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# Evaluation of Antidiabetic Drug Selection and Dosage Appropriateness in Hospitalized Type 2 Diabetes Mellitus Patients at RSU Royal Prima Medan. January-June 2024

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**Abstract**

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease that requires appropriate drug management to achieve optimal blood glucose control. Appropriateness of drug and dose is essential to ensure the effectiveness of therapy. While cost-effectiveness analysis is needed to assess the efficiency of resource use in its management. This study aims to assess the appropriateness of the use of drugs and doses of type 2 antidiabetics based on PERKENI 2021 clinical guidelines and analyze the cost-effectiveness of therapy in hospitalized patients. This study used a retrospective descriptive method with a cross-sectional approach. The research was conducted in January-February 2025 using purposive sampling technique.The result of the 43 patients. The majority were female (55.8%) and aged 56-65 years (48.8%). The suitability of drug use in accordance with PERKENI 2021 reached 100%. But there was a dose discrepancy of 1.36%. namely the drug sitagliptin. Based on ACER and ICER parameters. the most cost-effective monotherapy is Glimepiride with an effectiveness value of 100%. an ACER value of IDR 83,886.43. while the most cost-effective combination therapy is Pioglitazone + metformin with an effectiveness value of 100%. an ACER value of IDR 100,639.21 and an ICER value of IDR 76,734.39 and IDR 13,317.37. Most of the therapies are in accordance with the PERKENI 2021 guidelines. but dosage accuracy still needs to be improved.

***Abstrak***

*Diabetes melitus tipe 2 (DMT2) adalah penyakit metabolik kronis yang memerlukan pengelolaan obat yang tepat guna mencapai kontrol glukosa darah optimal. Kesesuaian obat dan dosis sangat penting untuk menjamin efektivitas terapi. sementara analisis efektivitas biaya diperlukan untuk menilai efisiensi penggunaan sumber daya dalam pengelolaannya. Penelitian ini bertujuan untuk menilai kesesuaian penggunaan obat dan dosis antidiabetes tipe 2 berdasarkan pedoman klinis PERKENI 2021 serta menganalisis efektivitas biaya terapi pada pasien rawat inap. Penelitian ini menggunakan metode deskriptif retrospektif dengan pendekatan cross-sectional. Penelitian dilakukan pada bulan januari- februari 2025 menggunakan teknik purposive sampling.Hasil: Dari 43 pasien. mayoritas perempuan (55.8%) dan berusia 56–65 tahun (48.8%). Kesesuaian penggunaan obat sesuai dengan PERKENI 2021 mencapai 100%. namun terdapat ketidaksesuaian dosis sebesar 1.36% yaitu obat sitagliptin. Berdasarkan parameter ACER dan ICER terapi monoterapi paling cost-effective adalah Glimepiride dengan nilai efektivitas sebesar 100%. Nilai ACER sebesar Rp 83.886,43. sedangkan terapi kombinasi terapi paling cost-efective adalah Pioglitazone + metformin dengan nilai efektivitas 100 %. Nilai ACER sebesar Rp 100.639,21 dan nilai ICER sebesar Rp 76.734,39 dan Rp. 13.317,37. Sebagian besar terapi telah sesuai pedoman PERKENI 2021. namun ketepatan dosis masih perlu ditingkatkan.*

**Keywords:** DM Type 2, Drug Appropriateness, Dosage Appropriateness, Cost Effectiveness Analysis

***Kata kunci:*** *DM Tipe 2, Kesesuaian Obat, Kesesuaian Dosis, Analisis Efektivitas Biaya*

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## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from insufficient insulin production or impaired insulin action. The global burden of diabetes is escalating. In 2021. the International Diabetes Federation (IDF) reported that 537 million adults aged 20–79 were living with diabetes. accounting for one in ten people worldwide and approximately 6.7 million deaths—equivalent to one every five seconds. Indonesia ranked fifth globally. with 19.47 million cases and a prevalence rate of 10.6% [1,2]

DM is broadly classified into type 1 and type 2 diabetes mellitus (T2DM). Type 1 results from autoimmune destruction of pancreatic beta cells. whereas T2DM is characterized by insulin resistance and/or insufficient insulin secretion[3]. While non-modifiable risk factors include age. sex. and genetics. modifiable factors such as smoking. sedentary behavior. and poor diet

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significantly contribute to disease onset and progression[4].

In Indonesia. diabetes prevalence continues to rise. The 2018 Basic Health Research (Riskesdas) showed an increase from 1.5% in 2013 to 2.0% in 2018. with higher rates among individuals aged 55–64 and women. Riskesdas 2023 data revealed that North Sumatra reported a prevalence of 8.47%. yet only 57.92% of patients had accessed medical care as of 2019[5].

