Factors Affecting Potentially Inappropriate Medications (PIMs) Based on STOPP/START Criteria in Geriatric Patients at RSUD Dr. Soedomo Trenggalek

(*Faktor-Faktor yang Mempengaruhi Potentially Inappropriate Medications (PIMs) Berdasarkan Kriteria STOPP/START pada Pasien Geriatri di RSUD Dr. Soedomo Trenggalek*)

Esti Ambar Widyaningrum[1*], Marina Fitriani[1], Reny Nur Satya Irawati[2], Shofiatul Fajriyah[1], Evi Kurniawati[1], Tri Puji Lestari[1]

[1]*Fakultas Farmasi, Institut Ilmu Kesehatan Bhakti Wiyata.*
[2]*Instalasi Farmasi RSUD Dr. Soedomo Trenggalek.*

Corresponding Author:
Esti Ambar Widyaningrum
Fakultas Farmasi
Institut Ilmu Kesehatan Bhakti Wiyata
Kediri
Indonesia
email:
esti.ambar@iik.ac.id

ABSTRACT

Background: Geriatric patients often have multiple comorbidities and decreased physiological function, leading to polypharmacy and potential exposure to inappropriate medications (PIMs). **Objectives:** This study investigates geriatric inpatients' characteristic profiles, evaluates PIMs using STOPP/START criteria, and explores factors influencing PIM incidence. **Method:** This study employed a retrospective observational analytical approach. The sampling technique was purposive sampling. The sample involved in this study was 312 patients. **Results:** The geriatric patients involved in this study had the following characteristics: 62% male and 38% female; 69% youngest-old (65-74 years), 30% middle-old (75-90 years), and 1% oldest-old (>90 years); 87% with BPJS service type and 13% with general service type; main diagnosis groups of the patients were gastrointestinal of 9%, cardiovascular of 31%, respiratory of 3%, neurological of 1%, infection of 11%, endocrine of 13%, genitourinary of 15%, immune an malignant of 1%, blood of 11%, musculoskeletal of 2%, eyes of 2% and skin of 1%; 13% patients had one disease, 43% had two diseases, 25% had three diseases, and 19% had ≥ four diseases;29% had 15 drugs, 50% had 6-10 drugs, 17% had 11-15 drugs, 3% had 20 drugs, and 1% had ≥ 20 drugs. There were 72 PIMs based on STOPP/START criteria. The results of the analysis using the C contingency coefficient test showed the following factors, such as gender (p-value of 0.894), age (p-value of 0.470), type of service (p-value of 0.166), main diagnosis (p-value of 0.042), number of illness (p-value of 0.106), and number of drugs (p-value of 0.182). **Conclusion:** There is a correlation between the main diagnosis factor and PIMs with a p-value of 0.042 (p-value < 0.05).

INTRODUCTION

Geriatric patients are elderly patients with multiple diseases (Minister of Health Regulation No. 79 of 2014, article I, paragraph 4). As people get older, physiological functions decrease due to aging causing non-communicable diseases that often appear in old age (Ministry of Health of the Republic of Indonesia, 2016). The ageing process in the elderly population affects the pharmacokinetics and pharmacodynamics of the drugs consumed. Lack of attention to these changes contributes to inappropriate drug use (Julaiha, 2018).

Potentially Inappropriate Medications (PIMs) can be defined as the use of medications that should be avoided by elderly patients due to high risks and adverse reactions and/or insufficient evidence of benefit when safer and equivalent or more effective therapeutic alternatives are available (Zhang *et al*., 2017). Various factors can influence the incidence of Potentially Inappropriate Medication (PIMs), including being female, elderly, polypharmacy, receiving prescriptions from several doctors and having poor health status (Lim *et al*., 2016; Shade *et al.*, 2017).

Commonly applied explicit criteria include geriatric prescription screening tools and screening tools to remind appropriate care criteria including the Beers criteria and STOPP/START criteria (Hsu *et al*., 2021). The STOPP/START criteria are one of the explicit criteria widely used to identify the safety of pharmacological therapy in geriatric patients. The STOPP (Screening Tool of Older Persons' Prescriptions) and START (Screening Tool to Alert to Right Treatment) criteria were created in 2003 to address possible shortcomings of the Beers criteria. These criteria consist of potentially inappropriate medications (PIMs) described by STOPP and potential prescribing errors. The START method is intended to increase the success of treatment in geriatric patients (Viviandhari *et al*., 2022). A previ'us study on STOPP/START criteria was conducted by Julaiha (2018) on 72 eriatricc inpatients. It was reported that 25 geriatric inpatients experienced 39 incidents of PIMs.

