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Assessment of Geriatrics Patients with Cardiovascular Disease Prescriptions for Appropriateness of Medications by Using Beers Criteria in Muhammadiyah Lamongan Hospital

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Abstract

***Background**: Number of geriatric residents has increased annually. Owing to pathological and physiological conditions, the geriatric population tends to consume more medications, thereby increasing their risk of adverse side effects and drug interactions. **Objective**: This study was to evaluate the appropriateness of therapy for outpatient geriatric patients with cardiovascular disease at Muhammadiyah Lamongan Hospital from August to October 2023. **Methods**: American Geriatrics Society (AGS) Beers Criteria are one of the tools used to identify drugs whose potential harm outweighs the expected benefits and should be avoided in the elderly population. This study employed a descriptive method, with retrospective data collection from secondary sources, including medical records and electronic prescriptions. **Results**: Findings revealed that out of 252 prescriptions for geriatric patients with cardiovascular disease, four types of medications were potentially inappropriate according to the Beers Criteria: nifedipine with 23 prescriptions (9.13%), amiodarone with one prescription (0.40%), digoxin with 13 prescriptions (5.16%), and diltiazem with four prescriptions (1.59%). Conversely, three types of medications were deemed appropriate: aspirin (96 prescriptions, 38.10%), digoxin (30 prescriptions, 11.90%), and diltiazem (11 prescriptions, 4.37%). In conclusion, of the 252 prescriptions reviewed for geriatric patients with cardiovascular disease, three types of drugs are appropriate, while four types increase the risk of potentially inappropriate treatment (PIM) based on the Beers Criteria. **Conclusion**: These findings underscore the need for careful consideration to mitigate the risk of drug reactions. If the medication cannot be used in geriatric patients, an alternative therapy should be used or a dose adjustment may be necessary.*

***Keywords**: beer criteria, cardiovascular disease, potentially inappropriate medication*

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INTRODUCTION

The number of elderly individuals (geriatric population) has been increasing annually, corresponding to rising life expectancy and reflecting improvements in community welfare. The global population aged ≥ 60 years is projected to grow from 1.4 billion in 2020 to 2.1 billion by 2050 (WHO, 2022). In 2021, Indonesia has reached an aging population structure, with approximately one in ten elderly residents. According to the National Socio-Economic Survey data from March 2022, 10.48% of Indonesia's population will be elderly. With advancing age, the incidence of degenerative diseases, particularly cardiovascular diseases, has increased. This trend is especially pronounced in the elderly population (Badan Pusat Statistik 2022).

Cardiovascular disease is caused by impaired heart and blood vessel function in the body (Unger et al., 2020). Cardiovascular diseases include acute coronary syndrome, hypertension, heart failure, and atrial fibrillation (AF) (Rampengan, 2014). Cardiovascular disease (CVD) is the leading cause of death worldwide. In 2019, an estimated 17.9 million people succumbed to cardiovascular disease, accounting for 32% of all global deaths. Of these deaths, 85% were attributed to heart attack and stroke. (WHO, 2021). Riskesdas (2018) also reported that the prevalence of heart disease based on doctors' diagnosis in Indonesia reached 1.5%, with the highest prevalence in North Kalimantan Province at 2.2%, Yogyakarta Special Region at 2%, and Gorontalo at 2% (Riskesdas, 2018). Based on the 2021 health profile in Lamongan District, there has been no specific prevalence of cardiovascular diseases; however, the risk factors for cardiovascular diseases such as hypertension and diabetes mellitus are quite high. The prevalence of hypertension is 48.02% in men and 51.98% in women, whereas the prevalence of diabetes mellitus is 97.2% of the existing estimates of people with diabetes mellitus. From these data, it can be concluded that the prevalence of cardiovascular diseases is high, but has not been recorded (Dinkes Lamongan, 2021).

The high prevalence of cardiovascular disease will inevitably burden the growing geriatric population. Physiological changes accompanying aging affect cardiovascular function, pharmacokinetics, and pharmacodynamics (Julaiha, 2021). Patients with pathological and physiological conditions in geriatric populations tend to consume more drugs (polypharmacy). Geriatric patients have a greater risk of adverse side effects and drug interactions than younger patients (Badan Pusat Statistik, 2022). One of the criteria used to identify drugs with potential harm outweighs the expected benefits and should be avoided in the elderly population (geriatrics) is the American Geriatrics Society (AGS) Beers Criteria. Several classes of drugs according to the Beers Criteria, which are potentially inappropriate for use in the elderly (geriatrics), include anticoagulants, digoxin, antiplatelets, ACEi, CCB, ARB, oral antiarrhythmic agents, and diuretics (Panel, 2023).

