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Potentially Inappropriate Medication Inpatient Elderly with DM Type 2 at RSUD M. Yunus Bengkulu based on Beer's Criteria 2019

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Abstract

This study aims to determine the incidence of PIMs and the factors that influence PIMs in geriatric patients with type 2 DM. This study was a non-experimental study with a cross-sectional method. The data collection technique uses medical record data of Type 2 DM patients without or with comorbidities who are elderly in the period of January-December 2022 who are receiving drug therapy. Sampling was done by purposive sampling of 42 patients and data were analyzed using Fisher's statistical test. The results showed that the use of PIMs at RSUD M. Yunus was 92.86% (39 patients). The incidence of PIMs for Type 2 DM drugs were insulin sliding scale (1 patient) and glimepiride (4 patients). For drugs other than Type 2 DM, PPI class drugs are 43.82%. Fisher's test showed that only the number of drugs had a significant relationship with the incidence of PIMs (p=0.019), while other characteristics such as age, gender, comorbidities and length of stay had no effect on PIMs.

Keywords: *Beer's Criteria 2019; DM Tipe 2; Geriatric; PIM; Polifarmasi*

Introduction

Geriatrics is someone who has reached the age of more than 60 years, and every year the elderly population continues to increase. In almost a span of 5 decades, the proportion of elderly people in Indonesia has increased more than 2 times (1971-2020), namely 9.92% (26 million), where elderly women are higher than the number of men, around a third hundred (10.3%: 9.2%) (BPS, 2020). The elderly are susceptible to various physical complaints due to natural factors and disease factors (Mampa et al, 2022). The aging process occurs due to changes in various organs, including the digestive system, genitourinary system, central nervous system, and others (Astuti et al, 2020). So that the elderly group is susceptible to disease, one of the diseases that often attacks the elderly is Type 2 DM. According to the results of the 2018 Riskesdas, the most common diseases of the elderly are Non-Communicable Diseases (PTM), including asthma, cancer, stroke, chronic kidney disease, joint disease, diabetes mellitus, heart disease, and hypertension. The incidence of Type 2 DM in Indonesia is included in the 10 deadliest diseases that occur in the elderly. The prevalence of Type 2 DM in Indonesia is in 3rd position for the Southeast Asia region, which is 11.3%. Based on data from the Bengkulu Provincial Health Office, sufferers of Diabetes Mellitus (DM) specifically in Bengkulu City in 2018 reached 19,353 people (Raasyidah et al, 2020).

The decline and changes that occur in the elderly are due to a decrease in absorption, distribution, metabolism and excretion that occurs in the elderly. This decrease causes changes in the bioavailability of the drugs consumed, causing the potential for inappropriate drug use (Afrilianto et al, 2020). Previous studies reported that the incidence of inappropriate drug use *Potentially Inappropriate Medication* (PIM) was found in geriatric patients of 62.5% where female and polypharmacy were risk factors for PIM (Al-Azayzih et al, 2019). Other studies also reported that the prevalence of patients who received PIM was 23.5% based on Beer's Criteria 20128 and around 55.6% of patients were identified (PIM) based on Beer's Criteria 2015 (Cahyaningsih & Amalia, 2019). Previous research in 2020 reported that PIM was found in geriatric patients with type 2 diabetes mellitus during hospitalization, polypharmacy, decreased kidney function and female were associated with a high incidence of PIM (Sharma et al, 2020; Rahmawati, 2022). The role of pharmacy in evaluating the appropriateness of drug use can improve the therapeutic outcome of geriatric patients.

Based on the Beer's Criteria of the American Geriatric Society 2019, Beer's Criteria aims to reduce drug-related problems in older adults consisting of potentially inappropriate drug exposures, drug-drug interactions, drug-disease interactions, and drugs that should use with caution in older adults. Comorbidities from diabetes were chosen because they are the most common disease group and place a higher burden on patients, payers, and the health care system. Beer's Criteria is a tool that can be used to evaluate the potential for inappropriate drug use in geriatrics. Since 2012 Beer's Criteria has been updated every 3 years. Beer's Criteria 2019 is an update of the Beer's Criteria 2015, so this research will be one of the latest studies using Beer's Criteria 2019 in analyzing PIM.

