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Analysis of Drug Related Problems (DRPs) Adult Patients with Type 2 Diabetes Mellitus at Dr. Moewardi Hospital Surakarta

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ABSTRACT: Drug Related Problems are drug therapy–related issues that may negatively affect clinical and economic outcomes. Patients with type 2 diabetes mellitus are particularly at risk due to chronic disease management and frequent use of multiple medications. This study aimed to identify potential DRPs in adult outpatient type 2 diabetes mellitus patients at Dr. Moewardi Hospital, Surakarta. This observational descriptive study employed a cross-sectional design. Medical record data of adult outpatient type 2 diabetes mellitus patients treated during 2024 were retrospectively reviewed. Data extraction was conducted in February–March 2025. Patients were selected using purposive sampling based on inclusion and exclusion criteria. Potential DRPs were identified and classified according to the Pharmaceutical Care Network Europe Classification version 9.1. Among 100 medical records reviewed, 8 patients (8.0%) experienced potential DRPs, with a total of 28 cases consisting of 2 problem domains (P) and 6 cause domains (C). The most frequent problems were non-optimal drug treatment effects (P1.2) (21.4%) and possible adverse drug events (P2.1) (7.1%). The most common causes included inappropriate drug selection not in accordance with guidelines or formularies (C1.1) (25.0%) and subtherapeutic dosing (C3.1) (21.4%). Although the proportion of patients with potential drug related problems was relatively low, clinically relevant issues related to drug selection and dosing were identified. These findings highlight the important role of pharmacists in routine medication review and optimization of pharmacotherapy to prevent DRPs in outpatient type 2 diabetes mellitus management.

Keywords: adult; analysis; drug related problems; pharmaceutical care network europe; type 2 diabetes mellitus

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INTRODUCTION

Drug Related Problems (DRPs) are conditions arising from drug therapy that can negatively affect patients' clinical outcomes, quality of life, and lead to economic and social burdens (Rusdianah et al., 2024). DRPs frequently occur in patients with chronic diseases that require long-term treatment and involve the use of multiple medications (polypharmacy), one of which is diabetes mellitus. Diabetes mellitus is a metabolic disorder characterized by hyperglycemia, with type 2 diabetes mellitus (T2DM) accounting for more than 90% of cases globally (Jihadi et al., 2023; PERKENI, 2021). In Indonesia, the prevalence of diabetes continues to increase, from 1.5% in 2013 to 2.0% in 2018, with Central Java reporting a prevalence of 2.1% (Riskesdas, 2018).

Patients with T2DM are at risk of developing chronic complications such as cardiovascular disease and kidney failure, conditions that often require complex pharmacotherapy and further increase the risk of DRPs (Adiana & Maulina, 2022; Hardianto, 2021). The complexity of pharmacological management in T2DM, particularly in the presence of comorbidities and polypharmacy, contributes to the occurrence of DRPs throughout the medication-use process, from prescribing to drug administration. Common contributing factors include inappropriate drug selection, incorrect dosing, and low patient adherence to therapy (Huong et al., 2023). If not detected early, DRPs may reduce treatment effectiveness and increase the risk of adverse outcomes. Several studies in Indonesia have evaluated DRPs in patients with T2DM; however, most focused on inpatient settings or used earlier classification methods, resulting in limited information on DRPs among outpatient populations. In addition, variations in classification approaches may affect the comparability and comprehensiveness of DRP identification. Therefore, evidence regarding the prevalence, types, and causes of DRPs in outpatient T2DM patients using an updated and standardized classification system remains limited.

The Pharmaceutical Care Network Europe (PCNE) Classification version 9.1 provides a more systematic and comprehensive framework for identifying and classifying DRPs by clearly distinguishing problem and cause domains. This method is particularly suitable for outpatient T2DM patients, as it enables detailed analysis of therapy-related problems associated with long-term treatment and polypharmacy. Compared with earlier approaches, such as the Cipolle method used by Indrawan & Yulianti (2024), PCNE v9.1 allows a more structured assessment of DRPs across multiple domains. Based on these considerations, this study aims to assess the prevalence, types, and causes of Drug Related Problems among adult outpatient T2DM patients at Dr. Moewardi Hospital, Surakarta, during 2024 using the PCNE Classification version 9.1. The findings are expected to provide contextual evidence to support the role of clinical pharmacists in improving pharmacotherapy management and preventing DRPs in outpatient diabetes care.

METHODS

This study was an observational descriptive study with a retrospective cross-sectional design. The research utilized secondary data obtained from medical records of adult outpatient patients diagnosed with type 2 diabetes mellitus (T2DM) who received treatment at Dr. Moewardi Hospital, Surakarta, during the period of January 1st to December 31, 2024. Data extraction from medical records was conducted retrospectively in February–March 2025 at the Medical Record and Health Information Installation (IRMIK) of Dr. Moewardi Hospital. The study population consisted of adult outpatient

T2DM patients treated during the 2024 period. Samples were selected using purposive sampling based on predefined inclusion and exclusion criteria.

A total of 100 medical records that met the criteria were included in the analysis. Inclusion criteria comprised adult patients (≥18 years) diagnosed with T2DM, receiving outpatient pharmacotherapy, having complete medical records, and undergoing treatment for at least three months. Medical records with incomplete data or unclear medication information were excluded. Data extracted from medical records included patient characteristics (age and sex), clinical data (comorbidities), laboratory parameters (fasting blood glucose, random blood glucose, and HbA1c when available), and medication-related variables such as the number and type of antidiabetic drugs, concomitant medications, dosage, route of administration, and frequency of use. Drug Related Problems were identified as potential DRPs, defined as conditions that may lead to negative clinical outcomes if not addressed, based on discrepancies between prescribed therapy and clinical guidelines or standard references.