In Indonesia, research on the suitability of therapy for geriatric patients with cardiovascular disease is still very rare. Cases of potentially inappropriate drug use that occur in geriatric patients need special attention because they can increase the risk of adverse drug reactions (ROTD) (Julaiha, 2021). Therefore, it is necessary to conduct more comprehensive research on this issue in geriatric patients. The novelty of this research is the limited evaluation of local data, with the results potentially supporting the integration of the Beers Criteria into digital systems.

MATERIALS AND METHODS

Materials

Patient medical record data and electronic prescriptions were obtained using the purposive sampling technique. The collected data included patient profiles (age, sex, diagnosis, laboratory results, and treatment profile).

Method

This study used a descriptive method, presenting demographic data, treatment profiles, and the suitability of patient therapy based on the Beers Criteria. Data were obtained from the medical records of geriatric patients with cardiovascular disease at Muhammadiyah Hospital Lamongan from August to October 2023. Data were collected by extracting information from the hospital's information system (SIRS). This research was conducted after obtaining an ethical permit from LPPM of Universitas Muhammadiyah Lamongan (Lembaga Penelitian dan Pengabdian Masyarakat/Institute for Research and Community Service) with the number 204/EC/KEPK-S1/01/2024.

RESULTS AND DISCUSSION

This study obtained A total of 252 patients were obtained from the medical records and electronic prescriptions of geriatric patients with cardiovascular disease at Muhammadiyah Lamongan Hospital.

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Table 1. Patients' demographic data

No	Demography	Categories	n (%)
1	Gender	Male	137 (54.4)
		Female	115 (45.6)
2	Age (Years) (Badan Pusat Statistik, 2022)	60-69	232 (92.1)
		70-79	17 (6.7)
		±80	3 (1.2)
3	Diagnosis	Hypertension heart disease	115 (26.20)
		Ischaemic heart disease	97 (22.10)
		Heart failure	66 (15.03)
		Atherosclerosis heart disease	37 (8.43)
		Angina stable	32 (7.29)
		Atrial fibrilasi dan flutter	30 (6.83)
		Old miokard infark	25 (5.69)
		Mitral requrgitation	15 (3.42)
		Dislipidemia	11 (2.51)
		Angina pectoris	8 (1.82)
		Coronary heart disease	2 (0.46)
		Aritmia	1 (0.23)
4	Comorbidities	No comorbidities	220 (87.3)
		Diabetes mellitus type 2	20 (7.9)
		Asthma	4 (1.6)
		Osteo arthritis genus	1 (0.4)
		Neuralgia	1 (0.4)
		Hyperuricaemia asymptomatic	2 (0.8)
		Dispepsia	2 (0.8)
		Vertigo	1 (0.4)
		Ganglion	1 (0.4)

In Table 1, it was observed that the number of male patients was 137, accounting for 54.4% of the total. The high prevalence of cardiovascular disease in men is closely associated with unhealthy lifestyle choices, including smoking, alcohol consumption, poor diet, obesity, physical inactivity, and exposure to environmental pollution. These risk factors are twice as prevalent in male patients, making them more susceptible to degenerative diseases, particularly cardiovascular diseases (Handayani et al., 2018).

A total of 232 patients were classified as elderly, aged 60-74 years, representing 92.1% of the sample. Previous research indicates that individuals within this age group have the highest prevalence compared with other older age groups. This trend can be attributed to the decline in physiological function and weakened immune systems among geriatric patients, making them more susceptible to various diseases. These age-related changes affect organ function, structure, tissues, and systems, leading to deterioration of both physical and psychological health (Rokhman et al., 2020). Age is also a non-modifiable risk factor; a person over or equal to 60 years old has a greater risk of death than a 25-49 year old (Kep et al., 2018).

The diagnosis of geriatric patients with the most cardiovascular disease was hypertensive heart disease in 115 patients (26.20%). Hypertension (HTN) is a major modifiable risk factor. Previous results showed that hypertension was associated with the incidence of coronary heart disease, in which respondents who had hypertension were 2,667 times more likely to have coronary heart disease than those who did not have hypertension (Amisi, 2018).

In addition to cardiovascular diseases, a significant number of patients had comorbidities: 7.9% had type 2 diabetes mellitus. These results indicate that type 2 diabetes mellitus was more prevalent among respondents than other comorbidities. This higher prevalence can be attributed to the metabolic disorder caused by hyperglycemia in individuals with diabetes mellitus, which leads to the production of metabolites

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that damage the endothelium of blood vessels, including coronary arteries (Kep et al., 2018).

