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EVALUATION OF ANTIDIABETIC DRUG UTILIZATION USING THE ATC/DDD AND DU 90% METHODS AT PUSKESMAS MRICAN

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder that requires long-term pharmacological therapy and continuous monitoring of drug utilization. Evaluation of antidiabetic drug utilization is essential to identify prescribing patterns and support rational drug use in healthcare facilities. This study aimed to evaluate the utilization of antidiabetic drugs among outpatients with type 2 diabetes mellitus at Puskesmas *Mrican using the Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) and Drug Utilization 90% (DU 90%) methods. This study employed a non-experimental observational design with a retrospective descriptive approach using a total sampling technique. The study sample consisted of 330 outpatient prescriptions of patients with type 2 diabetes mellitus during the June–September 2022 period that met the inclusion criteria. Data were analyzed using the ATC/DDD method to calculate DDD/1000 outpatient visits and the DU 90% method to identify the most dominantly utilized drugs. The results showed that the average daily utilization of metformin, glibenclamide, and glimepiride remained within the Defined Daily Dose (DDD) range recommended by the World Health Organization. Glimepiride demonstrated the highest DDD/1000 outpatient visits values, namely 33.33 in June, 32.29 in July, 32.89 in August, and 30.30 in September. DU 90% analysis indicated that glimepiride, metformin, and glibenclamide were included in the DU 90% segment, with glimepiride being the most predominantly utilized antidiabetic drug. This study provides an overview of antidiabetic drug utilization patterns in primary healthcare facilities and may serve as a basis for drug use evaluation to support the quality of pharmaceutical care services.*

Keywords: *Diabetes Mellitus, ATC/DDD, Antidiabetic Drugs, DU 90%.*

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from impaired insulin secretion, impaired insulin action, or a combination of both. This disease has become a major global health concern due to its increasing prevalence and its substantial contribution to morbidity and mortality rates. Diabetes mellitus is categorized as a degenerative disease requiring long-term pharmacological

therapy and continuous therapeutic monitoring to prevent complications (IDF, 2021; Sun et al., 2022). The International Diabetes Federation reported that Southeast Asia ranked second globally in the number of individuals with diabetes, reaching approximately 90 million cases in 2021 (IDF, 2021). In Indonesia, diabetes mellitus continues to represent a major public health concern. According to the International Diabetes Federation (IDF), Indonesia ranked among the countries with the highest number of adults living with diabetes, reaching approximately 19.5 million cases in 2021. Furthermore, the Indonesian Basic Health Research (Riskesdas) reported an increasing prevalence of diabetes mellitus among adults, highlighting the growing burden of the disease at both national and regional levels. In East Java Province, diabetes mellitus remains one of the leading chronic diseases managed in primary healthcare facilities, emphasizing the importance of monitoring antidiabetic drug utilization patterns to support rational prescribing and effective resource allocation (Ceriello et al., 2021; Kemenkes, 2023; Wilcox et al., 2020).

Etiologically, diabetes mellitus is classified into several types, namely type 1 diabetes mellitus, type 2 diabetes mellitus, gestational diabetes mellitus, and other specific types of diabetes. Type 2 diabetes mellitus is the most common form and is generally associated with insulin resistance and impaired insulin secretion (ADA, 2024; Davies et al., 2022). In this condition, the body is still capable of producing insulin; however, reduced tissue sensitivity to insulin results in inadequate glycemic control. Several risk factors, including aging, obesity, unhealthy dietary patterns, physical inactivity, and family history, contribute to the increasing incidence of type 2 diabetes mellitus (Buse et al., 2020; Sun et al., 2022).

The management of type 2 diabetes mellitus aims to control blood glucose levels and prevent long-term complications. The selection of antidiabetic therapy is generally based on glycated hemoglobin (HbA1c) levels. Patients with HbA1c levels below 7% are commonly treated with metformin as first-line therapy (ADA, 2024; Davies et al., 2022; McCreight et al., 2021). When glycemic targets are not achieved within a certain period, combination therapy with sulfonylureas or glinides may be initiated. In patients with more severe hyperglycemia, combination therapy with additional insulin may be considered. Therefore, evaluation of antidiabetic drug utilization is essential to ensure therapeutic rationality and optimize drug use in healthcare facilities (Godman et al., 2020; Khunti et al., 2020).

The World Health Organization has developed the Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) classification system as a standardized method for drug utilization studies (Wettermark et al., 2020; WHOCC, 2023). This system is used to evaluate drug utilization patterns based on therapeutic classification and the average maintenance dose established internationally. The ATC/DDD method can be applied to assess the quantity of drug utilization, compare prescribing patterns, and support the evaluation of rational drug use across healthcare facilities (Holloway & van Dijk, 2021). In addition, the Drug Utilization 90% (DU 90%) method is frequently used alongside the ATC/DDD system to identify the most predominantly utilized drug groups in healthcare services (Bergman et al., 2020; Wettermark et al., 2020).

