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Polypharmacy and Potentially Inappropriate Medications (PIMs) in Older Adults with Cardiometabolic Disease: A STOPP/START Criteria-Based Analysis

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Abstract: Potentially inappropriate medications (PIMs) are a common issue in older adults. Older adults often require multiple medications to manage cardiometabolic disease. This study aimed to identify potentially inappropriate medications and potential inappropriate omissions using STOPP/START criteria in older adult patients with cardiometabolic disease. We conducted an observational analytical study using retrospective data at a secondary care teaching hospital in Sukoharjo, Central Java. We included older adult patients admitted to the inpatient wards between January and June 2022. The prescriptions were analyzed using the STOPP/START Criteria 2016. The Chi-square test analysis was performed to examine the association between the number of drugs and the occurrence of PIMs. We included 97 geriatric inpatients. All patients received at least 5 drugs during each admission, 35.06% were classified as having hyperpolypharmacy. Among the 97 patients, 36.08% had PIM prescriptions, and 29.89% had PPOs. There was a statistically significant association between the number of drugs and PIMs in older adults. Compared with patients receiving > 10 medications, those receiving 5–10 medications had lower odds of PIM use (OR 0.409, 95% CI 0.173–0.969; p = 0.040). These findings highlight high medication burden as an important marker for targeted medication review in geriatric inpatients, particularly those with cardiometabolic multimorbidity.

Introduction

The global population is aging rapidly, including in Indonesia. Indonesia's National Health Insurance Data (2015-2024) indicated an increase in hospitalizations among older adults. Approximately, 63.7% of inpatient episodes among older adults were classified as moderate severity and 25.4% as severe. Cardiometabolic conditions were prominent among inpatient diagnoses, including congestive heart failure, diabetes mellitus, hypertension, stroke, and cerebral infarction (1). These findings underscore the substantial burden of cardiometabolic diseases among older adults receiving hospital care and the clinical complexity associated with their management.

Older adults experience age-related physiological changes (e.g., reduced renal and hepatic clearance, altered body composition, increased pharmacodynamic sensitivity) that amplify the risks of adverse drug reactions, drug–drug interactions, and drug–disease interactions (2). When combined with complex cardiometabolic regimens, these changes substantially increase the likelihood that some medications become potentially inappropriate over time, even if they were initially appropriate. Cardiometabolic drugs frequently appear on PIM lists for older adults (e.g., sulfonylureas, certain calcium channel blockers, digoxin, NSAIDs), underscoring the need to examine this therapeutic area specifically (3, 4).

Evidence shows that polypharmacy in older adults is strongly associated with adverse outcomes such as hospitalization, functional decline, and mortality, particularly when regimens include potentially inappropriate medications (PIMs). In some contexts, more than half of the elderly population experiences polypharmacy (5 – 7). Polypharmacy is the use of five or more medications, whereas the use of more than 10 is termed hyperpolypharmacy. Polypharmacy does not necessarily indicate inappropriate prescribing, but it has always been linked to a higher risk (8). Multiple drugs in older persons are known to raise the chance of adverse effects. Hyperpolypharmacy in hypertensive and diabetic patients increases the risk of chronic kidney disease and cardiovascular events (9). Increased risk of adverse drug reactions (ADRs) is connected with the presence of PIM (10). Evidence from other studies targeting this oldest-old demographic (individuals > 80 years) shows a

disproportionately high burden of both polypharmacy and PIMs compared with younger geriatric cohorts (11).

A systematic review stated that medication review programs that cut down on the number of drugs used may lower the risk of PIMs (12). PIMs can be detected with several screening tools such as Beer's criteria, Screening Tools of Older Person's Prescription (STOPP), Screening Tools to Alert doctors to Right Treatment (START), Medication Appropriateness Index (MAI), Fit fOR The Aged (FORTA), and European list of Potentially Inappropriate Medications (EU-PIM) (5, 13). Drug appropriateness in older adults can be enhanced through the application of the Beers criteria and STOPP START criteria, hence decreasing polypharmacy. Several instruments have been developed to assess potentially inappropriate medications (PIMs), among which the Beers Criteria and the STOPP (Screening Tool of Older Persons' Prescriptions) Criteria are the most widely used and validated tools in clinical practice and research (7). A study shows that the STOPP/START criteria handle polypharmacy better than the current Beers 2019 criteria, owing to their greater sensitivity in detecting PIMs (14).

