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Research Article

Combining Beers and STOPP Criteria to Identify Inappropriate Medication Use in Elderly Patients with Chronic Diseases and Polypharmacy

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ABSTRACT

Elderly individuals often suffer from multiple chronic conditions that require the prescription of various medications. This can increase the risk of being prescribed Potentially Inappropriate Medications (PIMs). The research objective was to evaluate the effectiveness of Beers 2019 and STOPP version 2 2016 criteria in detecting PIMs and their correlation with adverse drug events among geriatric patients who were admitted to the Hospital. The researchers conducted a retrospective analysis of the 100 patients' medical records admitted to the hospital in 2022. Beers 2019 criteria were more effective in identifying PIMs than STOPP version 2 2016 criteria. Using Beers 2019 criteria, 31 cases of PIMs were identified among the 100 patients who met the inclusion criteria, while only 25 cases were identified using STOPP version 2 2016 criteria. Alprazolam was the most frequently prescribed medication (19.54%) in the first criteria of Beers 2019, followed by ranitidine in category two and spironolactone in category 5, each named for seven cases (22.58%). The most commonly found PIMs, according to STOPP version 2 2016 criteria, were domperidone (40.00%) and spironolactone (28.00%). The study recommends that clinicians and pharmacists work together to develop critical supportive data to enhance the identification of potentially inappropriate medications.

INTRODUCTION

Indonesia is currently experiencing a population aging phase characterized by a rise in life expectancy and a subsequent increase in elderly citizens. Since 2010, the number of older adults has grown from 18 million individuals (7.56%) to 25.9 million individuals (9.7%) in 2019. This trend is expected to continue, with projections indicating a rise to 48.2 million individuals in 2035 (15.77%). The implications of population aging for healthcare systems are significant and a matter of concern for many nations (Fang *et al.*, 2015; Yancik, 2005). Many advanced countries have set up a dedicated long-term care service system that operates separately from the health insurance system. This approach ensures that those needing long-term care can receive coverage through a specialized insurance program. Several Ministry of Health Regulations are in place to ensure that older people receive high-quality healthcare services at primary and referral health facilities. In addition, the Ministry of Health recently introduced the National Action Plan for Elderly Health for 2020-2024. This comprehensive strategy comprises six essential components (Kementrian Kesehatan RI, 2021).

According to the 2018 Riskesdas report, older adults' most prevalent health issues are non-communicable diseases, such as hypertension, dental and joint problems, oral conditions, diabetes mellitus, heart disease, and stroke. Infectious diseases like acute respiratory infection (ARI), diarrhea, and pneumonia also pose a significant threat (Kementrian Kesehatan RI, 2021). Three in every four older individuals

residing in developing nations are plagued with multiple chronic illnesses. Many countries, China included, face a similar challenge (Wang, LM *et al*., 2019). The elderly often require multiple medications to manage their health conditions, which can result in polypharmacy (using five or more medications). This is prevalent among over half of the elderly population receiving healthcare services (Pazan and Wehling, 2021; Wastesson *et al*., 2018). Furthermore, it can result in a multitude of issues, including unfavorable drug reactions, drug interactions, failure to comply with medication regimens, and improper utilization of medications (Abdulah *et al*., 2018; Pasina *et al*., 2014; Rodrigues and Oliveira, 2016). These issues can cause serious treatment-related problems (Troncoso-Mariño *et al*., 2021).

Healthcare providers have many screening tools to help select appropriate treatment therapies for older adults while minimizing their exposure to Potentially Inappropriate Medications (PIMs). The American Geriatric Society (AGS) Beers Criteria and the Screening Tool for Older Person's Prescriptions (STOPP) are the most widely used criteria and provide a strong foundation for clinical decision-making (Alwhaibi, 2022; Troncoso-Mariño *et al*., 2021). The Beers Criteria, with a revised version issued in 2019, were initially released by the AGS in 1991 (American Geriatrics Society 2015 Beers Criteria Update Expert Panel, 2015). PIMs can harm older adults when the risks outweigh the benefits (O'Mahony *et al*., 2014). PIMs may end up in detrimental consequences including falls and frailty in older adults, which require significant healthcare and hospital resources. Furthermore, patients with treatment-related problems are at greater risk for experiencing adverse effects caused by drugs, increasing mortality risk (The 2019 American Geriatrics Society Beers Criteria® Update Expert Panel, 2019). Meanwhile, the Hospital STOPP criteria (Ireland) were first introduced by Cork University Geriatricians in 2008, with regular updates until 2016 (Tesfaye *et al*., 2021). Most studies on PIMs and treatment-related issues focus on their occurrence and causes, but few have studied the link between chronic diseases and PIMs. A long-term care facility in southwest Ethiopia was investigated to determine the prevalence and characteristics affecting PIMs among old people. The Beers and STOPP criteria showed that 83.1% and 45.2% of patients had at least one PIM. Age, high blood pressure, and many drugs raise PIM risk. The STOPP criteria state that diabetes, high blood pressure, ischemic heart disease, peripheral neuropathy, and polypharmacy greatly increase PIM risk (Almodóvar and Nahata, 2019).