Puskesmas Mrican, as a primary healthcare facility, plays an important role in the management of chronic diseases, including type 2 diabetes mellitus. The increasing number of patients requiring long-term antidiabetic therapy highlights the need for periodic evaluation of antidiabetic drug utilization to ensure therapeutic effectiveness and rational prescribing practices. However, information regarding antidiabetic drug utilization patterns based on the ATC/DDD method in primary healthcare settings remains limited. Therefore, this study was conducted to evaluate the utilization pattern of antidiabetic drugs among outpatients at *Puskesmas* Mrican using the ATC/DDD and DU 90% methods.

METHODS

This study employed a non-experimental observational design with a retrospective descriptive approach aimed at evaluating the utilization pattern of antidiabetic drugs using the Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) and Drug Utilization 90% (DU 90%) methods. The study was conducted at *Puskesmas* Mrican from March to April 2023 using outpatient prescription data from June to September 2022.

The study population consisted of all outpatient prescriptions of patients diagnosed with type 2 diabetes mellitus who received antidiabetic therapy during the study period. A total sampling technique was applied, in which all prescriptions meeting the inclusion criteria were included in the study sample. The inclusion criteria comprised outpatient prescriptions of patients with type 2 diabetes mellitus containing oral antidiabetic drugs and complete, legible data. The exclusion criteria included incomplete prescriptions, duplicate prescriptions, and prescriptions

for patients receiving insulin monotherapy. Based on these criteria, a total of 330 outpatient prescriptions were included in the study.

The data were obtained from archived outpatient prescriptions of patients with type 2 diabetes mellitus at the pharmacy installation of *Puskesmas* Mrican. The observed variables included patient characteristics based on age and gender, types of antidiabetic drugs prescribed, quantity of drug utilization, Defined Daily Dose (DDD) values, DDD/1000 outpatient visits, and the Drug Utilization 90% (DU 90%) segment. Drug classification and standard DDD values were based on the ATC/DDD system established by the World Health Organization.

Drug utilization analysis was performed using the ATC/DDD method. Defined Daily Dose (DDD) is defined as the assumed average maintenance dose per day for a drug used for its primary indication in adults according to WHO standards. Drug utilization was expressed as DDD/1000 outpatient visits using the following formula:

$$DDD/1000 = \frac{Monthly\ prescribing\ number\ x\ 1000}{WHO\ DDD\ index\ x\ population\ x\ 30\ days}$$

The percentage of drug utilization in the DU 90% method was calculated using the following formula:

$$DU\ 90\% = \frac{DDD\ value/Antidiabetes}{Total\ DDD\ value/Antidiabetes}\ x100\%$$

DU 90% analysis was performed by ranking drugs based on the highest percentage of utilization until reaching a cumulative total of 90% of overall drug utilization. This method was used to identify the most predominantly utilized drug groups in the treatment of type 2 diabetes mellitus.

The data were analyzed descriptively and presented in the form of tables, percentages, DDD values, DDD/1000 outpatient visits, and DU 90% segments. This study utilized secondary data, and all patient identities were kept confidential throughout the research process.

Permission to conduct the study and access prescription records was obtained from the management of *Puskesmas* Mrican prior to data collection. The study utilized retrospective secondary data without direct patient involvement. All patient identifiers were removed, and data confidentiality was maintained throughout the study.

RESULTS AND DISCUSSION

A total of 330 ambulatory prescriptions of patients with type 2 diabetes mellitus that met the inclusion criteria were analyzed in this study. Based on gender characteristics, female patients predominated, accounting for 261 patients (79.1%), while male patients accounted for 69 patients (20.9%). The predominance of

female patients in this study suggests that women may have a higher tendency to develop type 2 diabetes mellitus compared to men. This condition may be influenced by several factors, including hormonal changes, increased body mass index, and higher body fat composition in women, which contribute to insulin resistance. In addition, decreased physical activity and metabolic changes during adulthood and older age may further increase the risk of type 2 diabetes mellitus among women (Kautzky-Willer et al., 2023; Tramunt et al., 2020).

Based on age groups, the majority of patients were within the 56–65 years age range, comprising 184 patients (55.76%), followed by the 46–55 years age group with 125 patients (37.88%) and the 36–45 years age group with 21 patients (6.36%). These findings indicate that the incidence of type 2 diabetes mellitus tends to increase with advancing age. Aging is known to contribute to decreased insulin sensitivity and impaired pancreatic beta-cell function, resulting in reduced ability to maintain glucose homeostasis. These findings are consistent with previous studies reporting that the prevalence of type 2 diabetes mellitus is more commonly observed among older adults due to physiological and metabolic changes associated with the aging process (Bellary et al., 2021; Sinclair et al., 2020). The demographic characteristics of patients with type 2 diabetes mellitus included in this study are presented in Table 1.