Several studies evaluating potentially inappropriate medications (PIMs) have been conducted in Indonesia using both the Beers and STOPP/START criteria (15–18). However, recent studies have predominantly focused on describing the prevalence of PIMs (16, 18) or examining their association with polypharmacy (15, 17). Importantly, these studies have been conducted in older adults with a single specific diagnosis rather than in patients with multimorbidity. Consequently, evidence remains limited regarding the occurrence and clinical management of PIMs in older adults with multiple coexisting chronic conditions, particularly those with cardiometabolic multimorbidity, in whom medication regimens are often more complex and the risk of medication-related problems may be greater. To address this gap, this study provides a STOPP/START criteria-based analysis in an Indonesian inpatient cardiometabolic cohort. This study advances global knowledge by contextualizing tool utility within a high-risk, disease-specific synergy. It provides empirical evidence on how the STOPP/START framework performs when applied to complex regimen overlap. The STOPP/START criteria are particularly relevant to this population because they identify both potentially inappropriate medications and clinically important prescribing omissions. Therefore, focusing on elderly cardiometabolic patients provides a clinically relevant population for evaluating pharmacotherapy appropriateness and optimization.

A secondary-care hospital was selected as the study setting because it represents an important level of hospital-based care for older adults within the Indonesian healthcare system. Among older adults who directly entered advanced-level referral care, approximately 29.9% first accessed a secondary-care hospital (1). Universitas Sebelas Maret Hospital (RS UNS), a secondary care teaching hospital in Sukoharjo, Central Java, receives referrals from surrounding primary care facilities, with cardiometabolic conditions predominating among geriatric patients (19). Assessing PIM use in this setting may provide insight into real-world prescribing practices in an Indonesian teaching hospital and identify opportunities to improve medication safety among hospitalized older adults. Moreover, no RS UNS-specific study has applied the evaluation of PIMs using STOPP/START criteria. Studying this setting may therefore provide clinically relevant evidence.

Methodology

Study Design and Participants

We conducted an observational analytical study using retrospective data from a secondary-care teaching hospital in Sukoharjo, Central Java. The study population comprised older adult patients admitted to the inpatient wards between January and June 2022. We screened all medical records of patients who met the predefined eligibility criteria during the study period. We included eligible patients consecutively, with each patient represented by their first eligible admission. The eligibility criteria were patients aged 60 years or older diagnosed with cardiometabolic diseases, including diabetes mellitus, stroke, and cardiovascular diseases. In Indonesia, older adults are defined as individuals aged 60 years and above (20). We calculated the minimum sample size using the single-proportion formula for a cross-sectional study. Based on a previous study by Hamidah et al., the prevalence of potentially inappropriate medication (PIM) among older adults was 55.0% (21). Assuming a 95% confidence level (Z = 1.96) and a 10% margin of error, the minimum required sample size was 96 patients. We initially estimated the sample size using a single-proportion formula based on the expected proportion of potentially inappropriate medication use. Given the retrospective, hospital-based, non-probability sampling design, this calculation established a target sample size and was not intended to support population-level prevalence estimation. Accordingly, the observed proportion of PIMs is interpreted as the proportion identified within the study population rather than as a nationally representative prevalence estimate.

Data Collection

Data were collected between April and July 2022. A single trained researcher systematically abstracted data from electronic medical records using a standardized, pre-tested data collection tool to maintain consistency. To minimize abstraction bias and ensure data accuracy, a senior pharmacist independently reevaluated a random 10% sample of the abstracted patient profiles. The team resolved discrepancies in medication classification or STOPP/START criteria application by consensus. The extracted data included patient demographics, diagnoses, medication information (drug name, administration frequency, and dosage), and patient progress notes.