This research has not previously been conducted using the Beer's criteria 2019 method. The 2019 Beer's Criteria includes five categories to determine the prevalence of PIM in elderly patients. Drugs in category one should be avoided in elderly patients; drugs in category two should be avoided if the patient has a history of certain diseases; drugs in category three, which can still be used with caution; drugs in category four cause drug-disease interactions; and drugs in category five should be reduced in dose or avoided if a patient has a history of certain diseases (Al-Azayzih, 2019).

Research Methods

This research is a non-experimental analytic study with an observational cross-sectional design by examining the incompatibility of type 2 DM drugs in 42 elderly patients at the Regional Public Hospital (RSUD) M. Yunus Bengkulu city, Indonesia, using the Beer's Criteria 2019 method. The data were taken retrospectively from the medical records of elderly patients with type 2 DM. during the period January to December 2022. The population in the data study was the use of type 2 DM drugs in elderly patients at the Regional Public Hospital (RSUD) M. Yunus Bengkulu city, Indonesia. Samples were taken from the entire population using the purposive sampling method (Sirajuddin, 2012; Hakim et al, 2023) with inclusion criteria: (a) type 2 DM patients who underwent examinations in the period January to December 2022; (b) Elderly patients aged > 60 years; (c) type 2 DM patients without comorbidities or with comorbidities; (d) complete patient medical record data including age, gender, diagnosis, drug name, dosage form, dose, route of use, total use and frequency of use. In addition, there are also exclusion criteria, namely: (a) the patient's medical record data is incomplete; (b) the patient is forced home/died/referred to another place.

The data collection technique used medical record data obtained from the hospital in the form of demographic data such as age, gender, comorbidities, length of stay and records of drug administration to patients. Then the data were analyzed using (1) descriptive analysis to describe patient demographic data (Otuonye et al, 2021), (2) univariate analysis used to determine the incidence of PIM in elderly patients identified using Beer's criteria 2019 (Demirer Aydemir et al, 2021), and (3) bivariate analysis to determine the relationship between demographic data and incidence PIM in hospital with Fisher's statistic test (Masumoto et al, 2018).

Results and Discussion

Demographic Data of Elderly Patients Type 2

Table 1. Description of Demographic Data of Type 2 DM Elderly Patients treated at Regional Public Hospital (RSUD) M. Yunus Bengkulu City-Indonesia for the period January to December 2022

Patient Demographic Data	N=42	
	RSUD M. Yunus	
	Total	**%**
Age (years)		
60-69	33	78,57%
70-79	7	16,67%
>80	2	4,76%
Gender		
Male	17	40,48%
Female	25	59,52
Comorbidities		
Yes	30	71,43%
None	12	28,57%
Amount of medicine		
< 10	12	28,57%
≥ 10	30	71,43%
Length of stay (days)		
<5	39	92,86%
≥5	3	7,14%

Age

Most of the respondents at RSUD M. Yunus (n=33, 78.57%) were in the 60-69 year age group, 16.67% (n=7) were in the 70-79 year group and 4.76% (n = 2) over 80 years old. The age group above 80 years was the small number of elderly patients with Type 2 DM, namely 2 patients (4.76%). This data shows that the higher the age range, the fewer the number of patients. This condition is also consistent with the description of the percentage of elderly population based on age range according to the Badan Pusat Statistik (BPS). The percentage of population aged over 60 years is 65.56%, 70 years and over is 26.76% and 80 years and over is 7.69%.

Patients in the age group of 60-69 years are the most likely to suffer from Type 2 DM. Because at the age of 65 years the risk of someone getting diabetes mellitus will increase drastically, this is because at that age glucose intolerance begins and at at this age there is a decline and physiological changes and the function of the organs of the body, namely the pancreas organ in producing insulin, causing insulin resistance and insulin production to decrease resulting in instability of blood sugar levels, so diabetes mellitus often appears at a vulnerable age, namely 60-69 years (Isnaini & Ratnasari, 2018).

