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Comparative Analysis of Actual Costs and INA-CBGs Tariffs for Hemodialysis Services at Haji Abdul Manan Simatupang Regional General Hospital

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Outpatient hemodialysis is a high-cost chronic service that may generate a gap between actual hospital costs and the INA-CBGs reimbursement tariff under the JKN scheme. This study aimed to calculate the unit actual cost of outpatient hemodialysis, compare it with the INA-CBGs tariff, identify dominant cost components, and explore managerial strategies to address cost discrepancies. A mixed-methods approach was conducted at RSUD Haji Abdul Manan Simatupang from January to September 2025, combining quantitative cost and service-volume analysis with qualitative semi-structured interviews. Normality was tested using Shapiro–Wilk and differences were analyzed using the Wilcoxon signed-rank test. A total of 4,810 sessions were recorded, with total actual costs of IDR 4,193,552,621 and an average unit cost of IDR 871,840 per session, exceeding the INA-CBGs tariff of IDR 841,900. The average gap was IDR 29,940 per session, with deficits in 7 of 9 months. The difference was statistically significant (p=0.021). Consumables (BMHP) were the primary cost driver (60%). Strategic responses included consumable cost control, standardized clinical pathways, digital monitoring, capacity optimization, strengthened claims management, and capital planning. These findings highlight the need for strengthened cost governance to ensure financial sustainability and service quality.
Keywords: Hemodialysis, Unit Actual Cost, INA-Cbgs, Consumables, Hospital Strategy

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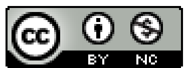
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1. Introduction

Hemodialysis is one of the high-cost healthcare services that continues to experience increasing demand, in line with the rising prevalence of chronic kidney disease in Indonesia (Hasibuan et al., 2024). In many hospitals, including Haji Abdul Manan Simatupang Regional General Hospital, hemodialysis constitutes an essential and strategic service, as it directly sustains the survival of patients with chronic kidney failure. The growing need for outpatient hemodialysis services requires hospitals to ensure the continuous availability of human resources, medications, consumable medical supplies (BMHP), medical equipment, and other operational support. However, the increase in service volume is not always accompanied by adequate reimbursement tariffs capable of covering the actual costs incurred by hospitals, whether internal hospital tariffs or the nationally regulated Indonesian Case-Based Groups (INA-CBGs) tariffs.

The mismatch between actual service costs and reimbursement tariffs may lead to operational deficits and, in the long term, threaten service sustainability, particularly in public regional hospitals that face financial constraints and limited budgetary flexibility (Kusuma, 2024). Hospital data indicate that hemodialysis visits increased from 5,972 visits in 2023 to 6,779 visits in 2024, reflecting the community's high dependence on

this service. Despite this growth, the hospital faces a significant cost gap between actual service expenditures and INA-CBGs tariffs used as the basis for reimbursement by BPJS Kesehatan.

According to the Minister of Health Regulation No. 3 of 2023, North Sumatra Province falls within Regional II, with an INA-CBGs package tariff for single-use hemodialysis services in Type C hospitals set at IDR 841,900. Since 2024, the hospital has implemented single-use consumables (BMHP), which has increased expenditure in the medication and consumables category and directly affected unit cash flow. The use of single-use consumables is estimated to absorb approximately 20% of the total medication and consumables budget, potentially reducing the availability of funds for other essential supplies.

From a managerial perspective, hemodialysis services are often perceived as financially unprofitable. However, at the operational unit level, the service is considered beneficial and strategically important due to its relatively stable service volume and its critical role in managing chronic kidney disease patients. This difference in perception may stem from variations in cost calculation approaches. Cost estimations for outpatient hemodialysis frequently include only direct costs such as labor, consumables, and medications, while indirect costs such as utilities, laundry, cleaning services, and other operational overhead are not comprehensively incorporated. Such limitations may result in inaccurate cost estimation and potentially affect managerial decision-making related to budgeting, efficiency, and service sustainability (Azizan et al., 2020).

At the national level, the financial burden of hemodialysis services has also shown a significant upward trend. In 2024, approximately 134,057 patients underwent hemodialysis procedures in Indonesia, with total treatment expenditures reaching around IDR 11 trillion (Azizah, 2025). Furthermore, the prevalence of chronic kidney disease, which reached 1,501,016 cases by 2023 (Purnama, 2024), indicates the likelihood of sustained demand growth in the future. These figures underscore the urgency of ensuring efficient, accurate, and sustainable cost management for hemodialysis services, particularly within public regional hospitals.

In this context, analyzing the actual cost of hemodialysis services becomes crucial to evaluate the alignment between hospital expenditures and INA-CBGs reimbursement (Pradnyantara, 2023). In this study, actual cost refers to the total expenditures incurred by the hospital during the study period, including human resources, medications, consumables, medical equipment, and unit overhead costs. Beyond identifying the magnitude of the cost gap, such analysis provides insight into its implications for operational performance, service quality, and hospital financial conditions (Satibi et al., 2019).

Previous studies have reported discrepancies between hemodialysis service costs and INA-CBGs tariffs in various hospitals. Several findings indicate that INA-CBGs tariffs may not fully reflect the complexity and resource intensity of hemodialysis services, thereby generating financial pressure for service providers (Nadhira et al., 2020; Fibionisa et al., 2023; Sulistiyaningsih et al., 2025). Nevertheless, most of these studies focus primarily on quantitative cost comparisons without exploring how hospitals strategically respond to cost discrepancies from managerial, operational, and administrative perspectives, particularly in public regional hospital settings.