In the United States, a recent research study delved into the correlation between chronic illnesses, polypharmacy, and medication-related issues among 65 years or older and Medicare beneficiaries. The findings revealed that those suffering from specific ailments are more likely to encounter treatment-related complications than those without these conditions. Additionally, the study discovered that Medicare beneficiaries consuming at least eleven medicines are 1.86 times more likely to encounter medication-related problems compared to people taking less medications (Almodóvar and Nahata, 2019).

After extensive research, we can confidently assert a significant occurence of PIMs and treatment difficulties among aging adults (Chen *et al*., 2016; Chen and Zhang, 2021; Fu *et al*., 2020; Yang *et al*., 2018). However, there is still a lack of information on PIMs and associated variables affecting elderly individuals with chronic illnesses and the use of many medications. To bridge this gap, we conducted a cross-sectional study at a single center in Serang City, which revealed important insights into the prevalence of PIMs and medication-related problems among elderly in patients with chronic illnesses and the use of many medications. The focus of our research not only sheds light on the problem but also identifies factors related to PIMs and medication-related issues in the study population, thus enabling physicians to manage at-risk patients better by promoting rational medication use.

METHODS

Research Instrument

For this study, we gathered data from medical records of elderly patients receiving treatment within the inpatient settings of a referral hospital in Serang during the year 2022. To determine appropriate medication usage for elderly patients with or without comorbidities, we adhered to the American Geriatric Society Beers Criteria 2019 and the STOPP Criteria 2016.

Research Procedure

This cross-sectional study retrospectively gathered data from 100 medical records of geriatric patients who underwent treatment in an inpatient facility at a referral hospital in Serang from January to December 2022. The patients were 60 or older and had medical records contained comprehensive

information, comprising of the patient's age, gender, diagnosis, medication usage, and laboratory results. The study used a systematic random sampling method to select the sample size, and the Slovin equation was used.

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

$$n = \frac{3.665}{1 + (3.665 \times 0{,}10^2)} = \frac{3.665}{1 + (3.665 \times 0{,}01)}$$

$$n = \frac{3.665}{1 + 36.65} = \frac{3.665}{37.65} = 97.34\ or\ 100\ samples$$

n = Number of samples
N = Populations
E = Percentage of error desired or tolerated

The study has received ethical approval from the Health Research Ethics Commission of the Faculty of Health Sciences at Respati University of Yogyakarta, with the reference number of 0179.3/FIKES/PL/VIII/2023.

Data Analysis

The data from medical records were carefully analyzed to obtain a frequency distribution and proportion of patient characteristics. Afterward, the data were meticulously reviewed to identify PIMs using both Beers and STOPP criteria. The objective of this investigation was to ascertain the ratio of samples containing PIMs and the drugs with the highest instances of PIMs. Then, a comparison was made between the PIMs identified by Beers and STOPP criteria.

RESULTS AND DISCUSSION

Characteristic of Elderly Patient

The distribution of patients according to their characteristics is clearly depicted in Table 1. A significant majority of the respondents (56%) were men, which aligns with the findings of a 2018 study that reported 60% of geriatric patients were male (Handayani *et al.,* 2018). Another study from the same year also found that 55.6% of patients were male, compared to 44.4% female (Julaiha, 2018). However, it's important to note that, according to data from the Central Statistics Agency for 2022, women account for 51.81% of older adults in Indonesia. In this study, the majority of participants fell within the age range of 60 to 74 years, comprising 82% of the total respondents. It is evident from the population pyramid data in Indonesia that the population aged between 60-64 years has consistently been higher than other elderly groups from 1971 to 2035. Conversely, the age group of individuals aged over 75 years constituted the most minor proportion. However, this particular age group is projected to increase twofold from 2020 to 2035 (Adioetomo and Mujahid, 2014).