Gender

Demographic characteristics of elderly patients with Type 2 DM at M. Yunus Regional Public Hospital, Bengkulu City based on gender showed that overall there were 25 female patients (59.52%) compared to male patients, namely 17 patients (40.48%). The drug regimens prescribed for men are different from those for female and this judgmental behavior is not necessarily evidence-based because men's and women's bodies have different responses to the drug therapy given. When gender differences

are ignored, females are more susceptible to the therapy given. Female will be more susceptible to unwanted drug effects. What happens to female, for example, will be more likely to be diagnosed with migraines, depression, insomnia and thyroid problems than male (Rochon et al, 2021). Female generally also have a higher risk than male. Female are more at risk of developing diabetes because physically female have a greater chance of increasing their body mass index (Sukmawati et al, 2016). Post-menopausal monthly cycle syndrome (premenstrual syndrome) which makes it easy for the distribution of body fat to accumulate due to this hormonal process so that female are at risk of developing type 2 diabetes mellitus.

Comorbidities

This study found that most of the elderly patients with Type 2 DM were given medication because of several co-morbidities experienced by the patients. With age, the number of chronic diseases increases, so the number of drugs given also increases in prescriptions along with the likelihood of adverse drug events (Thorell et al, 2020). Based on the results of the research in table 1, it can be seen that elderly patients with Type 2 DM with comorbidities are more than those without comorbidities, Regional Public Hospital (RSUD) M. Yunus showed results of 73.82% (30 patients) with comorbidities and 26.19 % (n = 12 patients) without comorbidities. As a study conducted by WHO in 2002 revealed that the most common diseases suffered by the elderly worldwide are cardiovascular disease, hypertension, diabetes mellitus, stroke, chronic obstructive pulmonary disease (COPD), and musculoskeletal conditions (such as arthritis and osteoporosis). Data from the Ministry of Health in 2013 showed that physiological function decline due to aging causes older people to suffer from more than one disease or multiple pathologies.

Amount of Drug Administration

In a study conducted at Regional Public Hospital (RSUD) M. Yunus, 71.43% (n=30) were given prescriptions with more than 10 types of drugs. Meanwhile, 28.57% (n=12) prescribed less than 10 drugs. Although some patients receive treatment for under 10 types of drugs, there are still many of them prescribed close to 10 types of drugs, such as 8-9 types of drugs prescribed to patients. Which is polypharmacy and is a dangerous thing for elderly patients with Type 2 DM. The results of a study conducted in 2019 found polypharmacy in 400 patients (64.72%) outpatients at the hospital polyclinic (Zulkarnaini et al, 2019). The reason for polypharmacy in geriatric patients is a multipathological chronic disease, drugs are prescribed by several doctors, lack of coordination in managing treatment, the symptoms felt by patients are sometimes unclear, patients often ask for prescriptions, and when administering drugs to eliminate drug side effects, new drugs are actually given.

Length of Hospitalization

The patient's length of stay was for more than 5 days and some for less than 5 days, it can be seen in this study at Regional Public Hospital (RSUD) M. Yunus, elderly patients with Type 2 DM who were treated for less than 5 days were 98.86% (n = 39) and patients treated for more than 5 days 7.14% (n = 3). On average, more patients at the RSUD M. Yunus in Kota Bengkulu were treated for less than 5 days than patients who were treated for more than 5 days.

Analysis of Potentially Inappropriate Medications (PIMs)

Table 2. PIMs in RSUD M. Yunus Bengkulu City, Indonesia

PIMs	N=42	
	RSUD M. Yunus	
	Total	**%**
Yes	39	92,86%%
None	3	7,14^%

The study of Potentially Inappropriate Medications (PIMs) in this study used the Beer's Criteria 2019, which is a method for measuring medication inappropriateness which includes drugs that should be avoided or can be used with special attention in elderly patients aged 60 years and over (Vasani et al, 2015). The incidence of PIMs at RSUD M. Yunus was recorded at 92.86% (n=39).