As shown in Table 2, the treatment profile of geriatric patients with cardiovascular disease revealed that the β-blocker drug group, particularly bisoprolol, was the most frequently prescribed group, with 129 prescriptions (9.31%). According to Frederix and McIntosh (2017) from the European Society of Cardiology, beta-blocker therapy is effective in controlling the heart rate and preventing the development of symptoms in stable coronary artery disease. In post-myocardial infarction conditions, beta-blockers have been shown to reduce the risk of death and heart rate by 20-25% in patients with atrial fibrillation (Arfania et al., 2023).

Table 2. Patient treatment profile

Drug Class	Medicine	n (%)
Antihypertensive		
B-Bloker	Bisoprolol	129 (9.31)
	Carvedilol	23 (1.66)
	Propranolol	10 (0.72)
	Nebivolol Hydrochloride	2 (0.14)
ARB	Valsartan	21 (1.52)
	Candesartan	110 (7.94)
	Irbesartan	7 (0.51)
ACEI Inhibitor	Lisinopril	56 (4.04)
	Ramipril	25 (1.80)
CCB (Dihydropyridine)	Amlodipine	58 (4.18)
	Nifedipine	23 (1.66)
CCB (Non Dihydropyridine)	Diltiazem	15 (1.08)
Diuretic		
Potassium-sparing diuretics	Spironolactone	101 (7.29)
Loop Diuretic	Furosemide	94 (6.78)
Thiazide Diuretic	Hydrochlorothiazide	7 (0.51)
Antiplatelet dan Anticoagulants	Clopidogrel	81 (5.84)
	Ticagrelor	15 (1.08)
	Aspirin	96 (6.93)
	Warfarin	35 (2.53)
	Apixaban	2 (0.14)
Antianginal	Isosorbide dinitrate	52 (3.75)
	Glyceryl trinitrate	58 (4.18)
Anti-cholesterol		
Statin	Simvastatin	46 (3.32)
	Atorvastatin	88 (6.35)
	Rosuvastatin	3 (0.22)
Fibrate	Fenofibrate	1 (0.07)
Heart Medicine		
Heart Glycocid	Digoxin	43 (3.10)
Inhibitor Phosphodiesterase	Sildenafil	4 (0.29)
Angiotensin II Antagonist	Uperio	1 (0.07)
Antiarrhythmic	Amiodaron	1 (0.07)
Inhibitor Sodium Glucose Co-Transporter 2	Forxiga	1 (0.07)
Antigout	Allopurinol 100mg	13 (0.94)
Antidiabetics		
Sulfonylurea	Glimepiride	16 (1.15)
	Glucodex	3 (0.22)
	Gluvas M	1 (0.07)
Biguanide	Metformin	6 (0.43)
Alpha glucosidase inhibitor	Acarbose	1 (0.07)
Gastric Medicine		
Proton Pump Inhibitor	Omeprazole	11 (0.79)
	Lansoprazole	14 (1.01)

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H2 Blocker	Ranitidine	3 (0.22)
Antiulcerant	Sucralfate syr	1 (0.07)
Central Nervous System Drugs		
Analgesic Opioid/Antitussive	Codeine	21 (1.52)
NSAID	Meloxicam	8 (0.58)
	Antalgin	3 (0.22)
	Kalium Diclofenac	1 (0.07
Benzodiazepine	Alprazolam	3 (0.22)
	Valisanbe	3 (0.22)
	Analsik	6 (0.43)
Antidepressant	Amitriptilin	4 (0.29)
Anticonvulsant	Gabapentin	2 (0.14)
Antivertigo	Betahistin Mesilat	2 (0.14)
Antipyretic Analgesic	Paracetamol	1 (0.07)
Respiratory Medicine		
Decongestant	Tremenza	3 (0.22)
	Rhinos	1 (0.07)
Antihistamine	CTM	1 (0.07)
Expectorant	GG	5 (0.36)
Mucolytic	N-Acetylcysteine	4 (0.29)
Antithyroid	Thiamazole	5 (0.36)
Anti-hemorrhoid	Anadium	1 (0.07)
Antibiotic	Amoxicillin	1 (0.07)
Supplements and Vitamins	Omega-3-acid ethyl esters 90%, Folic Acid, Curcuma, Vit B comp	10 (0.72)