Therefore, a research gap exists regarding the need for comprehensive studies that not only compare actual costs and INA-CBGs tariffs but also examine hospital strategies in addressing cost gaps while maintaining service quality and financial sustainability. Understanding managerial strategies, cost-control mechanisms, and cross-unit coordination under tariff limitations remains underexplored in previous research.

Accordingly, this study analyzes the comparison between actual costs and INA-CBGs tariffs for hemodialysis services at Haji Abdul Manan Simatupang Regional General Hospital using a mixed-methods

approach. The qualitative component explores managerial, operational, clinical, and administrative perspectives in responding to cost discrepancies. Data were obtained from key internal stakeholders involved in hemodialysis service management, including strategic decision-makers, financial managers, clinical staff, pharmacy and consumables managers, and INA-CBGs claims officers. Thus, the qualitative analysis captures not only general managerial responses but also cross-unit dynamics in sustaining service delivery and maintaining quality under reimbursement constraints.

2. Literature Review and Problem Statement

a. Hemodialysis

Hemodialysis is an extracorporeal therapy that partially substitutes kidney filtration through diffusion and ultrafiltration across a dialyzer membrane (Murdeshwar & Anjum, 2023). Diffusion facilitates removal of small solutes (e.g., urea, creatinine), while ultrafiltration removes excess fluid via transmembrane pressure gradients (Hechanova & Jaipaul, 2024). Clinically, it is indicated for ESKD and selected acute kidney conditions with refractory toxin/fluid/electrolyte disturbances (Bello et al., 2022).

Hemodialysis is the most widely applied renal replacement therapy for end-stage kidney disease (ESKD). Using a semi-permeable membrane, it removes nitrogenous waste, corrects electrolyte imbalance, and eliminates excess fluid to maintain homeostasis (KDOQI, 2015; Murdeshwar & Anjum, 2023). Globally, hemodialysis remains the dominant modality for ESKD management, with most patients depending on this therapy when transplantation is not feasible (Ratiu et al., 2025; Bello et al., 2022).

From an operational perspective, hemodialysis is characterized by intensive input requirements, including specialized staff, dialysis machines, consumables (BMHP), medications, laboratory support, and strict quality and safety protocols (Vanholder et al., 2016; Turgut et al., 2024). Consequently, hemodialysis services are highly sensitive to payment policy and tariff adequacy, particularly under bundled reimbursement mechanisms (Ghimire et al., 2024).

Hemodialysis is commonly delivered 2–3 times per week with session durations around 3–5 hours, depending on the patient's clinical condition (KDOQI, 2015). Cost components typically include direct costs labor, BMHP (dialyzer, bloodline/tubing, dialysate), medications, and laboratory tests and indirect costs such as utilities, maintenance, depreciation, and overhead (Margina & Prena, 2024). Evidence suggests BMHP frequently dominates the cost structure, while the single-use versus re-use policy can materially shift unit costs even when clinical outcomes remain comparable (Anthony et al., 2025; Lukkanalikitkul et al., 2025).

b. Hospital Service Characteristics

Hospital dialysis units require competent interdisciplinary teams, robust facility standards (e.g., ultrapure water), infection-control arrangements, and compliance with accreditation requirements, all of which increase operating and capital costs (The Hemodialysis Interdisciplinary Team, 2021; Coulliette & Arduino, 2013; Saskito et al., 2020). Under Indonesia's JKN reimbursement, studies frequently report misalignment between actual costs and INA-CBGs tariffs, creating financial pressure particularly in public hospitals (Margina & Prena, 2024).

c. Hospital Financial Management

Hospital financial management aims to sustain service delivery, improve efficiency, and maintain quality while operating under regulatory constraints and variable demand (Gapenski & Pink, 2006; Cleverley et al., 2017). Within Indonesia's JKN system, prospective payment via INA-CBGs is a central determinant of financial performance because hospitals are reimbursed at a fixed package tariff rather than actual expenditures (Leonard et al., 2020). This arrangement can create recurring deficits for high-cost chronic

services such as hemodialysis, particularly in regional public hospitals that have limited flexibility and cannot refuse JKN patients (Sulistyaningsih et al., 2025; Margina & Prena, 2024).

To manage these pressures, hospitals commonly pursue cost containment, process efficiency, resource optimization, and cross-subsidization while attempting to preserve service quality (Gapenski & Pink, 2006; Bchennaty et al., 2024). Accurate costing and integrated cost information systems are therefore essential for transparency, budgeting, and managerial decision-making (Quesado & Silva, 2021; Mbau et al., 2023).