Research related to Potentially Inappropriate Medication (PIMs) in Dr. Hospital Soedomo Trenggalek was carried out by Widyaningrum *et al.* (2021). This research looks at the relationship between the incidence of PIMs and the number of medications in geriatric hypertensive outpatients based on Beers criteria 2019. The study used patient prescribing data geriatric hypertension outpatient. In the research that will be carried out analyze the factors that influence the occurrence of PIMs in patients inpatient geriatrics based on STOPP/START criteria.

Meanwhile, this study was conducted to investigate the characteristics profile of geriatric inpatients at RSUD (Regional Public Hospital) dr. Soedomo Trenggalek, investigating the incidence of Potentially Inappropriate Medications (PIMs) based on the STOPP/START criteria and investigating the factors

that influence the incidence of Potentially Inappropriate Medications (PIMs) such as gender, age, type of service, main diagnosis, number of diseases, and number of drugs.

MATERIAL AND METHODS

This study employed an observational analytic approach with the independent variable of Potentially Inappropriate Medications (PIMs) and the dependent variables of gender, age, type of service, main diagnosis, number of diseases, and number of medications. This study was conducted at RSUD dr. Soedomo Trenggalek from April to May 2022.

The research population was all medical records of geriatric patients aged ≥65 years who received inpatient treatment at RSUD dr. Soedomo Trenggalek from January to September 2021 as many as 1,418 medical record data. A minimum number of samples were then taken of 312 medical records data.

The type of data used in this study was secondary data obtained by observing medical record data of geriatric inpatients from January to September 2021 at RSUD dr. Soedomo Trenggalek. The data obtained included name (anonymized), medical record number (anonymized), gender, type of service, age, main diagnosis, number of illnesses, supporting data, and name of medication.

The obtained data were analyzed in two kinds of analysis (univariate and bivariate). Univariate analysis was carried out to look at the characteristic profile of geriatric inpatients at RSUD dr. Soedomo Trenggalek using Microsoft Excel. Identification of PIMs was done by comparing medication data obtained using the STOPP/START criteria as a reference.

Bivariate analysis was carried out to determine whether there was a significant correlation between the incidence of PIMs and factors such as gender, age, type of service, main diagnosis, number of diseases, and number of medications using the C contingency coefficient test with a confidence level of 5%. This study has been approved by the Research Ethics Committee of IIK Bhakti Wiyata Kediri with Research Ethics Certificate No: 13/FF/EP/II/2022.

RESULT AND DISCUSSION

The sample involved in this study was 312 patients consisting of 194 males and 118 females. Table 1 presents the characteristic profile of geriatric inpatients. Characteristic profiles were created based on data on gender, age, type of service, main diagnosis, number of diseases and number of drugs given. Most of the geriatric inpatients were from the youngest-old group aged 65-74 years (69%), the middle-old age group of 30% and the oldest-old age group of 1%. The percentage of geriatric patients who used BPJS services was 87% and general services was 13%. The largest percentage of diseases of the geriatric inpatients was the cardiovascular group at 31% while the rest were the main diagnosis groups of gastrointestinal at 9%, respiratory at 3%, neurological at 1%, infection at 11%, endocrine at 13%,

genitourinary at 15%, immune and malignant at 1 %, blood at 11%, musculoskeletal at 2%, eyes at 2% and skin at 1%. The percentage of geriatric patients suffering from 2 diseases was 43%, followed by the percentage of 1 disease of 13%, 3 diseases of 25% and ≥ 4 diseases of 19%. The largest percentage was patients who received 6-10 drugs at 50% followed by the percentage results for 1-5 drugs at 29%, 11-15 drugs at 17%, 16-20 drugs at 3% and ≥ 20 drugs at 1%.