Table 1. Patient Characteristics

Patient Characteristics Criteria	Number	Percentage (%)
Gender		
Male	69	20.9
Female	261	79.1
Age (years)		
(36-45)	21	6.36
(46-55)	125	37.88
(56-65)	184	55.76

The evaluation of antidiabetic drug utilization was conducted using the Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) method. This method is widely used to quantitatively evaluate drug utilization patterns and compare drug use across healthcare facilities (Bergman et al., 2020; Wettermark et al., 2020). Based on the study findings, the average daily utilization of antidiabetic drugs during the June–September 2022 period remained within the Defined Daily Dose (DDD) range established by the World Health Organization. The average daily utilization of metformin was 1.31 g/day, glibenclamide was 0.01 g/day, and glimepiride was 0.002 g/day. These findings indicate that the utilization of antidiabetic drugs at *Puskesmas* Mrican remained within the average maintenance dose range recommended by WHO. The average daily utilization of antidiabetic

drugs and the corresponding WHO DDD index values during the June–September 2022 period are presented in Table 2.

Table 2. Antidiabetic Drug Utilization from June to September

Antidiabetic Drugs	WHO DDD Index (g)	Average Daily Utilization (g)
Metformin	2	1.31
Glibenclamide	0.01	0.01
Glimepiride	0.002	0.002

Further analysis using the DDD/1000 outpatient visits indicator demonstrated that glimepiride was the antidiabetic drug with the highest utilization rate during the study period. The DDD/1000 outpatient visits values for glimepiride in June, July, August, and September were 33.33, 32.29, 32.89, and 30.30, respectively. Meanwhile, metformin showed DDD/1000 outpatient visits values of 21.00, 21.82, 22.03, and 22.27, whereas glibenclamide exhibited the lowest utilization values of 17.52, 18.18, 16.67, and 16.67, respectively.

It is important to note that the Defined Daily Dose (DDD) is a technical unit developed by the World Health Organization for standardizing drug utilization measurements and facilitating comparisons across healthcare settings. DDD values do not necessarily reflect the prescribed daily dose for individual patients and should not be interpreted as direct indicators of therapeutic appropriateness, clinical effectiveness, or prescribing rationality. Therefore, the findings of this study should be interpreted as an overview of utilization patterns rather than an assessment of the quality of individual patient treatment.

The high utilization of glimepiride indicates that sulfonylureas remain one of the primary therapeutic options for type 2 diabetes mellitus management in primary healthcare settings. Glimepiride is a second-generation sulfonylurea with good efficacy in lowering blood glucose levels and a relatively lower risk of hypoglycemia compared to glibenclamide. In addition, glimepiride has a more stable duration of action and a better safety profile, making it more widely used in clinical practice (Kalra et al., 2020; Sola et al., 2021). The high utilization of glimepiride observed in this study may also be influenced by its availability in the healthcare facility formulary and its relatively affordable treatment cost.

Although metformin is widely recommended as the first-line pharmacological therapy for patients with type 2 diabetes mellitus, the higher utilization of glimepiride observed in this study may be influenced by several factors. First, the majority of patients included in this study were aged 56–65 years, suggesting that many patients may have been receiving long-term antidiabetic

treatment prior to the study period. In such cases, glimepiride may have been continued as part of an established therapeutic regimen. Second, glimepiride is commonly prescribed as an add-on therapy when glycemic targets are not adequately achieved with metformin monotherapy. Third, local prescribing practices, drug availability within the healthcare facility formulary, and cost considerations may also contribute to the higher utilization of glimepiride. Furthermore, glimepiride remains widely used in primary healthcare settings because of its proven effectiveness, convenient once-daily dosing, and relatively favorable safety profile compared with older sulfonylureas. However, because this study did not evaluate patients' clinical characteristics, duration of therapy, glycemic control status, or treatment indications, these explanations should be interpreted with caution and require further investigation.

The findings of this study are consistent with several previous studies reporting that sulfonylureas are among the most frequently utilized oral antidiabetic drug classes in primary healthcare facilities. The high utilization of sulfonylureas is generally associated with their therapeutic effectiveness, ease of administration, and broader accessibility compared to newer antidiabetic agents (Wilcox et al., 2020). Nevertheless, the selection of antidiabetic therapy should still consider the patient's clinical condition, risk of adverse effects, comorbidities, and individualized glycemic targets.

Metformin was identified as the second most frequently utilized antidiabetic drug in this study. According to various type 2 diabetes mellitus treatment guidelines, metformin is recommended as first-line therapy, particularly for patients with insulin resistance and obesity. The widespread utilization of metformin is attributed to its effectiveness in lowering blood glucose levels without significantly increasing the risk of hypoglycemia. Furthermore, metformin is relatively more affordable compared to several other antidiabetic agents, making it a preferred initial therapy in primary healthcare settings (Davies et al., 2022; McCreight et al., 2021).

