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Retrospective Evaluation of Drug-Related Problems in Hospitalized Adult Patients with Type 2 Diabetes Mellitus at X General Hospital in 2024

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ABSTRACT: Diabetes mellitus is a chronic disease characterized by high blood glucose levels due to metabolic disorders. Drug-Related Problems (DRPs) are treatment-related conditions that can lead to therapy failure, worsen glycaemic control, prolong hospitalization, and increase morbidity. This study aimed to identify DRPs in adult patients with type 2 diabetes mellitus hospitalized at General Hospital X during 2024. This retrospective descriptive study analysed medical records of 100 patients selected from 4,779 hospitalized diabetes patients in 2024. Data were analysed using Pharmaceutical Care Network Europe (PCNE) V.9.1 parameters focusing on problem and cause domains, then processed with SPSS. Most patients were female (61%) with the highest age group being 51-60 years (46%). The most common comorbidity was hypertension (42.26%). Treatment patterns were dominated by insulin aspart (NovoRapid) (29.12%) and metformin (25.82%). DRPs were identified in 33 patients (33%) with 49 total incidents. The most dominant category was treatment safety problems (P2) with 33 cases (67.34%), consisting of 1 adverse drug reaction and 32 potential drug interactions that could compromise patient safety and glycaemic stability. Other categories included drug selection problems (C1) in 11 cases (22.44%): 10 drugs without indication (C1.3) and 1 therapy duplication (C1.5); treatment effectiveness problems (P1) in 4 cases (8.16%) related to untreated indications (P3.1); and dose selection problems (C3) in 1 case (2.04%) involving insufficient dosage (C3.1). The predominance of treatment safety issues underscores the need for pharmaceutical care interventions in hospitalized diabetic patients.

Keyword: drug-related problems (DRPs); hospitalization; pharmaceutical care network europe (PCNE); type 2 diabetes mellitus.

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INTRODUCTION

Diabetes mellitus is a chronic disease with hyperglycaemia characteristics due to metabolic disorders (Kemenkes RI, 2022b). The global prevalence of diabetes reached 537 million cases in 2021 and is projected to increase to 783 million by 2045. Indonesia occupies the fifth position in the world with 19.5 million sufferers in 2021, predicted to rise to 28.6 million in 2045 (Kemenkes RI, 2022a). At the regional level, Central Java has an estimated 624,082 cases of diabetes in 2023 (Portal Data Jawa Tengah, 2024). This increase in the prevalence of diabetes is directly proportional to the complexity of pharmacotherapy required, especially in inpatients who generally have comorbidities and receive polypharmacy. This condition increases the risk of Drug-Related Problems (DRPs). Therefore, the identification and prevention of DRPs in hospitalized diabetic patients is crucial to optimize therapy outcomes and reduce the burden on the health system.

Type 2 diabetes mellitus in the early stages generally does not show obvious symptoms, but as the disease progresses, various typical symptoms will appear such as excessive thirst (polydipsia), increased hunger (polyphagia), and frequent urination (polyuria) due to the presence of glucose in the urine when blood sugar levels reach 180 mg/dl. Sufferers can also experience dehydration due to high glucose levels that cause extracellular fluids to become hypertonic, fatigue due to impaired carbohydrate utilization, as well as weight loss due to fluid loss and the breakdown of muscle and fat tissue for energy. Additional symptoms such as visual impairment, muscle cramps, constipation, and candidiasis fungal infections may also appear, all of which can affect the patient's quality of life and require proper medical attention (Baynest, 2015).

