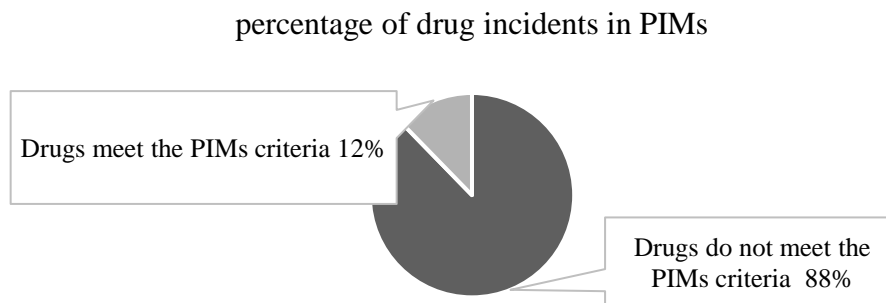
In Table 1, the top 3 diseases are hypertension, diabetes, and osteoarthritis, and 127 patients experience more than 1 type of disease or have comorbidities. These results are the same as the WHO (World Health Organization) statement, which lists hearing loss, cataracts, refractive errors, back pain, cardiovascular disease, osteoarthritis, diabetes, depression, and dementia as health issues common among older persons. Older persons typically encounter multiple diseases concurrently with aging (WHO, 2022).

Table 1. Characteristics of older adults at a Central Javan State General Hospital's Geriatric Polyclinic

Characteristics	N=134	
	Number	**Percentage (%)**
Age		
60-69	31	23
70-79	88	66
≥80	15	11
Gender		
Female	82	61
Male	52	39
Comorbidity		
Yes	127	95
No	7	5
Disease		
Hypertension	79	26.9
Type II diabetes	58	19.7
Osteoarthritis	56	19.0
Heart failure	34	11.6
BPH *(Benign Prostatic Hyperplasia)*	28	9.5
Dyspepsia	13	4.4
Hyperlipidemia	6	2.0
Hyperuricemia	4	1.4
Atherosclerosis	4	1.4
Ischemic Heart Disease	4	1.4
Myalgia	3	1.0
Rheumatoid arthritis	2	0.7
Kidney failure	2	0.7
Hemorrhoids	1	0.3
The number of drugs in one prescription		

≤5 drugs	22	16
>5 drugs	112	84

percentage of drug incidents in PIMs

Drugs meet the PIMs criteria 12%

Drugs do not meet the PIMs criteria 88%

Note:
N: number of patients

Fig 1. The proportion of PIMs drugs in older adult in a Central Javan State
General Hospital's geriatric polyclinic based on Beers criteria 2019

3.1. Proportion of Patients Receiving PIMs Drugs Included in the 2019 Beers Criteria

The proportion of patients who received PIMs drugs and did not get PIMs drugs can be seen in Figure 1. In the results of this study, based on the 2019 Beers criteria, there were 95 drug items (12%) from a total of 134 prescriptions containing 773 potentially inappropriate medication items. In the results of research conducted by Nurmainah and Astuti (2022), according to Beers 2019 criteria, out of 117 prescriptions, 198 item drugs were potentially inappropriate (Nurmainah and Astuti, 2022).

3.2. Prevalence of PIMs Prescribing Based on Beers 2019 Criteria

The study identified the top 3 possibly inappropriate medication prescriptions in older adult individuals, according to the 2019 Beers criteria guidelines. These prescriptions include cardiovascular drugs, NSAIDs, and PPIs **Table** 2. Older adult patients in the outpatient geriatric polyclinic of a regional public hospital in Central Java were overwhelmingly prescribed these drugs. These findings align with the research done by Malakouti et al. 2021, which recommends avoiding the use of potentially inappropriate medication (PIMs). Specifically, they highlight cardiovascular system drugs, analgesics, and NSAIDs as examples of such treatments (Malakouti *et al.,* 2021).

The types of drugs that are PIMs in this study are lansoprazole, omeprazole, diclofenac sodium, furosemide, meloxicam, and aspirin. The picture is almost the same as previous research, namely research by Nurmainah *et al.* 2022, showing that the most commonly prescribed types of PIMs are lansoprazole, glimepiride, diclofenac sodium, meloxicam, furosemide, glimepiride (Nurmainah and Astuti, 2022).