Table 1. Characteristics of Geriatric Inpatients

Characteristics	Total	Percentage (%)
Gender		
Male	194	62
Female	118	38
Age		
Youngest-old (65-74 years)	216	69
Middle-old (75-90 years)	93	30
Oldest-old (>90 years)	3	1
Type of Service		
BPJS service	271	87
General service	39	13
Main Diagnosis		
Gastrointestinal	27	9
Cardiovascular	97	31
Respiratory	10	3
Nerves	4	1
Infection	34	11
Endocrine	41	13
Genitourinary	46	15
Immune and Malignant	4	1
Blood and Nutrition	34	11
Musculoskeletal	7	2
Eyes	7	2
Skin	1	1
Number of Diseases		
1	42	13
2	138	43
3	77	25
≥ 4	55	19
Number of Drugs		
1-5	92	29
6-10	156	50
11-15	54	17
16-20	8	3
>20	2	1
Total	312	100

To determine the incidence of PIMs in geriatric inpatients at RSUD dr. Soedomo Trenggalek, medication in patients was identified using STOPP/START criteria. The research results are visualized in tables 2 and 3 which present that during the treatment there were 72 incidents of PIMs in 57 patients.

Table 2. PIMs Incidence Based on STOPP Criteria

System Group	PIMs Incidence	Total	Percentage (%)
Anticoagulants and Antiplatelet	Use of Rivaroxaban with an eGFR value < 15 ml/min/1.73m2	1	3.3
Musculoskeletal	Use of NSAID with an eGFR value < 50 ml/min/1.73m2	17	56.6
	Use of NSAID in severe hypertensive patients	3	10
	Use of NSAID and Warfarin	2	6.6
Endocrine	Use of Metformin with eGFR values below 30ml/min/1.73m2	4	13.3
Cardiovascular	Use of Clonidine as an antihypertensive	3	10.2
Total		30	100

Table 3. PIMs Incidence Based on START Criteria

System Group	PIMs Incidence	Total	Percentage
Gastrointestinal	PPI for patients on medications with a risk of intestinal bleeding	35	83.3
Cardiovascular	Antihypertensive therapy with systolic blood pressure > 160 mmHg consistently	7	16.7
Total		42	100

The C contingency coefficient test was carried out to determine the relationship between gender, age, type of service, main diagnosis, number of diseases, and number of drugs with the incidence of PIMs in the geriatric inpatients at RSUD dr. Soedomo Trenggalek. The research findings presented in Table 4 show that there is a relationship between the main diagnosis factor and the incidence of PIMs.

Table 4. Results of Analysis of Factors Affecting the Incidence of PIMs

Characteristic		PIMs	No PIMs	*p-value**
Gender	Male	35	159	0.894
	Female	22	96	
Age	Youngest-old	37	179	
	Middle-old	20	73	0.470
	Oldest-old	0	3	
Type of Service	BPJS	53	220	0.166
	General	4	35	
Main Diagnosis	Gastrointestinal	4	23	
	Cardiovascular	28	69	
	Respiratory	0	10	
	Nerve	1	3	
	Infection	4	30	
	Endocrine	6	35	0.042
	Genitourinary	11	35	
	Immune & Malignant	1	3	
	Blood and Nutrition	0	34	
	Musculoskeletal	1	6	
	Eye	1	6	
	Skin	0	1	
Number of Diseases	1	3	39	
	2	23	115	0.106
	3	18	59	

Characteristic		PIMs	No PIMs	*p-value**
	≥4	13	42	
Number of Drugs	1-5	12	80	
	6-10	28	128	
	11-15	14	40	0.182
	16-20	3	5	
	≥20	0	2	

*The statistical test used is the C contingency coefficient test

The profile of characteristics based on gender in the research sample showed that more males (62%) than females (38%). This finding aligns with a previous study conducted by Julaiha (2018) on geriatric inpatients at Advent Hospital Bandar Lampung which found that the percentage of male geriatric patients was 55.6%. This number is bigger than those in female geriatric patients at 44%. In other words, male patients are twice as likely to develop degenerative diseases as female patients. Degenerative diseases tend to occur in male patients due to poor lifestyles such as smoking, drinking alcohol, diet, lack of physical activity, and obesity (Handajani *et al.*, 2010 in Nurmainah *et al.*, 2021).

The profile of age characteristics in this study was divided into three groups which were youngest-old (65-74 years), middle-old (75-90 years), and oldest-old age group (>90 years). The age grouping in this study refers to the WHO age grouping. This study found that the percentage of the youngest-old was the biggest (69%) compared to the middle-old (30%) and the oldest-old age group (1%). This supports Nurhasna and Viviandhari (2020) who conducted a study on geriatric inpatients at RSI Pondok Kopi Jakarta. They found that from 308 patients, the highest percentage was found in the youngest-old group (60-74 years) with a percentage of 81%, followed by the middle-old group with 19%.