Table 3. Drugs for Type 2 DM prescribed for hospitalized elderly patients at Regional Public Hospital (RSUD) M. Yunus Bengkulu City, Indonesia

Drug class	RSUD M. Yunus	
	Frequency	%
Insulin, sliding scale (an insulin regimen containing only short-acting or rapid-acting insulin dosed according to current blood glucose levels without concomitant use of basal or long-acting insulin).	1	20
Sulfonylureas		
Glimepiride	4	80
Glibenclamide	-	-
Total	**5**	**100**

According to the 2019 Beer's Criteria, the incidence of PIM in elderly patients with Type 2 DM who were hospitalized at the Regional Public Hospital (RSUD) M. Yunus Hospital Kota Bengkulu was 5 patients. Details of the overall prevalence of PIM use in this study are shown in Table 3. In this study, the use of diabetes drugs included in the Beer's Criteria was still quite high. The use of insulin is related to sliding scale, as much as 20%. In addition to clear guidelines, the use of insulin sliding scales is also commonly practiced. Insulin therapy in elderly with poor glycemic control, HbA1c level > 9% (74.9 mmol/mol), FPG level > 250 mg/dL (13.9 mmol/L), random glucose value > 300 mg/dL or patients With ketonuria, insulin should be administered and is selected as initial therapy. When starting insulin therapy in elderly patients, it is important to have general health status, ability to make insulin, measure blood sugar, understand hypoglycemia, and capacity to treat it (Yakaryılmaz & Öztürk, 2017).

Among the antidiabetic drugs, the most frequently prescribed PIMs are sliding scale insulin, glimepiride and glibenclamide, because these drugs can cause severe prolonged hypoglycemia in the elderly, whereas sliding scale insulin (short or fast acting) is an approved agent for diabetic patients. However, older patients may have a higher risk of hypoglycemia without improving hyperglycemia management (Gagnon et al, 2020). Insulin use based on random blood glucose should be avoided (insulin regimens containing only short-acting or rapid-acting insulin dosed according to current blood glucose levels without concomitant use of basal or long-acting insulin). The findings of this study are in line with a 2020 study which stated that 19.7% of PIM is related to sliding scale insulin based on the 2015 and 2019 Beer's Criteria (Sharma etal, 2020). In this cohort study, 76 patients were administered sliding scale insulin, which not only failed to manage hyperglycemia but also resulted in more incidents of hypoglycemia and increased length of stay (Queale et al, 1997).

The overall incidence of PIMs based on the 2019 Beer's Criteria in this study was 92.86% (39/41) at Regional Public Hospital (RSUD) M. Yunus. Elderly patients who are hospitalized also receive treatment other than providing therapy for Type 2 DM due to congenital diseases suffered by the elderly patients themselves. So that the drugs given can be in large quantities because the patient can have one or even more co-morbidities that he suffers from. This research study found that drugs that fall into: (a) category 1 "drugs that should be avoided in general in elderly patients" based on the 2019 Beer's Criteria, have a number of prescription mismatches of 61.50%; (b) PIMs category 2 "drugs that should be avoided if you have a history of certain diseases" is 2.24%; (c) PIMs category 3 "drugs that can still be given to the elderly but with special attention or caution" is 33.71%; (d) PIMs category 4 “drug interactions that are potentially clinically important because they may worsen the condition of the elderly if administered

should be avoided" were noted not to occur, and (e) PIMs category 5 "drugs to be avoided or reduced in dose with varying degrees of renal function in the elderly" is 7.86%.

