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Cost Driver of Diabetes Mellitus Care in JKN Healthcare Facilities: A Case Study from Indonesia

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ABSTRACT

Background: Diabetes Mellitus (DM) is one of the most serious global health issues, with a sharply increasing healthcare cost burden, particularly in low- and middle-income countries such as Indonesia. Research on the determinants of DM treatment cost in JKN-affiliated healthcare facilities in Indonesia remains limited.
Purpose: This study aims to analyze the factors influencing variations in the treatment costs of DM patients at advanced referral healthcare facilities under JKN scheme.
Method: This research employed a observational analytical design with a cross-sectional approach. Data were obtained from a sample of JKN patients in 2021, comprising 25,539 primary DM cases. Statistical analysis was performed using the Kruskal-Wallis and Mann-Whitney tests to examine length of stay, type of healthcare facility, type of clinical intervention, disease severity, region, referral pattern, and JKN membership classification
Result: The average treatment cost for DM was IDR 2,512,968, while the weighted average cost was IDR 25,600,935. Statistically significant variations in treatment costs were identified across all independent variables (p value <0,001). Factors such as prolonged length of stay, higher disease severity, intensive clinical interventions, and referral to tertiary care facilities were associated with increased treatment costs. Regional disparities were also observed, with the highest treatment cost found in provinces on Java Island.
Conclusion: Effective management of DM treatment costs in Indonesia requires a regionally based approach, risk stratification according to service complexity, and the optimization of healthcare facility and workforce distribution. Strengthening preventive and promotive health programs is crucial to reducing long-term treatment costs.

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disorder from insufficient or ineffective use of insulin by the body. Currently, diabetes mellitus is one of the most serious global health issues. The International Diabetes Federation (IDF) estimates that the number of diabetes cases will reach 589 million by 2024, with a projected 45% increase in cases by 2050, rising to 853 million. Additionally, 11.9% of global health expenditure is spent on diabetes mellitus, leading to 3.4 million deaths annually due to diabetes. This increase is occurring at a faster rate in low-middle-income countries, where access to treatment and prevention remains highly limited[1].
The rising prevalence of diabetes, influenced by lifestyle changes and an aging demographic, is linked to numerous complications, such as retinopathy, foot problems, heart attack, stroke, nephropathy, neuropathy, gum disease, oral problem, increasing the risk of cancer and infection [2] cognitive impairment and sexual problem [3] [4] [5] These complication significantly reduce the quality of life of patients, increasing illness and death rates. The healthcare costs required for diabetes mellitus patient have posed significant challenges for public health system in many countries [6][7].

In recent years, research on diabetes mellitus has seen significant advancements in terms of publication volume and application of technologies, covering various topics such as the relationship between diabetes an another diseases [8] [9], epigenetics in diabetes mellitus [10][11], and the application of artificial intelligence (AI) in the prediction, detection, and management of DM [12][13]. Research related to the cost of diabetes mellitus has focused on areas such as the analysis of the cost of illness of DM [14][15] [16][17][7], cost-effectiveness of anti-diabetic therapies [18][19], projections of increasing diabetes treatment costs [20], the impact of diabetes mellitus complication on healthcare expenses [21], and the prevalence and economic burden on specific age group and demographics [22] [23]. Several studies have highlighted factors influencing the cost of DM patient care, such as length of hospitalization, complication levels, type of therapy, class of care, type of hospital, and BPJS membership status [24] [17][25][26]. Additionally, there are studies examining the impact of regional INA-CBGs tariff differences on variations in DM treatment costs in Indonesia[27][28].

Research on the factors influencing Diabetes Mellitus treatment cost remains partial, as it typically analyzes only 3-6 factors and does not comprehensively address the interconnection among variables. Therefore, this research presents a novel approach by filling the gap through a comprehensive study on the variation in conducted simultaneously on various factors (14 independent factors) affecting the variation in DM treatment costs for JKN patients. The result of study are expected to provide tangible benefits in improving accessibility, equity, and the quality of healthcare service for diabetes mellitus patient in Indonesia.