This study also found that 87% of geriatric inpatients used BPJS service and only 13% used general services from the total samples. According to Statistics Indonesia (2021), health insurance from the government (BPJS PBI) dominates funding for outpatient and inpatient treatment instead of BPJS non-PBI. This domination illustrates that for older people who use health insurance, their health insurance premiums/contributions are still borne by the government.

The characteristic profile of the main diagnoses in the research samples showed that the main diagnoses were grouped according to organ systems referring to the British National Formulary (BNF) edition 82 for September 2021 – March 2022. In this study, the results showed that diagnoses included in the cardiovascular system had a percentage of 31%, which is higher than the percentage of other groups of organ systems. This finding is under research conducted by Nabila Ayu *et al.* (2019) which showed that the main diagnosis group of cardiovascular disease is a disease often suffered by geriatric patients with a percentage of 27.35% (29 incidents). The increase in the prevalence of cardiovascular disease in geriatric patients is due to anatomical, functional, and histopathological structural changes in the cardiovascular system (Dai *et al.*, 2015, Nabila Ayu *et al.*, 2019).

The number of diseases in this study found in the samples in this study was a group following the study conducted by Nurhasna and Viviandhari had two diseases a percentage of 43%. This supports a previous study conducted by Alhawassi *et al*, 2019, where it was found that from 4,073 samples, there were 3,174 (77.9%) geriatric outpatients with two or more chronic disease conditions. Factors that cause multimorbidity, such as the pathophysiology of one disease which can cause other diseases, the consumption of drugs in less common quantities (polypharmacy), and the genetic factors of each individual are direct causes of multi-morbidity in the elderly. Meanwhile, other indirect factors are socioeconomic conditions, nutritional status, and educational level of the elderly (Lappenschaar *et al.*, 2012).

The number of drugs in this study was grouped based on Nurhasna and Viviandhari (2020) study. The grouping for the number of drugs was 1-5, 6-10, 11-15, 16-20 and > 20. The highest percentage of the number of drugs 6-10 is 50% higher than the number of drugs 1-5, 11-15, 16-20 and > 20. This result is based research by Nurhasna and Viviandhari (2020) where the number of drugs 6-10 has a percentage of 61% with a total of 206 out of 340 medical records. Polypharmacy is often found in geriatric patients and is often associated with the patient's disease condition and increasing age. The existence of polypharmacy that occurs in geriatric patients can increase the risks, including increased costs, side effects, drug interactions, non-compliance with medication, decreased functional status and geriatric syndrome (Fauziyah *et al*., 2020).

The incidence of PIM which was classified as an anticoagulant and antiplatelet has one criterion, namely the use of rivaroxaban with a GFR value < 15 ml/min/1.73 m^2 with a percentage of 3.3 %. This PIM incident was aimed at patients who received rivaroxaban therapy and had eGFR values < 15 ml/min/1.73 m^2. The risk of bleeding caused by the use of rivaroxaban is that rivaroxaban therapy has a risk of gastrointestinal bleeding. Compared with other groups of new oral anticoagulants (NOACS), rivaroxaban has the highest risk of causing gastrointestinal bleeding. In addition to gastrointestinal bleeding, rivaroxaban may cause more nosebleeds and hematuria compared with warfarin (National Health Service, 2013).

There are three PIMs incidents included in the musculoskeletal system. The first is the use of NSAIDs with eGFR value < 50 ml/min/1.73 m^2 with a percentage of 56.6%. The incidence of PIMs in this study was found in the drug list of patients who received NSAID therapy and had an eGFR value < 50 ml/min/1.73 m^2. The use of NSAIDs included in this study included dexketoprofen, ketorolac, mefenamic acid and metamizole. The NSAID group causes inhibition of prostaglandin and thromboxane synthesis which causes renal vasoconstriction and consequently reduces renal perfusion and distorts renal function. Clinical manifestations of NSAID-induced nephrotoxicity include hyperkalemia,

decreased glomerular filtration rate, nephrotic syndrome, chronic kidney disease, acute interstitial nephritis, sodium retention, edema, renal papillary necrosis (Wongrakpanich *et al.*,2019).