Table 3. Suitability of therapy based on Beers Criteria

Drug Name	**Conformity (%)**	
	Appropriate	**Not Appropriate**
Criteria 1		
Aspirin	96 (38.10)	0
Warfarin	5 (1.98)	30 (11.90)
Nifedipine	0	23 (9.13)
Amiodaron	0	1 (0.40)
Digoxin	30 (11.90)	13 (5.16)
Criteria 2		
Diltiazem	11 (4.37)	4 (1.59)
Criteria 3		
Ticagrelor	16 (6.35)	0
Criteria 4		
ARB (Candesartan, Valsartan, Irbesartan) with Potassium sparing diuretics (Spironolactone)	0	56 (22.22)
ACEI Inhibitor (Lisinopril, Ramipril) with Spironolactone	0	52 (20.63)
Opioid (Codeine) with gabapentin	0	1 (0.40)

The prescribing pattern of geriatric patients with cardiovascular disease has four criteria: criterion 1 of drugs that are potentially inappropriate for the elderly, criterion 2 of drugs that are potentially inappropriate in the elderly due to certain conditions, criterion 3 of drugs that are used with caution, and criterion 4 of potentially inappropriate drug interactions. In the first category, criterion 1 is a potentially inappropriate drug for the elderly, which is strongly recommended for avoidance. Aspirin was used for 96 patients (38.10%) who were compliant based on the 2023 Beers Criteria. The use of aspirin in geriatric patients may result in gastric bleeding; therefore, it is only used for secondary prevention (Panel 2023). In this study, aspirin was prescribed only for secondary prevention because all patients already had cardiovascular disease. Prophylactic aspirin in healthy elderly patients does not provide benefits and harms, and is not used for primary prevention in patients over 60 years of age with cardiovascular disease (Rory et al., 2018). Nifedipine, with 23 prescriptions (9.13%), was potentially inappropriate. The use of nifedipine in geriatric patients

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will result in hypotension, which results in reduced blood flow to the heart, so that the heart muscle does not receive sufficient oxygen (Panel, 2023). In cardiogenic shock, the heart is unable to pump effectively, and this situation is exacerbated by inhibiting the entry of calcium ions into heart cells (Khan, 2023). The choice of antihypertensive therapy in elderly patients is adjusted for comorbidities, because CCB is not an absolute contraindication for geriatric patients (HUA et al., 2024).

Amiodarone has only one prescription (0.40%), which is potentially inappropriate based on the 2023 Beers Criteria. Amiodarone is effective at maintaining sinus rhythm but is more toxic than other antiarrhythmic drugs used in atrial fibrillation (Stanton et al., 2020). According to the 2023 Beers Criteria, Amiodarone is only used in geriatric patients with a diagnosis of atrial fibrillation (AF) with heart failure or atrial fibrillation and left ventricular hypertrophy (LVH) (Panel, 2023). Digoxin obtained 13 prescriptions (5.16%) that were potentially inappropriate, and 30 prescriptions (11.90%) met the Beers criteria. Digoxin is not recommended as first-line therapy in geriatric patients diagnosed with atrial fibrillation (AF) and heart failure. It is used to avoid doses >0.125 mg/day, except when treating cases of atrial arrhythmia (Panel, 2023). In this study, the appropriateness of prescriptions based on the Beers criteria was assessed for patients without a diagnosis of atrial fibrillation (AF) or heart failure. However, for those diagnosed with AF and heart failure, doses exceeding 0.125 mg/day were considered. A reduced renal clearance increases the risk of toxicity. In cases where there is objective evidence of impaired heart structure or function at rest, electrocardiography should be performed on all patients with suspected heart failure. Routine laboratory examinations for such patients should include a complete blood count (hemoglobin, leukocytes, and platelets), electrolytes, creatinine, glomerular filtration rate (GFR), glucose, liver function tests, and urinalysis (Handayani et al., 2018). Warfarin in this study obtained 5 prescriptions (1.98%) which met the Beers criteria and 30 prescriptions (11.90%) which were potentially inappropriate. According to Beers, the use of warfarin for the treatment of nonvalvular atrial fibrillation or venous thromboembolism (VTE) is not recommended. For older adults who have been on warfarin long-term, it is okay to use warfarin with a well-controlled International Normalization Ratio (INR)

demonstrating high efficacy in cases of acute coronary syndrome without ST-segment elevation or in patients with invasive interventions such as primary (i.e., >70% of the time in the therapeutic range) and no adverse effects (Panel, 2023). According to the guidelines for warfarin management in the community, the normal INR value of warfarin ranges from to 2-3 (Health 2024). It states that >70% of the time in the range of being picked is the percentage of times the patient in a given period reaches the target INR 2-3. For example, in 10 INR checks, the patient must achieve an INR value of 2-3 in as many as seven checks so that the INR value is well controlled (Badawoud et al., 2024). In this study, according to the Beers criteria, patients received warfarin drugs with an INR value of 2-3, and which is potentially inappropriate if they have an INR value <2 and >3. Dabigatran or rivaroxaban can be administered to geriatric patients with atrial fibrillation who are contraindicated with warfarin (Di *et al.*, 2023). Rivaroxaban may be reasonable in special situations, such as when once-daily dosing is necessary to facilitate medication adherence. All Direct oral anticoagulants confer a lower risk of intracranial hemorrhage than warfarin (Panel 2023).