According to the American Diabetes Association (ADA) (2024) guidelines, the diagnosis of diabetes mellitus can be established through four laboratory parameters: fasting blood glucose levels ≥126 mg/dL, 2-hour oral glucose tolerance test ≥200 mg/dL, HbA1c ≥6.5%, or random plasma glucose ≥200 mg/dL in symptomatic patients. Type 2 diabetes mellitus is caused by a combination of genetic factors, insulin resistance, and pancreatic beta cell dysfunction. Insulin resistance results in a decrease in the target cell's response to insulin, especially in obese individuals, thus requiring higher insulin production. When pancreatic beta cells are unable to compensate for increased insulin resistance, chronic hyperglycaemia occurs (Huang, 2018). There are several pharmacological therapies for type 2 diabetes mellitus, namely insulin secretion stimulation consisting of two main groups: sulfonylureas and glinides; Insulin Sensitivity, which includes the biguanide group (metformin); thiazolidinediones; alpha-glucosidase inhibitors; DPP-4 inhibitors; SGLT-2 inhibitors; and insulin therapy. Insulin therapy is used in patients with HbA1c ≥7.5% despite taking 1-2 oral medications or if HbA1c >9% (Soelistijo, 2021). Diabetes is a chronic disease requiring lifelong medication use, as long-term medication use can lead to errors in patient treatment.

Drug-Related Problems (DRPs) are defined as adverse events in pharmacological therapy that potentially interfere with treatment effectiveness (Rokiban et al., 2017). The identification of DRPs (Drug-Related Problems) aims to serve as a guide for clinical pharmacy practice to recognize and manage various problems related to drug use, thereby expected to improve patient quality of life, optimize treatment cost-effectiveness, and accelerate patient recovery processes (Adiana & Maulina, 2022) so that pharmacists and health workers can improve clinical services to patients. DRPs according to PCNE (Pharmaceutical Care Network Europe) V.9.1 is classified in the category of problems (including potential problems), causes (including potential causes for potential problems), planned interventions, acceptance of interventions, status data recovery plans (DRPs).

Research on DRP in patients with type 2 diabetes mellitus who underwent hospital admissions in Indonesia analysed using PCNE V 9.1 is still limited, so further research is needed to obtain findings that can guide pharmacists or health review priorities. In this study, data were analysed based on problem categories (P1-P3) and causes (C1-C9)(PCNE, 2020).

METHODS

This study is an observational descriptive study that analyses population characteristics and variable relationships without intervention (Prayoga, 2023). This study applies a purposive sampling technique based on inclusion and exclusion criteria that have been set according to the research objectives (Amruddin et al., 2022). Data collection through a retrospective review of patients' medical records. Based on data from patients with type 2 diabetes mellitus treated at Hospital X in 2024, data was obtained from 4,779 patients. The sample size was calculated using the Slovin formula and the results of 100 research samples with a margin of error set at 10%, samples were obtained with inclusion criteria: type 2 diabetes mellitus patients aged 20-60 years who were hospitalized in the January-December 2024 period, including those with or without comorbidities. The exclusion criteria are patients with type 2 diabetes mellitus who are undergoing outpatient treatment, patients who die during treatment and whose medical records are damaged, illegible and incomplete. Informed consent from patients was ruled out in this study because it used a retrospective design with secondary data collection from medical records. However, the confidentiality and security of patient data are maintained through the anonymization of identity and the provision of codes on each study sample.

The researcher used data collection sheets sourced from the patient's medical records containing the initials of name, age, gender, height, weight, medical record number, drug name, form of preparation, route of administration, drug dose, and lab data diagnosed with type 2 diabetes mellitus who underwent inpatient treatment at X general hospital in 2024. The identification of DRP was carried out by the main researcher using the criteria of PCNE V.9.1, then validated by two clinical pharmacists (supervisors) independently. Cases with differences in interpretation are discussed until a consensus is reached. This multi-level validation process is carried out to ensure the credibility of the DRPs classification. Data on drug use patterns and patient characteristics were presented in the form of a table and analysed with univariate statistics using SPSS 26 for windows software. DRPs data were analysed descriptively using the PCNE V.9.1 classification based on the category of cause and problems.