This study showed an 8.2% incidence of category 1 PIMs. Older adults avoid these drugs. There were also category 2 drugs to avoid for older people with particular diseases or conditions at 0.6%, and category 3 drugs to use with caution at 2.8%. In addition, there were category 4 drug

interactions with other medicines at 0.3%. It's essential to avoid or adjust the doses of category 5 drugs for older adult patients with decreased kidney function, as their prevalence was 0.1%.

3.2.1. Category 1

Should generally avoid drugs in category 1 in older adult patients.

Lansoprazole dan Omeprazole

Proton Pump Inhibitors (PPIs) include lansoprazole, pantoprazole, esomeprazole, and omeprazole. The most common prescription of category 1 PIMs in this study was lansoprazole (3.7%) and omeprazole (1.3%). There was a decrease from previous research by Guillot et al. in 2020, which showed that the most common prescription of PIMs was PPIs (43.3%) (Guillot *et al.,* 2020). The difference in results may be due to the place of the study, regional location, period, sample size, illness profiles, prescription practices, and the number of medications patients acquire, which varies among studies.

In this study, 16 patients were at high risk of receiving PPIs, while 15 patients had osteoarthritis diagnoses, and one patient was diagnosed with osteoporosis. Using PPIs at high doses or for a long time can raise the risk of fractures in the hip, wrist, or spine (Kim *et al.,* 2020).

Table 2. Prevalence of prescribing Potentially Inappropriate Medications (PIMs) listed in the 2019 Beers criteria older adult patients at the geriatric polyclinic of a public hospital in Central Java

PIMs Category	Drugs	N=95			
		QE	SR	Number	Percentage (%)
Category 1	Lansoprazole	High	Strong	29	3.7
	Omeprazole	High	Strong	10	1.3
	Nifedipine	High	Strong	9	1.1
	Sodium diclofenac	Moderate	Strong	9	1.1
	Glimepiride	High	Strong	3	0.4
	Insulin NovoRapid	Moderate	Strong	3	0.4
	Metoclopramide	Moderate	Strong	1	0.1
	Meloxicam	Moderate	Strong	1	0.1
Subtotal				**65**	8.2
Category 2	Diltiazem	Moderate	Strong	3	0.4
	Meloxicam	Moderate	Strong	1	0.1
	Celecoxib	Moderate	Strong	1	0.1
Subtotal				**5**	0.6
Category 3	Furosemide	Moderate	Strong	12	1.5
	Aspirin	Moderate	Strong	9	1.1
	Rivaroxaban	Moderate	Strong	1	0.1
Subtotal				**22**	2.8
Category 4	Alpha-1 blockers +	Moderate	Strong	2	0.3

				N	%
	loop diuretic				
Subtotal				**2**	0.3
Category 5	Pregabalin	Moderate	Strong	1	0.1
Subtotal				**1**	0.1
Quantity				**95**	12.0

Note:

N: Number of PIMs medications

SR: Strength of Recommendation based on the 2019 Beers criteria guidelines

QE: Quality of evidence based on Beer 2019 criteria guidelines.

Diclofenac sodium and meloxicam

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs) are drugs pain relievers. They block Cyclooxygenase-1 (COX-1) and Cyclooxygenase-2 (COX-2) enzymes, reducing inflammation (Indrayani and Andi, 2021). This study identified diclofenac sodium (1.1%) and meloxicam (0.1%) as NSAIDs in category 1 of PIMs.

Avoid prolonged use of NSAIDs in the older adults. NSAIDs can harm the stomach, causing bleeding and ulcers, especially in those over 75 who are more prone to these issues (Fick *et al.,* 2019). Gastrointestinal protective agents, such as Histamine-2 receptor (H2) blockers, misoprostol, or proton pump inhibitors (PPIs), can decrease gastrointestinal bleeding or peptic ulcers caused by NSAIDs (Wongrakpanich *et al.,* 2018).

In this study, doctors expected stomach problems in patients taking NSAIDs, so they prescribed PPIs to protect against them.

Nifedipine

In this study, some patients received dihydropyridin calcium channel blockers (CCBs) e-class drugs, including category 1 PIMs. The drug was nifedipine as much as (1.1%). Nifedipine was one of these drugs, and it was taken by 1.1% of the patients. Dihydropyridine CCBs block L-type calcium channels in the smooth muscle of blood vessels and cardiac cells, which stops calcium ions from entering. Lowering calcium levels within cells can decrease the resistance of the small arteries and boost blood flow through the heart, resulting in a decrease in blood pressure (Kashif *et al.,* 2023).