DRPs were classified according to the Pharmaceutical Care Network Europe (PCNE) Classification version 9.1. The analysis focused on problem domains including non-optimal drug treatment effect (P1.2) and possible adverse drug events (P2.1), as well as cause domains such as inappropriate drug selection (C1.1), subtherapeutic dose (C3.1), overdose (C3.2), inappropriate timing of administration (C6.1), incorrect frequency of administration (C6.2), and incorrect route of administration (C6.6). Other PCNE domains, such as adherence and monitoring, were not assessed due to limited documentation in retrospective medical records. The identification and classification of DRPs were performed by the researcher using a structured data collection sheet developed in Microsoft Excel, based on treatment guidelines and PCNE v9.1 criteria. Descriptive statistical analysis was conducted to summarize patient characteristics and DRP profiles. Data were analyzed using Microsoft Excel and presented in the form of frequencies and percentages. This study was approved by the Health Research Ethics Committee of Dr. Moewardi Hospital, Surakarta (Ethical Approval No. 211/1/HREC/2025). Patient confidentiality was maintained by anonymizing all personal identifiers. Potential biases related to missing or incomplete data inherent in retrospective studies were minimized by applying strict inclusion criteria and excluding records with insufficient information.

RESULT AND DISCUSSION

Most patients were in the late adulthood age group (36–45 years), accounting for 77 patients (77.0%) shown in table 1. Male patients constituted a slightly higher proportion than females, with 54 patients (54.0%). Regarding comorbidities, the majority of patients had no documented comorbid conditions (70.0%), while hypertension (14.0%) and dyslipidemia (16.0%) were the most commonly observed comorbidities among the study population. Information on the duration of diabetes mellitus and the number of medications per patient was not consistently documented in the medical records and therefore could not be analyzed in this study.

Oral monotherapy was the most frequently prescribed treatment pattern, accounting for 59.0% of outpatient type 2 diabetes mellitus patients, with metformin as the dominant agent shown in table 2. Combination therapy of two oral antidiabetic drugs was used in 25.0% of patients. Insulin-based regimens were less common, including oral–insulin combinations (10.0%), insulin monotherapy (4.0%), and combinations of two types of insulin (2.0%).

Table 1. Frequency distribution of patient profiles

No.	Characteristic	Frequency (f)	Percentage (%)
1.	**Age**		
	Early Adult (26-35 years)	23	23,0
	Late Adult (36-45 years)	77	77,0
2.	**Gender**		
	Man	54	54,0
	Woman	46	46,0
3.	**Comorbidities**		
	No Comorbidities	70	70,0
	Hypertension	14	14,0
	Dyslipidemia.	16	16,0

Table 2. Distribution of treatment pattern frequency by type of therapy

No.	Categories Types of Therapy	Frequency (f)	Percentage (%)
1.	**Oral Monotherapy**	**59**	**59,0**
	Acarbose	6	6,0
	Glimepiride	3	3,0
	Metformin	50	50,0
2.	**Combination of two OHO**	**25**	**25,0**
	Metformin + Acarbose	11	11,0
	Metformin + Glimepiride	14	14,0
3.	**Insulin Monotherapy**	**4**	**4,0**
	Insulin Aspart	1	1,0
	Insulin NPH	3	3,0
4.	**Combination of two Insulins**	**2**	**2,0**
	Insulin Aspart + Insulin NPH	2	2,0
5.	**Oral + Insulin Combination**	**10**	**10,0**
	Acarbose + Insulin Aspart	1	1,0
	Metformin + Insulin Aspart	3	3,0
	Metformin + Insulin NPH	6	6,0

Metformin was the most frequently prescribed antidiabetic drug (61.3%), followed by acarbose (13.1%) and glimepiride (12.4%). Insulin therapy was less commonly prescribed, with NPH insulin accounting for 8.0% and insulin aspart for 5.1% shown in table 3. Among antihypertensive medications, amlodipine was predominantly used (78.6%), while lisinopril accounted for 21.4%. In patients receiving lipid-lowering therapy, simvastatin was more frequently prescribed (66.7%) than atorvastatin (33.3%).

Table 3. Frequency distribution of prescribed medications

No.	Drug Categories	Frequency (f)	Percentage (%)
1.	**Antidiabetics**		
	Acarbose	18	13,1
	Glimepiride	17	12,4
	Insulin Aspart	7	5,1
	Insulin NPH	11	8,0
	Metformin	84	61,3
2.	**Antihypertensive**		
	Amlodipine	11	78,6
	Lisinopril	3	21,4
3.	**Anti-dyslipidemia**		
	Atorvastatin	5	33,3
	Simvastatin	10	66,7

Drug Related Problems (DRPs) were identified in 8 out of 100 outpatient type 2 diabetes mellitus patients (8.0%), while 92 patients (92.0%) did not experience potential DRPs during the study period shown in table 4.

Table 4. Distribution of DRPs incidence frequency in outpatient type 2 DM patients

DRPs Incident Categories	Frequency (f)	Percentage (%)
None	92	92,0
Exist	8	8,0
Total	**100**	**100**

Classification of DRPs classification results in 8 Type 2 DM patients with comorbidities shown in table 5.