In contrast, glibenclamide demonstrated the lowest utilization rate among the antidiabetic drugs evaluated. The lower utilization of glibenclamide may be associated with its higher risk of hypoglycemia, particularly in elderly patients. In clinical practice, the use of glibenclamide has gradually declined and tends to be replaced by newer-generation sulfonylureas with better safety profiles, such as glimepiride. This finding suggests a

shift in antidiabetic drug utilization patterns toward agents with improved effectiveness and safety (Schernthaner et al., 2020).

The results of the Drug Utilization 90% (DU 90%) analysis showed that glimepiride, metformin, and glibenclamide were included in the DU 90% segment. Glimepiride demonstrated the highest utilization percentages, accounting for 46.39% in June, 44.67% in July, 45.95% in August, and 43.77% in September. Detailed information regarding actual DDD values, DDD/1000 outpatient visits, percentage of drug utilization, and DU 90% segments for each antidiabetic drug is presented in Table 3.

Table 3. DDD Values of Antidiabetic Drugs and DU 90%

Indicator	Metformin	Glibenclamide	Glimepiride
June			
Actual DDD (g)	992.5	2.15	0.828
DDD (g)	496.25	215	414
KPRJ	79	39	37
DDD/1000 KPRJ	21.00	17.52	33.33
Percentage	29.23%	24.38%	46.39%
DU 90%	46.39%	75.62%	100%
July			
Actual DDD (g)	724	1.15	0.74
DDD (g)	0.362	0.115	0.370
KPRJ	53	22	32
DDD/1000 KPRJ	21.82	18.18	32.29
Percentage	30.19%	25.15%	44.67%
DU 90%	44.67%	74.85%	100%
August			
Actual DDD (g)	760	1.3	0.7
DDD (g)	0.38	0.13	0.385
KPRJ	59	26	33
DDD/1000 KPRJ	22.03	16.67	32.89
Percentage	30.78%	23.28%	45.95%
DU 90%	45.95%	76.72%	100%
September			
Actual DDD (g)	989.5	0.975	0.66
DDD (g)	0.49	0.10	0.33
KPRJ	69	19	33
DDD/1000 KPRJ	22.27	16.67	30.30
Percentage	32.16%	24.07%	43.77%
DU 90%	43.77%	75.93%	100%

The Drug Utilization 90% (DU 90%) method is used to identify the most predominantly utilized drug groups in healthcare services. DU 90% evaluation provides an overview of prescribing patterns and may assist in controlling drug utilization as well as planning pharmaceutical procurement (Bergman et al., 2020).

The fewer the number of drug types included in the DU 90% segment, the more focused and controlled the prescribing

pattern may be considered (Pillai et al., 2021; Raschetti et al., 2020). In this study, only three antidiabetic drugs were included in the DU 90% segment, namely glimepiride, metformin, and glibenclamide. These findings indicate that the pattern of antidiabetic drug utilization at *Puskesmas* Mrican was relatively focused on the drugs most frequently prescribed for the management of type 2 diabetes mellitus. This condition may support more efficient drug management and facilitate pharmaceutical procurement processes in primary healthcare facilities (Erku et al., 2021).

In addition, the utilization pattern observed in this study reflects the tendency of clinicians to prioritize antidiabetic agents with established clinical effectiveness, acceptable safety profiles, and affordable treatment costs (Cosentino et al., 2020). The application of the ATC/DDD and DU 90% methods in this study provides important information regarding prescribing trends and may serve as a basis for evaluating rational drug utilization and improving the quality of pharmaceutical care services for patients with type 2 diabetes mellitus.

Nevertheless, this study has several limitations. The study was conducted retrospectively using prescription data and therefore could not evaluate clinical outcomes such as HbA1c levels, therapeutic success, or medication adherence. Furthermore, the study was conducted in only one healthcare facility, limiting the generalizability of the findings. Despite these limitations, this study provides valuable information regarding antidiabetic drug utilization patterns based on the ATC/DDD and DU 90% methods, which may serve as a basis for drug utilization evaluation and the improvement of pharmaceutical care quality in primary healthcare settings.

CONCLUSION

ATC/DDD analysis demonstrated that glimepiride had the highest utilization rate among antidiabetic drugs prescribed for outpatients with type 2 diabetes mellitus at *Puskesmas* Mrican. DU 90% analysis showed that glimepiride, metformin, and glibenclamide constituted the DU 90% segment, with glimepiride being the predominant antidiabetic drug. These findings provide baseline information on antidiabetic drug utilization patterns and may support future drug utilization evaluations in primary healthcare settings.

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