Data Analysis

Descriptive analysis was conducted to summarize patient characteristics, including sex, age, diagnosis, and number of prescribed medications, using frequency distribution tables. We assessed potentially inappropriate prescribing (PIMs) and potential prescribing omissions (PPOs) by comparing patients'medication regimens with the STOPP/START Criteria 2016, which served as the reference standard. Because some patients had more than one hospitalization during the study period, we included only

Table 1. Characteristics of research subjects (N=97).

Characteristics	Frequency	Percentage (%)
Gender		
Male	49	50.52
Female	48	49.48
Age (years)		
< 75	85	87.63
≥ 75	12	12.37
Primary diagnosis*		
Diabetes Mellitus (DM)	29	29.89
Heart Failure	25	25.77
Stroke	19	19.58
Angina pectoris	10	10.30
Hypertension	8	8.25
Intracerebral Hemorrhage (ICH)	3	3.09
Acute coronary disease	2	2.06
Myocarditis	1	1.03
Atrial Fibrosis	1	1.03
Number of drugs		
5–10	63	64.94
> 10	34	35.06

***Primary diagnosis:** Refers to the principal diagnosis documented at discharge. Each patient was classified into one primary diagnostic category; coexisting secondary diagnoses/comorbidities were not included in the diagnostic distribution.

the first eligible hospitalization for each patient to avoid non-independence of observations. PIMs and PPOs were assessed for each patient based on the medications prescribed during the first eligible hospitalization. A patient was classified as having PIM if at least one PIM/PPO was identified in their medication regimen. Polypharmacy was determined if patients received five or more drugs in a day during hospitalization. The medication count represented the cumulative number of regularly scheduled medications used concomitantly during the hospital stay, rather than the number of medications prescribed on a single day or at discharge. Intravenous fluids, nutritional supplements, and PRN (pro re nata) medications were excluded from the medication count.

Furthermore, bivariate analysis was performed to examine the association between the number of medicines and the occurrence of PIMs using the Chi-square test in SPSS 22.

Ethical Consideration

The Health Research Ethics Committee, Faculty of Medicine, Universitas Sebelas Maret, approved the study protocols (No. 29/UN27.06.11/KEP/EC/2022) in accordance with the Declaration of Helsinki, the Council for International Organizations of Medical Sciences (CIOMS), and the World Health Organization (2016).

Results and Discussion

Profile of Studied Subjects and Drug Prescriptions

We included 97 geriatric inpatients, each contributing one first eligible admission to the final analysis. Characteristics of the research subjects were provided in **Table 1**. The

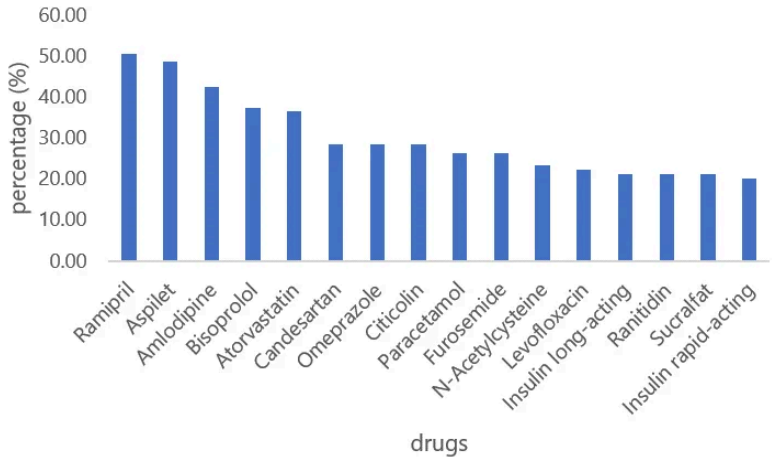


Figure 1. Top ten drug prescriptions for inpatient geriatric with cardiometabolic disease (N=97).

study population was predominantly patients aged 60–74 years (87.63%), with approximately equal numbers of males and females. The most common diagnosis was diabetes mellitus, observed in 29.89% of patients. The age classification followed a study that reported positive changes in the physical and mental health of those < 75 years (22). All patients received at least 5 drugs during each admission; 35.06% were classified as having hyperpolypharmacy, defined as the use of > 10 drugs.