These findings show that most of the patients had cardiovascular problems and were hospitalized for 1-7 days. Interestingly, over 40% of respondents had at least two chronic conditions. The comparison between patients receiving polypharmacy and non-polypharmaceuticals did not yield significant differences. Of all respondents, 39% received a polypharmacy, while 61% did not. A 2020 study by Sasfi found that patients receiving 1-4 medications were more common than those receiving ≥ 5 medications in one prescription. This underscores the widespread occurrence of taking multiple medicines in healthcare settings (Sasfi, 2020). Polypharmacy is a significant contributing factor to adverse drug reactions (ADR), and individuals afflicted with comorbidity, polypharmacy, and drug sensitivity are especially susceptible (Ahmed *et al*, 2014).

Based on the result of this study, most geriatric patients had a length of stay (LOS) between 1-7 days (90 patients, 90%). Only a small number of patients (10%) had an extended hospitalization period of more than a week. Another study by Nabilla, Utami, and Mustikaningtias (2019) confirmed this finding, suggesting that geriatric patients with hospital stays of less than seven days tend to receive fewer medications than those who stay longer (Utami and Mustikaningtias, 2019). This is an essential aspect to consider because using multiple medications may increase the risk of PIMs (Potentially Inappropriate Medications).

The Charlson Comorbidity Index (CCI) is a tool used to forecast the 10-year survival rate of older people who have various health issues (Sahingoz *et al*, 2021). By assigning varying weights to each health condition, the tool generates a combined score that indicates the severity of the accompanying diseases. The severity of the conditions is then divided into three tiers: CCI scores range from 1 to 2 for mild cases, 3 to 4 for moderate cases, and ≥5 for severe cases. In this study, most patients had mild associated diseases (70%), while only 6 had moderate related disorders (Huang *et al*, 2014). The CCI gives healthcare professionals a prognosis for elderly patients with multiple health conditions.

Table 1. Patient Characteristics

Characteristics	Frequency	(%)
Predisposing Characteristics		
Age (years)		
60-74	82	(82%)
75-90	18	(18%)
> 90	0	(0%)
Gender		
Male	56	(56%)
Female	44	(44%)
Number of Chronic Health Conditions		
0	5	(5%)
1	37	(37%)
2	41	(41%)
3+	17	(17%)
Polypharmacy Status (use of ≥ 5 medications)		
Yes	39	(39%)
No	61	(61%)
Hypertension		
Yes	15	(15%)
No	85	(85%)
Diabetes Mellitus		
Yes	22	(22%)
No	78	(78%)
Cardiovascular Disease		
Yes	63	(63%)
No	37	(37%)
Asthma		
Yes	13	(13%)
No	87	(87%)
Arthritis		
Yes	14	(14%)
No	86	(86%)
Chronic Kidney Disease		
Yes	15	(15%)
No	85	(85%)
Gastroesophageal Reflux Disease		
Yes	3	(3%)
No	97	(97%)
Length of Stay		
1-7	90	(90%)
8-14	10	(10%)
CCI[c]		
0	24	(24%)
1-2	70	(70%)
3-4	6	(6%)

a. Heart attack, coronary heart disease, hypertension, heart failure, heart rate disorders, ischemic heart, heart valve disorder, heart rhythm disturbance, pulmonary heart disease, and stroke
b. Gout and osteoarthritis
c. CCI (Charlson Comorbidity Index)

Potentially Inappropriate Medications (PIMs) Based on Beers Criteria 2019 and STOPP Criteria version 2 2016

According to Table 2, utilizing Beers criteria led to the discovery of more PIMs, which can be attributed to the availability of corroborating evidence, including laboratory data.

Potentially Inappropriate Medication (PIMs) Based on Beers Criteria 2019

As per the Beers Criteria 2019, benzodiazepines (alprazolam) are the most common drugs potentially unsuitable for older people, with a percentage of 19.45%, as stated in Table 3.

Table 2. PIMS Based on Beers Criteria 2019 and STOPP Criteria 2016

Beers Criteria 2019	STOPP *Criteria* 2016
PIM was detected in a total of 31 cases among 21 individuals. Fourteen patients (out of 17) had PIM category one prescribed to them, while PIM category two was found on four patients' prescriptions (out of seven cases). There were three cases of PIM category three and seven cases of PIM category five. The highest percentage of PIM was found in category two patients who were taking Ranitidine, which was observed in seven cases (22.58%). Spironolactone (22.58%) in category five and Alprazolam (19.45%) in category one had the following highest rates of PIM.	PIM was detected in 25 individuals, resulting in 25 cases. Spironolactone usage resulted in 7 cases of PIM among cardiovascular patients who did not monitor their serum potassium, followed by the use of Furosemide in hypertensive patients for 3 cases. The final PIM associated with the cardiovascular system was seen in one patient taking Aspirin and Clopidogrel simultaneously for secondary stroke prevention and another patient taking Digoxin is prescribed for the treatment of heart disease in patients with typical systolic ventricular function. In the Gastrointestinal system, three patients experienced Metoclopramide when it was used for more than five days. In one patient, Domperidone was given for more than one week, and in nine patients with underlying serious heart conditions, it was prescribed.