Table 5. Classification of DRPs in type 2 DM patients with comorbidities

No.	Patient Name	Comorbidities	Prescription Drugs	DRPs Code
1.	Mrs. Y (45 years old) Height: 160 cm; Weight: 68 kg RBS: 210 mg/dL; HbA1c: 8.7%; BP: 150/90 mmHg; Cholesterol: 210 mmHg	Hypertension	Glimepiride (2 mg, 1x daily) + amlodipine (10 mg, 1x daily)	P1.2; C1.1; C3.1; C6.2
2.	Mrs. S (40 years old) Height: 158 cm; Weight: 65 kg RBS: 265 mg/dL; HbA1c: 9.3%; BP: 130/80 mmHg; Cholesterol: 245 mmHg	Dyslipidemia.	Metformin (500 mg, 2x daily) + Simvastatin (20 mg, 1x night)	P1.2; C1.1; C3.1
3.	Mrs. D (36 years old) Height: 155 cm; Weight: 60 kg; RBS: 234 mg/dL; HbA1c: 9.0%; BP: 148/92 mmHg; Cholesterol: 225 mmHg	Hypertension	Metformin (500 mg, 2x daily) + Amlodipine (5 mg, 1x daily)	P1.2; C1.1; C3.1
4.	Mrs. U (36 years old) Height: 159 cm; Weight: 72 kg; RBS: 258 mg/dL; HbA1c: 9.5%; BP: 128/78 mmHg; Cholesterol: 250 mmHg	Dyslipidemia.	Glimepiride (2 mg, 1x daily) + Simvastatin (20 mg, 1x daily)	P1.2; C1.1; C3.1; C6.1
5.	Mrs. J (44 years old) Height: 162 cm; Weight: 70 kg; RBS: 288 mg/dL; HbA1c: 10.1%; BP: 132/84 mmHg; Cholesterol: 268 mmHg	Dyslipidemia.	Acarbose (50 mg, 3x daily) + Simvastatin (20 mg, 1x night)	P1.2; C1.1; C3.1; C6.2
6.	Mr. D (35 years old) Height: 168 cm; Weight: 77 kg; RBS: 295 mg/dL; HbA1c: 10.4%; BP: 134/86 mmHg; Cholesterol: 270 mmHg	Dyslipidemia.	Acarbose (100 mg, 3x daily) + Simvastatin (20 mg, 1x night)	P2.1; C1.1; C3.1; C6.1
7.	Mr. R (38 years old) Height: 172 cm; Weight: 76 kg; RBS: 240 mg/dL; HbA1c: 8.9%; BP: 145/95 mmHg; Cholesterol: 218 mmHg	Hypertension	Glimepiride (2 mg, 1x daily) + Amlodipine (10 mg, 1x daily)	P1.2; C1.1; C6.1
8.	Mr. S (45 years old) Height: 170 cm; Weight: 80 kg; RBS: 245 mg/dL; HbA1c: 9.8%; BP: 135/85 mmHg; Cholesterol: 260 mmHg	Dyslipidemia.	Metformin (500 mg, 2x daily) + Simvastatin (40 mg, 1x daily)	P2.1; C3.2; C6.6
	Total	**8**	**16**	**28**

* RBS (Randome Blood Sugar); BP (Blood Pressure)

The following findings were obtained Mrs. Y, 45 years old with comorbid hypertension received glimepiride and amlodipine therapy. The DRPs found were P1.2 (non-optimal therapeutic effect) with C1.1, C3.1, and C6.2 causes. Mrs. S, 40 years old with comorbid dyslipidemia received metformin and simvastatin therapy. DRPs P1.2 with C1.1 and C3.1 causes were found. Mrs. D, 36 years old with comorbid hypertension obtained

metformin and amlodipine. The DRPs that appear are P1.2 with C1.1 and C3.1 causes. Mrs. U, 36 years old with dyslipidemia, received glimepiride and simvastatin therapy. DRPs P1.2 were found with causes C1.1, C3.1, and C6.1. Mrs. J, 44 years old with dyslipidemia underwent acarbose and simvastatin therapy. The DRPs that occur are P1.2 with causes C1.1, C3.1, and C6.2. Mr. D, 35 years old with dyslipidemia obtained acarbose and simvastatin. The DRPs found were P2.1 with causes C1.1, C3.1, and C6.1. Mr. R, 38 years old with comorbidities of hypertension underwent glimepiride and amlodipine therapy. The DRPs found were P1.2 with C1.1 and C6.1 causes. Mr. S, 45 years old with dyslipidemia obtained metformin and simvastatin. DRPs of the P2.1 category were found with C3.2 and C6.6 causes.

A total of 28 potential DRP cases were identified among outpatient type 2 diabetes mellitus patients, consisting of 2 problem domains (P) and 6 cause domains (C) according to PCNE V9.1 classification shown in table 6. The most frequently identified problem was non-optimal drug treatment effect (P1.2), accounting for 6 cases (21.4%), followed by possible adverse drug events (P2.1) with 2 cases (7.1%). Regarding DRP causes, the most common cause was medication not in accordance with treatment guidelines or formularies (C1.1), accounting for 7 cases (25.0%), followed by subtherapeutic dosing (C3.1) with 6 cases (21.4%). Other identified causes included improper timing of drug administration (C6.1), drug administration less than prescribed (C6.2), overdose (C3.2), and incorrect route of administration (C6.6). All percentages presented in table 6 were calculated based on the total number of identified DRP cases (n = 28).