1. Actual Cost Concept
   Actual costs refer to real expenditures incurred in producing services, including direct and indirect (overhead) components, and can also be analyzed as fixed, variable, and semi-variable costs (Stavros et al., 2023; Rahmantya & Tyas, 2022). Unit cost information supports efficiency assessment and tariff adequacy evaluation, particularly under prospective payment systems (Jaelani & Purnama, 2022).
2. Tariffs and Reimbursement
   Hospital tariffs may be internal (set by hospitals) or external (regulated by payers). In Indonesia, INA-CBGs functions as an external bundled tariff for JKN patients (Noviyanti & Sulistiadi, 2020; PMK RI, 2024). Prior studies suggest that some INA-CBGs tariffs may not fully reflect local cost structures, producing underpayment risks for resource-intensive services such as hemodialysis (Margina & Prena, 2024; Ibrahim et al., 2025).
3. INA-CBGs Prospective Payment
   INA-CBGs is a prospective payment system derived from DRG concepts, intended to promote efficiency and cost control at the national level (Rivany, 2009; Leonard et al., 2020). However, a fixed package tariff can shift financial risk to providers when input costs rise or when service complexity is not adequately represented in tariff calculation frequently reported in hemodialysis and other high-resource services (Anthony et al., 2025; Manopo & Susanti, 2025).

d. Actual Cost–Tariff Differences (Cost Gap) in Hospital Services

Under prospective payment theory, the gap between actual costs and reimbursement is structural: fixed tariffs incentivize efficiency but transfer cost risk from payers to providers (Rivany, 2009; Cleverley et al., 2017). In this context, a cost gap is defined as the difference between actual service costs and INA-CBGs reimbursement received by hospitals (Gapenski & Pink, 2006). Negative gaps (actual cost > tariff) can create deficits, whereas positive gaps may support cross-subsidization.

e. Determinants of Cost Gaps

Cost gaps may be driven by (i) rising BMHP and medication prices, including import dependency and market volatility (Hornig et al., 2024; Margina & Prena, 2024), (ii) equipment maintenance and facility requirements such as ultrapure water systems (Coulliette & Arduino, 2013), (iii) specialized workforce needs and staffing standards (Turgut et al., 2024), and (iv) regulatory and accreditation compliance costs that are not always reflected in tariff adjustments (PMK RI, 2024).

f. Impacts and Managerial Responses

Persistent negative gaps can disrupt unit budgets and threaten long-term financial sustainability, especially for regional public hospitals with limited flexibility (Cleverley et al., 2017). Managerial responses often include cross-subsidization, BMHP utilization control, procurement and supplier contract management, pathway standardization, process efficiency, and improved claims governance to protect revenue realization (Gapenski & Pink, 2006; Homauni et al., 2023; Turgut et al., 2024).

g. Research Gap and Problem Statement

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Prior studies on hemodialysis financing in Indonesia and comparable settings largely emphasize quantitative comparisons between actual costs and INA-CBGs tariffs, documenting the presence of cost gaps (Nadhira et al., 2020; Fibionisa et al., 2023; Sulistiyaningsih et al., 2025). However, the literature remains limited in integrating managerial and operational responses, including procurement governance, BMHP control, clinical pathway standardization, capacity optimization, and claims management, into a single analytical framework, particularly in regional public hospitals that face constrained fiscal space and rigid reimbursement arrangements (Margina & Prena, 2024; Manopo & Susanti, 2025).

Accordingly, the central problem addressed in this study is the potential misalignment between the actual unit cost of outpatient hemodialysis and the INA-CBGs tariff, and the need to understand not only the magnitude and drivers of the gap but also how hospitals strategically respond to sustain service delivery while maintaining quality.

3. Method

Study Design

This study employed a mixed-methods approach with a sequential explanatory design, in which quantitative analysis was conducted first and subsequently elaborated through qualitative inquiry. This design was selected to (i) calculate outpatient hemodialysis actual costs objectively and (ii) interpret the managerial implications and hospital strategies in responding to the gap between actual costs and the INA-CBGs tariff (Creswell & Creswell, 2018). The quantitative component used an observational analytic cross-sectional approach based on routinely recorded monthly data during the study period, without any intervention. The qualitative component used semi-structured in-depth interviews to explain cost drivers and managerial responses.

Setting and Study Period

The study was conducted at the outpatient hemodialysis unit and the finance-related departments of UPTD RSUD Haji Abdul Manan Simatupang. Data covered the service period January–September 2025. Research activities (preparation, data collection, and analysis) were implemented from November 2025 to January 2026.

Data Sources and Variables

Quantitative Data

Quantitative data were obtained from official hospital documents and administrative records related to outpatient hemodialysis, including:

1. Service volume data: number of outpatient hemodialysis sessions per month.
2. Cost data: monthly expenditures attributable to outpatient hemodialysis, categorized into:
   a. Human resources (labor): costs of medical and non-medical personnel involved in outpatient hemodialysis, proportionally allocated based on documented involvement.
   b. Medications: drugs used according to standard practice in outpatient hemodialysis.
   c. Consumables (BMHP): dialyzer, bloodline/tubing, dialysate, and other disposable materials.
   d. Equipment and maintenance: use and maintenance of dialysis machines and relevant supporting equipment.
   e. Overhead: utilities (electricity, water), cleaning, administration, medical waste management, and other supporting costs allocated to the hemodialysis unit.
3. Tariff data: the applicable INA-CBGs tariff for outpatient hemodialysis during the period (type and regional classification consistent with the hospital context).

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Qualitative Data

Qualitative data were collected through semi-structured in-depth interviews with seven key informants selected purposively based on their direct involvement in outpatient hemodialysis financing and operations. Informants represented cross-functional roles, including hospital leadership/management, finance, casemix/claims, planning, pharmacy, and clinical implementation at the hemodialysis unit (head/physician and head nurse/staff nurse). Non-participant observation of service flow was used as supporting information to contextualize operational processes.

Population, Sampling, and Eligibility Criteria

Quantitative Component

The quantitative population included all outpatient hemodialysis activities during January–September 2025. The study applied total sampling (census) for all available and verifiable cost and service-volume records in the study period. For inferential testing, the unit of analysis was monthly aggregated data (n = 9 months), including monthly unit actual cost and monthly cost gap relative to the INA-CBGs tariff.