Table 3. PIM Listings According to Beers Criteria 2019

PIMs Category	Drug	Quality of Evidence	Recommendation	n	%
Category 1	Metoclopramide	Moderate	Strong	2	6.45%
	Mefenamic Acid	Moderate	Strong	2	6.45%
	Glimepiride	High	Strong	1	3.22%
	Amiodaron	High	Strong	1	3.22%
	Digoxin	Low	Strong	1	3.22%
	Trihexyphenidyl	Moderate	Strong	1	3.22%
	Alprazolam	Moderate	Strong	6	19.45%
Category 2	Ranitidine	Low	Strong	7	22.58%
Category 4	Gabapentin	Moderate	Strong	3	9.67%
Category 5	Spironolactone	Moderate	Strong	7	22.58%
Total				31	100%

This finding is consistent with earlier research that indicated benzodiazepines to be the most commonly used drug in category 1 PIMs. Category 2, or inappropriate drugs that may exacerbate a disease due to drug interactions, is the most prevalent cause of PIMs. Category 4, which focuses on preventing drug interactions in older individuals, has the greatest number of instances, supported by evidence of middling quality and strong recommendations. For individuals in Category 5, it is advisable to avoid or decrease the dosage of medications like ranitidine and spironolactone (22.58%) by evaluating the renal function in older individuals.

Potentially Inappropriate Medication (PIMs) Based on STOPP Criteria Version 2 2016

According to the STOPP version 2 2016 criteria, the most common PIMs were the administration of domperidone for more than one week and its use in patients with serious underlying heart diseases. Additionally, another common PIM was prescribing spironolactone without monitoring the patient's potassium serum level, which was observed in 28% of cases (O'Mahony, 2015). Research has demonstrated that the Beers criteria are superior to the STOPP criteria in accurately detecting PIMs and assessing patients. Due to missing data on PO2, PCO2, serum K, and Serum Creatinine, the STOPP criteria of 18 patients could not be assessed in this study. According to similar research, the occurrence of PIMs was more common when using the Beers criteria (ranging from 26.31% to 71.9%) than with the STOPP criteria (ranging from 14.03% to 67.3%) (Huang *et al*., 2019; Ma *et al*., 2018; Mathur and Shah, 2018; Rodrigues and Oliveira, 2016). Category 1 of the Beers criteria advises against the use of benzodiazepines in older individuals due to heightened sensitivity and reduced metabolism. Elderly adults who consume benzodiazepines face an elevated likelihood of encountering cognitive decline, confusion, collapses, fractures of the bones, and vehicular incidents as a result of the medicine. Studies have also found that benzodiazepines can induce dependence and a tendency to recur, particularly in older women (Tannenbaum, 2015). Ranitidine may cause or exacerbate delirium in older individuals as classified by Beers Category 2 (The 2019 American Geriatrics Society Beers Criteria® Update Expert Panel, 2019).

Table 4. List of PIMs Based on STOPP Version 2 2016 Criteria

System	PIMs Criteria	n	%
Cardiovascular	When taking drugs such as spironolactone or eplerenone, which are aldosterone antagonists, along with ACE inhibitors or amiloride, it can lead to an increase in potassium levels without proper monitoring of serum potassium levels. Additionally, when combined with ARBs, these drugs can also cause an increase in potassium levels.	7	28.00
	Loop diuretics as a treatment for hypertension	3	12.00
	Digoxin is prescribed for the treatment of heart disease in individuals with typical systolic ventricular function.	1	4.00
Anticoagulant and antiplatelet	Clopidogrel is prescribed alongside Aspirin for the purpose of secondary stroke prevention.	1	4.00
Gastrointestinal	Metoclopramide after a maximum treatment time of 5 days	3	12.00
	Domperidone after a maximum treatment time of one week	1	4.00
	Domperidone in patients with underlying serious heart conditions.	9	36.00
Total		25	100

Despite the limited strength of the evidence, it is advised to avoid its usage in elderly patients and lower the dose in those with creatinine clearance levels <50 mL/min to prevent mental status changes.