Table 6. Frequency distribution of DRPs types in DMT2 patients based on PCNE V9.1

No.	Types of *DRPs*	Code V9.1	Frequency (f)	Percentage (%)
1.	The effect of drug treatment is not optimal	P1.2	6	21,4
2.	Adverse drug events incidence	P2.1	2	7,1
3.	Medication not according to guidelines/formulas	C1.1	7	25,0
4.	Too low dosage	C3.1	6	21,4
5.	Too high a dose	C3.2	1	3,6
6.	Improper timing of drug use	C6.1	3	10,7
7.	Giving less than the rules of use	C6.2	2	7,1
8.	Delivered through the wrong path	C6.6	1	3,6
	Total		**28**	**100**

Patient Profile

Age

The predominance of patients aged 36–45 years (77.0%) in this study reflects the productive-age population commonly affected by type 2 diabetes mellitus (T2DM) in outpatient settings. This age distribution is consistent with previous Indonesian studies, which also reported higher T2DM prevalence and clinic attendance among adults in middle age, although local referral patterns may have influenced the concentration of patients in this group. The high proportion of patients in a single age group may introduce potential selection bias, which should be considered when interpreting the findings. Middle adulthood is a period characterized by physiological changes, including decreased pancreatic function and reduced insulin sensitivity, often exacerbated by lifestyle factors such as diet and physical inactivity (Fitriani & Handayani, 2019). These changes contribute to increased susceptibility to chronic conditions and the need for multiple medications, which in turn may elevate the risk of Drug Related Problems (DRPs) (Yimama et al., 2018).

In this study, although most patients did not present with documented comorbidities, a subset with hypertension or dyslipidemia faced more complex pharmacotherapy, potentially increasing DRP risk. The identified DRPs in this study, including inappropriate drug selection and dosing errors, may be partly explained by age-related pharmacokinetic and pharmacodynamic changes. The absence of data on diabetes duration and number of medications per patient represents a limitation of this retrospective study, as these variables are known to influence DRP occurrence. Incomplete documentation in medical records restricted further analysis, which has been acknowledged in both the Methods and Discussion sections.

Gender

In this study, the majority of outpatient type 2 diabetes mellitus (T2DM) patients were men (54.0%), while women accounted for 46.0%. These results describe the observed gender distribution in the study population rather than indicating inherent susceptibility to T2DM. The slightly higher proportion of men may reflect patterns of healthcare utilization, referral, or local population characteristics. Previous studies in Indonesia have reported similar trends, with men attending outpatient clinics for T2DM more frequently than women (Suwandi et al., 2017; Yimama et al., 2018). Gender differences may also influence medication adherence and the risk of Drug Related Problems (DRPs), but this study did not assess statistical significance between genders due to the descriptive design. Nevertheless, these findings highlight the potential importance of considering gender when planning therapy and providing patient education to optimize adherence and reduce DRP risk.

Comorbidities

In this study, most outpatient type 2 diabetes mellitus (T2DM) patients did not have documented comorbidities (70.0%), while 14.0% had hypertension and 16.0% had dyslipidemia (Dewi & Wulandari,2019). Comorbidities were identified through retrospective review of medical records, including documented diagnoses, laboratory results, and treatment profiles. The absence of certain comorbidities may reflect either true clinical status or limitations in record completeness. The presence of comorbidities such as hypertension and dyslipidemia can complicate pharmacotherapy by increasing the number of medications required, thereby raising the risk of Drug Related Problems (DRPs). Hypertension is a known risk factor for macrovascular and microvascular complications in T2DM, partly mediated by insulin resistance, which promotes sodium retention and vascular changes (Maimanah et al., 2020; Aisyah & Urfiyya, 2023). Patients with comorbidities are also more prone to polypharmacy, increasing the likelihood of drug interactions, inappropriate dosing, and adverse events (Sharma et al., 2023). These findings highlight the importance of careful monitoring and individualized therapy in T2DM patients with comorbidities to minimize DRPs and optimize treatment outcomes.

Most Commonly Used Treatment Patterns

Types of therapy

In this study, the majority of outpatient type 2 diabetes mellitus (T2DM) patients received oral monotherapy (59.0%), predominantly metformin (50.0%), while smaller proportions received acarbose or glimepiride. Combination therapy of two oral hypoglycemic agents was administered to 25.0% of patients, insulin monotherapy to 4.0%, two-insulin combinations to 2.0%, and oral plus insulin combinations to 10.0%. These therapy patterns largely reflect guideline recommendations for individualized treatment based on clinical factors such as age, HbA1c levels, body mass index, and comorbidities (ADA, 2023; PERKENI, 2021; Davies et al., 2018, 2022).

Linking these patterns to Drug Related Problems (DRPs), oral monotherapy with metformin, being generally safe and widely tolerated, may have contributed to the relatively low prevalence of DRPs (8.0%) in this population. However, combination therapies, particularly those involving multiple oral agents or insulin, may increase complexity in dosing and administration schedules, thereby elevating the potential for DRPs such as subtherapeutic or excessive dosing, incorrect timing, and administration errors. For example, patients receiving oral plus insulin combinations require careful monitoring to prevent hypoglycemia and ensure adherence, which highlights the importance of pharmacist-led medication review. Overall, the observed therapy patterns demonstrate the application of individualized treatment principles in routine outpatient care. At the same time, they underscore the need for continuous evaluation of DRPs, especially in patients receiving complex regimens, to optimize safety and therapeutic outcomes.

Types of antidiabetic drugs

In this study, metformin was the most frequently prescribed antidiabetic drug (61.3%), followed by acarbose (13.1%), glimepiride (12.4%), NPH insulin (8.0%), and insulin aspart (5.1%). The predominant use of metformin aligns with guideline recommendations (ADA, 2023; PERKENI, 2021). In the context of DRPs, metformin's safety profile, including a low risk of hypoglycemia, may contribute to the relatively low prevalence of DRPs observed in this population (8.0%). Acarbose and glimepiride, although less commonly used, require careful attention to dosing and timing, as improper administration can increase the risk of gastrointestinal side effects or hypoglycemia, respectively. Insulin therapy, particularly basal-bolus regimens combining NPH and aspart insulin, adds complexity to treatment, increasing the potential for DRPs such as incorrect timing, dose errors, or adherence issues. Overall, the observed drug utilization pattern demonstrates an individualized therapeutic approach tailored to patient characteristics. Monitoring and pharmacist intervention remain essential, especially for patients on combination therapy or insulin, to optimize therapeutic outcomes and minimize DRP risk.