The second category, criterion 2, includes drugs that are potentially inappropriate for the elderly owing to certain conditions that strongly recommend their avoidance. The research found that diltiazem was included in criterion 2, with four prescriptions (1.59%) deemed appropriate according to the Beers criteria and 11 prescriptions (4.37%) considered potentially inappropriate. Diltiazem is a non-dihydropyridine calcium channel blocker (CCB) that inhibits the entry of calcium ions into the heart muscle during depolarization. This decrease in intracellular calcium concentration promotes the relaxation of smooth muscles, leading to arterial vasodilation and a subsequent decrease in blood pressure (Puspitasari et al., 2022). Diltiazem should be avoided in geriatric patients with heart failure, as it will result in increased fluid and/or may worsen heart failure (Panel, 2023)

Category 3 consisted of drugs that must be used with caution. Ticagrelor is included in this category, with 16 prescriptions (6.35%) aligning with the Beers criteria. According to these criteria, ticagrelor can increase the risk of gastric bleeding when used in combination with clopidogrel, especially in adults over 70 years of age, necessitating its careful use. In this study, the use of ticagrelor adhered to the Beers criteria, as it was prescribed only to patients aged << 70 years old. Ticagrelor is a newer drug replacing clopidogrel, percutaneous coronary intervention. It works by inhibiting binding to the P2Y12 receptor (Firdaus, 2016).

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Category 4 includes potentially inappropriate drug interactions that are strongly recommended to be avoided. In this study, there were three groups of potentially inappropriate drug interactions, namely, the ARB group that interacted with potassium-saving diuretics; the results of 56 prescriptions (22.22%) and ACEI Inhibitor drug groups that interacted with potassium-saving diuretics were 52 prescriptions (20.63%). Avoid routinely using 2 or more RAS inhibitors, or a RAS inhibitor and potassium-sparing diuretic, concurrently in those with chronic kidney disease stage 3A or higher because of an increased risk of hyperkalemia (Panel, 2023).

The opioid group that interacted with gabapentin was prescribed 1 (0.40%). The interaction of ARB and ACEI inhibitors with potassium-sparing diuretics resulted in an increased risk of hyperkalemia. Hyperkalemia is defined as plasma/serum potassium levels that exceed the upper limit of the normal range (Linders et al., 2020). Cell damage can lead to the release of intracellular potassium (K+) into the extracellular space, as observed in conditions such as rhabdomyolysis from crush injuries, excessive physical exercise, and other hemolytic processes. Insulin deficiency and diabetic ketoacidosis can cause significant and rapid shifts in intracellular and extracellular K+ levels, resulting in elevated serum K+ levels despite a decrease in total K+ levels. Tumor lysis syndrome following chemotherapy can also cause acute hyperkalemia due to extensive death of cancer cells (Kasper et al., 2015). In addition, the interaction between opioid drugs and gabapentin increases the risk of overdose and adverse drug effects. These side effects include respiratory distress, coma, and even death (Drug.com 2024).

The limitation of this study is that it did not include follow-up on not appropriate with the Beers Criteria, as the data collection was retrospective and conducted over a limited time.

CONCLUSION

This study showed that seven types of inappropriate drugs increased the risk of potentially inappropriate medication according to the Beers Criteria 2023. The drugs used were warfarin, nifedipine, amiodarone, digoxin, diltiazem, the interaction between ARB/ACEi, and potassium-sparing diuretics. If medication cannot be used in geriatric patients, an alternative therapy should be used, or dose adjustment may be necessary.

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AUTHOR CONTRIBUTIONS

Conceptualization: I.S.; Methodology, D.P.; Software, A.Z.F.; Validation: I.S.; Formal Analysis, D.P.S.; Investigation: D.P.S.; Resources, D.P.S.; Data Curration; D.P.S.; Writing - Original Draft, D.P.S.; Writing - Review and Editing, I.S.; Visualization: D.P.S.; Supervision: I.S.; Project Administration I.S.; Funding Acquisition, D.P.S.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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