METHOD

Research Type

This study is an observasional analytical method with a cross-sectional design. This study utilizes data provided by the Indonesia Nastional Social Security Agency (BPJS Kesehatan), which encompasses all participants in the National Health Insurance Program (JKN). The data used consists of publicly available healthcare service claims data, covering the period from 2015 to 2021. The population in this study comprises all participants in the National Health Insurance Program (JKN) who meet the inclution criteria having a diagnoses with diabetes mellitus, as per ICD-X coding, and are enrolled in the JKN program with valid and complete healthcare service claim data from 2015-2021. The sampling process followed these step, first sub-population entails of participants who joined BPJS Kesehatan prior to 2021, and sub population 2 consists of participants who joined BPJS Kesehatan in 2021, comprising new individuals who registered as BPJS participants based on the master membership data up the end of 2021.
A stratified random sampling tehnique was employed, with strata constructed based on the type of healthcare service received (i.e primary care (FKTP, referral care (FKRTL), or no healthcare service

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utilization) to ensure a representative sample. The final research sample comprised individual who fulfilled the inclution criteria after undergoing filtering and weighting procedures. In total 25,539 patient met the criteria and were included in the study sample.

Reseach Procedure

The research procedure involved applying for access to BPJS Kesehatan data, followed by data cleaning to eliminate invalid or incomplete entries. Research variables were extracted from the dataset, followed by data validation, descriptive analysis to examine the distribution of variables, hypothesis testing using statistical methods, and interpretation of result followed by report writing.

Reseach Variables

In this study, the independent variables consist of categorical data, healthcare service categories, types of healthcare services, classifications of healthcare services, clinical interventions, service units, care classes, treatment outcomes, diagnoses, clinical decisions after diagnosis, severity level, length of stay, region, referral sources, and referral purposes. The dependent variable is direct medical costs.

Data Collection Method

The data collection method employed by total sampling, involving 25,539 patients who met the inclusion criteria of having a primary diagnosis of diabetes mellitus according to ICD-X (E10-E14) recorded in the BPJS Kesehatan data set. Only patient who received care at Advanced Referral Health Facilities (FKTL) and had complete data on healthcare costs and other required variables were included.

Data Analysis Method

Data analysis consisted of both descriptive and inferential methods. Descriptive analysis was used to assess to distribution of variables. Hypothesis testing was conducted using appropriate statistical tests. Given that the healthcare cost sample data did not follow a normal distribution, the Kruskal-Wallis test was used to compare costs across categories with more than two groups, followed by post hoc analysis. For data two categories, the Mann-Whitney U test was applied, with a significance level set at $p < 0.05$. Data processing was performed using IBM SPSS Statistics 24 to ensure the validity of the statistical results.

Research Limitation

The limitations of this study include the use of secondary data from the BPJS Kesehatan Sample Data, meaning that the availability of variables could impact the findings. This study not include patient with diabetes who are not registered in the JKN scheme or those receiving treatment outside BPJS-partnered health facilities. The long-term effectiveness of therapies, age and gender were not the primary focus.

Ethical Approval

This study has received ethical approval from the Ethic Committee with the reference number KEKP-NK/02/04/2025/03266. The ethical clearance that the research adhered to ethical guidelines and standards required for conducting research. All necessary measures were taken to protect the privacy, rights, and well-being of the participants.

RESULTS AND DISCUSSION

Treatment Cost Distribution for Diabetes Mellitus JKN for 2021

An analysis for treatment cost distribution for diabetes mellitus patient registered in Indonesia ‘s National Health Insurance (JKN) program in 2021 is provided in table 1. Direct medical costs and weighted direct medical costs, which both reflect the financial burden of healthcare expenses.

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Table 1. Treatment Costs Are Paid By Patients With Diabetes Mellitus Under The JKN Program

Variable	Minimum	Maximum	Median	Mean	SD
Direct Medical Cost	102.700	178.007.700	192.700	2.512.968	4.122.348
Weighted Direct Medical Cost	152.216	2.393.260.167	2.510.308	25.600.935	48.064.413

According to this study, patients with diabetes mellitus under JKN plot typically incurred a coordinated therapeutic tool of IDR 2,512,968, compared with the others variables in Table 1, indicating significant variation treatment costs among patient. Similarly, the result of the weighted treatment cost were consistent that the fetched run was strikingly wide, from IDR 152,216 to IDR 2,393,260,167. This is consistent with the study by Corrina (2019) on the wide variation in diabetes mellitus treatment costs. These discoveries recommend that a generally small extent of patient account for huge share of total healthcare uses, likely due to the need for serious care, the administration of constant complication, or delayed helpful intercessions[15]. These come about and are reliable with discoveries by Hidayat (2022), who detailed that the biggest component of coordinate restorative costs was freed form inpatient care (56%), followed after by hospital specialist (38%), whereas unbundled non diabetic and anti-hyperglycemic medicines accounted for a smaller parcel of the full toll taken. Additionally, the high degree of taken toll changeability among patients highlights the need for actualizing a hazard level empower the advancement of a more impartial and productive advantage bundle, wherein high-risk patients may get more serious checking and more noteworthy budgetary backing for their treatment needs.