Figure 1 provides the profile of drug prescriptions in the studied population. The appendix presents a complete list of drug profiles. Ramipril, an angiotensin-converting enzyme inhibitor (ACEI), was the most frequently prescribed. In addition to its antihypertensive effects, ramipril has been shown to reduce the urinary albumin-to-creatinine ratio and slow the progression of renal impairment. These renoprotective properties make ramipril particularly beneficial for patients with DM, as it helps prevent progression of diabetic kidney disease and improves long-term renal outcomes (23, 24).

The second most frequently prescribed drug was aspirin. Low-dose aspirin is widely used for secondary prevention of cardiovascular events. Although aspirin may reduce the incidence of first cardiovascular events, its overall benefit is uncertain because of the accompanying risk of major hemorrhagic complications. Evidence from multiple studies suggests that in primary prevention settings, the increased risk of major bleeding may outweigh the potential benefits in reducing cardiovascular events (25–27). A study recommends aspirin deprescribing, especially among older adults without a history of cardiovascular disease (28).

Amlodipine was the third most frequently prescribed medication among the studied subjects. Compared with other dihydropyridine calcium channel blockers (CCBs), amlodipine exhibits distinctive pharmacokinetic properties, including high oral bioavailability, slow absorption, and prolonged action with fewer vasodilatory peaks (29). Amlodipine is widely accepted across age groups, including older adults and diabetic patients, because of its hemodynamic stability and fewer metabolic adverse effects (30). Amlodipine has been reported for its superior protection against stroke and myocardial infarction for Asian Pacific patients. Amlodipine also has benefits for older persons by not adversely affecting electrolytes, eliminating the need for follow-up electrolyte monitoring (31).

Profile of PIMs and PPOs

The prevalence of potentially inappropriate medications (PIMs) identified using the STOPP criteria was calculated based on the total number of prescriptions. Among 97 patients, 36.08% of patients were identified as having PIMs (**Table 2**). Defined as medications where the risk of adverse effects exceeds the expected therapeutic benefit despite safer alternatives, PIMs present a critical challenge in older adults' care. Progressive physiological aging alters drug pharmacokinetics and pharmacodynamics, most notably through impaired renal elimination, thereby expanding the risk profile of pharmacotherapy in this vulnerable population (32). A study in Japan also reported the increasing trend of PIMs, especially in the oldest age group (33).

The prescription of benzodiazepines was the most frequently identified potentially inappropriate medication (PIM) in this study. These results align with research in Thailand indicating a high prevalence of potentially inappropriate medications (PIMs) resulting from benzodiazepine prescribing (34). The predominance of benzodiazepines in the present study may reflect the challenges of managing sleep disturbances and other symptoms in older adults, particularly in the context of multimorbidity and complex medication regimens. Alprazolam was identified as a PIM and was prescribed for sleep disorders. In older adults, benzodiazepine use warrants particular caution because age-related changes in pharmacokinetics and pharmacodynamic sensitivity may increase susceptibility to cognitive impairment and other central nervous system adverse effects, while prolonged use may increase the risk of dependence (35). The finding may indicate an opportunity for systematic reassessment of the indication, duration of therapy, and availability of

Table 2. Potentially Inappropriate Medications (PIMs) based on STOPP criteria (N=97).

No	Section	PIMs	Frequency	Percentage (%)
1	Central nervous system	Benzodiazepine for ≥ 4 weeks (risk of prolonged sedation, confusion, or impaired balance)	10	10.31
2	Cardiovascular system	Aldosterone antagonist (spironolactone) with concurrent potassium-conserving drugs	7	7.22
		Loop diuretic as first-line treatment for hypertension	2	2.06
		Beta-blockers in combination with verapamil or diltiazem (risk of heart block)	2	2.06
		Centrally-acting antihypertensives (clonidine)	2	2.06
3	Coagulation system	Aspirin plus clopidogrel as long-term secondary stroke prevention	6	6.18
4	Musculoskeletal system	NSAID for severe hypertension	3	3.09
5	Endocrine system	Long-acting sulphonylurea (glimepiride) for type 2 diabetes mellitus	2	2.06
6	Analgesic drugs	Use of oral or transdermal opioid (tramadol) as first-line therapy for mild pain	1	1.03
Total number of PIM with STOPP criteria			**35**	**36.08**

safer non-pharmacological or pharmacological alternatives, rather than simply reflecting the use of a particular benzodiazepine.