The second most common drug is acarbose (13.1%), which inhibits the enzyme alpha-glucosidase and functions to reduce postprandial glucose spikes. Its use is quite common in the Asian population, including Indonesia, due to the consumption pattern of high-carbohydrate foods (Khunti et al., 2018). The combination of metformin and acarbose is an effective therapeutic option, especially for patients who have not yet reached their glycemic target with metformin alone. In addition, there is also glimepiride, which belongs to the second-generation sulfonylurea group, found in 12.4% of prescriptions. This drug works by stimulating the secretion of insulin from pancreatic beta cells. However, its use is now starting to decline due to the risk of hypoglycemia and weight gain, especially in elderly patients or those with comorbidities (Davies et al., 2018).

Insulin is also part of therapy in patients who do not achieve glycemic control with OHO. NPH insulin (8.0%) is used as basal insulin, while aspart insulin (5.1%) is used as prandial insulin. The combination of the two is widely applied in the basal-bolus scheme. Insulin selection is usually considered in patients with a long duration of illness, high HbA1c levels, or previous therapy failure (ADA, 2023). Overall, the pattern of drug use in this study reflects an individualized therapeutic approach, taking into account the clinical condition of each patient. This approach is in line with recent recommendations that emphasize the importance of selecting a therapy regimen based on age, kidney function, body mass index, and hypoglycemia risk (Davies et al., 2022; PERKENI, 2021).

Types of antihypertensive drugs

In this study, amlodipine was the most commonly prescribed antihypertensive drug among T2DM patients with hypertension (78.6%), followed by lisinopril (21.4%). The preference for amlodipine, a calcium channel blocker, likely reflects its effectiveness in lowering blood pressure without adversely affecting glucose metabolism, making it suitable for long-term use (ADA, 2023; Whelton et al., 2018). Lisinopril, an ACE inhibitor, was less frequently used, although it is recommended for patients at risk of nephropathy or with microalbuminuria due to its renal-protective effects (KDIGO, 2020; PERKENI, 2021). Potential adverse effects of lisinopril include cough, hyperkalemia, and changes in renal function, which may influence prescription patterns in clinical practice.

The selection of antihypertensive therapy in this population demonstrates adherence to evidence-based principles, with drug choice tailored to patient comorbidities and clinical conditions. This individualized approach may help minimize DRPs related to inappropriate drug selection, dosing errors, or adverse drug reactions in patients with hypertension. Therefore, the high use of amlodipin in this study may reflect that most patients have not shown signs of kidney damage, as well as demonstrate adaptation of clinical practices to drug tolerability and availability in healthcare facilities. Thus, the pattern of antihypertensive administration in DMT2 patients in this study was in accordance with the principle of *evidence-based practice*, with the selection of drugs tailored to the patient's clinical conditions and comorbidities.

Types of antidyslipidemia drugs

This study shows that statins were the most commonly prescribed antidyslipidemia drugs in T2DM patients, with simvastatin used in 66.7% of prescriptions and atorvastatin in 33.3%. Simvastatin, a moderate-intensity statin, is often prescribed in primary healthcare due to its availability, affordability, and effectiveness for patients with moderate cardiovascular risk (PERKENI, 2021) cardiovascular risk or prior cardiovascular events, in line with ADA and ACC/AHA guidelines (ADA, 2023; Grundy et al., 2019). The selection of statin type in this population reflects efforts for both primary and secondary prevention of cardiovascular complications in diabetic patients. Lowering LDL levels through statin therapy has been shown to significantly reduce the risk of myocardial infarction, stroke, and cardiovascular mortality (Ridker et al., 2017).

In addition to selecting appropriate statin therapy, pharmacists and clinicians play an important role in preventing DRPs in this patient population. Interventions include regular medication review to assess dose appropriateness, monitoring for side effects such as myopathy or liver enzyme elevation, adjusting therapy according to lipid targets and comorbidities, and providing patient counseling to ensure adherence and understanding of therapy. Implementing these practices can reduce the risk of adverse drug reactions, suboptimal treatment, and drug interactions in outpatient T2DM care.

Drug Related Problems (DRPs) Analysis

In this study, eight DRP cases were analyzed in detail. These cases were selected to represent a range of clinical scenarios including severe hyperglycemia, uncontrolled hypertension, and dyslipidemia in outpatient T2DM patients. The selection aimed to illustrate common patterns of DRPs, their causes, and potential clinical consequences, rather than being a random sample. Across these cases, the most frequent DRPs were categorized as P1.2 (effect of drug treatment not optimal) and P2.1 (adverse drug events or potentially ineffective therapy), with causes including C1.1 (inappropriate drug selection), C3.1/C3.2 (sub- or supra-therapeutic dosing), and C6.1/C6.2/C6.6 (non-adherence, inappropriate administration, or risk of adverse effects) according to PCNE V9.1

classification. Patient-specific factors such as renal function, body mass index, duration of diabetes, and comorbidities were considered when available, although limitations in the retrospective medical records prevented complete assessment in all cases. For example, in cases with elevated HbA1c (>9%) and GDS >250 mg/dL, therapy intensification with combination OHO or insulin was indicated according to ADA and PERKENI guidelines, but monotherapy or suboptimal dosing persisted, highlighting both prescription and adherence-related DRPs. The labeling of P2.1 as "unwanted side effect" has been corrected to align with PCNE terminology: P2.1 refers to adverse drug events possibly occurring, rather than general "side effects." Overall, the cases demonstrate that inadequate therapy selection, insufficient dosing, and failure to adjust treatment in response to laboratory values contributed to DRPs, emphasizing the need for continuous monitoring, individualized therapy, and multidisciplinary involvement including pharmacist review and patient counseling.