Healthcare Administration' Diabetes Mellitus Utilizations Design Under the JKN Plot

The analysis revealed that the only 38,9% of JKN members with diabetes mellitus needed hospitalization, while a significant majority (61,1%) received advanced outpatient care (RITL). Most patient were diagnoses with type 2 diabetes mellitus, which is consistent with global epidemiological trends that indicate type 2 DM is more prevalent than type 1. 13,6 % of patient had nonspecific DM (E14), which raise the possibility that the diagnosis process was not precise. These mistakes may have an impact on treatment decisions and BPJS claims submissions since accurate diagnosis codes are essential for case-mix-base reimbursement system. From demonstrative perspective, type 2 DM (E11) accounted for 76,5% of cases and type 1 (9,4%). The majority patient (53,4%) received outpatient care without a procedure, followed by inpatient care (34,4%).

Aspects of Benefit Regulation in Private Sector

Open district or city offices treat 30,2% of people with diabetes mellitus, whereas private healthcare facilities treat more than half of all patient with the condition (55,4% of treatments). These result highlight how important the private sector is to the JKN program's success. The preference for private healthcare service is facilitated by greater availability of services, healthcare personnel, medications, improved accessibility [29][30] and the perception of higher service quality, including longer operation hours [31], better cleanliness, and shorter waiting time [32]. However several studies have indicated that some individuals avoid private healthcare service due to concern over the profit-driven motives [30]. Therefore, strengthening the capacity and improving the quality of public healthcare facilities remain a strategic priority in managing the burden of diabetes mellitus.

Previous studies have highlighted that collaboration with BPJS Kesehatan has contributed to an increase in patient visits to private hospital[33][34]. In any case, the concentration of private health centers in urban ranges raises concern around healthcare getting to aberration in provincial or inaccessible locales [35]. Subsequently, certifiable approach measures are fundamental to energizing a more evenhanded dispersion of healthcare offices [36].

Frequency distribution of JKN DB patient based on unit service and treatment outcomes

The result of the study indicate that critical extent of patient (97%) received administrations in healing centers, overwhelmingly in internal medicine (46.9%) and common outpatient offices (38.9%). Ward classification shows a prevailing underutilization of class3 rooms (79.2%). The majority of patients receiving therapy experienced stable circumstances, as evidence by the recovery rate 94.5%. The 2,4%

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mortality rate suggests case that required further research because diabetes mellitus is a chronic condition that must be managed over an extended period of time to prevent fatal complication. The requested discharge against medical advice (DAMA) for those who decided to leave before completing treatment was 0.7%. This decisions may be influenced by a variety of factors, such as financial constraints, dissatisfaction with the medical services, or a lack of awareness regarding to importance of continuing care.

Table 2. Frequency Distribution and of Variables and Result of the Kruskla-Wallis/Mann-Whitney Test

Variables	f	%	Kruskal-Wallis/Mann-W Test Result			
			Mean rank	H	df	p-value
Length of Stay (LOS)				17646	4	0,0000
0 days (Outpatient)	15.721	61,6	7931,21			
1-3 days	4.580	17,9	20203,56			
4-7 days	4.120	16,1	20610,25			
8-14 days	926	3,6	21291,96			
≥15 days	192	0,8	22310,17			
Categories of healthcare facilities				975	8	0,0000
Private Sector	14.141	55,4	13498,10			
District/Municipal Government	7.718	30,2	11005,23			
Provincial Government	1.515	5,9	13433,17			
National Police (POLRI)	672	2,6	10593,91			
Indonesian Army (TNI AD)	591	2,3	13444,01			
Central Government (Vertical Agencies)	360	1,4	18765,18			
State-Owned Enterprises (SOE)	345	1,4	16188,68			
Indonesia Air Force (TNI AU)	103	0,4	11712,98			
Indonesian Air Force (TNI AL)	94	0,4	14416,82			
Types of medical facilities (Mann Whitney)				8239982	-5,8	0,0000
Hospital	24.780	97,0	12816,97			
Main Clinic	759	3,0	11236,37			
Classification of healthcare facilities				2256	18	0,0000
Private Hospital Equivalent to Type C	7.594	29,7	13753,18			
Type C Hospital	5.833	22,8	10671,94			
Private Hospital Equivalent to Type D	3.216	12,6	12128,67			
Type B Hospital	2.994	11,7	14256,07			
Type D Hospital	1.263	4,9	8767,38			
Eye Specialty Hospital	1.044	4,1	13222,32			
Private Hospital Equivalent to Type B	1.044	4,1	18241,22			
Type III Military/Police Hospital	801	3,1	11468,43			
Other Specialty Hospital	511	2,0	10728,11			
Type A Hospital	459	1,8	19175,51			
Type IV Military/Police Hospital	418	1,6	10793,44			
Type II Military/Police Hospital	215	0,8	17080,74			
Maternal and Child Specialty Hospital	69	0,3	12935,21			
Surgical Specialty Hospital	36	0,1	14974,17			
Psychiatric Specialty Hospital	21	0,1	20401,69			
Pulmonary Specialty Hospital	7	0,0	9081,71			
Cardiac Specialty Hospital	6	0,0	15352,50			
Private Hospital Equivalent to Type A	6	0,0	21363,83			
Non-Emergency Provider Hospital	2	0,0	17298,50			