RESULT AND DISCUSSION

This study analysed medical records data from 100 adult patients with type 2 diabetes mellitus who were treated at General Hospital X during the 2024 period and met the inclusion criteria. Patient characteristic data included gender and age to describe the demographic distribution shown in table 1. The distribution of type 2 diabetes mellitus patients is dominated by women (61%) compared to men (39%). These results are consistent with the research of Rosita et al. (2022) which shows that women have a higher risk of developing diabetes mellitus due to physical factors, especially the tendency to increase body mass index. The reduction of estrogen and progesterone hormones during menopause is also a factor in increasing blood sugar levels, because this condition disrupts

the glucose metabolism pathway and weakens the body's capacity to maintain blood sugar balance (Paschou & Papanas, 2019).

Table 1. Characteristics of the patient

Variable	Frequency (f)	Percent (%)
Gender		
Man	39	39%
Woman	61	61%
Age		
20-30 years	0	0%
31-40 years old	10	10%
41-50 years old	44	44%
51-60 years old	46	46%

Age characteristics show an increased risk of type 2 diabetes mellitus with age due to decreased insulin metabolism ability and lifestyle changes. The 51-60 age group dominates (46%). This data shows a high risk of type 2 diabetes mellitus at the age of ≥40 years. These results are in line with research with Rosita et al. (2022) which found that people over the age of 45 are more at risk of developing type 2 diabetes because the body's metabolism changes and interferes with blood sugar regulation as we age. Genetic factors and an unhealthy lifestyle also increase the risk of this disease.

The analysis results show that the most frequently used therapy was insulin NovoRapid (insulin aspart) with 53 patients (29.12%) shown in table 2. Based on the American college of clinical pharmacy (2013). NovoRapid injection is widely used because it is classified as rapid-acting insulin that can lower postprandial blood glucose levels more effectively and quickly compared to regular insulin (Nuraisyah et al., 2022). Postprandial blood glucose control can be improved with the use of rapid-acting or short-acting insulin (Soelistijo et al., 2021).

Table 2. Patient treatment therapy

Drug name	Frequency (f)	Percentage (%)
Biguanide		
Metformin	47	25,82 %
Sulfonylurea		
Glimepiride	23	12,63 %
Gliquidone	4	2,19 %
Glibenclamide	2	1,09 %
Thiazolidinedione		
Pioglitazone	3	1,64%
Retardant Alfa glucosidase		
Acarbose	3	1,64%
Insulin		
NovoRapid	53	29,12 %
Lantus solostar	31	17,03 %
Levemir	12	6,59%
Glaritus	4	2,19 %
Total	182	100%

For oral medication, metformin from the biguanide class became the most frequently prescribed choice with a total of 47 patients (25.82%). Its main mechanism is that metformin works by reducing glucose production in the liver (gluconeogenesis) and increasing glucose uptake in peripheral tissues. In the management of most type 2 diabetes mellitus cases, metformin is established as the recommended first-line therapy (Soelistijo

et al., 2021). Metformin is also frequently prescribed due to its low cost and does not cause hypoglycaemia.

From the results of data analysis collected from 100 patient's medical records, it was shown that there were 3 patients without comorbidities and 97 patients with type 2 diabetes mellitus with comorbidities as shown in table 3. In this study, hypertension was the most frequent comorbidity in patients with type 2 diabetes mellitus with a prevalence of 41 patients (42.26 %). These findings are consistent with the research of Hasan (2023) reported that hypertension is the most dominant comorbidity in type 2 diabetes mellitus patients, with a prevalence reaching 27 cases (19% of the total sample).