The second PIMs incidence which included the musculoskeletal system was the use of NSAIDs in patients with severe hypertension with a percentage of 10%. The incidence of PIMs in the study was found in this study found in the drug list of patients receiving NSAID therapy and blood pressure which was included in severe hypertension. The use of NSAIDs that is included in these criteria is the use of metamizole. Blood pressure in this study refers to the British National Formulary (BNF) where severe hypertension patients have systolic blood pressure $\geq$ 180 mmHg or diastolic blood pressure $\geq$ 120 mmHg. The use of NSAIDs in patients with severe hypertension can increase the risk of exacerbation of hypertension. In general, NSAIDs can increase blood pressure by an average of 5 mmHg. The mechanism by which NSAIDs can cause exacerbation of hypertension is related to the inhibition of prostaglandin synthesis, which leads to renal vascular disruption that manipulates blood pressure regulation. Additionally, NSAIDs can cause an increase in serum aldosterone leading to sodium retention and hypertension (Wongrakpanich *et al.*, 2018).

The third incidence of PIMs belonging to the musculoskeletal system was the use of NSAIDs and warfarin with a percentage of 6.6%. The incidence of PIMs in this study was found in the drug list of geriatric inpatients receiving NSAID and warfarin therapy. A consideration in using NSAIDs and warfarin together is the risk of gastrointestinal bleeding. The mechanism underlying NSAID-induced gastrointestinal side effects lies in the fact that NSAIDs inhibit prostaglandin synthesis, leading to a weakening of the gastrointestinal mucosal barrier that predisposes to bleeding (Wongrakpanich *et al.*, 2018).

The PIMs incidences in the endocrine system were due to the use of metformin with an eGFR value below 30 ml/min/1.73 m^2 with a percentage of 13.3%. Metformin was contraindicated in GFR < 30 ml/minute with the main problem that can occur being accumulation of metformin which can cause Lactic Acidosis. Lactic acidosis is the occurrence of metabolic acidosis with increased lactic acid and anion gap values (Sartika and Umar, 2021). Lactic acidosis can occur if the plasma concentration of metformin is > 20 mg/L and can be fatal if it reaches the level of 50 mg/L. The therapeutic range for metformin plasma level is 0.3-1.0 mg/L. Metformin is excreted 90% through the kidneys in intact form, correlating with GFR. Side effects of metformin toxicity in the form of vomiting and diarrhoea were not observed due to the use of metformin together with the use of omeprazole or ranitidine (Haryati *et al.*, 2019).

There was one incident of PIMs involving the cardiovascular system, namely the use of clonidine as an antihypertensive with a percentage of 10.2%. The PIMs incidence was found in the drug list of patients

given clonidine therapy with a comorbid diagnosis of hypertension. The use of clonidine for geriatric patients should be avoided because clonidine is not well tolerated by geriatric patients (National Health Service, 2016).

The PIMs incidence included in the START criteria from the gastrointestinal system was the use of PPIs for patients receiving treatment who were at risk of intestinal bleeding with a percentage of 83.3%. Patients who received this recommendation were patients who received antiplatelet therapy, NSAIDs, and corticosteroids (single or in combination) without adding gastroprotective therapy to the treatment list for geriatric inpatients.

The mechanism underlying NSAID-induced gastrointestinal side effects lies in the fact that NSAIDs inhibit prostaglandin synthesis, leading to a weakening of the gastrointestinal mucosal barrier that predisposes to bleeding. NSAID-induced gastroduodenal ulcers might be prevented with gastrointestinal protective agents such as misoprostol, H2-receptor antagonist (H2RA) or proton pump inhibitor (PPI) (Wongkrapanich *et al.*, 2018).

The START criteria for the cardiovascular system were the use of antihypertensive therapy with a systolic blood pressure of more than or equal to 160 mmHg consistently with a percentage of 16.7%. Patients who received consideration for this criterion point were those who had a systolic blood pressure of more than 160 mmHg consistently and did not receive antihypertensive therapy on the medication list during hospitalization. Hypertension in geriatrics must be treated immediately because geriatric patients who suffer from hypertension are at risk of stroke, the tendency to have high systolic blood pressure, and any accompanying comorbidities (Elliot and Black, 2008 in Julaiha, 2018). The importance of treating hypertension in geriatric patients is demonstrated by the results of research conducted by Bucket et al, 2008 in Julaiha (2018) which concluded that treating hypertension in geriatric patients aged 80 years and over can reduce the risk of death by 21% and reduce the incidence of stroke by 30%.