Other PIMs identified in this study reflected the complexity of cardiovascular and renal pharmacotherapy in older adults with cardiometabolic multimorbidity. For example, spironolactone and furosemide were identified in the context of diuretic therapy, where the therapeutic benefits must be balanced against the risks of volume depletion and electrolyte disturbances. The concomitant use of spironolactone with renin–angiotensin system inhibitors may further increase the risk of hyperkalemia, particularly in older adults with impaired renal function (36–38). The appropriateness of these regimens requires consideration of the treatment indication, renal function, serum potassium, volume status, blood pressure, and concurrent medications. These findings highlight that potentially inappropriate prescribing may arise not only from the use of a drug, but also from the interaction between medication regimen complexity and patient-specific clinical factors.

Similarly, NSAID use illustrates the importance of considering the interaction between medication burden and cardiometabolic vulnerability. In older adults with hypertension or cardiovascular and renal comorbidities, NSAIDs may adversely affect blood pressure control, renal function, and overall cardiovascular risk (39). Rather than interpreting NSAID prescribing as inherently inappropriate, medication review should determine whether the expected therapeutic benefit justifies the potential risks in the individual patient. This is particularly relevant in patients receiving multiple antihypertensive or renally active medications, in whom NSAID-related effects may further complicate disease management.

Several PIMs also reflected the challenge of balancing preventive or disease-specific treatment benefits against age-related safety concerns. Long-term dual antiplatelet therapy for secondary stroke prevention, for example, may expose older adults to an increased risk of major and intracranial bleeding without providing a corresponding benefit in long-term stroke prevention (26). Similarly, glimepiride was identified as a PIM because of the increased risk of severe hypoglycemia associated with sulfonylurea therapy in older adults. Previous observational evidence has demonstrated an increased risk of severe hypoglycemia among older adults receiving sulfonylureas (40). While other evidence has linked sulfonylurea use with an increased risk of hospitalization for falls (41). These findings emphasize the importance of individualizing treatment intensity according to age, comorbidity, functional status, hypoglycemia risk, and treatment goals, rather than pursuing disease-specific targets without considering geriatric vulnerability. The availability of alternative agents with a lower risk of hypoglycemia further supports individualized reassessment of continued sulfonylurea therapy in appropriate patients (42, 43).

Tramadol represented another important example of the interaction between medication selection and geriatric vulnerability. Previous studies have also associated tramadol use in older adults with increased healthcare utilization and adverse clinical outcomes (44). In this context, the clinical issue is not simply whether tramadol was prescribed, but whether the severity of pain, treatment indication, duration of therapy, concurrent CNS-active medications, and availability of safer alternatives were adequately considered (45).

The PIMs identified in this study suggest that potentially inappropriate prescribing may be driven by the complexity of managing multimorbidity rather than by isolated prescribing decisions. Older adults with cardiometabolic diseases frequently require multiple medications for the simultaneous management of cardiovascular risk, glycemic control, symptom relief, and prevention of disease complications. This creates competing therapeutic priorities and requires clinicians to continuously balance treatment benefits against adverse effects, drug–drug interactions, treatment burden, and age-related vulnerability.

We calculated PPOs identified using the START criteria based on the total number of eligible clinical indications/diagnoses for which a recommended therapy was omitted. The prevalence of PPO in this study was 29.89%, with cardiovascular medications predominating (**Table 3**). As in the previous study, PPO remains high among older adults, especially in cardiovascular treatment (46, 47).

Statins have consistently ranked among the most frequently omitted medications in patients with established atherosclerotic cardiovascular disease. Clinicians may intentionally avoid initiating statins because of concerns regarding polypharmacy, medication burden, and potential adverse effects (48, 49). A prospective multicenter study also reported that women are more likely to experience statin undertreatment than men, despite having similar indications for secondary

Table 3. Potential Prescribing Omissions (PPOs) based on START criteria (N=97).