First case

In this study, it was found that *Drug Related Problems (DRPs)* In a 45-year-old female patient with a diagnosis of type 2 diabetes mellitus accompanied by hypertension. Clinical examination showed a current blood glucose (GDS) of 210 mg/dL, HbA1c of 8.7%, and blood pressure of 150/90 mmHg, indicating failure to achieve therapeutic targets for both glycemic and blood pressure. Patients received 2 mg of glimepiride therapy and 10 mg of amlodipine per day. Based on the PCNE (2020) classification, this condition is categorized as *DRPs* type P1.2, which is a non-optimal therapeutic effect. Causes include too low a dose of glimepiride (C3.1), possible patient non-adherence to treatment (C6.2), and a single treatment option that is not appropriate (C1.1), given that high HbA1c levels should already require intensification of therapy. According to the American Diabetes Association (ADA, 2023), patients with HbA1c ≥8% after three months of monotherapy should be considered for a combination of OHO or insulin supplementation (Davies et al., 2022). In addition, the patient's blood pressure remained high despite the maximum dose of amlodipine, which should be an indication for the use of combination antihypertensives such as CCB and ACEI/ARB, as per the recommendations of ACC/AHA and PERKENI for cardiovascular and renal protection in diabetic patients (PERKENI, 2021; Whelton et al., 2018). This case confirms the importance of evaluating therapy regimens, selecting appropriate medications, and improving patient adherence to prevent long-term complications.

Second case

The second case involved a 40-year-old female patient with type 2 diabetes mellitus and dyslipidemia. The examination showed blood glucose at 265 mg/dL, HbA1c 9.3%, and total cholesterol at 245 mg/dL. Patients received metformin 500 mg twice daily and simvastatin 20 mg nightly. However, glycemic and lipid control has not been achieved as targeted, so it is categorized as *Drug Related Problems (DRPs)* type P1.2, which is the effect of drug therapy that is not optimal (PCNE, 2020). Cause *DRPs* includes the selection of less appropriate drugs (C1.1), as metformin alone is considered less effective for patients with HbA1c ≥ 9%, who should already require a combination of therapy or insulin supplementation (ADA, 2023). In addition, the dose of metformin of 1000 mg/day is still below the maximum effective dose (2000–2550 mg/day), so it is a cause of C3.1 (too low dose).

According to the ADA (2023) recommendations, patients with HbA1c ≥9% and blood glucose at >250 mg/dL need to be intensified therapy, either with a combination of oral antihyperglycemia drugs (OHO) and insulin if initial therapy does not provide the expected results (Davies et al., 2022). Meanwhile, high total cholesterol levels indicate

inadequate lipid control, even though the patient has received simvastatin. In diabetic patients with severe dyslipidemia and high cardiovascular risk, guidelines recommend the use of higher-potency statins such as atorvastatin or rosuvastatin (Mach et al., 2020; PERKENI, 2021). Without improved therapy, these hyperglycemia and dyslipidemia conditions have the potential to increase the risk of macrovascular complications such as heart disease and stroke, as well as microvascular conditions such as retinopathy and nephropathy. Therefore, adjustments to pharmacotherapy regimens are crucial to achieve optimal metabolic control and prevent long-term complications.

Third case

The third case involved a 36-year-old female patient suffering from type 2 diabetes mellitus with hypertensive comorbidities. The results of the examination showed blood glucose levels at 234 mg/dL, HbA1c 9.0%, and blood pressure 148/92 mmHg. Patients received metformin 500 mg twice daily and amlodipin 5 mg once daily. However, glycemic parameters and blood pressure have not yet shown the achievement of the therapy target, so they are categorized as Drug Related Problems (DRPs) type P1.2, which is a treatment effect that is not optimal (PCNE, 2020).

Main causes DRPs in this case it is the selection of a less suitable drug (C1.1), since metformin monotherapy is not recommended for patients with HbA1c ≥9%, which requires intensification of therapy from the beginning, either through a combination of OHO or the addition of insulin (ADA, 2023). In addition, the dose of metformin administered (1000 mg/day) is also relatively low and has not reached the maximum effective dose (C3.1), which is 2000–2550 mg/day. For the therapy of hypertension, amlodipin is given at an initial dose of 5 mg, which may not be enough to lower blood pressure to the recommended target, which is <140/90 mmHg or <130/80 mmHg in high-risk patients such as diabetics (PERKENI, 2021; Whelton et al., 2018).

Based on the guidelines ADA (2023), the recommended HbA1c target for most adult patients is <7%. With HbA1c levels reaching 9.0%, this patient should receive intensive modification of the therapy regimen. Similarly, in the management of hypertension, an increase in dosage or the addition of other antihypertensives (e.g. ACEI/ARB) is necessary if monotherapy is insufficient, especially in diabetic patients at risk of vascular complications. If pharmacological interventions are not immediately adjusted, patients are at high risk of developing both microvascular (such as nephropathy, retinopathy) and macrovascular (such as heart disease and stroke) complications. Therefore, the selection of the right regimen and the adjustment of the dosage of the drug are essential to achieve the success of long-term therapy.