Table 3. Patient comorbidity disease

Types of Comorbidity Diseases	Frequency (f)	Percentage (%)
Hypertension	41	42,26 %
Heart (CAD)	13	13,40 %
Kidney failure (CKD)	10	10,30 %
Anemia	7	7,21 %
Dyspepsia	5	5,15 %
Febris	5	5, 15 %
Paresis	3	3,09 %
Vertigo	3	3,09 %
Other	10	10,30 %
Total	**97**	**100%**

The condition of hypertension can trigger insulin resistance, which is a state in which the body's cells become less responsive to the hormone insulin. Meanwhile, insulin plays an important role in facilitating the absorption of glucose into the body's cells and comprehensively controlling the process of carbohydrate metabolism. If this mechanism is dysfunctional, dysregulation of blood sugar levels will occur, which can lead to glucose abnormalities in circulation (Kuna et al., 2023). A persistent unhealthy lifestyle also contributes as a risk factor for diabetes mellitus and hypertension in most patients. The comorbidities of hypertension and diabetes mellitus also increase the complexity of therapy and the risk of polypharmacy in patients.

Meanwhile, there were other comorbid diseases in 10 patients (10.30%) including Chronic Obstructive Pulmonary Disease, rectal cancer (ca recti), anorexia, hypothyroidism, hypoglycaemia, hypokalaemia, angina pectoris, stroke, hyperuricemia, and urosepsis. These comorbid diseases occur because diabetes not only affects blood sugar levels but can gradually damage blood vessels and other body organs, making patients susceptible to complications that require comprehensive management.

The duration of hospital treatment or length of stay (LOS) is the main factor in evaluating the success of treatment in patients with type 2 diabetes mellitus shown in table 4. In this study, most patients with type 2 diabetes mellitus were treated for 4-7 days (58%), this is in line with the findings of Hasan (2023) who showed an average treatment duration of 4-6 days as an indicator of therapy success. The 4–7 days period is a phase in which the patient's treatment is often adjusted either in the form of medication changes, insulin dose adjustments, or the addition of new drugs based on clinical conditions. Many of these changes increase the risk of DRP, so strict monitoring is needed, especially to prevent drug interactions.

Table 4. Length of stay

Length of stay	Frequency (f)	Percentage (%)
1-3 day	17	17%
4-7 day	58	58%
8-10 day	20	20%
>10 day	5	5%
Total	**100**	**100**

Drug Related Problems (DRPs) in inpatients with type 2 diabetes were analysed through examination of medical records using PCNE version 9.1 criteria for problem categories (P1, P2, P3) and causes (C1-C9). Of the 100 medical records studied, 67 patients (67%) did not experience DRPs, while 33 patients (33%) experienced DRPs with a total of 49 events, indicate that multiple patients experience multiple DRPs simultaneously or consecutively during the treatment period. Details of the classification and frequency of DRPs are listed in the table 5.

Table 5. Identification drug related problems (DRPs)

No.	Information	Code	Frequency (f)	Percentage (%)
1.	Treatment effectiveness	P1	4	8,16%
2.	Treatment safety	P2	33	67,34 %
3.	Other	P3	0	0%
4.	Drug selection	C1.	11	22,44 %
5.	Drug form	C2	0	0%
6.	Dosage selection	C3.	1	2,04 %
7.	Duration of treatment	C4	0	0%
8.	Drug preparation	C5	0	0%
9	Drug use process	C6	0	0%
10	Related to patients	C7	0	0%
11	Related patient transfers	C8	0	0%
12	Others	C9	0	0%
	Total		**49**	**100%**

Treatment Effectiveness

Treatment effectiveness is a pharmacotherapy problem that has the potential to reduce the effectiveness of treatment in patients. In this study, the drug therapy problems that occurred were untreated symptoms or indications (P1.3) totalling 4 cases (8.16%), namely patients who did not receive therapy for hypertension (1 patient), anaemia (1 patient), and type 2 diabetes mellitus (2 patients). Hypertension cases were not given antihypertensive therapy, anaemia was not given initial treatment in the form of supplements, vitamins, or Fe tablets for blood cell formation. Similarly, type 2 diabetes mellitus patients did not receive antidiabetic therapy to control elevated blood sugar levels. In Hasan (2023), untreated indications also occurred in anaemia and type 2 diabetes mellitus diseases totalling 6 cases (7.4%).