The study found that nine patients received nifedipine treatment. There were no side effects, and all patient blood pressure remained controlled. Nevertheless, due to the possibility that nifedipine may lower blood pressure, it is advisable to monitor blood pressure at regular intervals.

3.2.2. *Category 2*

Category 2 drugs if there is a history of particular disorders or if the drug used has the potential to interact with diseases that may worsen the condition.

Diltiazem – *Heart Failure*

In this research, diltiazem is in the group of cardiovascular drugs known as non-dihydropyridine CCB. This drug is identified as potentially inappropriate in category 2, which accounts for only 0.4% of the cases.

The study shows that three patients were given diltiazem for heart failure treatment. However, there is no data available on the evaluation of the patient's condition after the use of diltiazem. Diltiazem may cause fluid retention and worsen heart failure, so it is recommended to avoid or use it with caution, according to the 2019 Beers Criteria (Fick *et al.,* 2019).

3.2.3. Category 3

Category 3 drugs are those that need to be used with caution by older adults. This research shows that among these medicines are furosemide at 1.5%, aspirin at 1.1%, and rivaroxaban at 0.1%.

Furosemide

Furosemide is a type of diuretic drug commonly given to older adults. In this study, only 1.5% of the subjects were prescribed furosemide. This is lower than the findings of Nurmainah's research (2022), which found a prevalence of 7.6% (Nurmainah and Astuti, 2022). Diuretic drugs can increase the excretion of sodium, water, and chloride, thereby reducing the volume of blood and extracellular fluid. Diuretic drugs should be administered to older adults with 'caution' as they have the potential to cause adverse effects such as hyponatremia or syndrome of inappropriate antidiuretic hormone (SIADH) (Fick *et al.,* 2019).

In the results of this study, of the 12 patients who received furosemide therapy, the average was diagnosed with heart failure. In all patients, there were no laboratory results or signs and symptoms of hyponatremia and SIADH. Given the risks of hyponatremia and SIADH, it is essential to perform regular laboratory tests and monitor symptoms to prevent or reduce the potential adverse effects of furosemide therapy.

Aspirin

Taking aspirin to prevent heart disease in people who have a history of this condition can increase the chances of bleeding in older adults. Nine patients over 70 with heart conditions were given aspirin treatment for this study. When used at the same time, enteric aspirin and PPIs can lower the gastrointestinal risk for older patients. (Saad *et al.,* 2019). The Beers Criteria 2019 recommends being cautious when prescribing aspirin to individuals 70 and older (Fick *et al.,* 2019).

3.2.4. Category 4

Category 4 PIMs should not be used due to possible drug interactions. A study found that a small number of older adult patients (0.3%) took tamsulosin and furosemide simultaneously, which could cause an interaction. This study found only one male patient who was 66 years old. He had prostate problems, congestive heart failure, and frequent urination. This information pertains to the

2019 Beers criteria, which warns that using furosemide with *alpha-blockers* (such as tamsulosin) can lead to a higher likelihood of urination (Fick *et al.,* 2019).

3.2.5. Category 5

Category 5 potentially inappropriate medication may interfere with renal function. To prevent this, reduce the dosage of these drugs in older patients according to their *Creatinine Clearance* (CrCl) level.

Pregabalin

One of the drugs in group five of the research is pregabalin. Pregabalin is a medication that prevents seizures and is utilized in individuals with diabetic neuropathy, fibromyalgia, trigeminal neuralgia, and even to control anxiety (Behroozi *et al.,* 2023). In this study, a 69-year-old man with high blood pressure, type 2 diabetes, high cholesterol, and a lab result showing low kidney function was prescribed pregabalin. However, due to his low kidney function with a laboratory result of ClCr 44.70 mL/min, less than 60 mL/min, the dose must be adjusted according to the Beers 2019 criteria (Fick et *al.,* 2019).

4. Conclusion

The prevalence of *potentially inappropriate Medication* or PIMs in older adults was 95 drug items (12%). The category of drug prescription that experienced the most PIMs was category 1 (8.2%). The largest group of drugs that are potentially inappropriate based on the 2019 Beers criteria guidelines from all categories are PPIs, NSAIDs, and diuretics. The implementation of prescribing PIMs continues without consideration and can impact morbidity, mortality, and costs.

Acknowledgment

The author expresses gratitude to the Rumah Sakit dr. Moewardi Surakarta for supporting the research.

Conflict of Interest

The researcher has no conflicts of interest with other people.

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