T2DM accounts for approximately 90–95% of all diabetes cases. Risk factors include age. sex. family history. education. occupation-related stress. and lifestyle choices. If uncontrolled. T2DM can lead to severe acute and chronic complications. including microvascular (retinopathy. nephropathy. neuropathy) and macrovascular (cardiovascular disease. stroke) damage[6]. These conditions often necessitate polypharmacy. increasing the risk of drug-related problems (DIDRs). such as inappropriate drug choices. incorrect dosages. adverse reactions. and drug interactions—leading to poor treatment outcomes and increased healthcare costs[7]

Beyond clinical consequences. diabetes imposes a substantial economic burden through higher medical costs and reduced productivity. Pharmaceutical expenses constitute a significant portion of treatment costs. Given that T2DM requires lifelong pharmacotherapy. optimizing treatment based on cost and effectiveness is crucial[8].

Pharmacoeconomic evaluations. particularly cost-effectiveness analysis (CEA). support evidence-based decisions in clinical practice. CEA measures clinical benefits in relation to treatment costs. typically using Average Cost-Effectiveness Ratio (ACER) and Incremental Cost-Effectiveness Ratio (ICER) to identify optimal therapies[9].

A study by Rusli et al. (2024) in Makassar found that 87.5% of 56 diabetic patients received inappropriate drug choices. while 12.5% received incorrect dosages—highlighting the gap between practice and guidelines. Therefore. hospitals must routinely assess drug use to ensure safe. effective. and economically sound diabetes management[10].

Aligning prescribing practices with national clinical guidelines. such as those from the Indonesian Society of Endocrinology (PERKENI 2021). is essential. Given this background. the present study aims to evaluate the appropriateness of antidiabetic drug selection and dosage in hospitalized T2DM patients at Royal Prima General Hospital Medan from January to June 2024. It also seeks to assess the cost-effectiveness of the therapies used to provide recommendations for improving both clinical and economic outcomes in T2DM care.

## METHODOLOGY

### *Study Design*

This study employed a non-experimental. descriptive research design with a cross-sectional approach. The cross-sectional design is used to explore the relationship between risk factors and outcomes through observational data collection conducted at a single point in time. Measurements of all variables were carried out once during the study period[11].The aim was to evaluate the appropriateness of antidiabetic drug selection and dosage. as well as to perform a cost-effectiveness analysis in patients with type 2 diabetes mellitus (T2DM) who were hospitalized. Data were collected retrospectively from patient medical records during the period of January to June 2024. A purposive sampling technique was used. where samples were selected based

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on specific inclusion criteria relevant to the study objectives[12].

***Study Location and Period***

This research was conducted at Royal Prima Hospital Medan. located at Jl. Ayahanda No. 68A. Sei Putih Tengah. Medan Petisah District. Medan City. North Sumatra. Indonesia. Data collection and analysis were performed in February 2025.

***Population and Sample***

The study population included all medical records of inpatients diagnosed with type 2 diabetes mellitus who received antidiabetic therapy at Royal Prima Hospital Medan during the specified study period.

The research sample comprised medical records that met the inclusion criteria. A total of 48 medical records were identified as the study population. The sample size was calculated using Slovin's formula with a 5% margin of error. yielding a sample of approximately 43 patients:

$$n = \frac{N}{1+N(e^2)} = \frac{48}{1+48(0.05^2)} = \frac{48}{1.12} \approx 43 \text{ patients}$$

Where:
n = required sample size
N = total population (48)
e = margin of error (0.05)

***Inclusion Criteria***

a. Medical records of inpatients aged ≥18 years with a confirmed diagnosis of type 2 diabetes mellitus.
b. Complete medical records containing the following data: patient ID. age. gender. year of diagnosis. date of examination. blood glucose levels. and comprehensive pharmacotherapy information. including drug name. dosage. formulation (oral or injectable). duration. frequency. and dosing interval.
c. Patients receiving antidiabetic therapy in any form—oral. injectable. or combination therapy.

***Exclusion Criteria***

a. Incomplete or missing medical records.
b. Medical records of patients who were deceased during the hospitalization period.

***Data Collection and Measurement***

The data collection process involved reviewing and extracting relevant information from inpatient medical records and cost-related documentation. The primary data obtained included demographic characteristics (age. sex). clinical data (diagnosis. blood glucose levels) and pharmacotherapy details (drug name, dosage, route, frequency and treatment duration). Cost data were obtained from hospital records pertaining to the total expenditure related to antidiabetic therapy [13].