The occurrence of untreated indications in the inpatient environment can be caused by several factors, such as the high workload of health workers so that some comorbid conditions are missed or poorly documented, the priority of handling acute conditions that make chronic conditions such as hypertension or anaemia less attention, and the lack of communication between medical teams that cause some indications to not be identified. This emphasizes the importance of comprehensive medication reviews and interprofessional collaboration to ensure that all patient indications are optimally handled.

Medication Safety

Treatment safety issues were the most common problem in this study in 33 cases (67.34%), consisting of 1 case of ADR (Adverse Drug Reaction) and 32 cases of potential drug interactions (P2.1). ADR (Adverse Drug Reaction) cases occur in patients with type 2 diabetes mellitus with impaired kidney function who receive high doses of fenofibrate (300mg), where the drug has the potential to increase creatinine levels and worsen the patient's condition. Research by Bonds et al. (2012) shows that fenofibrate can increase serum creatinine in patients with diabetes mellitus.

The recommendation given is the use of low-dose fenofibrate accompanied by strict monitoring in patients. Fenofibrate may be added to statin therapy if triglyceride levels remain high (>200 mg/dL) in patients with diabetes mellitus to optimize lipid profile control (Erwinanto et al., 2022). Fenofibrate doses are administered with a maximum dose range of 45-300mg, with the lowest dose being 45 mg and the highest of 300 mg to be determined based on the medical circumstances and clinical response of each patient (Aman et al., 2021).

The analysis of potential drug interactions was assessed using drugs.com applications with major, moderate and minor categories shown in table 6. Drug interactions are a relationship in which one drug and another ingredient affect each other, which can interfere with the ability of the drug to provide the expected therapeutic effect. The 32 interaction cases found were potential interactions based on drug profiles, not necessarily clinically manifested. Its manifestations depend on the patient's condition, dosage, and other individual factors. This identification is preventive to increase alertness, so an individual clinical evaluation is required to determine appropriate follow-up.

Table 6. Potential drug interactions

Interacting Drugs	Information
Amlodipine + Metformin (Moderate)	There were 9 cases (28.12%) of this drug interaction. Amlodipine lowers metformin's effectiveness through pharmacodynamic antagonism
Aspirin + Bisoprolol (Minor)	There were 8 cases (25%) of these drug interactions. Aspirin reduces the effectiveness of bisoprolol should be monitored therapy
Aspirin + Insulin aspart (Moderate)	3 cases occurred (9.37%) drug interactions. Can increase the risk of hypoglycaemia, dosage adjustments should be made
Captopril + Glimepiride (Moderate)	3 cases occurred (9.37%) drug interactions. Captopril strengthens the effects hypoglycaemia glimepiride; Blood sugar monitoring and adjustment of the dosage of both drugs is required
Captopril + Metformin (Moderate)	4 cases occurred (12.5%) drug interactions. The combination of captopril with metformin increases the risk of hypoglycaemia because captopril amplifies the decreasing effects Metformin Blood Sugar
Glimepiride + NSAID (Moderate)	1 case occurred (3.12%) drug interactions. Increases the risk of hypoglycaemia, it is recommended to use non-opioid analgesics
Candesartan + Insulin glargine	3 cases occurred (9.37%) drug interactions. Can increase the risk of hypoglycaemia, dose adjustments and blood sugar levels monitoring should be made
Total	**32 (100%)**