Qualitative Component

The qualitative population comprised hospital stakeholders involved in managing and delivering outpatient hemodialysis services. Purposive sampling was used to select informants with relevant authority, experience, and knowledge about cost management, claims governance, and service sustainability.

Inclusion and Exclusion Criteria

For the outpatient hemodialysis service records included in the costing analysis:

a. Inclusion: routinely treated outpatient hemodialysis cases with sufficiently complete and verifiable service and cost documentation; cost components reflecting major inputs (labor, medications, BMHP, equipment, overhead).
b. Exclusion: acute/emergency dialysis and inpatient hemodialysis; incomplete/unverifiable records; sessions with incidental procedures/examinations and non-hemodialysis-related medication use that could distort outpatient hemodialysis costing.

Costing Procedures and Outcome Measures

Unit Actual Cost

Monthly total actual cost was calculated as the sum of all relevant cost components (labor, medications, BMHP, equipment/maintenance, and allocated overhead) attributable to outpatient hemodialysis. The unit actual cost per session was calculated as:

$$\text{Unit Actual Cost}_m = \frac{\text{Total Actual Cost}_m}{\text{Number of HD Sessions}_m}$$

where $m$denotes the month (January–September 2025).

Cost Gap

The monthly cost gap was computed as the difference between the unit actual cost and the INA-CBGs tariff:

$$\text{Cost Gap}_m = \text{Unit Actual Cost}_m - \text{INA-CBGs Tariff}$$

A positive value indicates a deficit (actual cost > tariff), whereas a negative value indicates a surplus (tariff > actual cost).

Statistical Analysis

Quantitative results were summarized using descriptive statistics (mean/median, range, and monthly trend tables). Normality of the monthly cost-gap distribution was assessed using the Shapiro–Wilk test, which is commonly recommended for small samples ($n < 50$) (Shapiro & Wilk, 1965; Habibzadeh, 2024). Because the cost-gap data were not normally distributed, the difference between monthly unit actual costs and the INA-CBGs tariff was tested using the Wilcoxon signed-rank test to assess whether the median cost gap differed significantly from zero (Razali & Wah, 2020). A two-tailed significance level of $\alpha = 0.05$ was applied.

Qualitative Analysis

Interview data were transcribed verbatim, organized by informant group, and analyzed using thematic analysis. The analysis followed sequential steps: familiarization with transcripts, data reduction to information relevant to the research objectives, coding, theme development, and interpretive synthesis. Themes were specifically developed to explain (i) dominant cost drivers (e.g., BMHP), (ii) operational constraints (supply chain, capacity/shift, service flow), and (iii) managerial strategies (cost containment, pathway standardization, procurement governance, claims optimization, and planning for capital investment). Qualitative findings were used to explain and contextualize the quantitative results rather than to generate cost estimates.

Integration of Quantitative and Qualitative Findings

Integration was conducted at the interpretation stage. Quantitative results (unit costs, cost gaps, and statistical tests) were linked with qualitative themes to provide a comprehensive explanation of why cost gaps occurred and how the hospital responded operationally and managerially. Data triangulation was applied by cross-checking documentary evidence with informant narratives, and discrepancies were resolved through document re-checking and clarification when required.

4. Results and Discussion

Overview of UPTD RSUD Haji Abdul Manan Simatupang

UPTD RSUD Haji Abdul Manan Simatupang is a public Type C hospital owned by the Government of Asahan Regency and serves as the only regional public referral hospital in the district, covering surrounding areas such as Batu Bara, North Labuhan Batu, and Tanjungbalai. Located in Kisaran City, the hospital has implemented full PPK-BLUD financial management status since 2014, allowing managerial flexibility while maintaining efficiency and public service orientation. Its mandate includes the provision of comprehensive individual healthcare services across medical, nursing, and supporting units.

The hemodialysis unit has operated since 2017 and provides dialysis therapy primarily for outpatient chronic kidney disease patients. In 2025, the unit was supported by 13 functioning Fresenius 4008S machines under an operational cooperation agreement (KSO) with PT Fresenius Medical Care Indonesia, covering equipment provision, maintenance, reverse osmosis systems, staff training, and consumables supply. The unit employs 12 personnel, including specialist physicians, general practitioners, nurses, and administrative staff.

Operating in two daily shifts, the unit serves approximately 67 routine patients and recorded 4,810 outpatient hemodialysis sessions during January–September 2025. This high service volume forms the basis for unit cost calculation and tariff comparison in the subsequent analysis.

Research Subjects and Field Data Sources

This study utilized secondary data (hospital financial reports and administrative documents) and primary field data collected through interviews and limited observation at the Hemodialysis Unit of UPTD RSUD Haji Abdul Manan Simatupang. Field data collection was conducted to clarify service flow, resource utilization, procurement mechanisms, and cost components that were not fully captured in routine administrative records. Research subjects included stakeholders directly involved in the provision, financing, planning, and logistical support of outpatient hemodialysis services. Their perspectives were essential to contextualize quantitative cost findings and to explain operational and managerial considerations related to service sustainability.

Informants were selected using purposive sampling, based on their roles and responsibilities in clinical service delivery, financial management, claims processing, planning, pharmacy management, and operational implementation of hemodialysis services. Interview topics covered service activities, resource utilization, consumables (BMHP) procurement mechanisms, cost management practices, reimbursement processes, and operational constraints affecting service delivery.