Fourth case

In the fourth case, a 36-year-old female patient was diagnosed with type 2 diabetes mellitus accompanied by dyslipidemia. The examination showed blood glucose at 258 mg/dL, HbA1c 9.5%, and total cholesterol at 250 mg/dL. Patients received glimepiride therapy 2 mg once daily and simvastatin 20 mg nightly. However, clinical results show that neither glycemic nor lipid control has been achieved, so this case is classified as Drug Related Problems (DRPs) category P1.2, i.e. the effect of non-optimal drug therapy (PCNE, 2020).

Some causes of DRPs identified in this case. First, the selection of inappropriate drugs (C1.1), such as glimepiride as monotherapy is not recommended for patients with HbA1c >9%, especially without the use of metformin as first-line therapy. Second, the dose used is relatively low (C3.1), where glimepiride 2 mg is still an initial dose that may not be enough to effectively lower blood glucose. A dose of simvastatin of 20 mg is also categorized

as moderate intensity, which may not be enough to control total cholesterol levels >240 mg/dL. Third, there is an inaccuracy in the therapy regimen (C6.1), namely not being given additional therapy such as metformin, which should be used in conjunction with sulfonylurea, especially in patients with severe hyperglycemia (ADA, 2023; PERKENI, 2021).

According to the guidelines ADA (2023), patients with HbA1c ≥9% and GDS >250 mg/dL require intensification of therapy from the outset, either through a combination of two oral antihyperglycemia drugs or the addition of insulin (Davies et al., 2022). In addition, the guidelines recommend the use of statins with higher potency, such as atorvastatin or rosuvastatin, in patients with severe dyslipidemia, especially if total cholesterol is >240 mg/dL (Mach et al., 2020; PERKENI, 2021). Therefore, the use of simvastatin alone in moderate doses is not necessarily sufficient to achieve lipid targets in high-risk patients. If the therapy regimen is not optimized immediately, patients are at risk of atherosclerotic complications, such as coronary heart disease and stroke, as well as faster progression of diabetes, which can ultimately increase insulin requirements in the future. Optimization of therapy is essential to prevent microvascular and macrovascular complications due to an uncontrolled combination of hyperglycemia and dyslipidemia.

Fifth case

In the fifth case, a 44-year-old female patient with type 2 diabetes mellitus and dyslipidemia, showed blood glucose levels of 288 mg/dL, HbA1c of 10.1%, and total cholesterol of 268 mg/dL. The therapy given was in the form of acarbose 50 mg three times a day and simvastatin 20 mg every night. However, both glycemic and lipid control have not been achieved, so this case is included in the Drug Related Problems (DRPs) P1.2 category, which is a therapy that has not given optimal results (PCNE, 2020).

Some causes of DRPs in these cases include: selection of an inappropriate drug (C1.1), in which acarbose is used as a monotherapy although it is not a first-line agent for DMT2. The effectiveness of acarbose in lowering HbA1c is relatively low (about 0.5–0.8%), so it is not enough to handle cases with HbA1c ≥10% (ADA, 2023; PERKENI, 2021). In addition, simvastatin 20 mg is classified as a moderate-intensity statin and is considered inadequate for patients with total cholesterol of >260 mg/dL, which is included in the category of high cardiovascular risk (Mach et al., 2020), so it falls into the C3.1 category (too low dose). Finally, patients also do not receive the necessary additional therapies (C6.2), such as metformin or insulin, even though metformin is a first-line therapy that can significantly lower HbA1c (1–1.5%) and provide an additional effect on insulin resistance (Davies et al., 2022).

The latest guidelines from ADA and PERKENI emphasize the importance of immediate therapeutic intensification in patients with HbA1c ≥10% and blood glucose at >280 mg/dL, which may include a combination of two or more OHOs or basal insulin supplementation. In addition, in patients with severe dyslipidemia and high cardiovascular risk, high-intensity statins such as atorvastatin or rosuvastatin are more recommended than simvastatin (ADA, 2023; Mach et al., 2020). Without optimization of therapy, patients like Mrs. J are at high risk of developing serious macrovascular complications such as myocardial infarction, stroke, and peripheral artery disease. Failure to intensify therapy can also accelerate disease progression and increase the likelihood of insulin needs later in life. Therefore, the selection of appropriate drugs and the appropriate adjustment of the therapeutic regimen are indispensable to prevent the burden of long-term chronic diseases.

Sixth case

The sixth case involved a 35-year-old male patient with a diagnosis of type 2 diabetes mellitus and dyslipidemia. The results of the examination showed that the current blood glucose was 295 mg/dL, HbA1c was 10.4%, and the total cholesterol was 270 mg/dL. Patients were treated with 100 mg of acarbose therapy three times a day and simvastatin 20 mg once night. However, this therapy has not succeeded in achieving the expected glycemic and lipid control. By classification NCCP (2020), this condition falls into the category Drug Related Problems (DRPs) type P2.1, which is ineffective therapy. This is due to the selection of inappropriate drugs (C1.1), because acarbose as monotherapy is not strong enough to lower HbA1c, especially in patients with severe hyperglycemia. The effectiveness of acarbose in lowering HbA1c is only about 0.5–0.8%, so it is not recommended as a single therapy in patients with HbA1c >10% (ADA, 2023; Inzucchi et al., 2022).

In addition, the 20 mg simvastatin used was classified as a moderate-intensity statin, and was considered insufficient for patients with total cholesterol of >270 mg/dL and high cardiovascular risk (Mach et al., 2020). Patients also did not receive the necessary additional therapies (C6.1), such as metformin or basal insulin, which should be prescribed in conditions of severe hyperglycemia. According to recommendations ADA (2023) and PERKENI (2021), patients with HbA1c ≥10% and GDS close to 300 mg/dL need immediate intensification of therapy through a combination of two or more OHO or insulin supplementation. Without optimization of the therapy regimen, the risk of long-term complications such as retinopathy, nephropathy, neuropathy, coronary heart disease, and stroke will increase. In addition, ineffective therapy also increases the likelihood of needing insulin in a faster time and burdening the overall health system.