***Data Analysis***

The collected data were analyzed using descriptive statistical methods to provide an objective representation of the current prescribing practices for antidiabetic drugs. The data were first screened for completeness. then entered into a tabulation format. The frequency and percentage of each variable were calculated and presented in tables. Drug and dose appropriateness were evaluated based on the 2021 Clinical Guidelines from the Indonesian Society of Endocrinology (PERKENI). Appropriateness was defined as the alignment between the prescribed drug and dosage and the recommendations in the guideline. considering patient-specific parameters such as age. renal function. and glycemic targets [12].

For the cost-effectiveness analysis. treatment regimens were evaluated using two main pharmacoeconomic indicators:

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a. Average Cost-Effectiveness Ratio (ACER): calculated by dividing the total treatment cost by the clinical outcome (i.e. reduction in blood glucose)[14]
b. Incremental Cost-Effectiveness Ratio (ICER): calculated by comparing the difference in costs and outcomes between two treatment alternatives[15].

The data were processed and analyzed using SPSS version 25 for descriptive statistics and Microsoft Excel 2019 for tabulation. graphical representation. and cost-effectiveness analysis.

## RESULTS AND DISCUSSION

### *Patient Characteristics*

This study included 43 inpatients diagnosed with type 2 diabetes mellitus (T2DM) at Royal Prima Hospital Medan from January to June 2024. The analysis of patient characteristics covered demographic aspects (gender and age). presence of comorbidities. and the types of antidiabetic therapy administered.

### *Gender and Age Distribution*

As shown in Table 1 and visualized in Figure 1. the majority of patients were female (55.8%). while male patients accounted for 44.2%. This trend aligns with the findings from the Indonesian national survey (*Riskesdas 2018*). which reported a slightly higher prevalence of diabetes in women. One possible explanation is the decline in estrogen levels post-menopause. which impairs insulin sensitivity and predisposes women to glucose metabolism disorders. Additionally. lifestyle factors such as decreased physical activity and higher rates of central obesity in women may contribute to this observation[16]

.

**Table 1.** Patient Characteristics by Gender and Age

| Category | Frequency | Percentage (%) |
|---|---|---|
| Male | 19 | 44.2 |
| Female | 24 | 55.8 |
| 25–35 years | 1 | 2.3 |
| 36–45 years | 5 | 11.6 |
| 46–55 years | 6 | 14.0 |
| 56–65 years | 21 | 48.8 |
| >65 years | 10 | 23.3 |