Table 1. Characteristics of Research Informants

No	Code	Position	Unit/Department	Role in Hemodialysis Service
1	I-01	Hospital Director	Hospital Management	Strategic policy-making, oversight of financing and service sustainability
2	I-02	Head of Finance Subdivision	Finance	Cost calculation, cost-structure analysis, and expenditure control
3	I-03	Claims Officer	Claims/Casemix	INA-CBGs claims processing and revenue reporting
4	I-04	Head of Planning Division	Planning	Budget preparation and service capacity planning
5	I-05	Head of Pharmacy Installation	Pharmacy	Management of medications and consumables (BMHP)
6	I-06	Head of Hemodialysis Unit / Responsible Physician	Hemodialysis Unit	Clinical and operational supervision of hemodialysis services
7	I-07	Hemodialysis Nurse	Hemodialysis Unit	Direct implementation of dialysis procedures and resource use

Source: Primary research data (2026)

The informants represent cross-functional perspectives from management, finance, claims administration, planning, pharmacy, and frontline clinical staff. This diversity strengthened the comprehensiveness of qualitative insights regarding cost drivers, reimbursement dynamics, and operational strategies within the hemodialysis unit.

Field data were also collected through direct observation of hemodialysis service delivery at the Hemodialysis Unit. Observation was conducted over fourteen days, covering both morning and afternoon shifts. The purpose was to document the service flow, activity duration, and resource utilization at each stage of the hemodialysis procedure. Observational findings were used to validate documented service processes and to estimate activity time allocation, which subsequently informed the identification and tracing of cost components in the unit cost calculation.

Classification of Hemodialysis Cost Components

Hemodialysis is a resource-intensive medical service involving multiple clinical and supporting activities that utilize human resources, consumables, medications, medical equipment, and hospital infrastructure. Each activity generates costs that collectively form the total service cost. Based on document review, field observation, and interview findings, cost components at UPTD RSUD Haji Abdul Manan Simatupang were identified and classified according to their relationship to service activities. This classification facilitated systematic cost tracing for unit cost calculation.

Table 2. Cost Components of Hemodialysis Services

No	Cost Component	Related Activity
1	Service fees	Hemodialysis procedure (physicians, nurses)
2	Salaries and allowances	Service delivery and monitoring (medical, nursing, administrative staff)
3	Medications	Intradialytic therapy
4	Consumables (BMHP)	Per-session dialysis materials
5	Laboratory examinations	Supporting diagnostic tests
6	Electricity	Operation of dialysis machines
7	Water	Reverse osmosis and utilities
8	Depreciation – medical equipment	Dialysis machines and related medical devices
9	Maintenance – medical equipment	Maintenance of medical devices
10	Depreciation – non-medical equipment	AC units, furniture, computers, printers
11	Maintenance – non-medical equipment	Maintenance of non-medical assets
12	Medical waste management	Disposal of dialysis-related waste
13	Laundry	Patient linen services
14	Training	Staff certification and competency development
15	Office supplies (ATK)	Administrative processes
16	Cleaning services	Unit hygiene and sanitation
17	Building depreciation	Use of service space
18	Building maintenance	Facility upkeep
19	Water quality maintenance	Endotoxin testing and water system control

Monthly Unit Cost and Tariff Gap

Quantitative results are presented in monthly tabular and narrative form (January–September 2025), including number of sessions, total actual cost, unit actual cost per session, the INA-CBGs tariff, and the cost gap per session. The gap was calculated as:

Unit Actual Cost – INA-CBGs Tariff

A positive value indicates a deficit (actual cost > tariff), while a negative value indicates a surplus (tariff > actual cost).

Table 3. Monthly Recap of Outpatient Hemodialysis Costs (January–September 2025)

Month	Sessions (n)	Total Actual Cost (IDR)	Unit Actual Cost (IDR)	INA-CBGs Tariff (IDR)	Gap per Session (IDR)	Status
January	534	467,136,148	874,787	841,900	32,887	Deficit
February	495	440,762,993	890,430	841,900	48,530	Deficit
March	513	446,864,123	871,080	841,900	29,180	Deficit
April	536	462,559,856	862,985	841,900	21,085	Deficit

Month	Sessions (n)	Total Actual Cost (IDR)	Unit Actual Cost (IDR)	INA-CBGs Tariff (IDR)	Gap per Session (IDR)	Status
May	571	479,499,799	839,754	841,900	-2,146	Surplus
June	483	466,626,440	966,100	841,900	124,200	Deficit
July	573	481,218,914	839,824	841,900	-2,076	Surplus
August	560	475,377,760	848,889	841,900	6,989	Deficit
September	545	473,506,588	868,819	841,900	26,919	Deficit
Total / Mean	**4,810**	**4,193,552,621**	**871,840**	**841,900**	**29,940**	**Deficit**

Normality Test

Prior to inferential analysis, the distribution of the monthly cost gap per session (January–September 2025; n = 9) was examined using descriptive statistics. This step aimed to summarize central tendency and dispersion and to identify potential extreme values that might affect normality assumptions. Descriptive statistics of the monthly cost gap are presented in Table 3

Table 4. Descriptive Statistics of Monthly Cost Gap (IDR per Session)

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Selisih	9	100.0%	0	.0%	9	100.0%