Seventh case

Patient Mr. R, age 28, was diagnosed with type 2 diabetes mellitus (DMT2) with comorbid hypertension. The results of the examination showed a blood glucose level (GDS) of 240 mg/dL, HbA1c of 8.9%, and blood pressure of 145/95 mmHg. The therapy given was in the form of glimepiride 2 mg once a day and amlodipine 10 mg once a night. However, this therapy has not succeeded in achieving the optimal glycemic control target, so it is categorized as Drug Related Problems (DRPs) type P1.2, which is the effect of treatment that is not optimal. The causes include category C1.1, i.e. the selection of drugs that are not suitable for the patient's condition because glimepiride as monotherapy at 8.9% HbA1c is at risk of not being effective enough, and C6.1, i.e. additional therapies that are not administered, such as metformin as a first-line drug. Based on the guidelines of the American Diabetes Association (ADA, 2023) and consensus PERKENI (2021), patients with HbA1c >7.5% should get a combination of two oral antidiabetic drugs, one of which is metformin, unless there are contraindications.

In these cases, patients received only glimepiride, which is known to have a risk of hypoglycemia and weight gain, and is less recommended as monotherapy in young patients (Inzucchi) et al., 2022). This shows that the treatment is not suitable for the patient's clinical condition. Meanwhile, for hypertension management, the administration of amlodipine 10 mg is still acceptable as an initial monotherapy, but blood pressure of 145/95 mmHg is classified as stage 1–2 hypertension and still requires close monitoring to ensure the achievement of the target <140/90 mmHg. Overall, failure to achieve glycemic targets and the potential ineffectiveness of long-term therapy can increase the risk of microvascular complications such as retinopathy and nephropathy, as well as macrovascular complications such as heart disease and stroke, especially when appropriate therapy intensification is not performed.

Eighth case

Patient Mr. S, age 45, was diagnosed with type 2 diabetes mellitus (DMT2) with comorbid dyslipidemia. The results of the clinical examination showed a blood glucose level (GDS) of 245 mg/dL, HbA1c of 9.8%, and total cholesterol of 260 mg/dL. The therapy given was in the form of metformin 500 mg twice daily and simvastatin 40 mg once night. Based on this condition, patients are categorized as having Drug Related Problems (DRPs) type P2.1, which is an unwanted side effect of the drug. This is due to the administration of simvastatin at high doses (40 mg), which according to various clinical guidelines, has a higher risk of myopathy, increased liver enzymes, and even rhabdomyolysis, especially if used long-term or in patients with additional risk factors (FDA, 2016). Cause *DRPs* it falls into the category of C3.2, i.e. the dose is too high, and C6.6, i.e. the risk of side effects is too high. According to the guidelines of the American Diabetes Association (ADA, 2023) and AHA/ACC (Grundy et al., 2019), DMT2 patients with moderate to high cardiovascular risk may be given moderate-intensity statins first, such as simvastatin 20 mg, unless there is a history of atherosclerotic heart disease (ASCVD) or LDL ≥190 mg/dL. In this case, there is no explanation for the existence of a history of ASCVD or clear clinical indications for the administration of high-dose simvastatin, so the use of a 40 mg dose can be said to be disproportionate and increases the potential for side effects. On the other hand, although the main focus is *DRPs* is the safety of statin use, it should also be noted that the patient's glycemic control has not been achieved optimally, with an HbA1c of 9.8%. This indicates the need for evaluation and optimization of antidiabetic therapy as well. Overall, the use of high-dose simvastatin without strong indications reflects the risk of excessive therapy, which can lead to long-term complications if not strictly monitored.

CONCLUSION

This study characterized outpatient type 2 diabetes mellitus patients at Dr. Moewardi Surakarta Hospital in 2024 and identified associated Drug Related Problems (DRPs). The majority of patients were aged 36–45 years, predominantly male, and most did not have comorbidities. The most common antidiabetic therapy was oral monotherapy, with metformin as the first-line drug. For patients with comorbid hypertension or dyslipidemia, amlodipine and simvastatin were the most frequently prescribed agents, reflecting individualized therapy according to clinical guidelines.

A total of 28 DRPs were identified, classified according to PCNE V9.1. The main problems included non-optimal effects of drug treatment (P1.2) and possible adverse drug events (P2.1). Common causes were inappropriate drug selection (C1.1), doses too low (C3.1) or too high (C3.2), incorrect timing (C6.1), non-adherence (C6.2), and wrong route of administration (C6.6). These findings highlight areas where therapy intensification, dose adjustment, and close monitoring are needed to optimize glycemic, blood pressure, and lipid control. The results emphasize the importance of regular medication review, individualized therapy, and patient education to prevent DRPs and improve therapeutic outcomes in outpatient type 2 diabetes care. By identifying and classifying DRPs, clinicians and pharmacists can implement targeted interventions to reduce risks of complications and ensure safer, more effective pharmacotherapy.

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AUTHOR CONTRIBUTION

FA : Primary researcher, literature search, analytical analysis, manuscript writing.
RR : Research mentor and consultant.
AWA : Research mentor and consultant.
EZW : Research mentor and consultant.

ETHICS APPROVAL

Ethical clearance in this study was carried out at the Dr. Moewardi Surakarta Regional General Hospital with ethical number: 211/1/HREC/2025.

CONFLICT OF INTEREST

The authors have no competing interests related to this study.

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