No	Section	PPO	Frequency	Percentage (%)
1	Cardiovascular system	Statin therapy with a documented history of coronary, cerebral, or peripheral vascular disease	10	10.31
		ACEi for heart failure with reduced ejection fraction	2	2.06
2	Endocrine system	ACEi or ARB in diabetes with evidence of renal disease	9	9.27
3	Coagulation system	Antiplatelet therapy with a documented history of coronary, cerebral, or peripheral vascular disease	6	6.19
4	Gastrointestinal system	PPI with low-dose aspirin and a previous history of peptic ulcer or reflux esophagitis	2	2.06
Total number of PPO based on START criteria			29	29.89

Table 4. Association of the number of drugs and PIMs based on STOPP/START criteria.

Number of drugs	PIMs		Total	p value
	Yes	No		
5-10	27	36	63	0.040 (OR =0.409, 95% CI: 0.173-0.969)
>10	22	12	34	
Total	**49**	**48**	**97**	

cardiovascular prevention (50, 51).

Similarly, clinicians omitted ACEIs or ARBs in 9.27% of patients with diabetes nephropathy. Although ACEIs and ARBs are highly recommended for their renoprotective and cardioprotective properties, clinicians consider the greater risks associated with hyperkalemia, hypotension, renal function, and complex therapy regimens in older adults. A systematic review study reported that ACEIs significantly increased the risk of hyperkalemia and hypotension compared to placebo. Elderly patients, especially those with CKD, should be closely monitored for severe adverse events and timely discontinuation of ACEIs or ARBs (52).

This study also reports underprescribing of antiplatelets. Another study provides similar evidence, and omission rates are generally lower than those for statins (48). Clinicians frequently individualize antiplatelet therapy after balancing cardiovascular benefit against the increased risk of gastrointestinal or intracranial bleeding, particularly in frail older adults, those receiving anticoagulants, or those with a history of bleeding.

In this study, the clinical relevance of the identified PPOs (Prescribing Omissions) was assessed based on available laboratory and clinical parameters, including serum creatinine/eGFR, serum potassium, and blood pressure. However, the study's retrospective nature limited our ability to determine the precise clinical rationale for each identified PPO. Consequently, some PPOs identified using the START criteria might actually represent clinically justifiable omissions rather than prescribing errors. Therefore, we interpret these identified PPOs as potential opportunities for medication review, rather than definitive prescribing errors.

Direct comparisons of omission rates between studies should be interpreted with caution due to changes in study populations, healthcare settings, prescribing rules, and START criteria versions. Variations in the prevalence of cardiovascular disease, diabetes, chronic renal disease, and frailty can significantly impact the proportion of people eligible for various START guidelines.

Some studies in Southeast Asian countries (Thailand, Malaysia) reported that PIM exposure in older adults was common (23.7%-79%) but highly context-dependent. The highest prevalence rates are observed when explicit instruments were applied to outpatient or inpatient populations with a high burden of disease. In this study, a key pattern requiring attention was that polypharmacy consistently emerges as a risk factor (34, 53, 54). Furthermore, discrepancies in prescribing trends across nations may be influenced by healthcare system characteristics such as medication availability, payment policies, access to specialist care, and the integration of clinical pharmacists into multidisciplinary teams. These contextual factors are likely to explain some of the differences reported between the current study and prior international findings.

Association of Number of Drugs and PIMs

The presence of at least one PIM/PPO in a patient's medication regimen was defined as PIMs. PIMs were identified in 27 patients (42.9%) receiving 5–10 medications and in 22 patients (64.7%) receiving ≥10 medications. Using ≥10 medications as the reference group, patients receiving 5–10 medications had significantly lower odds of PIM use (OR 0.409, 95% CI 0.173–0.969; p = 0.040) (**Table 4**). These data suggest that a greater number of drugs was more likely to be inappropriate prescribing. Although hyperpolypharmacy is frequently unavoidable in older adults due to multimorbidity and the need to manage multiple chronic conditions, increasing medication burden significantly increases prescribing complexity, raising the risk of drug-drug interactions, therapeutic duplication, prescribing cascades, and continued use of medications whose risks outweigh their benefits.