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Length of Stay (LOS) among patient with Diabetes Mellitus JKN

The distribution shows that only a small percentage of diabetes mellitus cases require extended hospitalization (38.4%), with the rest receiving treatment as outpatients (61.6%). In order to reduce unnecessary hospital stays, diabetes management must be optimized because longer lengths of stay have been linked to increased morbidity and treatment costs [37].

Tables 3. Frequency Distribution and of Variables and Result of the Kruskal-Wallis/Mann-Whitney Test (cont.)

Variables	f	%	Kruskal-Wallis Test Result			
			Mean rank	H	df	p-value
Clinical Intervention (Mann Whitney)				649731	-133,8	0,0000
Outpatient Care at Advanced Referral Facilities	15.608	61,1	7846,13			
Inpatient Care at Advanced Referral Facilities	9.931	38,9	20508,58			
Service Unit				18551	21	0,0000
Internal Medicine	11.988	46,9	7268,04			
Outpatient	9.931	38,9	20508,00			
Ophthalmology	1.744	6,8	11989,44			
Emergency Department	975	3,8	7504,15			
Surgery	483	1,9	7828,73			
Neurology	230	0,9	7394,33			
Cardiology	52	0,2	10106,43			
Anesthesiology	29	0,1	6348,45			
Orthopedy	27	0,1	7663,39			
Pulmonology	19	0,1	8049,18			
Medical Record departement	18	0,1	5062,11			
Nutrition	10	0,0	10764,70			
Cardiothoracic Surgery	6	0,0	10963,17			
Hemodialisa	6	0,0	12264,83			
Urology	5	0,0	10537,40			
Chemotherapy	3	0,0	14934,00			
Obstetric and Gynecology	3	0,0	12861,17			
ENT (Ear, Nose, Throat)	3	0,0	7980,33			
Oral Surgery	2	0,0	13218,50			
Plastic Surgery	2	0,0	9693,00			
Dermathology Unit	2	0,0	2254,50			
Psychiatry	1	0,0	7078,00			
Ward Classification						
Class 3 Ward	20.235	79,2	10565,73			
Class 1 Ward	3.431	13,4	21372,49			
Class 2 Ward	1.873	7,3	20825,69			
Treatment Outcome						
Recovered	24.129	94,5	12495,52			
Death	611	2,4	21164,47			
Referred	510	2,0	13918,67			
Discharged Against Medical Advice (DAMA)	188	0,7	18339,53			
Unknown	101	0,4	11394,68			

Analysis of National Health Insurance (JKN) Participant' Determinant Factors Affecting the Cost of Treating Diabetes Mellitus

This study conducted a weighted treatments cost analysis of diabetes mellitus treatment among JKN participants based on several explanatory factors, including length of stay, type and classification of

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healthcare facilities, type of clinical intervention, service units, ward class, severity level, referral direction and sources, and JKN membership classification. To determine whether cost differ significantly depending on patient characteristic and healthcare service quality, statistical testing was done using the Kruskal-Wallis and Mann-Whitney U techniques.