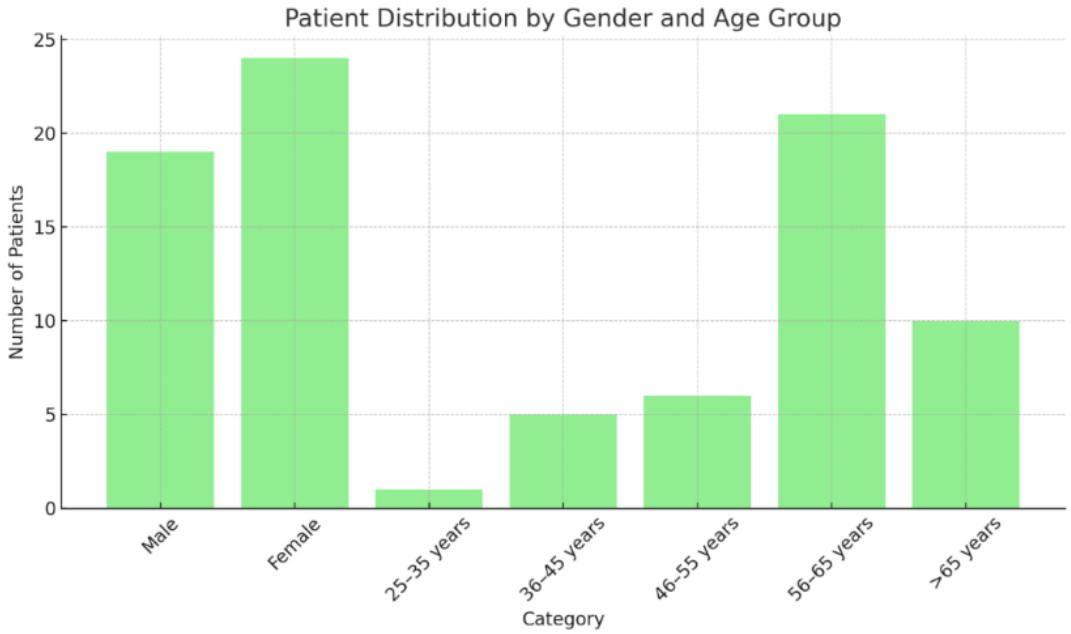


**Figure 1.** Patient Distribution by Gender and Age Group

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The 56–65 years age group comprised the largest proportion of patients (48.8%), followed by patients aged >65 years (23.3%). This distribution reflects the chronic. progressive nature of T2DM. where age is a significant non-modifiable risk factor. As people age. beta-cell function tends to decline, insulin resistance increases and cumulative exposure to metabolic stressors exacerbates glycemic dysregulation. The prevalence of T2DM among patients aged 36 to 55 years. although lower. indicates the disease's onset can occur relatively early. especially in individuals with poor lifestyle habits or a strong family history of diabetes[17–19].

***Comorbid Conditions***

Out of the 43 patients analyzed. 23 (53.5%) had one or more comorbidities. while the remaining 20 patients (46.5%) did not have recorded comorbid conditions. The most frequently observed comorbidity was hypertension (14.0%), followed by neuropathy (9.3%) and anemia and stroke each affecting 7.0% of patients. Renal colic was found in 4.7% of cases and other less frequent conditions—such as pneumonia, tuberculosis, brain tumors, abdominal colic, and infective endocarditis—were each reported in 2.3% of patients[20].

The coexistence of T2DM and hypertension is well-established in literature. and can be attributed to shared risk factors such as insulin resistance. Inflammation, and endothelial dysfunction. Chronic hyperglycemia leads to vascular damage. promoting the development of both microvascular and macrovascular complications.

This finding is consistent with previous studies which highlight that endothelial injury due to prolonged high blood glucose levels may increase vascular permeability. lipid accumulation. and inflammatory responses—ultimately contributing to atherosclerosis and elevated blood pressure in diabetic patients[16].

***Type of Antidiabetic Therapy***

Regarding treatment regimens. 33 patients (76.7%) received combination therapy. while only 10 patients (23.3%) received monotherapy. The predominance of combination therapy suggests that a significant portion of patients had advanced disease requiring intensified glycemic control. In many hospitalized cases. basal insulin alone may not suffice. and additional prandial insulin or oral antidiabetics are needed to maintain target glucose levels. The frequent use of basal-bolus insulin regimens. as well as combinations involving Metformin and DPP-4 inhibitors (e.g. Sitagliptin). Reflects adherence to current guideline recommendations for hospitalized patients with uncontrolled T2DM. Therapy intensification is typically required when HbA1c exceeds 7.5% or when oral agents alone fail to control fasting and postprandial glucose levels[21].

***Antidiabetic Therapy Profile and Appropriateness***

Antidiabetic pharmacotherapy in hospitalized patients with type 2 diabetes mellitus (T2DM) requires careful selection and dosing to ensure optimal glycemic control. prevent complications. and reduce hospital stays. This study analyzed the treatment patterns among 43 inpatients at Royal Prima Hospital Medan from January to June 2024[22].

***Distribution of Antidiabetic Therapy***

The overall therapy profile. presented in Table 2 and Figure 2. indicates a clear predominance of combination therapy over monotherapy. Of the 43 patients:

a. 33 patients (76.7%) received combination therapy
b. 10 patients (23.3%) received monotherapy

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**Table 2.** Therapy Types for T2DM Inpatients

| Therapy Type | Number of Patients | Percentage (%) |
|---|---|---|
| Glimepiride (monotherapy) | 1 | 2.3 |
| Metformin (monotherapy) | 4 | 9.3 |
| Pioglitazone (monotherapy) | 2 | 4.7 |
| Novorapid® (monotherapy) | 2 | 4.7 |
| Lantus® (monotherapy) | 1 | 2.3 |
| Metformin + Sitagliptin | 4 | 9.3 |
| Pioglitazone + Metformin | 1 | 2.3 |
| Pioglitazone + Sitagliptin | 1 | 2.3 |
| Novorapid® + Metformin | 2 | 4.7 |
| Novorapid® + Lantus® | 19 | 44.1 |
| Glimepiride + Metformin | 1 | 2.3 |
| Lantus® + Metformin | 5 | 11.6 |