Gabapentin, when used in category 4, has been associated with an elevated likelihood of experiencing severe sedative-related adverse effects, such as respiratory depression and potentially fatal outcomes. As the body ages, it undergoes pharmacokinetic and pharmacodynamic changes that affect the organs responsible for eliminating drugs from the system. Additionally, the blood-brain barrier may become more permeable, and receptor sensitivity to the central nervous system may increase. These changes make elderly patients more sensitive to drugs that affect the central neural system, such as gabapentin. This drug can increase the levels of gamma-aminobutyric acid (GABA) in the brain by 55.7%, leading to side effects such as dizziness, drowsiness, and an increased risk of falling (Rahmawati *et al*., 2019).

Previous research has shown that diuretics comprise most of the PIMs in category 5 (Zhang *et al*., 2017). The outcomes of this investigation are consistent with that finding, with spironolactone being the largest PIM at 22.58%, followed by furosemide at 18.23%. It is essential to be cautious when administer diuretics in geriatric patients, as they can cause the Syndrome of Inappropriate Antidiuretic Hormone (SIADH). This condition occurs when an excessive amount of antidiuretic hormone (ADH) causes heightened reabsorption of water from the renal tubules. Consequently, this leads to the retention of water and a decrease in the concentration of sodium, resulting in hyponatremia. Geriatric patients are at a higher risk of hyponatremia due to their age, gender, use of diuretics, and low sodium levels. Hence, intensive monitoring of salt levels is necessary when initiating or altering the dosage of diuretics (Filippatos *et al*, 2017).

The use of spironolactone in the cardiovascular system has been linked to a higher likelihood of hyperkalemia, which can be dangerous if the serum potassium level exceeds 6.0 mmol/L. Regular monitoring of serum potassium is recommended, with a frequency of at least every six months. According to STOPP, Furosemide is not considered a recommended treatment for geriatric hypertension due to the availability of safer and more effective alternatives (O'Mahony *et al.*, 2015).

The use of Digoxin is prescribed for the treatment of heart failure in patients with typical systolic ventricular function. is not recommended in elderly patients, as there is limited evidence of its benefits. One patient was prescribed aspirin co-administered with clopidogrel for secondary stroke prevention despite the lack of evidence supporting its use over clopidogrel monotherapy. This practice is not recommended and may not confer any additional benefits (O'Mahony *et al.*, 2015).

Research has documented extrapyramidal symptoms as the main adverse effects of metoclopramide. The conditions encompassed are dystonia, akathisia, parkinsonism, and tardive dyskinesia. The occurrence of these adverse effects is approximately 0.2% and can happen in both high and typical doses. Nevertheless, it has the potential to escalate to 25% in geriatric individuals and adolescents. High doses, long-term treatment, and the administration of metoclopramide in young and elderly patients are factors that heighten the probability of experiencing neurological side effects (Ştefănescu *et al.*, 2015).

In addition, elderly patients who are over 60 years old are at a higher risk of experiencing domperidone-induced cardiac ADRs compared to younger adults. The elderly population commonly has a higher incidence of heart failure and arrhythmia and often suffers due to a variety of medical ailments, including liver, kidney, and heart dysfunction. Moreover, elderly patients frequently take numerous medications, which can increase the likelihood of ADRs affecting the heart and prolonging the QT interval caused by drug-drug interactions. Hence, the administration of domperidone to older individuals necessitates meticulous attention and vigilant monitoring (Rhew *et al*, 2019).

This study has certain limitations due to its retrospective design. The study couldn't observe directly the effects of PIMs or the occurrence of adverse drug reactions (ADRs) in the samples. It is crucial to acknowledge that the conclusions of this study cannot be universally applied, as it solely examined the medical records of 100 patients at one single hospital in Serang. To enhance the credibility of the findings, it is advisable to carry out comparable research using a prospective study design in other hospitals that are representative of the Serang region.

CONCLUSIONS

The study reveals that a considerable number of potentially inappropriate medications

(PIMs) were identified, with Beers 2019 criteria reporting a prevalence rate of 31% and STOPP version 2 2016 criteria reporting a prevalence rate of 25%. Ranitidine and spironolactone were the most common PIM according to Beer's criteria. On the other hand, the most commonly identified PIM based on STOPP criteria was the use of Domperidone, which was only recommended for a maximum of one week and only in patients without serious underlying heart conditions. The study argues that Beers 2019 criteria are more effective in describing PIM data than STOPP version 2 2016 criteria, considering data availability. Having reliable data is vital for evaluating PIMs, and it is crucial for clinicians and pharmacists to work together to gather the necessary supporting data in order to ensure correct assessment of PIMs.

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CONFLICT OF INTEREST

There are no competing interests for the authors in relation to this investigation.

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