Analysis of Treatment Cost Variations by Length of Stay for Patient with Diabetes Mellitus under JKN Program

According to the Kruskal-Wallis test result, treatment costs for patient diabetes mellitus JKN differ substantially based on the duration of stay. The cost of treatment varies significantly between these groups. The length of stay has an effect on the cost of treating diabetes mellitus, as the median test also reveals significant variations in treatment costs. Treatment costs for DM generally increase with length of stay, the highest cost were incurred by patient who stayed more than 15 days. Hospital policy should take efficiency in reducing treatment costs into consideration, especially for prolonged inpatient stays. Earlier research has shown that a connection between comorbidities and the severity of the conditions with the length of hospitalization in patient with DM which result in an increase in treatment costs [38][39][40].

Analysis of Treatment Cost Variation by Ward Class

The Kruskal-Wallis test results show a significant variation in the costs of treating DM based on hospital ward class. Class 1, Class 2, and Class 3 cost differenced are significant, with a p-value of 0.000 and a chi-square value of 8,716.107. Comparing class 1 and class 2 treatment expenses class 3, the post hoc results demonstrate a considerable difference. This finding is consistent with previous research [17]. However, the study by Riyanto (2024) found that there were significant financial losses for hospital across the different ward classes.

Analysis of treatment Cost Variation by Categories of Healthcare Facilities

A Kruskal-Wallis test revealed a statistically significant difference in treatment cost between facility types based on the type of healthcare facility ($p<0.0001$), suggesting that institution type plays a crucial role in determining cost burdens. The hospital with the highest average cost ranking were Vertikal Hospitals (central government–owned referral hospitals), state-owned Enterprise (BUMN) and Navy-affiliated Institution (TNI AL). These facilities, which are usually tertiary referral centers, deal with complicated patient that frequently necessitate for more involved diagnostic processes, loner treatment periods, and inpatient care, all of which add to their heavy financial load. On the other hand , Soewono and Tjahjadi's research found that high costs were attribute of high operational expenses of hospitals, which include marketing costs, excessive medication inventory, stockout of drug from manufacturers, the need for the implementation of information and communication technology, as well as the cost associated with non-physician medical personnel [41].

In contrast, POLRI healthcare facilities and local government hospital in Pemkab/Kota were found to have the lowest ranking in terms of cost, indicating a lower average spending per case. Financial effectiveness may be indicated by this, but it may also indicate underutilization, limited service availability, or more limited range of treatment options in these types of facilities. The middle-of-the-road trend observed in provincial and private hospitals suggest more standardized costs, which could be the result of more stable service levels and well-established tariff structures. The findings corroborate earlier National Social Security Council (DJSN) (2023) reports that identified referral hospitals as a major of cost concentration.

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Tables 4. Frequency Distribution of Variables and Result of the Kruskal-Wallis/Mann-Whitney Test (cont.)

Variables	f	%	Kruskal-Wallis /Mann-Whitney U Result			
			Mean rank	H	df	p-value
Diagnosis				94	4	0,0000
E11 Type 2 diabetes mellitus	19.525	76,5	12764,18			
E14 Unspecified diabetes mellitus	3.463	13,6	12128,44			
E10 Type 1 diabetes mellitus	2.406	9,4	13693,05			
E13 Other specified diabetes mellitus	115	0,5	11892,32			
E12 Malnutrition-related diabetes mellitus	30	0,1	19953,32			
Post-diagnosis clinical decision				19061	5	0,0000
Outpatient care without associated procedure	13.631	53,4	7220,85			
Inpatient care without procedure	8.784	34,4	20136,12			
Significant outpatient procedure	1.558	6,1	10971,89			
Inpatient procedure	1.146	4,5	23361,97			
Major outpatient procedure	419	1,6	16564,94			
Inpatient obstetric care	1	0,0	22203,00			
Severity Level				18213	3	0,0000
Outpatient Care	15.608	61,1				
Mild (Inpatient Care – Severity Level 1)	5.660	22,2				
Moderate (Inpatient Care – Severity Level 2)	3.071	12,0				
Severe (Inpatient Care – Severity Level 3)	1.200	4,7				
Referral to				2435	9	0,0000
Private Sector	11.518	45,1	14292,34			
Regency Government	11.385	44,6	10566,26			
Provincial Government	657	2,6	18452,23			
Indonesian Army (TNI-AD)	484	1,9	15217,89			
State-Owned Enterprise (SOE)	465	1,8	14356,65			
Indonesian National Police	406	1,6	14505,09			
Non-referral	273	1,1	8960,91			
National Referral Hospital (under Ministry of Health)	202	0,8	22573,46			
Indonesian Navy (TNI-AL)	88	0,3	15097,68			
Indonesian Air Force (TNI-AU)	61	0,2	13587,52			
Referral from				11123	3	0,0000
General Practitioner (GP)	13204	51,7	17381,06			
Community Health Center (Puskesmas)	7.911	31,0	6945,78			
Primary Clinic	3.856	15,1	8978,40			
Non-referral	568	2,2	12438,08			
Classification of JKN Membership Types				185	4	0,0000
PBPU	7.889	30,9	13342,33			
PPU	7.712	30,2	11880,76			
BP	4.434	17,4	12925,59			
PBI APBD	2.883	11,3	12710,52			
PBI APBN	2.621	10,3	13466,02			