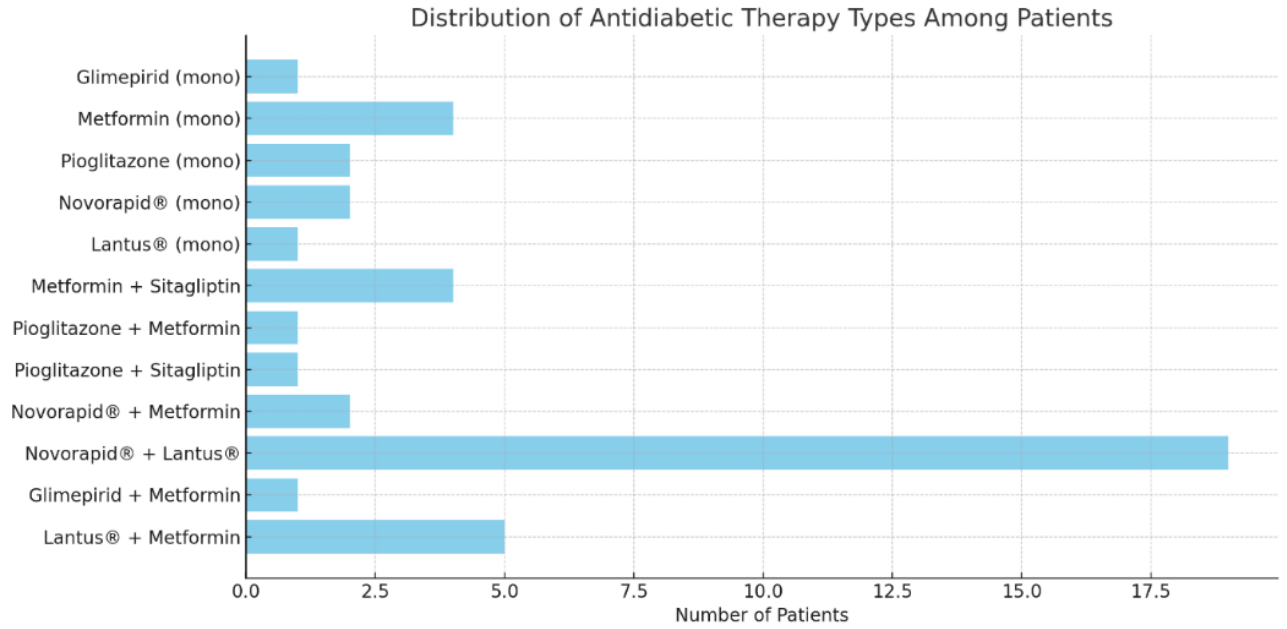


**Figure 2.** Distribution of Antidiabetic Therapy Types Among Patients

As seen in Figure 2. the most frequently prescribed regimen was the combination of Novorapid® (rapid-acting insulin) and Lantus® (long-acting insulin). administered in 44.1% of patients. This finding aligns with basal-bolus insulin therapy guidelines. which are often employed in hospitalized patients experiencing significant hyperglycemia or stress-induced glycemic fluctuations. Basal-bolus regimens offer better flexibility in controlling both fasting and postprandial blood glucose levels. especially in patients unresponsive to oral hypoglycemic agents[4]

***Monotherapy Trends and Rationale***

Among monotherapies. Metformin was the most commonly used agent (9.3%). consistent with the PERKENI 2021 and ADA 2022 recommendations that endorse Metformin as first-line therapy in T2DM. Metformin's mechanism—primarily the inhibition of hepatic gluconeogenesis and enhancement of peripheral insulin sensitivity—makes it effective and widely applicable.

Other monotherapies included:

a. Pioglitazonee (4.7%): a thiazolidinedione that improves insulin sensitivity in peripheral tissues. However. its use is often

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limited due to adverse effects like fluid retention. weight gain. and potential cardiovascular risks in patients with heart failure.

b. Glimepiride (2.3%): a sulfonylurea that stimulates pancreatic insulin secretion. Although cost-effective. its usage is declining due to risks of hypoglycemia and weight gain. especially in elderly or renally impaired patients.
c. Insulin Monotherapy: Novorapid® and Lantus® were used independently in a small proportion of cases (4.7% and 2.3%. respectively). These cases likely involved patients with contraindications to OHAs or acute glucose dysregulation requiring rapid intervention.

***Combination Therapy Insights***

Combination therapies are commonly required in patients with:

a. Prolonged disease duration
b. Poor glycemic control
c. Coexisting comorbidities

After Novorapid® + Lantus®. the most frequent combinations were:

a. Lantus® + Metformin (11.6%): Combining long-acting insulin with a sensitizer (metformin) helps control both fasting and overall glycemia.
b. Metformin + Sitagliptin (9.3%): A cost-effective and weight-neutral combination that boosts endogenous insulin secretion without causing hypoglycemia.
c. Other combinations (each 2.3–4.7%) included Pioglitazone + Metformin. Pioglitazone + Sitagliptin. Novorapid® + Metformin. and Glimepiride + Metformin—representing more tailored therapeutic decisions based on individual patient profiles. tolerance. and renal/hepatic considerations.