In this study, the results showed that the percentage of PIMs incidence in geriatric inpatients was 18.3%. Meanwhile, a previous study on geriatric inpatients at Advent Hospital Bandar Lampung using the STOPP/START criteria carried out by Julaiha (2018) found that from a total research sample of 72 patients, an analysis done and obtained that the PIMs incidence was found in 35 patients with a percentage of 48.6%. Another study conducted by Mazhar et al (2017) on geriatric inpatients in Pakistan showed that from a total sample of 167 patients, 39 patients were found to have PIMs using STOPP criteria with a percentage of 21.6%. The prevalence of inappropriate medication use in geriatric patients based on STOPP/START criteria was in the range of 21.6% - 48.6% (Mazhar *et al.*, 2017; Julaiha, 2018;

Ma *et al.*, 2020). Yet, in this study, the incidence of PIMs was not included in this range due to differences in research methodology, sample size, and sample characteristics.

Stages of analysis of factors influencing the incidence of Potentially Inappropriate Medications (PIMs) based on STOPP/START criteria in geriatric inpatients at RSUD dr. Soedomo Trenggalek tested the distribution of data and then determined the analysis method. The data distribution test or normality test was carried out using the Kolmogorov-Smirnov. After that, the *asymp. 2 tailed* was found of 0.000, where $\alpha < 0.05$, indicating that the data were not evenly or normally distributed. Then, a correlation test was conducted using the C contingency coefficient test with a nominal data scale. The test results showed that the main diagnosis factor was related to the PIMs incidence with a p-value of 0.042 (p-value < 0.05). The findings in this study support the study carried out by Alhawassi *et al.* (2019) which found that the main diagnosis affected the PIMs incidence.

The study done by Allhawassi et al (2019) also mentioned that the presence of certain conditions in geriatric patients predicts an increase in the PIMs incidence if geriatric patients suffer from diabetes, ischemic heart disease, heart failure, chronic kidney disease, cancer, osteoarthritis, osteoporosis, and anxiety. Several previous studies have shown a significant correlation between the use of PIMs and cardiovascular disease, diabetes, and osteoporosis, as well as an increase in the number of chronic diseases (Vieira *et al.*, 2013 in Alhawassi *et al.*, 2019).

However, this study has a limitation which was the application of START criteria which required professional adjustment, namely the doctor in charge of the patient. The results reported in this study are in accordance with the START criteria in which the results were in the form of a pharmaceutical perspective and had not received approval from any doctor. This study utilized a retrospective type of study meaning the reseachers could not review the condition of geriatric patients directly. Therefore, it is not possible to directly observe the incidence of PIMs in geriatric patients to see the emergence of clinical manifestations that occur in geriatric patients due to the use of drugs included in the STOPP/START criteria. The incidence of PIMs was determined by looking into the patient's medical records obtained from the patient's discharge summary and medication prescriptions without looking at the list of daily medications given.

CONCLUSION

The characteristics of the geriatric inpatients at RSUD dr. Soedomo showed that the most common gender found was male (62%), in the youngest-old age group (65-74 years) (69%) the most frequently used type of service was BPJS (87%). The main diagnosis showed in geriatric inpatients was mostly cardiovascular (31%) with the number of diseases suffered by geriatric inpatients being mostly 2 (43%). Finally, the number of drugs administered to the geriatric inpatients was mostly 6 up to 10 drugs (50%).

According to the STOPP/START criteria, there were 57 patients with PIMs incidence, with a percentage of 18.3%. There is a correlation between the main diagnosis factor and the incidence of PIMs based on the STOPP/START criteria with a value of 0.042 (p-value < 0.05).

ACKNOWLEDGEMENT

Thanks to the Director of RSUD Dr. Soedomo Trenggalek and the Dean of the Faculty of Pharmacy IIK Bhakti Wiyata Kediri. This article was presented at "Seminar Nasional Kefarmasian ke-6 STIFA Pelita Mas Palu".

CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES

Alhawassi, TM., W. W. Alatawi dan M. Alwhaibi. (2019). Prevalence of Potentially Inappropriate Medications Use Among Older Adults and Risk Factors Using the 2015 American Geriatrics Society Beers Criteria. *BMC Geriatrics*, (2019) 19:1-8.

Statistics Indonesia. (2021). *Statistik Penduduk Lanjut Usia*. Ministry of Home Affairs. Jakarta. *Environmental Research and Public Health*, 18 (985), 1-11.

Fauziyah, H., R. Mulyana and R.D. Martini. (2020). Polifarmasi pada Pasien Geriatri. *Jurnal Human Care*, 5 (3), 804-812.