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Analysis of Treatment Cost Variation by Service Unit

Depending on the healthcare service unit, the JKN program's diabetes mellitus treatment costs can differ substantially. According to a post-hoc test, only 6 out of 100 comparison of treatment costs between diabetes mellitus patients enrolled in the JKN program. In particular, there were notable difference in treatment costs between internal medicine and outpatient care, internal medicine and ophthalmology, anesthesiology and both units and internal medicine and outpatient acre. The study's conclusion it that, in order to guarantee efficiency and equity, a risk stratification approach and need based budgeting, specific to the kind of healthcare service unit are required.

Analysis of Treatment Cost Variation by JKN Membership Types

The cost of treatment for patient with diabetes mellitus varies greatly depending on their type of JKN membership. This study demonstrates a difference in treatment cost by JKN membership. The state budget-supported, PBPU and PBI had higher average treatment costs, indicating that they are more likely to have diabetes mellitus with severe consequences that require more costly and intensive care. PBI APBN and PBPU are, therefore crucial targets for preventive measures due to their high treatment costs. Conversely, Pekerja Penerima Upah (PPU) demonstrates relatively lower treatment costs, demonstrating the efficacy of disease prevention and health management. This situation demonstrates how PPU members, as involved worker, are a model for efficient healthcare cost control.

The significant mean rank values that demonstrate the higher treatment cost in the PBI and PBPU group, which emphasize the need for prevention-focus strategies. Regular screening programs, public health education and the promotion of healthy behaviors should all crucial component of health policies in order to reduce the need for more costly curative treatments. Additionally, optimizing primary healthcare service is necessary to lower treatment costs, especially for population with high disease burdens. Expanding access to primary healthcare facilities will enable the early detection of diabetes mellitus and its consequences before the come more severe and costly illness. Therefore, the program of free health screening conducted with the society's anniversary is an initiative that deserves strong support [42].

Analysis of Treatment Cost Variation by Diagnosis

According to the ICD-10 classification of diabetes mellitus diagnoses, the study's results demonstrate differences in treatment costs JKN ($p< 0.001$). The most expensive diagnosis is E12 (malnutrition-related diabetes mellitus), even though only a small proportion of patient (n=30; mean rank =19,953.62). These high costs are probably due to the need for hospitalization nutritional therapy, and the treatment of systemic problem caused by poor nutritional status. This finding supports past studies in underdeveloped countries showing how challenging it is to treat diabetes mellitus linked to malnutrition. According to WHO and IDF data malnutrition-related diabetes (E12) is rare but severe, occasionally accompanied by complication that require complex management, and treatment costs are relatively high. Even though type 1 diabetes is standardized, it frequently log-term insulin therapy, which can be more moderately to significantly costly. The most common type of diabetes is type 2, and the cost of treatment varies according to glycemic control and the frequency of complications[43].

Analysis of Treatment Cost Variation by Classification of Healthcare Service

After adjusting for weighting, a statistically significant difference in treatment costs were discovered between the various type of healthcare facilities ($p < 0.001$). The highest average prices were seen in specialty facilities including cardiac and psychiatric hospital, and private hospitals that were comparable to Type A hospitals. The use of sophisticated technology, the greater complexity of cases and more costly medical subspecialist services rendered are probably caused. However, because of their limited service capacity, Class D and C hospital as well military/police facilities of class III-IV, displayed the lowest average prices.

Implication for policy include bolstering tiered referral system to stop patient from going straight to big hospital, unless it is medically necessary. To prevent overutilization, high –cost healthcare facilities also use efficiency incentives and quality control measures. To avoid inequities in the use of JKN financing, a cost rationalization assessment for specialized and private healthcare facilities is also necessary.