Table 4. Medicines categorized into the 2019 Beer's Criteria given to elderly patients with Type 2 DM with comorbidities inpatient at Regional Public Hospital (RSUD) M. Yunus Bengkulu City, Indonesia

Name of Drugs	RSUD M. Yunus	
	Total	%
Category 1		
Omeprazole	29	32,58
Lansoprazole	10	11,24
Ketorolac	6	6,74
Clonidine	3	3,37
Na. Diklofenak	1	1,12
Nifedipin	1	1,12
Meloxicam	-	-
Metoclopramide	-	-
Diazepam	-	-
Alprazolam	-	-
Digoxin	-	-
Category 2		
Asam Mefenamat	1	1,12
Cilostazol	1	1,12
Category i 3		
Furosemide	12	13,48
Aspirin	8	8,99
Spironolactone	6	6,74
Diphenhydramine	2	2,25
Haloperidol	2	2,25
Category 4		
Kortikosteroid + Oral atau Parenteral NSAIDs	-	-
Category 5		
Ranitidin	4	4,49
Tramadol	2	2,25
Gabapentin	1	1,12
Ciprofloxacin	-	-
Total	**89**	**100**

The incidence of drug incompatibility in this study when viewed from categories 1 to 5, shows that category 1 is the largest. It can be seen that the most widely used drug is omeprazole. The reason for the possibility of using omeprazole is greater than ranitidine which has the same function and compared to omeprazole, ranitidine is safer to give when compared to omeprazole. This is possibly because when elderly patients have gastric ulcers, they are more likely to recover when patients receive concomitant treatment with PPIs than ranitidine (Yeomans et al, 2006).

The use of furosemide in this study was also quite high, as shown in table 4. Furosemide is a drug to treat conditions with volume overload and edema secondary to exacerbations of congestive heart failure, liver failure, or kidney failure, including nephrotic syndrome. However, based on the clinical guidelines panel report of the Eighth Joint National Committee (JNC-8) published in 2014 and the American College of Cardiology/American Heart Association (ACC/AHA) Task Force Panel Guidelines

do not recommend the use of loop diuretics as first-line drugs to treat hypertension. Nevertheless, Furosemide may be a second-line agent in symptomatic HF patients and advanced renal disease with an estimated glomerular filtration rate of less than 30 ml per minute; Loop diuretics (furosemide) are preferred over thiazide diuretics for treating hypertension. According to Beer's Criteria, caution is required when administering diuretics to patients aged 65 years and over to avoid the potential side effect of inducing hyponatremia by causing or exacerbating the syndrome of inappropriate antidiuretic hormone secretion (SIADH); therefore, close monitoring of serum sodium is recommended at initiation or during dose adjustments in older adults. In this study, it is possible that furosemide was given as a second-line treatment to patients, even though furosemide is included in Beer's Criteria category 3 where treatment is given with caution.

The use of PIMs in elderly patients with Type 2 DM hospitalized in this study was quite diverse, some patients only used 1 PIMs but some other patients used more than 1 PIMs. Data on the use of PIMs in elderly patients with Type 2 DM hospitalized at Regional Public Hospital (RSUD) M. Yunus can be seen in table 5.

Table 5. Use of PIMs in elderly patients with Type 2 DM hospitalized at Regional Public Hospital (RSUD) M. Yunus Bengkulu City, Indonesia

Use of PIMs per patient	RSUD M. Yunus	
	Number of patients	Percentage (%)
0	3	7,14
1	12	28,57
2	11	26,19
3	10	23,81
4	3	7,14
5	3	7,14

The number of PIMs that occur in elderly patients with Type 2 DM from RSUD M. Yunus ranges from 1-5. Among them, 12 (28.57%) elderly patients with Type 2 DM received at least 1 PIM, while 2 PIM were identified in 11(26.19%) patients, 3 PIM occurred in 10 (23.81%) patients, 4 PIM in 3 (7.14%) patients, 5 PIM in 3 (7.14) elderly patients with Type 2 DM. Drugs listed in the 2019 Beer's Criteria must be administered with caution, if not avoided, because the risk of side effects outweighs the benefits if used in elderly patients (Tesfaye et al, 2021).