Based on the research conducted, no drug interaction cases were identified in the major category. Major category drug interactions are interactions that can cause serious and dangerous clinical effects requiring immediate medical intervention (Hasan, 2023). Then in this study, there were 24 incidents of moderate category drug interactions. Moderate-level drug interactions can affect the patient's clinical condition and require adjustments to the therapeutic regimen, although the impact is relatively milder and more limited compared to major category drug interactions (Reyaan et al., 2021). The next level of interaction is the minor category, which was found in 8 cases in this study. Minor category drug interactions are characterized by mild side effects, so they can be handled easily without requiring modifications to the ongoing treatment plan (Reyaan et al., 2021). Although there were no major interactions, the 24 cases of moderate interactions still required attention because they could affect therapy outcomes. Priority is given to clinically significant interactions, such as the risk of hypoglycaemia (insulin-antihypertensive) or impaired renal function (metformin with nephrotoxic drugs). Monitoring strategies required include periodic laboratory monitoring, observation of clinical signs, patient education, and scheduling of medication. This monitoring approach is more effective than avoiding the combination that the patient needs.

Drug Selection

Drug selection problems were found in 11 cases (22.44%) including 1 therapy duplication (C1.5) and 10 unindicated drugs (C1.3). Duplication of therapy occurs in patients with type 2 diabetes mellitus with rectal cancer who receive kanamycin sulphate and gentamicin sulphate (both aminoglycoside group), so it is enough to give one antibiotic to avoid resistance and save costs. The use of drugs without proper medical indications has the potential to harm patients through side effects and lead to financial expenses that are avoidable (Hasan, 2023). Some cases of unindicated medications may be preventative or empirical therapies, such as PPIs for peptic ulcer prophylaxis in at-risk patients who experience stress. However, the absence of clear documentation makes it difficult to assess the rationality of its use. This emphasizes the importance of adequate clinical documentation for any drug administration. In this study, the unindicated drugs given to patients can be seen in table 7.

Table 7. Unindicated drugs

Drug Name	Total	Percentage (%)
Omeprazole	7	70%
Lansoprazole	1	10 %
Valsartan	1	10%
Alprazolam	1	10%
	Total	**100%**

Unindicated drugs are given to patients who do not have relevant complaints or comorbidities, indicating a medication error for no obvious medical reason. The most common drugs were omeprazole (70%), followed by lansoprazole (10%), valsartan (10%), and alprazolam (10%). Omeprazole and lansoprazole are a group of Proton Pump Inhibitors (PPI) that work to inhibit stomach acid production through blockade of H+K+ATPase enzymes in parietal cells (Dipiro et al., 2015). Valsartan from the Angiotensin Receptor Blocker (ARB) group is indicated for hypertension, heart failure, and myocardial infarction with a mechanism that blocks angiotensin receptor type II 1 (AT_1) to prevent vasoconstriction and aldosterone secretion (MIMS, 2023). Alprazolam from the benzodiazepine group has mild antiemetic effects to treat anxiety and nausea and vomiting (Dipiro et al., 2015).

Dosage Selection

Drug dose problems were found in 1 case (2.04%) in the form of too low doses (C3.1). Patients received nifedipine 10 mg twice daily (20 mg/day total), whereas JNC 8 guidelines recommend a therapeutic dose range of 30-90 mg/day, indicating the dose is below the minimum effective limit (James et al., 2014). This too low dose risks making blood pressure not well controlled, thus increasing the risk of diabetes complications such as kidney, eye, and heart disorders. Dose adjustment to the recommended range (30-90 mg/day) is important to prevent further complications.

CONCLUSION

It was found in 33% of inpatient diabetic patients, dominated by treatment safety issues (67.34%) that were mostly preventable. These findings emphasize the importance of the role of pharmacists in conducting medication reviews to identify and prevent DRP early. Interprofessional collaboration in drug interaction screening, evaluation of treatment rationality, and therapy monitoring is essential to improve the safety and therapeutic outcomes of inpatient diabetic patients.

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AUTHOR CONTRIBUTION

HSA : Primary researcher, literature search, analytical analysis, manuscript writing
RR : Research mentor and consultant
APS : 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: 210/I/HREC/2025.

CONFLICT OF INTEREST

None to declare

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