Descriptives

			Statistic	Std. Error
Selisih	Mean		-3.1730E4	1.28451E4
	95% Confidence Interval for Mean	Lower Bound	-6.1351E4	
		Upper Bound	-2.1089E3	
	5% Trimmed Mean		-2.8475E4	
	Median		-2.6919E4	
	Variance		1.485E9	
	Std. Deviation		3.85354E4	
	Minimum		-1.24E5	
	Maximum		2146.00	
	Range		1.26E5	
	Interquartile Range		3.83E4	
	Skewness		-1.970	.717
	Kurtosis		4.685	1.400

Based on descriptive statistics, the monthly cost gap values (n = 9) showed a mean of –31,730, a standard deviation of 38,535, and a median of –26,910, with a minimum of –124,000 and a maximum of 2,146. The distribution was negatively skewed (skewness = –1.870) with elevated kurtosis (4.885), indicating the presence of extreme values and deviation from normal distribution. The relatively wide range and substantial standard deviation suggest considerable variability in monthly cost gaps.

These distributional indicators imply asymmetry and heavier tails compared to a normal distribution, suggesting potential violation of the normality assumption. Therefore, a formal normality test was conducted using the Shapiro–Wilk test, as the number of observations was less than 50 (n = 9). The Shapiro–Wilk test evaluates the null hypothesis that the data are normally distributed. A significance level

of 0.05 was applied: $p > 0.05$ indicates normal distribution, whereas $p \leq 0.05$ indicates non-normal distribution.

Table 5. Shapiro–Wilk Normality Test

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Selisih	.266	9	.066	.787	9	.014

a. Lilliefors Significance Correction

Based on the Shapiro–Wilk test results, the monthly cost gap data showed p = 0.014 (< 0.05), indicating that the distribution deviates from normality. Since the normality assumption was not met, the difference between the unit actual cost and the INA-CBGs tariff was analyzed using the nonparametric Wilcoxon signed-rank test, which does not require normally distributed data.

Since the Shapiro–Wilk test indicated non-normal distribution ($p < 0.05$; $n = 9$), the parametric one-sample t-test was not applied. Instead, a one-sample Wilcoxon signed-rank test was used to determine whether the median monthly cost gap differed significantly from zero (break-even condition).
The hypotheses tested were:
H_0: median gap = 0
H_1: median gap ≠ 0

A significance level of 0.05 was applied. The Wilcoxon results, including positive and negative ranks, test statistic (Z/W), and p-value, are presented in Table 6.

Table 6. Wilcoxon Signed-Rank Test Results

Ranks				
		N	Mean Rank	Sum of Ranks
Biaya Riil - Tarif Pemerintah	Negative Ranks	2[a]	1.50	3.00
	Positive Ranks	7[b]	6.00	42.00
	Ties	0[c]		
	Total	9		

a. Biaya Riil < Tarif Pemerintah
b. Biaya Riil > Tarif Pemerintah

Test Statistics[b]	
	Biaya Riil - Tarif Pemerintah
Z	-2.310[a]
Asymp. Sig. (2-tailed)	.021

a. Based on negative ranks.
b. Wilcoxon Signed Ranks Test

Based on the Ranks table, 7 months showed actual costs higher than the tariff (positive ranks, n = 7), while 2 months showed actual costs lower than the tariff (negative ranks, n = 2), with no ties. This indicates that most months were in a deficit condition. From the Test Statistics table, the Wilcoxon result showed $Z = -2.310$ with $p = 0.021$. Since $p < 0.05$, H_0 was rejected. Thus, there is a statistically significant difference between unit actual costs and the INA-CBGs tariff during January–September, with actual costs generally exceeding the tariff (deficit condition).

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Cost Structure of Hemodialysis Services

Following the identification and classification of cost components, the next step was to describe the overall cost structure based on hospital financial records. The cost structure reflects the proportion of each component contributing to the total actual cost of hemodialysis services during the study period.

Data were derived from hospital financial reports, consumables (BMHP) usage records, and other supporting cost documents. The recapitulation aimed to identify dominant cost components and provide a basis for efficiency analysis and service sustainability assessment. The cost structure of hemodialysis services is presented in Table 7.

Table 7. Cost Structure of Hemodialysis Services at UPTD RSUD Haji Abdul Manan Simatupang

Rank	Cost Component	Total (Jan–Sep) (IDR)	Percentage (%)
1	Consumables (BMHP) and Equipment Rental	2,516,255,949	60
2	Service Fees	553,468,215	13.2
3	Employee Salaries	336,867,900	8.03
4	Medications	277,976,182	6.63
5	Laboratory Services	200,804,000	4.79
6	Employee Allowances	136,787,000	3.26
7	Electricity	34,108,200	0.81
8	Laundry	26,448,908	0.63
9	Medical Waste Management	24,594,960	0.59
10	Water	24,449,720	0.58
11	Inventory Procurement	23,724,750	0.57
12	Building Depreciation	12,287,538	0.29
13	Non-Medical Equipment Depreciation	7,577,396	0.18
14	Cleaning Services	7,057,980	0.17
15	Medical Equipment Depreciation	7,014,978	0.17
16	Non-Medical Equipment Maintenance	2,100,000	0.05
17	Office Supplies	1,169,946	0.03
18	Water Quality Maintenance	859,000	0.02
19	Medical Equipment Maintenance	0	0
20	Training Costs	0	0
21	Building Maintenance	0	0
	Total	**4,193,552,621**	**100**

Source: Financial data of UPTD RSUD Haji Abdul Manan Simatupang, processed by the researcher (2026).