Relationship between Patient Demographic Data and PIMs

Relationship between Number of Drugs and Duration of Hospitalization with PIMs

Tabel 6. Results Bivariate analysis of the number of drugs and length of stay on the incidence of PIM in Regional Public Hospital (RSUD) M. Yunus Bengkulu City, Indonesia

Variable	PIMs		*P*
	N	%	
Amount of Drugs			
<10	9	23,08%	0,019
≥10	30	76,92%	
Length of Stay (days)			
<5	36	92,31%	1,000
≥5	3	7,69%	

The use of bivariate analysis between patient demographics and the incidence of PIMs using Fisher's test because there are cells that have an expected value of less than 5 more than 20% of the

number of cells. From table 6, it can be seen that of all patients who used PIMs, 23.08% had the number of drugs <10 types of drugs and 76.92% had the number of drugs ≥10 types of drugs. The results of the bivariate analysis showed that there was a relationship between the number of drugs prescribed and the use of PIMs (p=0.019). The results of this study are in line with previous studies in which the number of drugs prescribed was significantly associated with the use of PIMs (p=0.001). The incidence of PIMs appeared 4.26 times higher in patients who received 10 or more drugs (Viviandhari et al, 2022). Likewise, the results of a study on the effect of the number of drugs prescribed on the risk of PIMs in elderly patients at a hospital in Lahore, Pakistan showed that polypharmacy (5-9 drugs) was associated with the incidence of PIMs with a value of p=0.012. The use of these drugs is highly irrational and significantly associated with polypharmacy. Therefore, caution should be exercised in prescribing the PIM listed in Beer's Criteria for elderly patients (Sarwar, 2018).

Meanwhile, the results of evaluating the relationship between length of stay and the incidence of PIMs (table 6) showed that there was no significant relationship between the length of stay and the incidence of PIMs (p=1,000). The results of this study are in line with research in 2015, in which the study stated that the duration of hospitalization was not significantly affected by the incidence of PIMs (p=0.145) (As et al, 2015). However, these results are not in line with another study conducted in 2019 where it was found that the duration of hospitalization had an effect on the incidence of PIMs (Escrivá Gracia et al, 2019). In the length of stay, the more drugs given during treatment, the greater the possibility of errors and drug interactions that will occur, which will affect the length of patient care in the hospital.

Relationship Between Age, Gender and Comorbid Diseases with PIMs

Table 7. Results of bivariate analysis of the relationship between gender, age, length of stay and comorbidities with PIM at Regional Public Hospital (RSUD) M. Yunus Bengkulu City, Indonesia

Variable	PIMs		*P*
	N	%	
Gender			
Male	17	40,47%	1,000
Female	25	59,52%	
Age *(years)*			
60-69	33	78,57%	0,356
70-79	7	16,66%	
≥80	2	4,76%	
Comorbidities			
Yes	30	71,42%	0,545
None	12	28,57%	

Other results of the variables age, gender and comorbidities from this study showed no significant relationship with the incidence of PIM (p=<0.005). The results of this study are in accordance with other studies that have been conducted on the incidence of DRPs in heart failure treatment of inpatients which stated that gender, age and comorbidities had no effect on the incidence of PIMs (Rufaidah et al, 2015; Julaiha, 2018).

Conclusions

The incidence of PIMs based on the 2019 Beer's Criteria in inpatient geriatric patients with Type 2 DM at Regional Public Hospital (RSUD) M. Yunus in 2022 was 92.86% (39 patients) with a predominance of patient characteristics in the patient age group, namely 60-69 years, female sex and with comorbidities. The class of antidiabetic drugs included in the Beer's Criteria 2019 category are sliding scale insulin (1 event) and glimepiride (4 PIMs events). For other drugs, most are from the PPI group. Of

the several demographic factors studied, significant differences in PIMs were only found in the number of drugs given, but not in other factors such as age, gender, length of stay, and comorbidities. Beer's criteria analysis has an important role for pharmaceutical health workers in preventing drug incompatibility in elderly patients with type 2 DM and other diseases. This criterion can also be useful for doctors and patients to increase awareness in drug selection, reduce drug side effects and serve as a tool to evaluate the quality of care, costs, and patterns of drug use in elderly patients.

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