Tao et al. found that among hospitalized older adults, those taking five or more drugs had a considerably increased risk of inappropriate prescribing (53). A systematic review and meta-analysis also found that older adults exposed to polypharmacy had approximately twice the risk of receiving PIMs compared with those prescribed fewer medications (RR = 2.03, 95% CI: 1.13–3.64) (54). A previous study in another secondary teaching hospital in Indonesia also showed that polypharmacy was the sole variable associated with PIM use. The presence of metabolic diseases was the strongest factor associated with PIM use and increased medication complexity (21). This finding is consistent with the concept that increasing medication burden and polypharmacy may increase the risk of inappropriate prescribing, particularly among older adults with cardiometabolic disease. Previous studies in different healthcare settings and countries in Southeast Asia support these results (34, 53, 54). Notably, across all regional evidence, regimen complexity and cumulative drug count consistently emerge as the predominant risk factors for PIMs. This cross-country consistency underscores that clinical efforts to mitigate PIM risk must prioritize structured deprescribing strategies to reduce overall medication burden.

These findings highlight the significance of conducting medication review using established explicit screening criteria like the STOPP/START, especially for older adults with polypharmacy. Patients receiving multiple medications may be at greater risk of potentially inappropriate prescribing, emphasizing the importance of regular medication reconciliation, identification of PIMs, and pharmacist-led medication review, particularly for patients with multiple comorbidities (55). Therefore,

integrating ward-based clinical pharmacists into the geriatric care team is essential for proactive medication reconciliation and identifying inappropriate prescribing. Pharmacist-led intervention, including deprescribing treatments, has been found to eliminate unneeded drugs and increase prescribing accuracy. Comprehensive medication reviews have a beneficial effect for reducing PIM use. Early identification of patients exposed to polypharmacy may facilitate targeted deprescribing interventions and optimize medication safety (56).

A limitation of this study was that its retrospective design, confined to a single secondary care teaching hospital, may limit generalizability (external validity) to other healthcare settings across Indonesia due to potential institutional variations in prescribing behaviors and formulary availability. While the study successfully quantified the prevalence of PIMs and PPOs using explicit screening tools (STOPP/START criteria 2016), it did not prospectively correlate these inappropriate prescribing patterns with clinical outcomes. Furthermore, this study did not analyze the influence of confounding factors such as treatment duration, number of conditions, and disease severity on the association between PIMs and polypharmacy. Despite these limitations, this study provides valuable baseline insights into the prevalence of PIMs and PPOs, as assessed using the STOPP/START criteria, in Indonesian geriatric care. Future prospective multicenter studies are highly warranted to link these screening criteria with concrete clinical outcomes and to evaluate the direct impact of pharmacist-led deprescribing interventions.

Conclusion

This observational study demonstrated that the prevalence of potentially inappropriate medications (PIMs) (36.08%) and potential prescribing omissions (PPOs) (29.89%) remain remarkably common among hospitalized older adults diagnosed with cardiometabolic conditions in a secondary teaching hospital setting. Furthermore, patients receiving more than 10 medications exhibited significantly higher odds of experiencing PIMs compared to those receiving 5-10 medications (OR 0.409, 95% CI 0.173–0.969; p = 0.040). These critical clinical findings highlight an elevated medication burden as an important practical marker for targeted medication review in geriatric inpatients, particularly those suffering from complex cardiometabolic multimorbidity.

Abbreviations

PIMs = Potentially Inappropriate Medications; PPOs = Potential Prescribing Omissions; STOPP/START = Screening Tools of Older Person's Prescription/Screening Tools to Alert Doctors to Right Treatment

Declaration

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Yeni Farida *(*Corresponding author)*, Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret, Indonesia. **Contribution:** Writing – Original Draft, Supervision, Methodology, Conceptualization.

Rizki Amalia Taufany, Pantai Indah Kapuk Jakarta Hospital. **Contribution:** Data Curation, Investigation.

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Grammarly and ChatGPT were used to assist in improving English grammar, spelling, sentence structure, and overall language clarity. The authors reviewed and approved all revisions and take full responsibility for the final content of the manuscript

Conflict of Interest

The authors declare no conflict of interest.

Data Availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Ethics Statement

Not applicable.

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Additional Information

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