To identify the dominant cost components in hemodialysis services, all actual cost elements were aggregated for the January–September 2025 period. The cumulative total actual cost amounted to IDR 4,193,552,621 (Table 5.9), with an average unit cost of IDR 871,840 per session.

The cost structure indicates that consumables (BMHP) and equipment rental constituted the largest component at IDR 2,516,255,949 (60.00%) of total cost. This was followed by service fees (13.20%), employee salaries (8.03%), medications (6.63%), laboratory services (4.79%), and employee allowances (3.26%). Collectively, these six components accounted for 95.91% of total expenditure, demonstrating a highly concentrated cost structure dominated by consumables and human resource-related components.

Other cost elements each contributed less than 1%, including electricity (0.81%), laundry (0.63%), medical waste management (0.59%), water (0.58%), and inventory procurement (0.57%). Depreciation and minor supporting costs (e.g., building and equipment depreciation, cleaning, office supplies, and water quality

maintenance) each accounted for less than 0.5%. Several items recorded zero expenditure during the study period, indicating either no disbursement or no recorded allocation for those components.

These findings suggest that cost-efficiency strategies should primarily focus on consumables (BMHP) as the dominant driver, alongside strengthened control of human resource and medication/laboratory expenditures due to their substantial contribution to total costs.

Interview Findings

Interviews were conducted to obtain in-depth insights into hemodialysis service delivery, resource utilization, financing mechanisms, operational conditions influencing costs, and managerial strategies in responding to the cost–tariff gap. The qualitative approach complemented quantitative findings to provide a comprehensive understanding of cost structure, influencing factors, and strategic responses. Informants represented hospital management (Director), finance, claims/casemix, planning, pharmacy, and clinical staff within the hemodialysis unit (head physician and nurse). Thematic analysis generated eight major themes.

1. Hemodialysis as a Strategic and Non-Deferrable Service

Hemodialysis was consistently described as a life-saving and non-deferrable service requiring institutional commitment.

> "Hemodialysis is a service that cannot be postponed. It is life-saving…" (I-01)
> "This service is strategic and must be maintained…" (I-04)

The unit prioritizes patient safety, consumables availability, machine readiness (including RO systems), and staff competence, despite financial pressures.

2. Cost Structure Dominated by Consumables and Service Fees

Most informants identified consumables (BMHP) as the primary cost driver, due to their per-session use and high unit prices. The finance division emphasized BMHP and service fees as the two main cost contributors, particularly under the single-use dialyzer policy.

> "The most dominant and burdensome component is clearly BMHP…" (I-01)
> "The largest components are BMHP and service fees… single-use dialyzers increase hospital costs." (I-02)
> "Major cost contributors include dialyzers, bloodline sets, dialysate concentrate, and certain drugs such as EPO." (I-05)

3. Cost Control through Standardization and Monitoring

Cost control strategies focus on efficiency without compromising quality, including standardized consumable use per session, volume-based planning, and routine stock monitoring.

> "Efficiency is mandatory, but quality must not decline…" (I-01)
> "Monitoring is conducted through stock card inspection and physical verification…" (I-05)

4. Procurement Dynamics and Supply Constraints

Stock shortages have occurred due to distributor limitations or administrative/payment constraints. Units sometimes adjusted supporting items while maintaining safety standards or coordinated emergency borrowing from other hospitals.

> "There were stock shortages due to distributor limitations and payment delays…" (I-05)
> "When consumables were nearly depleted… we coordinated quickly with pharmacy and management." (I-07)

5. Capacity Constraints and Workforce Burden

Limited machine capacity (13 units, two shifts) resulted in waiting lists. Staff reported operational pressure, especially during peak hours when documentation of consumables usage adds workload.

> "We only operate two shifts… demand is high and waiting lists occur." (I-01)
> "We are told HD is financially burdensome, yet we must maintain excellent service…" (I-06)

6. Financial Impact of Cost–Tariff Gap

Management acknowledged that persistent deficits strain cash flow, delay capital investment, and necessitate cross-subsidization.

"The impact can be significant… it pressures cash flow and forces reprioritization." (I-01)

"HD consumables account for around 20% of total drug and BMHP expenditure." (I-02)

7. INA-CBGs Claims as a Critical Revenue Safeguard

The claims process is considered crucial to protecting revenue. Common issues include pending claims due to incomplete documentation or coding inaccuracies.

"We conduct initial verification of documents before submission…" (I-03)

"Most issues are pending cases due to incomplete or inconsistent data." (I-03)

"Revenue leakage often occurs when claims are delayed or coding is inaccurate." (I-01)

8. Sustainability Strategies

Cross-informant strategies include renegotiating KSO contracts, exploring alternative vendors, expanding machine capacity through DAK/APBD funding, adding shifts, strengthening human resources, and long-term planning for hospital-owned dialysis machines.

"We push for renegotiation of KSO contracts and adding machines and shifts…" (I-01)

"Long-term strategy includes hospital-owned machines for more competitive procurement." (I-02)

"Capital funding through DAK or APBD is the most feasible path." (I-04)

Hemodialysis services involve integrated roles of specialists, general practitioners, nurses, and administrative staff, supported by pharmacy and finance units. Interviews indicated that limited trained personnel remains a constraint, contributing to the continuation of a two-shift operational model despite high patient demand.