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Analysis of Treatment Cost Variation by Clinical Severity

The Kruskal-Wallis analysis and post hoc revealed statistically significant differences in the weighted average treatment costs for each clinical severity level ($p < 0.001$). In general, severe cases were highest in term of cost, followed by moderate and mild cases. This finding demonstrate how crucial clinical severity is in influencing healthcare expenditure. Severe cases typically necessitate costly medication and technology, prolonged hospital stays, intensive care, and complex procedure [17][44]. As a result, these findings offer compelling justification to guarantee that inpatient care is only used when clinically necessary, and improve the INA-CBG reimbursement framework to better account for clinical severity.

Analysis of Treatment Cost Variation by Post-Diagnosis Clinical Decision

The Kruskal-Wallis test results indicate a significant difference in the treatment costs of Diabetes Mellitus JKN program based on the categories of clinical decisions made after diagnosis. This finding implies that clinical decision have a considerable impact on the magnitude of treatment costs for DM patients. The highest treatment cost were observed in the inpatient procedure group, followed by maternity inpatient care and nonprocedural inpatient care. Meanwhile, the lowest costs were associated with nonprocedural outpatient care. This suggests that more intensive the clinical intervention, the higher the incurred costs. The post hoc analysis further revealed that most pairs of clinical decision categories demonstrated significant differences in treatment costs ($p<0.001$), with the exception of comparison between maternity inpatient care and inpatient procedures, as well as major outpatient procedures, which didn't show statistically significant differences.

Analysis of Treatment Cost Variation by Discharge Outcome

The result of the Kruskal-Wallis test indicate that there is a statistically significant difference between the discharge outcome groups in terms of the treatment costs for diabetes mellitus under the JKN program. The patient who died incurred the highest treatment costs, likely due to the need for intensive care, expensive medical procedures, or severe complications that increased the overall costs. The post hoc analysis revealed that nearly all pairwise comparison between discharge outcomes showed significant different in costs ($p<0.001$), except for the group with unknown discharge outcomes. The policy implication is that greater attention should be given to the management of severe cases to reduce costs and improve patient outcomes.

Analysis of Treatment Cost variation by Source Referral

The Kruskal-Wallis test revealed that the differences in healthcare costs between source referral institution types were statistically significant ($p < 0.001$). The Ministry of Health's National Referral Hospital, provincial government hospital, and Army–affiliated hospitals (TNI AD & TNI AD) had the highest mean rank. In contrast, non-referred patient had the lowest cost ranking, followed by district level hospitals. These findings suggest that the target referral institution is significant determinant of healthcare costs. Because referral to higher-tier facilities (vertical & provincial hospitals) more advanced case management, the use of state-of-the art medical technology, and greater variety of subspecialist services, they are associated with higher costs. Conversely, lower-tier institutions or those that accept direct (non-referred) admission usually handle less complicated cases, which reduces service costs. The result are consistent with DSJN, 2024 report, which indicated that JKN program's primary sources of claim burden were vertical and provincial hospitals, particularly cases involving advanced referrals and chronic illness[45][46].

Analysis of Treatment Cost Variation by Referral Institution' Source

This result of the Kruskal-Wallis test indicates a significant difference in diabetes treatment costs under the JKN program based on the source of referral. Post hoc analysis revealed that all combination of referral sources exhibited statistically significant difference from one another. The highest treatment costs were observed among patient referred by general practitioners, while the lowest costs were found among patients referred from Community Health Center. Patient without a formal referral incurred higher costs compared to those referred from Community Health Center and primary clinics, but lower costs than those

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referred by general practitioners. These findings imply that an effective referral system could contribute to better control treatment costs.

Analysis of Treatment Cost Variation by Region

Based on Figure 1. The highest distribution of DM JKN were in east Java (13,9%), West Jawa (10,4%) and Central java (9,9%). In contrast, provinces with the lowest frequencies were West Sulawesi (0,3%), Bangka Belitung (0,6%), and West Papua (0,6%). This distribution pattern indicates that densely populated regions such as Java dominate the burden of DM JKN treatment. Meanwhile, provinces with limited geographical access and healthcare infrastructure eastern Indonesia tend to have lower case proportion, potentially reflecting challenges in service accessibility and early disease detection. This finding is consistent with previous studies indicating that provinces with higher ratio of hospital and healthcare personnel tend to a higher prevalence of DM[47][48] and there are significant disparities in healthcare access across Indonesia [49].