Handajani, A., Oosihermiatie, B. and Maryani, H. (2010). Faktor-faktor yang Berhubungan dengan Pola Kematian pada Penyakit Degeneratif di Indonesia. *Buletin Penelitian Sistem Kesehatan*, (13), 42-53.

Hsu, KC., H.L. Liu., C.M. Kuan, J.S Wu, C.L. Huang, P.H Lin, D, Tresize, T.C. Wang. (2021). Potentially Inappropriate Medication among Older Patients Who Are Frequent Users of Outpatient Services. Int. J. Environ. Res. Public Health 2021, 18, 985

Julaiha, S. (2018). Identifikasi Inappropriate Medications (PIMs) Berdasarkan Kriteria STOPP START pada Pasien Geriatri Rawat Inap di RS Advent Bandar Lampung. *Jurnal Analis Kesehatan*, 7 (1), 657-665

Ministry of Health of the Republic of Indonesia. (2016). *Situasi Lanjut Usia (LANSIA) di Indonesia*. South Jakarta Selatan: Ministry of Health of the Republic of Indonesia.

Laporan Penelitian Pengembangan IPTEKS. Jakarta: Universitas Muhammadiyah Prof. Dr. Hamka

Lappenschaar, M, A. Hommersom, and P.J.F. Lucas. (2012). Probabilistic Causal Models of Multimorbidity Concepts. *AMIA Annual Symposium Proceeding Archive*.

Ma, Z., Y. Tong, C, Zhang and L, Liu. (2020). Potentially Inappropriate Medications and Potentially Prescribing Omissions in Chinese Older Patients: Comparison of Two Versions of STOPP/START. *Wiley J Clin Pharm Ther*, (00): 1-9.

Mazhar, F., S. Akram., S.M. Malhi and N, Haider. (2017). A prevalence study of potentially inappropriate medications used in hospitalized Pakistani elderly. *Aging Clin Exp Res.*

Nabilla, A.A., Esti D.U., Ika M. (2019). Pengobatan Berpotensi Tidak Tepat Berdasarkan Kriteria Beers 2015 pada Pasien Geriatri di RSUD Prof. Dr. Margono Soekarjo. *Acta Pharm Indo*. 7(1): 12-18.

National Health Service. (2013). Dabigatran, Rivaroxaban And Apixaban, The New Oral Anticoagulants (NOACS), For The Prevention Of Stroke And Systemic Embolism In Nonvalvular Atrial Fibrillation. *NHS West Suffolk Clinical Commissioning Group*, November (2): 1-32.

Nurmainah, Rindu A., Ressi A. (2022). Detection of Potentially Inappropriate   Medication in Elderly Outpatient Based on The Beer's Criteria 2019 *Jurnal Farmasi dan Ilmu Kefarmasian Indonesia*. 9(1): 82-91.

Regulation of the Minister of Health of the Republic of Indonesia Number 79 of 2014 concerning the Implementation of Geriatric Services in Hospitals. Ministry of Health of the Republic of Indonesia. Jakarta

Royal Pharmaceutical Society of Great Britain. (2022). *British National Formulary ed 82nd: September 2021-March 2022*. London: BMJ Group.

Sartika, S.D. and H. Umar. (2021). Asidosis Laktat pada Penggunaan Metformin. *Jurnal Ilmiah Ecosystem*, 21 (1):168-176.

Shade, M.Y., A. M. Berger, C. Chaperon, G. Haynatzki, L, Sobeski And B, Yates. (2017). Factor Associated With Potentially Inappropriate Medication Use In Rural Community-Dwelling Older Adults. *Journal Of Gerontology Nursing*, 43(9), 21-30

Viviandhari, D, Nurhasnah N, Sakinah, R.N, Wulandari, D. (2022). A Comparison of Potentially Inappropriate Medications Identification Using Beers and STOPP Criteria in Hospitalized Geriatric Patients in Jakarta, *Indonesian Journal of Clinical Pharmacy, June,* Vol. 11 Iss. 2, pg 105–115

Widyaningrum, E. A., Sari K. P. D. W., Astuti, L. W., Suhartatik, S., Rimawati, S. E. K. (2021). Correlation Between the Number of Prescribed Drugs and Potentially Inappropriate Medication (PIMs) Based on Beers Criteria in Geriatric Hypertension Outpatients at Dr. Soedomo Hospital in Trenggalek, *Galenika Journal of Pharmacy,* 7(3): 238–250.