***Antidiabetic Therapy Profile and Appropriateness***

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***Appropriateness of Drug Selection and Dosage***

The appropriateness of drug therapy in managing type 2 diabetes mellitus (T2DM) is critical to ensuring therapeutic effectiveness. minimizing adverse effects. and achieving glycemic targets. In this study. the evaluation was performed based on the 2021 Indonesian Society of Endocrinology (PERKENI) guidelines. which provide comprehensive recommendations on antidiabetic drug selection and dosage tailored to patient characteristics and clinical status[12].

***Drug Selection Appropriateness***

All 76 recorded prescriptions were found to be 100% appropriate in terms of drug selection. demonstrating full compliance with the PERKENI 2021 guideline. This indicates that prescribers at Royal Prima Hospital Medan followed recommended clinical pathways in choosing antidiabetic agents according to the patient's profile. including glycemic levels. comorbidities. and organ function status. Such adherence is essential for avoiding Drug Related Problems (DIDRs) such as therapeutic failure or adverse events. particularly in hospitalized patients who often present with complex clinical conditions[23].

***Dosage Appropriateness***

The appropriateness of dosage was slightly below optimal. with 98.64% of prescriptions having correct dosing and 1.36% (1 case) classified as inappropriate. The detailed findings are presented in Table 3 below:

**Table 3.** Appropriateness of Dosage for Antidiabetic Drugs

| Appropriateness | Frequency | Percentage (%) |
|---|---|---|
| Appropriate Dose | 75 | 98.64 |
| Inappropriate Dose | 1 | 1.36 |
| Total | 76 | 100 |

The single case of inappropriate dosing involved Sitagliptin being administered at a daily dose of 50 mg. which is below the standard therapeutic dose of 100 mg/day recommended for patients with normal renal function. According to clinical pharmacology references. the reduced dose of 50 mg is generally reserved for patients with moderate renal impairment (eGFR 30–50 mL/min/1.73 m²). Therefore. unless renal function was compromised (which was not indicated). this dosing was considered subtherapeutic.

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***Clinical Implication of Underdosing***

Underdosing in antidiabetic therapy poses significant clinical concerns:

a. Subtherapeutic drug levels may result in insufficient glycemic control. exposing patients to prolonged hyperglycemia and increased risk of both microvascular and macrovascular complications.
b. Delayed therapeutic response may lengthen hospital stays and escalate healthcare costs.
c. In the case of Sitagliptin. insufficient DPP-4 inhibition limits the enhancement of endogenous incretin hormones. reducing insulin secretion and postprandial glucose regulation.

Appropriate dosing is particularly crucial in hospitalized settings where glucose fluctuations are common due to physiological stress. inflammation. altered nutritional intake. and use of corticosteroids or other interacting drugs.

Importance of Routine Dose Review

This finding underscores the need for:

a. Routine medication reviews by clinical pharmacists and physicians.
b. Integration of renal function monitoring into prescribing systems. especially for renally excreted drugs like Sitagliptin.
c. Continued education and updates for prescribers on evolving guideline recommendations and individualized dose adjustments.

***Direct Medical Cost Analysis***

Direct medical cost analysis is an essential component in evaluating the economic burden of type 2 diabetes mellitus (T2DM) management. particularly in hospitalized settings. These costs include not only pharmacological therapy but also encompass inpatient care. physician consultations. laboratory diagnostics. nursing services. and medical device usage. Understanding the average expenditure per therapy regimen allows clinicians and hospital administrators to assess resource allocation and identify opportunities for cost-effective treatment.

In this study. the direct medical costs of each antidiabetic therapy regimen were calculated based on 43 inpatient cases from Royal Prima Hospital Medan (January–June 2024). with the results summarized in Table 4.

The cost analysis revealed several notable findings. The lowest average treatment cost was observed in patients receiving Metformin + Sitagliptin (IDR. 7.531.686). despite this being a combination therapy. This outcome may be attributed to the outpatient-oriented nature of oral agents. which typically require less intensive inpatient monitoring and fewer supportive interventions. Similarly. Glimepiride monotherapy demonstrated a relatively low cost (IDR 8.388.643). likely due to its affordability. straightforward dosing. and the absence of injectable components or complex monitoring requirements.