Discussions

This discussion interprets the findings on the real cost of hemodialysis services by integrating quantitative cost analysis with qualitative insights from interviews and field observations. During January–September 2025, the hemodialysis unit operated in two shifts, serving approximately 67 regular patients and delivering 4,810 sessions with an average duration of 4–5 hours per session. The high and repetitive service volume confirms hemodialysis as a resource-intensive, non-deferrable life-sustaining therapy, consistent with activity-based costing principles that emphasize the importance of identifying cost drivers in high-volume, recurrent services (Kaplan & Anderson, 2004; Kaplan & Cooper, 1998).

The total real cost reached IDR 4,193,552,621, with an average cost per session of IDR 871,840. The cost structure was highly concentrated, with medical consumables (BMHP) accounting for approximately 60% of total costs, followed by service fees and personnel expenses. This pattern aligns with the procedural and technology-dependent nature of hemodialysis, in which single-use materials such as dialyzers, bloodlines, and dialysate are mandatory to ensure patient safety and infection control (KDOQI, 2015; Upadhyay, 2019). Similar findings in health economic literature indicate that in standardized and repetitive clinical services, direct clinical inputs particularly consumables and human resources dominate total costs, while overhead components appear proportionally smaller (Drummond et al., 2015; Turner et al., 2025). Given that chronic kidney disease patients undergo dialysis two to three times weekly, even minor changes in consumable prices may substantially affect cumulative costs (Murdeshwar & Anjum, 2023).

Comparison with the INA-CBGs tariff (IDR 841,900) shows a statistically significant deficit of approximately IDR 29,940 per session. Although relatively small in nominal terms, this gap becomes financially meaningful when multiplied by service volume. The finding is consistent with the inherent risk of prospective case-based payment systems, where providers bear financial risk if actual costs exceed

predetermined tariffs (Busse et al., 2011; Kementerian Kesehatan RI, 2021). Literature on DRG-like systems suggests that tariff–cost mismatches frequently arise when operational costs increase faster than tariff adjustments (Furceri et al., 2020). In this study, the dominance of consumables renders costs highly sensitive to market price fluctuations, exchange rates, and procurement mechanisms (Daugirdas et al., 2015).

Operational factors further shape the cost structure. The prolonged treatment duration intensifies labor utilization, making human resources a structurally significant component (Hashemi et al., 2018). Capacity constraints and waiting lists indicate suboptimal utilization, while economic theory suggests that higher service volume can lower average costs through better distribution of fixed inputs (Drummond et al., 2015). However, expansion must preserve quality, as hemodialysis safety depends on strict infection control and water quality standards (CDC, 2024; ISO, 2019). Therefore, efficiency should be interpreted as process optimization and waste reduction rather than reduction of essential clinical inputs, consistent with value-based healthcare principles emphasizing outcomes relative to costs (Porter, 2010).

Qualitative findings highlight procurement governance and claim management as critical leverage points. Because consumables represent the primary cost driver, renegotiation of contracts, standardization of consumable kits, multi-vendor strategies, and improved monitoring are more impactful than marginal cuts in smaller components (Belotti Pedroso et al., 2025). Moreover, pending INA-CBGs claims due to incomplete documentation threaten cash flow stability, reinforcing the importance of strengthening coding accuracy, documentation bundles, and internal verification processes (Nadhira et al., 2020). Together, these findings suggest that sustainable hemodialysis financing depends on structural cost governance, supply chain resilience, optimized capacity utilization, and improved revenue cycle management rather than clinical cost-cutting.

The study demonstrates that the sustainability of hospital-based hemodialysis under a prospective payment system is determined by the interaction between high-volume service characteristics, consumable-dominated cost structures, labor intensity, and tariff rigidity. Strategic responses should therefore prioritize safe efficiency, reducing waste and strengthening operational governance while safeguarding quality and patient safety.

5. Conclusion

Based on the empirical findings and analytical discussion, this study concludes that outpatient hemodialysis services at UPTD RSUD Haji Abdul Manan Simatupang during the observed period constitute a routine, high-frequency clinical service with substantial financial consequences. The magnitude of actual expenditures relative to service volume confirms that hemodialysis is a cost-intensive medical intervention that significantly affects hospital resource allocation and financial performance. Comparative analysis between actual service costs and the INA-CBGs reimbursement tariff reveals a statistically significant financing gap. The distribution of monthly cost differentials did not meet normality assumptions, and non-parametric testing confirmed a significant discrepancy between real unit costs and standardized package-based reimbursement rates. Empirically, deficit conditions were more dominant than surplus conditions throughout the observation period, indicating structural under-compensation within the prospective payment framework. This imbalance poses potential risks to service sustainability if not mitigated through strengthened financial governance and operational efficiency strategies.

The cost structure analysis demonstrates a high concentration of expenditure components. Medical consumables emerge as the primary cost driver, followed by service fees, personnel expenses, pharmaceuticals, laboratory services, and employee allowances. Collectively, these components account for

the overwhelming proportion of total costs, reflecting limited flexibility within the expenditure structure. Furthermore, inter-monthly variations in unit cost indicate sensitivity to fluctuations in service volume and operational dynamics, highlighting the importance of capacity planning and workload stabilization. Managerially, the findings underscore the necessity of implementing comprehensive cost-control and revenue-optimization strategies. Priority actions include improving procurement governance and supplier contract management for medical consumables, standardizing clinical pathways to reduce inefficiencies and waste, optimizing machine utilization and scheduling systems, and strengthening claims management to maintain liquidity. These strategic interventions are essential to enhance financial sustainability and ensure continuity of hemodialysis services under a bundled payment reimbursement scheme aligned with national health financing regulations.

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