Grounded on result of the nonparametric Kruskal-Wallis test, a largely significant difference was observed in the direct medical costs (after weighting) among provinces in Indonesia (chi square = 3369,878; df = 33; $p < 0.001$). These finding indicate that the cost burden associated with healthcare services for diabetes mellitus cases is explosively told by regional factor. Central Java had the highest mean rank (16,283.45) based on the distribution of mean rank, followed by the Jakarta Capital Region (15,924.37) and the Yogyakarta (15,427.08). These regions typically maintain better access to treatment and more sophisticated tertiary healthcare facilities, indicating a higher level of services intensity and case complexity, which ultimately result in higher medical costs. This finding highlights the inequity in diabetes –related healthcare financing across regions which poses challenges to the equity and efficiency of Indonesia' JKN system. Such strategy may include such territorially sensitive healthcare budgeting, risk-based financing stratification, and optimization of infrastructure and workface distribution to ensure equitable access to diabetes care throughout the country [50][51].

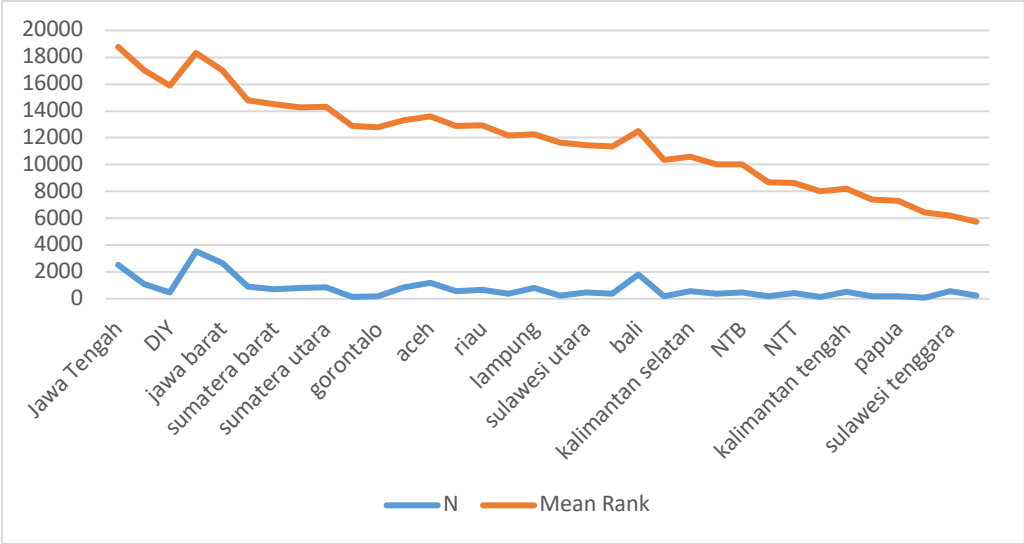

Figure 1. Distribution of Diabetes Mellitus cases and Mean Rank by Region

Conclusion

The average cost of diabetes treatment under the JKN program is IDR 2,512,968, while the weights average treatment cost reaches IDR 25,600,935. Private healthcare facilities play a crucial role in management of diabetes mellitus in Indonesia. To avoid lagging behind private hospitals, it is essential to prioritize the enhancement of capacity and quality within public healthcare services. The majority of diagnosed diabetes cases are classified as type 2, since this disease is predominantly caused by unhealthy

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lifestyles, preventive and promotive programs must be enhanced and innovatively expanded across Indonesia.

Statistically significant differences in diabetes treatment costs were found with all independent variable are length of stay, healthcare service category, type of healthcare facility, classification of health care services, clinical interventions, service units, ward classification, treatment outcomes, diagnoses, clinical decisions post-diagnosis, severity level, geographic region, referral sources, referral destinations, and JKN membership classification.

There is a disparity in diabetes care financing across regions highlighting the need for territorially-based health budget planning, risk stratification of healthcare financing according to service complexity and capacity in each region, as well as optimization of the distribution of healthcare facilities and personnel. Care throughout Indonesia.

Author Contributions

Susilawati: conceptualization, formal analysis, investigation, methodology, project administration, supervision, writing-original draft, writing-review & editing. Andri Yan Prima Zani: Formal analysis, Data curation, Funding acquisition, Resources, Software. Adinda Wulandari: data curation, resources (BPJS data request). Rahmi Nurmadinisia: Resources, Funding acquisition, Data curation. Yulia Anggraeni H.P: Funding acquisition, Project administration.

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