In contrast. Pioglitazone monotherapy was associated with the highest average cost among all monotherapy regimens (IDR. 21.629.202). This elevated cost may reflect extended hospitalization periods. the need for additional supportive treatments. or its use in patients with more complicated clinical profiles. Among the combination therapies. the Novorapid® + Lantus® regimen. which represents a basal-bolus insulin strategy. incurred the highest overall average cost (IDR 12.430.457). This finding aligns with the known demands of insulin-based therapy. which include frequent blood glucose monitoring. increased nursing intervention. greater use of disposable medical supplies (such as pens. syringes. and glucometer strips). and a higher likelihood of inpatient complications. particularly hypoglycemia.

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***Clinical and Economic Implications***

The wide variation in direct medical costs among different therapy regimens underlines the importance of pharmacoeconomic evaluation in hospital settings. While costlier regimens like basal-bolus insulin may be clinically necessary in poorly controlled or advanced T2DM. their higher resource utilization underscores the need for:

a. Strict glycemic control prior to hospitalization
b. Optimization of oral therapy before transitioning to insulin
c. Efficient discharge planning to reduce length of stay

Furthermore. oral combination therapies (e.g. Metformin + Sitagliptin) offer a compelling balance between effectiveness and cost. especially for stable patients or those without severe hyperglycemia. These regimens may be particularly suitable for broader implementation in resource-limited hospital environments.

***Cost-Effectiveness Analysis Based on ACER***

The Average Cost-Effectiveness Ratio (ACER) is calculated by dividing the average total medical cost by the effectiveness percentage of a therapy. A lower ACER indicates a more cost-effective intervention. From the table 5. Glimepiride is the most cost-effective monotherapy (oral and injectable) with an ACER of IDR. 83.886.43. due to its maximum effectiveness at the lowest cost. Among combination therapies. pioglitazone + metformin is the most cost-effective. with an ACER of IDR 100,639.21.

This result is reinforced through cost-effectiveness grid analysis. where all other monotherapy options (e.g. metformin. pioglitazone. Novorapid®. Lantus®) fall into "dominated" (C) positions. indicating they are more expensive and less effective compared to Glimepiride. Likewise. in combination therapies. pioglitazone + metformin dominates others like pioglitazone + sitagliptin. Novorapid® + metformin. and Lantus® + metformin. which are less effective and more costly.

***Cost-Effectiveness Analysis Based on ICER***

Incremental Cost-Effectiveness Ratio (ICER) quantifies the additional cost required to achieve one additional unit (1%) of therapeutic effectiveness compared to a standard therapy.

All therapies other than Glimepiride yielded negative ICER values. indicating higher costs with lower effectiveness. and thus are not cost-effective compared to Glimepiride. This reinforces Glimepiride as the dominant monotherapy option. Based on the ICER calculation table of the drug combination of Pioglitazone + metformin (dominant option) against the combination of Metformin + sitagliptin and the combination of Novorapid® + metformin. which are IDR 76,734.39 and 13,317.37. The ICER value is positive. which means that additional costs of IDR. 76.734.39 and IDR. 13.317.37 are required to obtain an additional 1% effectiveness. Glimepiride has the most cost-effective incremental cost-effectiveness ratio (ICER) for oral and injectable monotherapy medications. Other treatments are in region C (Dominated), which indicates that they are less effective and more expensive than the comparator treatment[24]. In other words. treatments that fall into column C are not advised for use since they are less economically efficient due to their greater costs and lower benefits. The combination therapy of metformin + sitagliptin and Novorapid + metformin has ICER values of IDR 76,734.39 and IDR 13,317.37 per 1% increase in efficacy.

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respectively. According to the ICER calculations for the oral and injection combinations. This indicates that. in comparison to pioglitazone + metformin. the combination of Novorapid + metformin and metformin + sitagliptin required additional expenses of IDR 76,734.39 and IDR 13,317.37 to obtain an extra 1% effectiveness. The Novorapid + metformin and metformin + sitagliptin combinations had lower ICER values, suggesting that the cost-effectiveness gain from pioglitazone + metformin use is still proportionate to the efficacy gain[25]. Therefore, the pioglitazone + metformin therapy can be regarded as more cost-effective than alternative medicines in terms of both cost and effectiveness. With an ACER value of IDR 4,523 and an ICER value of IDR 1,755. Glimepiride was shown to be the most cost-effective oral monotherapy for patients with type 2 diabetes mellitus at RSUD Bumiayu. This study is consistent with studies done by Jannah et al. (2021). With a negative ICER value ranging from –IDR 387,767 to –IDR 935,074. suggesting a dominating therapy. Pambagyanik et al.'s research from 2023 also supports this study. showing that Glimepiride + Pioglitazone is more cost-effective than Glimepiride + Metformin[23,26].

**Table 4.** Average Direct Medical Costs by Therapy

| Therapy | Average Cost (IDR) |
|---|---|
| Glimepiride (monotherapy) | 8,388,643 |
| Metformin (monotherapy) | 12,833,267 |
| Pioglitazone (monotherapy) | 21,629,202 |
| Novorapid® (monotherapy) | 11,699,987 |
| Lantus® (monotherapy) | 12,021,821 |
| Metformin + Sitagliptin | 7,531,686 |
| Pioglitazone + Metformin | 10,063,921 |
| Novorapid® + Lantus® | 12,430,457 |

**Table 5.** ACER Values of Antidiabetic Therapies

| Therapy | Average Medical Cost (IDR) | Effectiveness (%) | ACER (IDR) |
|---|---|---|---|
| Glimepiride | 8,388,643 | 100 | 83,886.43 |
| Metformin | 12,833,267 | 90 | 142,591.00 |
| Pioglitazone | 21,629,202 | 50 | 432,584.04 |
| Novorapid® Pen | 11,699,987 | 50 | 234,000.00 |
| Lantus® Pen (Glargine) | 12,021,821 | 33.33 | 360,691.00 |
| Metformin + Sitagliptin | 7,531,686 | 67 | 112,413.00 |
| Pioglitazone + Metformin | 10,063,921 | 100 | 100,639.21 |
| Pioglitazone + Sitagliptin | 11,565,589 | 33.33 | 347,002.00 |
| Novorapid® Pen + Metformin | 9,065,118 | 25 | 362,605.00 |
| Novorapid® Pen + Lantus® Pen | 12,430,457 | 23.25 | 534,645.00 |
| Glimepiride + Metformin | 20,997,076 | 50 | 419,942.00 |
| Lantus® Pen + Metformin | 12,626,634 | 27.27 | 463,023.00 |

**Table 6.** ICER of Oral and Injectable Monotherapies (Comparator: Glimepiride)

| Therapy | Avg. Cost (IDR) | ΔCost (IDR) | Effectiveness (%) | ΔEffectiveness (%) | ICER (IDR) |
|---|---|---|---|---|---|
| Glimepiride | 8.388.643 | – | 100 | – | Comparator |
| Metformin | 12.833.267 | 4,444,624 | 90 | -10 | -444,462.40 |
| Pioglitazone | 21.629.209 | 13,240,566 | 50 | -50 | -264,811.32 |
| Novorapid® Pen | 11.699.987 | 3,311,344 | 50 | -50 | -66,226.88 |
| Lantus® Pen | 12.021.821 | 3,633,178 | 33.33 | -66.67 | -54,494.94 |

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**Table 7.** ICER value calculation results for antidiabetic drug combinations

| Therapy | Average medical cost (IDR) | Direct medical cost (IDR) | Effectiveness (%) | ACER | Effectiveness difference | ICER value |
|---|---|---|---|---|---|---|
| Comparator drugs (Pioglitazone+Metformin) | 10,063,921 | - | 100 | 100,639.21 | - | 100,639.21 |
| Metformin+sitagliptin (compared) | 7,531,686 | 2,532,235 | 67 | 112,413 | 33 | 76,734.39 |
| Novorapid®pen + metformir | 9,065,118 | -998,803 | 25 | 362,605 | -75 | 13,317.37 |

## CONCLUSION

Based on the evaluation of drug and dosage appropriateness as well as cost-effectiveness analysis in Type 2 Diabetes Mellitus patients at Royal Prima Hospital Medan, several conclusions can be drawn. The majority of patients were female (55.8%), which may be related to decreased estrogen levels after menopause that affect insulin sensitivity. Most patients were within the 56–65 year age group (48.8%), and more than half (53.5%) had comorbidities, with hypertension being the most common (14.0%). All patients received antidiabetic medications in accordance with the 2021 PERKENI clinical guidelines. However, there was a 1.36% discrepancy in dosage, notably the administration of sitagliptin at 50 mg/day instead of the recommended 100 mg/day, which could potentially reduce therapeutic effectiveness or increase the risk of side effects. The cost-effectiveness analysis revealed that Glimepiride was the most cost-effective option for monotherapy, achieving 100% effectiveness with an ACER value of IDR 83,886.43. In combination therapy, pioglitazone + metformin was found to be the most cost-effective, with 100% effectiveness, an ACER value of IDR 100,639.21, and ICER values of IDR 76,734.39 and IDR 13,317.37, indicating its efficiency in terms of both cost-effectiveness and clinical benefit.

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